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Authors

Kasper Albrektsen

Mads Harder Danielsen

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Supervisors
Hans Kiib
Architect MAA, PhD, Professor
Department of Architecture, Design and Media Technology

Tenna Doktor Olsen Tvedebrink
PhD, Research assistant
Department of Civil Engineering

Consultants
Anna Marie Fisker,
Architect MAA, PhD, Associate Professor
Head of Division for Food+Design
Department of Civil Engineering

Michael Robdrup Rasmussen
PhD, Associate Professor
Division of Water and Soil
Department of Civil Engineering

External partner
Municipality of Aalborg
/Hanna Byskov Ovesen

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Published sections of Master's thesis

As this Master's thesis is written as a long thesis during two semesters it features extended theoretical investigations. In the creation of these investigations a research-based approach has been the aim. As part of this approach three main theoretical sections have been formulated as papers with individual foci within the overall frames of the project.
The three theoretical sections have been submitted to conferences and an online journal for further publication after the completion of the thesis; two section have been accepted for publication under peer-review and one is currently under review.
The accepted theoretical sections has been written for and as a part of this Master's thesis and will only be published after the completion of the thesis.
The three mentioned sections are:

The section "Architecture & Nature" are currently under peer-review at *Arts* by *MDPI - Open Access Publishing* for a special issue on Sustainable Architecture.
The section has been submitted under the title of "Dissolution of Hierarchy - A Further Development of Sustainable Architecture in the Time of Climate Adaption?"

The section "Architecture & Production" has been peer-reviewed and accepted for publication and presentation at the conference *The XII International Forum Le Vie dei Mercanti* at the Faculty of Architecture of the Second University of Naples, Italy.
The section will be published in the conference proceedings under the title of "The Atmosphere of Industrial Architecture: Experience and Production".

The section "Architecture & Place" has been peer-reviewed and accepted for publication and presentation at the conference *ARCHHIST'14* at Mimar Sinan Fine Arts University, Istanbul, Turkey.
The section will be published in the conference proceedings under the title of "Architectural place as outsider in the hegemony of space".

CONTENTS

SYNOPSIS

The focus of the thesis is to address the challenges of the climatic changes related to stormwater management by focusing on the design of a stormwater treatment plant under the theme of Urban Farming. The thesis is written as a long Master's thesis. The treatment plant is placed at Kjærs Møllesø with the adjacent areas of Kærby and Håndværkerkvarteret as catchment areas for the stormwater; the aim is to secure these two areas from flooding and to protect Østerå from polluted discharge of stormwater into the stream from the two areas. The thesis therefore addressed two major challenges of contemporary stormwater management: The purification of stormwater running off the surfaces of the cities collecting pollution and the delay of the heavy rains caused by the climatic changes.

The plant consists of two separate sections on either side of Østerå; through the processes of the treatment plant the stormwater is purified by means of sedimentation, absorption of dissolved substance and removal of nitrogen and phosphor. The delay of stormwater is secured by establishing frames the containment of a 5 year rain incident.

Through the frame of Urban Farming the thesis addresses the challenges of stormwater management by focusing on three characteristics that stormwater management shares with Urban Farming: Holistic conception of nature, Production as problem solving and Emphasis of place.

By departing from these points of focus the thesis applies a research based approach formulating strategic areas of foci for the integration of architecture into the question of stormwater management. The design of the treatment plant emphasises in continuation of the theoretical section a holistic approach to nature, utility of the specific contexts of the projects and the creation of experiences by emphasising sensory perception in connection to the industrial frames of the treatment plant.

III.2 Aerial photo of Aalborg

URBAN FARMING

Frames for the thesis

The projects is written as a long Master's thesis under the theme of Urban Farming in an interdisciplinary cooperation between the Department of Architecture, Design and Media technology and the Department of Civil Engineering of Aalborg University – including supervisors from the sections of Architecture, Urban Design, Food+Design, Water and Soil, Indoor Environmental Engineering and Structural and Civil Engineering.
The overall focus of the cooperation on the theme of Urban Farming is to transform a general understanding of a contemporary trend into a theoretical level debating the role of architecture in Urban Farming and to engage in a re-evaluation of how traditional conceptions of Urban Farming can be developed through an interdisciplinary approach including perspectives of architecture, food design and different aspects of engineering.

These frames and the theme of Urban Farming form a common ground for five Master's theses - including this project.
Each of these long Master's thesis represents an individual focus on various topics within the interdisciplinary domain of Urban Farming, architecture, food design and civil engineering. The five projects are respectively concerned with the architectural design of a public school, dwellings, a mussels farm, a cowshed and urban stormwater management - the latter the focus of this thesis.
The group of the five Master's theses have the department of the City Architect Peder Baltzer Nielsen of Aalborg Municipality as an external partner and each of the five projects is therefore located in the near context of Aalborg.
The location of this thesis is north of the residential area of Kærby near the old Freight rail area currently being transformed into a city campus and apartments.
The choice of this location in connection to urban stormwater management will be elucidated during the analysis of the context.

With the five vast various foci the projects are not directly connected and the five designs are therefore not interwoven, but rather five examples and approaches to the theme of Urban Farming and architecture's role herein. The main intention with the joined theme and frames for the projects is therefore to present a joined, varied picture of the possibilities for Urban Farming when connected to architecture.
The foci of the five projects were displayed through posters during *Bæredygtighedsfestivalen* in Aalborg in September 2013 and the projects are to be displayed together at ESOF (Euroscience Open Forum) in June 2014. In addition to this the projects will form the foundation for a summer school in August 2014 in connection to the *14th International Architecture Exhibition* in Venice.

Within these overall frames for the project this thesis therefore seeks to shed light on the potentials of the connection of Urban Farming to stormwater management and architecture. To engage in this task the thesis therefore departs from an initial analysis of the term of Urban Farming.

Ill.3 Wheatfield, a Confrontation
Agnes Degnes, 1982, New York

It is not about food!

The production of food in cities and the notion of Urban Farming have in recent years been of growing interest by both popular media and various academic disciplines - which is seen in the increasing general public awareness and focus on guerrilla gardening, food communities, kitchen gardens, Fødevarefællesskaber, Ny Nordisk Mad, Maritime Nyttehaver etc… Realised examples of Urban Farming have been seen in projects such as DYRK Nørrebro at the rooftops next to the Assistent Cemetery in the center of Copenhagen, Byskolehaven at Amager Fælled Skole, Byhaven 2200 at the centre of Nørrebro, Aquaponics Nu at Islands Brygge, Prags Have at Amager, the association Bybi's beekeepers in Copenhagen… the number of examples are growing almost concurrently with the numbers of bees spreading from the beehives at the cities' rooftop! And as the amounts of picked ramson is peaking a cross the Danish nation such publications as *Spis din Have*, *Spis vilde planter*, *Naturens Køkken*, *Spis dit ukrudt* and *Vild Verden* are preaching the gospel of how the small sustainable urban gardens and the non-culture plants are to save the day…
Urban Farming has become the new next thing in Denmark! Only, Urban Farming is far from a new invention. It is not necessary to look further back than to the twentieth century to find plenty of examples: The establishment of gardens for food production in New York City during the Great Depression from 1929 where nearly 5,000 relief gardens on vacant city lots were sponsored for unemployed; the establishment of Victory Gardens during World War II which produced around 40% of fresh vegetables in USA; the reintroduction of landscape and small gardens in the city as an reaction to the vulnerable of a mechanised food system exposed by the oil crisis in 1973; the global focus on exponential human growth and the relating food crisis illustrated in architectural examples such as the Pig City by MVRDV… These examples share one common characteristic: ***Urban Farming prospers in times of crises!*** The motivation connected to these historical examples is the basic need of food supply and urban agricultural production is in these examples a pragmatic solution to a problem: The inhabitants of the city do not have enough food, so therefore they start growing their own food. The problem is solved where it arises. Urban Farming can therefore be described as an answer to a problem with local anchorage in the approach to the problem: If you are starving enough you eventually have two choices – either relocate to a place where there is enough food or begin to hunt or grow your own food where you live. Urban Farming is the latter solution. ***Urban Farming solves the problem where it arises!*** However with 47% of the grown Danish population suffering from obesity (BMI >25) it seems that the lack of food in the Kingdom of Denmark is not the problem (Sundhedsstyrelsen 2013). The abundance of food in Denmark is also reflected in the numbers of the Danish food production where perhaps the pig production is the most striking example: In 2012 over 19,4 million pigs were slaughtered in Denmark – with the production of 1.635.000.000 kg of pork as result! A straightforward profusion of pigs (Landbrug og Fødevarer 2012).
If the Danes alone were to consume these amounts of pork it would mean that everybody had to eat 0,8kg of pork per day – including newborns and vegans! This is of course not a real scenario as Denmark exports the main part of the produced pigs. However it does testify to the state of food production in Denmark: A nation that ships that much bacon abroad does not have a problem with the amount of food produced! ***Contemporary Denmark is producing far more food that it is consuming!***
In addition to this glut of production, the distance from the main consumption in the cities to the agricultural production in the landside is minimal – the distance from the centre of Copenhagen to the first field is approximately 10km! And it takes less than 24 hours for the cow's milk to leave the warm of the udder before it reaches the cold of the refrigerators of the local supermarkets. ***Contemporary Denmark has such developed infrastructure that accessibility to food is secured!***
The motivation for Urban Farming in Denmark is thus distinctly different than the motivation for Urban Farming in African cities where not enough food is produced in the landside or in Asian megacities where not enough food is reaching the city centre due to distance. Neither an insufficient food production nor logistical challenges are a problem in Denmark – the Danish people are not forced by hunger to slave away in the urban gardens to survive. But then why are they then happily slaving away?
Something else than the food outcome is in play here.

Ill 4 Urban Farming in backyard, 2012- Copenhagen

Ill 5 Factory specialising in the manufacture and export of canned tomato paste Jiang Xi, China

Three characteristics of Urban Farming

If Urban Farming is not solely concerned with food what then?

To answer this question the term of Urban Farming is in the following sections addressed and by analyse described through three key characteristics. This is done to facilitate tangibility of the otherwise wide-ranging and ambiguous term of Urban Farming.

The following sections present three characteristics of Urban Farming that together comprise how Urban Farming will be further addressed.

Holistic conception of nature

Conventional farming has one output as goal: The production of food to cost-competitive prices!
To secure the buyer the best product to the price the production has to meet several quality demands within the cheapest price: The production has to take place within legislative demands of animal welfare, hygiene of production, security of quality etc. - but in the end there is only one benchmark: How much bacon is produced per invested krone. Even the buyers that are willing to pay more for other qualities connected to the production - pork from pigs grown out of doors, potatoes grown exclusively on Samsø, eggs laid by hens fed with ecological forage etc. – are still in the end buyers of a product. The willingness to pay more than the minimal market price for pork, potatoes and eggs are adding qualities connected to the production. However the experience of these extra qualities is for the buyer in the end exclusively tied to the product – the steps of production are means to the absolute goal that is the product.
Conventional farming is product orientated!

The emphasis on the end product as the predominant objective is directly reflected in the conception of nature intrinsic in conventional farming - a conception of nature departing from the idea of utility: In this conception all steps of the production are of interests as they can be controlled to further optimisation of the production and thereby enhance the utility – and in the end the yield. Urban Farming is also concerned with all steps of the process from the planting of the seed to the harvest of the crop, but since it is not the lack of nutrition nor vitamin C that has driven the Urban Farmers into urban agriculture the concern is not solely regarding the product - and therefore it is not paramount whether the end product is carrots or barley: The process of production and not the product alone is at centre of attention. This means that conventional farming's absolute hierarchy with the product as sole purpose cannot be transferred to Urban Farming as the quality of the farming is not exclusively tied to the product, but as much to the steps of the process of production: Urban Farming is not only about the product.
Urban Farming is process orientated!

Where conventional farming's mono-focus on product results in a utility conception of nature, Urban Farming unfolds a multi-pronged focus on nature where quality is connected to all steps of the process: This means that other values of nature than the productive element comes into focus: Values such as the understanding of nature's processes, the increased health of staying in green environment etc. This means that the quality of the product is just one quality connected to one step in a process consisting of several steps. Together these several steps of production with different qualities comprise a conception of nature characterised by wholeness.
Urban Farming has intrinsic a holistic conception of nature!

Production as problem solving

The holistic characteristic of Urban Farming is however menaced by the contemporary development within Urban Farming in Denmark: The qualities connected to Urban Farming in Denmark are addressing problems different from the examples of Urban Farming in the twentieth century; i.e. the relief gardens, Victory Gardens etc.: Where these examples solved problems essential to human survival it seems that contemporary Urban Farming is primarily focused on first world problems! By suggesting this it seems necessary to ask whether the product is more important than knowledge of and interaction with the process. According to Maslow's hierarchy of needs the short answer would be: YES! It is nice to follow the process of food production – but the consumption of the actual food product is necessary to survive. Does this then mean that contemporary Urban Farming is not addressing relevant problems? The short answer would here be: NO! Urban Farming has the potential to solve critical problems in connection to health, education and social aspects - themes of utmost societal importance! These qualities are main strengths of Urban Farming - but all are primarily connected to the process and not the product of Urban Farming. The efficiency of conventional farming have robbed Urban Farming's products the ability to solve a relevant problem. An unbalance is present in Urban Farming: The product is not valued as high as the process because the process has the ability to solve problems, but the product does not as conventional farming by far fulfils all food needs.
Can the products of Urban Farming reclaim the domain of problem solving? A step toward this is an extension of Urban Farming beyond food production. This could be achieved by focusing on a production which also includes natural processes like food production does – and in this expanded view focus on the problem solving aspect of both the product and the processes of production.
Urban Farming's product as a problem solving product of natural processes!
Another step is related to the type of production: Urban Farming is characterised by a high degree of user involvement – which is also to a great extend why the qualities of the processes exist within Urban Farming and not within conventional farming. But the user-driven aspect is simultaneously what makes Urban Farming less productive than conventional farming – an amateur farmer can never be as efficient as a professional farmer. And in the end this also why the product of Urban Farming has lost importance compared to the process of Urban Farming. Can this loss be avoided by applying a top down approach? Can this be obtained if the production is of industrial character and driven by another community e.g. at municipality level? The challenge in such a top down approach would then be to secure the qualities connected to interaction with the processes of the production. If succeeded this could result in an efficient problem solving production with a product not dependent on the efficiency of user participation, but at the same time offering the additional qualities that access to the processes secure.
Urban Farming as a production of industrial efficiency!

Ill.6 Kastrup Substation (transformer station), Gottlieb Paludan Architects and artist Ingvar Cronhammar, Copenhagen

Emphasis of place

Integration of an industrial production in urban settings is however far from uncomplicated - and not all productions are suitable to be integrated in the city - nuisances as obnoxious smell, noise of machinery etc. of areas of production drastically narrow down the field of possible production facilities which are possible to integrate in the city: As it is not the smell of bacon that is dominating the production facilities of pig production it is not possible – at least not with current technology - to integrate all productions, however some productions can be integrated in the Danish cities to the benefit of both the production and the cities! The industrial elements that the segregation of modernistic urban planning left in the cities point towards which capacities productions in the cities needs to embrace: Water towers, transformer station, power substations, combined sewer overflow etc. are all connected to the challenges of the cities – which means that it is just as difficult to imagine these placed in a rural setting as a pig farms in the centre of the city. But what if the pig production also was connected to the challenges of the city? This question suggests which capacities an industrial production of Urban Farming needs to contain: For the integration to be meaningful the industrial production needs to address at least one of two aspects: The industrial production needs to solve a problem in the city which cannot be solved anywhere else! By solving a problem where it arises a substantiation of the urban placement is created in the utilisation of the specific context. The qualities of learning, healing, sociality etc. make Urban Farming meaningful to integrate close the homes of the city's inhabitant – but if the product of Urban Farming also is to be problem solving then the same aspect of local anchorage concerns the product too.

Urban Farming solves problems that cannot be solved elsewhere!

Another aspect for the integration of an industrial production in the city is the focus on synergy: Assuming a scenario where all nuisances of production are eliminated it could still make sense to integrate a production where the product is not solving a problem tied to the very place, as long as the production is benefitting from the context or vice versa. The products of pig production in the city does not solve a problem that conventional rural farming cannot solve; however if the surrounding buildings in the context can utilise the process of the industrial production – e.g. heating of houses from use of the pig produced methane gas – then it could make sense to integrate industrial production in the city.

Urban Farming has a reciprocal relation with the context!

Both approaches share the common factor of context orientated production: The particular place and the challenges of this place are therefore focal points for Urban Farming: The characteristics of the place of production are at utmost importance when the production seeks to solve problems connected to just this place and when the context of production is to be embraced in a synergic interplay. This means that the question of place and local anchorage becomes essential to Urban Farming.

Urban Farming is an emphasis of place!

Urban Farming in further process

Together the three characteristics of Urban Farming also give a joined characteristic of how Urban Farming will be approached in this thesis: Urban Farming is qua its holistic character focused on problem solving via both process and product by facilitating a production of natural processes and industrial efficiency in reciprocal relation with the context where the problems arise.
The further approach to Urban Farming in this thesis departs from the three characteristics of Urban Farming as they form the foundation for the foci of the theoretical investigations: The three characteristics define three individual foci that in the combination with architecture are sought to shed light on the potentials of Urban Farming and architecture in combination:

Holistic conception of nature → Architecture & Nature

Production as problem solving → Architecture & Production

Emphasis of place → Architecture & Place

This leaves above all one paramount question for the implementation for the further investigations: Which problems are the cities of Denmark currently facing?

MOTIVATION

Climate changes as contemporary challenge

Denmark is facing a number of changes in relation to its appearance, infrastructural functioning and the entire inner physics: Changes influenced by both comprehensive global trends and national oriented trends – after-effects of the economic crisis that occurred in 2008, the depopulation of the Danish outer areas, the large growth in the major Danish cities, new infrastructural developments, a change in the Danish agricultural landscape etc.
One of the biggest challenges at global, national and local level is the contemporary climatic change causing a warmer, wetter and wilder weather. Despite a possible reduction of the emission of greenhouse gasses these changes will in a Danish context lead to higher sea levels, higher annual average temperature and more storms, floods and heavier rain (CAN WE DESIGN A NEW COUNTRY 2013: 21).
The Danish climate will be warmer in the future with an increase in the annual mean temperatures of approx. 1.2 C where it is expected that the biggest increase will be at winter (Task force Klimatilpasning 2012: 6) The big climate challenge in Denmark is based on the side effects of these higher temperature related to the rise of the water level in the seas around the country and the increasing annual mean precipitation – which is expected to increase by 7% until 2050. This increase is expected to peak during winter. The increase in rainfall is not expected to be distributed over large periods but to occur at more frequent extremes in relation to heavy rains or longer lasting rains in large quantities (Task force Klimatilpasning 2012: 6).
When these extremes appear the stormwater cannot stream away and the sewers are not dimensioned to the huge quantities in such a short time – the result is major flooding and problems in urban areas.
One of these events with an extreme amount of rain in a short time hit Denmark in July 2011 and was a wake-up call in terms of which damages the extreme weather events can afflict. Especially Copenhagen was badly afflicted and during the short period approximately from 19 to 22 in the evening there fell approximately 177 millimetres rain, with a big intensity of a fall of 30 millimetres in 10 minutes (Thostrup 2012: 4).
In an urban area this is especially a problem as the sewers cannot handle these amounts of stormwater and the stormwater cannot percolate or stream away because of the large paved surfaces – as a result the stormwater accumulates and causes massive damage.

The potentials of linking stormwater management with architecture - and especially landscape architecture - are currently being addressed through numerous projects:
The on-going 2010 collaboration “Vand i byer” seeks to develop methods to manage stormwater at local level in urban contexts. Through the project knowledge institutions, public authorities and private organisations seek in joined force to create robust, attractive and sustainable urban areas as an increased societal capacity to face climatic adaptation with innovation and efficiency (vandibyer.dk).
Another collaboration project is the 2013 project “Vandplus” launched as a part of Task Force on Climate Change Adaptation under the Danish Nature Agency that seeks to unfold the potentials of the future investments in urban spaces as a part of climate adaptation. The project connects climate adaptation with the possibility for play, sport, culture and other experiences in urban spaces in a search for innovative solutions of both functional and recreational value. The projects asks “Why not have fun at the same time?” when facing billion investments in climate adaptations in any case (klimatilpasning.dk 2014). In the “Vandplus” project there has been launched 4 pilot projects related to LAR-solutions which will help to create an awareness of the problem and simultaneously help to highlight the potentials that exists in the handling of stormwater in dense urban contexts.
The four projects are located in Solrød, Gladsaxe, Frederiksberg and Viborg.
The project in Frederiksberg is centred in a small city park that is located relatively low. Is it desired that the stormwater passes through the park during the heavy rains and thus transform the park’s grass area to a large bowl where the water is withhold and during time it will be percolated (klimatilpasning.dk 2014).
One of the other projects is the Solrød project, a transformation of an abandoned overgrown field to a collection area. The area is a low-lying area and therefore a desired area to use as a stormwater reservoir where the stormwater from the nearby areas can be gathered during large heavy rains. As the Frederiksberg project it is supposed to percolate or be directed to the nearest recipient, Solrød Bæk (Klimatilpasning.dk 2014).

Two challenges of stormwater management

The abovementioned projects dealing with the more frequent extreme rains and large quantities of stormwater in dense urban contexts are however not unproblematic as they are dominated by a biased approach: The use of LAR-solutions.

LAR-solutions (or SUDS, Sustainable Drainage System) is a common name for the solutions focused on reducing the burden on sewers systems during heavy rains. It is oriented towards a local solution of the problem where various tools such as detention, infiltration, evaporation or discharge to the nearest recipient minimise the risk of flooding and overflow of the existing sewer system (Miljøstyrelsen 1992; 11).
The water is held back during rains by the locale water management either by a fascine, a ditch, a rain bed etc. and thus reducing discharges to the sewer system. The stormwater is thereby controlled and prevented from accumulation on roads, running into basements etc. From the catchment the stormwater percolates through the different soil layers. At the same time the solution is placed in the vicinity of plants or trees or they are part of a rain bed where the stormwater is absorbed by the plants and trees and is evaporated away which contribute to a cooler microclimate and cleaner air.
Other solutions are primarily focused on functioning as a retention basin from which it is discharged into the nearest recipient, either through soil layers or by open or closed piping.

In the use of percolation or by deducing the stormwater to nearby lakes, streams or wetlands new challenges however appear in the maintenance and security of the Danish water environment.
The problem is that stormwater become polluted in the contact with the rooftops and paved surfaces of the cities. Stormwater is generally not polluted, but when it hits the paved surfaces of the city and runs on the surfaces it collects various forms of pollution: Oil, metal particles, animal excrement etc. (Thostrup 2012; 8).
The challenges of stormwater are therefore not only a question of the vast amounts of water during peaks of storms, but also the pollution of the stormwater.
The motivation for addressing the latter problem of pollution is not the lack of clean water – the ground water reservoirs are large and the pollution that the stormwater absorbs through the atmosphere is removed by the percolation through the layers of soil before it reaches the phreatic surface.
However in cities a problem arises when asphalt and other non-permeable surfaces further pollute the stormwater and prevent percolation and therefore also purification. The polluted stormwater is instead lead directly to the recipient via sewers.
This means that the problems of stormwater in urban areas are not only a quantitative question – the stormwater is also polluted: The result is large amounts of polluted stormwater.
The pollution of stormwater is not only a problem during the extreme rains. If all the stormwater is being led to the nearby recipients without purification then all the pollution from the city surfaces will also be led the recipient regardless of the amount of rainwater. The purification of stormwater is therefore not only related the extreme rains (Thostrup 2012; 8).
The possibility of leading the stormwater to recipients such as fjords, lakes, streams etc. therefore only solve one of the problems – the pollution is not addressed in this solution.

I Denmark there is on governmental, municipal, and civic levels more focus on the problem related to the floods caused by the frequent and heavier rains due to the enormous societal costs.
The motivation is therefore present to deal with the challenges of the stormwater management and the motivation has backing of billions for future investments!
The second problem is however not at the same level of attention of the public as the protection of the water environment often is overshadowed by the enormous material damage of the cities costing the society billions in reconstruction and renovation after the destructions of the extreme rains. This is evident as the connection of the stormwater collection and the purification - with exception of some unrealised projects – is almost non-existent.

This project therefore aims to investigate architecture's role in this gap of knowledge and thus create a debate and awareness related to the connection of both collecting/delaying and purification of stormwater.
The challenges addressed in the thesis are therefore:

Flooding after heavy rains and
Pollution of the stormwater

Ill.8 Stormwater from sewer on road during heavy rain

Ill.9 Stormwater polluted from road

Stormwater management as Urban Farming

How are the challenges of the climate changes and the two main challenges of stormwater management related to Urban Farming?
To elaborate on this focus is aimed at the characteristics of Urban Farming as they are in accordance with key characteristics of urban stormwater management.

Ill.10 Stormwater polluted from road

Holistic conception of nature

As “Vandplus” and “Vand i byer” show there are currently a focus on exploring the possibilities of stormwater management. The point of departure is that the sewers cannot contain the heavy rains and large enough sewers cannot be built to meet the demands – the stormwater therefore steps into the urban scene from being hidden away in underground pipes. When facing this scenario the stormwater is approached in a vastly different way: The functional main function of managing the stormwater is still at center, but new possibilities are introduced as the recreational values of the stormwater create enhanced quality of urban spaces. This means that the unilateral approach of managing stormwater by sewers is replaced by a holistic approach to stormwater management above the pavement.

Production as problem solving

The focus on problem-solving is intrinsic in stormwater management as the motivation for the projects currently dealing with stormwater management is the problems of the heavy rains. When the aspect of purification is added to the question then stormwater management gets a character of production as an end product is introduced: Clean stormwater.
The process of purification also introduces the possibility for further physical products if biological purification means are used: Plants can be used to remove parts of pollution and thereby supplement the main product of clean water with harvested plant by-products.
As stormwater management is in municipal domain the possibility for introducing an efficient production of industrial character is present.

Emphasis of place

As Urban Farming emphasises a reciprocal relation with to the context, so does stormwater management: The use of sewers and large centralised treatment plants at the outskirts of the city stand in contrast to the approach of the contemporary projects of urban stormwater management. Here the problem is solved where it arises as the stormwater is approached on local level in decentralised solutions; the challenges of the stormwater are addressed where the stormwater falls. As the challenges of stormwater in the cities cannot be solved anywhere else than in the cities the specific place come to play a vital role in contemporary stormwater management - and catchment, purification and discharge of the stormwater are gathered at the same place seeking synergy with the context.

Problems to potentials

In continuation of the affinity and kinship of Urban Farming and urban stormwater management the thesis therefore seeks to address the contemporary problems connected to stormwater by approaching stormwater as Urban Farming.The three characteristics of Urban Farming and stormwater management are therefore utilised to at once engage in Urban Farming and stormwater management.
In this approach it is the intension to turn the problems in the cities connected to stormwater into potentials by engaging through the three characteristics and connecting these to architecture.
The point of departure for the further engagement is therefore to investigate the role of architecture in the process of turning problems into potentials.

PROJECT OUTLINE

Focus

The focus of the thesis is under the theme of Urban Farming to investigate architecture's role in the two major contemporary challenges of urban stormwater management: **Flooding after heavy rains and pollution of the stormwater.**
In order to establish an efficient production that can address the societal challenges of stormwater management a certain scale of the project is necessary:
A top down approach and an industrial character of a treatment plant is therefore the focal point of the design.
The design task of the thesis is therefore

a design of a decentralised stormwater treatment plant of industrial character.

The contemporary projects of stormwater management are dominated by water engineerical aspects of stormwater management and urban design. The thesis therefore seeks to investigate how architecture can contribute to the tension field from which stormwater management typically arises. When addressing stormwater management with architecture as the point of departure the thesis is thereby inscribed in an interdisciplinary field of three areas: Water engineering, urban design and architecture.
The connection of urban design and architecture points towards an approach where cross-scale considerations of design is in focus. The thesis therefore focuses on

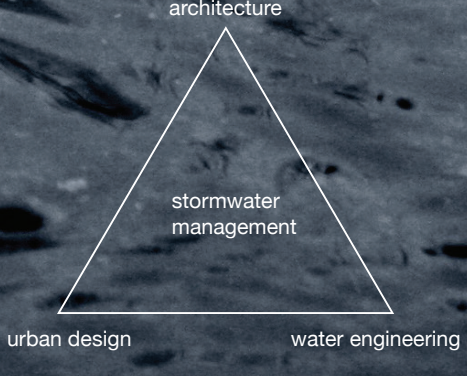
a design which embraces scales ranging from landscape considerations to the single building element.

The connection of water engineering and architecture points towards an investigation of how architectural elements can facilitate efficient solutions of water technical character, but also how water can become an architectural element. The thesis therefore focuses on a design which contains both

functional and aesthetic considerations to the element of water.

The connection of urban design and stormwater management are the field which stormwater management arises from when the water leaves the pipes and enters the spaces of the cities. This connection points towards an architectural design which focuses as much on interior as exterior spaces. The thesis therefore focuses on the creation of

a coherent design operating across the borders of the building.



Objectives

Urban Farming: The overall focus of theme of Urban Farming is to transform a general understanding of a contemporary trend into a theoretical level debating the role of architecture in Urban Farming and to engage in a re-evaluation of how traditional conceptions of Urban Farming can be developed through an interdisciplinary approach including perspectives of architecture, food design and different aspects of engineering. The thesis seeks to elaborate on the potentials of Urban Farming through the connection of architecture to the stormwater management.The aim is to shed light on both how the characteristics of Urban Farming can contribute to architecture and how architecture can contribute to a further development of Urban Farming. The goal is therefore mutual development.

Theoretical investigations: As the thesis is written as a long thesis the theoretical section constitutes a larger part compared to a normal thesis. The aim is therefore to conduct thorough theoretical investigations on the connection of stormwater management and architecture by focusing of the three characteristics of Urban Farming and stormwater management in connection with architecture.
The aim is to apply a research based approach emphasising the connection of theoretical writings and contemplations with the goal of establishing strategies for the connection of stormwater management and Urban Farming to architecture.
The final outcome is a joined strategy for this connection.

Architectural design: The thesis is concerned with the architectural design of a stormwater treatment plant of industrial character.
The main goal is to establish frames for the catchment and purification of stormwater through the design of basins for purification and delay.
The aim of the architectural design is thereby to provide a pertinent answer to a societal challenge that at once offer functional solutions, but also facilitate awareness of the challenge of stormwater management.
The scales in focus span from 1:500 for siteplan to 1:5 for structural details with the overall building design in 1:100.
Connections to the surrounding areas and connections to the catchment areas will be designed in the scale of 1:10000.

Technical aspects: The thesis aims to facilitate an integrated architectural design.
The buildings are to meet the requirements of Br2020 - documented via simulations on month basis. The aim is to meet the requirements by passive means.
The thesis aims to let the structural elements of the buildings create coherence in the overall design of the treatment plant. Simulations via Finite Element Method will be conducted on decisive details and elements.
The thesis aims to integrate aspects of water engineering by including dimensioning of purification and delay basins and to introduce the processes in the purification into the design. The thesis therefore aims at an extension of the range of traditional technical domains of the architectural design process.

Delimitations

Water engineering: By introducing aspect of water engineering to a thesis on architecture an entire field of knowledge is opened up which calls for a delimitation of which aspects are emphasised in the approach.
The thesis is therefore delimited from calculations on flow between basins and flow in basins, the dimensions of the basins links and the sewer planning necessary to facilitate the treatment plant: Everything that lies before the inlet of the water to the basins and the specificities of the movement of the water in the basins.
By establishing these limits focus is aimed at the sizes, physicalities and content of the basins of the treatment plant which is assessed to be primary for the connection to architecture.

By-products of purification process: As the primary focus of the design task is the management of stormwater the thesis is delimited from in-depth unfolding of how the by-products of the purification process of the stormwater are handled.
The treatment of the by-products of the purification process is therefore approached on an overall level seeking to render the handling of the by-products probable by focusing on the physical facilities for the by-products.
The architectural design will therefore contain spaces for the handling, storage and serving of by-products.

Initial problem statement

How can Urban Farming and its key characteristics be the point of departure for an architecture adressing the challenges of the global climate changes connected to stormwater management?

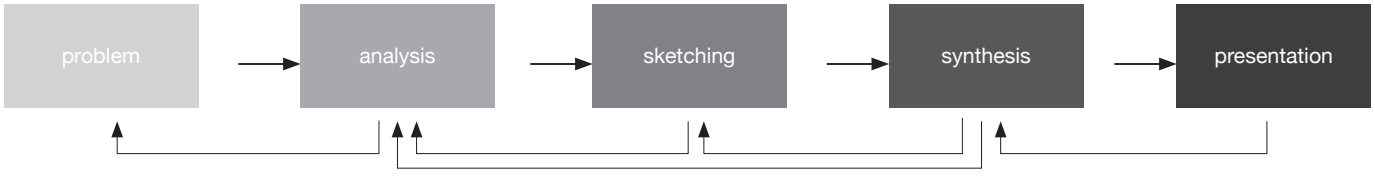
III.12

“A great building must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable”

Louis Kahn (Rykwert 2001)

METHODOLOGY

Jonas Salk Institute for Biological Studies, Louis Kahn



(Knudstrup 2004: 3)

Phases of the Integrated Design Process

Problem formulation
The description of problem or idea of the project. Outcome is initial problem statement.

Analysis phase
Analysis of all information gathered and established, e.g. site analyses, development plans for context, chart of functions, aim and programme. Outcome is the project's aim and programme including spatial program, vision and problem statement.

Sketching phase
The sketching phase links functional demands and architectural ideas to considerations of construction, energy consumption and indoor environment. Outcome is conceptual design.

Synthesis phase
The further combination and integration of the elements of the sketching phase and possible addition of more qualities. Goal of aim and programme are met in final form and expression. Outcome is the final design.

Presentation phase
The project is presented in report, drawings and models in a manner where all qualities are displayed and where focus is the clear communication of how the aim of the project has been met.

(Knudstrup 2004: 3-7)

Methodical foundation

Together with the basic educational model of Problem Based Learning at Aalborg University the overall method of the specialisation in architecture at Architecture&Design is the Integrated Design Process (IDP), which therefore forms the methodical foundation for the approach of this project.
The IDP can in a condensed description be characterised as the integration of knowledge from the disciplines of engineering and architecture to solve complicated problems connected to building design in an interplay of functionality, aesthetics and technique (Knudstrup 2004: 1-2). As this thesis is concerned with the management of stormwater the traditional technical aspects of indoor climate, energy consumption and construction within the IDP are supplemented with technical considerations to water management.
As this thesis is written as a long Master's thesis the two first phases of the IDP – Problem formulation and Analysis Phase – are expanded because they constitute the majority of the first semester of the thesis. These phases are the preceding work of the design phases and the main part of knowledge is brought into the project in these two phases to outline the frames which the solution to the formulated problem is to be unfolded within.
The division of the IDP into phases is to a certain degree artificial as one of the main focuses of the IDP is the aspect of integration: This aim on integration is not limited to the approaches and disciplines of architecture and engineering, but also includes the integration of the phases in the design process. Because of this the iterations between the design phases are a key element to secure solutions of synthesis which is the distinct force of the IDP. The iterations between phases are therefore of pivotal importance as it is here in the interplay between engineering and architecture can inform each other in the path towards solutions of synthesis.

The division of the phases is however uphold here in order to address the approach of the individual phases of the IDP thoroughly – keeping in mind that the phases in reality are never separated.
A decisive aspect in the creation of synthesis is the management of the different epistemological traditions of engineering and architecture: Engineering traditionally departs from an empirical analytical tradition rooted in the ideas of Positivism. Here causality induces a system of knowledge with focus on models and empirical data and induction is therefore dominant as model of reasoning (Hyldgaard 2006: 99) (Delanty 2003: 14).
Architecture is in opposition to this approach connected to an aspect of human experience which can be connected to the epistemology of phenomenology. A phenomenological approach is based on the intentional focus of the subject on object or subject and a physical connection between subject and object or subjects are therefore necessary. The system of knowledge is based on abduction (Botin 2010: 3).
As the IDP contains both chains of reasoning comparison between conclusions departing from different epistemological is therefore necessary, e.g. the plausible true conclusion of abduction and a compelling true conclusion of rationality need to be considered of equal quality: The measurability of a day light factor does not alone dictate the placement and size of windows because of its tangible nature of measurability – it does not trump the consideration to the bodily experience of the light. This means that the IDP does not revolve around the choice of one aspect at the expense of the other: As quantitative and qualitative goals are equals in the IDP the synthesis of the two is the main goal.

The theoretical investigations of the project are comprised by the IDP's two first phases – where interaction between the two phases exists: The focus of the Problem Formulation defines the scope of the Analysis Phase and the findings of the Analyses Phase informs the focus the Problem Formulation in a further development of focus etc.
The investigations of the Analysis Phase include both analytical investigations of empirical character and theoretical investigations – where the latter especially is extended in a long Master's thesis. The descriptions of latter is therefore extended here.

Theoretical investigation

The theoretical investigations departs from the method of Literary Review which can be described as a survey of various sources in order to introduce knowledge to a project. The professors of architecture Linda Groat and David Wang describe in Architectural Research Methods one of the forces of a Literary Review as the ability to focus the topic of inquiry – to find the balance between overly general topical questions and overly restricted questions. An indicator of this balance is "*the ability to clearly and simply identify a body of literature to which the topical question can be referred*" (Groat and Wang 2002: 45, 52).
When addressing the connection of Urban Farming with architecture a preliminary question could be: How can Urban Farming contribute to a further development of contemporary architecture?
However the range of possible answers to this question is almost unlimited - and the question does not contribute to a significant delimitation of the possible literature to apply to the investigation – especially within architecture as the amount of available literature here is significant superior than to the amount of available literature on the phenomenon of Urban Farming. The preliminary question is therefore simply too broad.
As sparse literature on the connection of architecture and Urban Farming exist the strategy of this thesis is the formulation of the foci of the topics of inquiry by use of the identified three characteristics of Urban Farming. These characteristics are used to define which areas of contemporary architecture Urban Farming especially has the ability to contribute to. The characteristics of Urban Farming are as stated:

- Holistic conception of nature
- Production as problem solving
- Emphasis of place

By utilising one of three characteristics of Urban Farming the focus becomes applicable in defining the limits for the focus of the answer and the possible literature – e.g. Urban Farming's Holistic conception of nature suggest a focus on the conceptions of nature in contemporary architecture. The overall question on how Urban Farming can contribute to a further development of contemporary architecture is in this case guided by the focus on the conception of nature and a more specific focus can be defined.

The characteristics of Urban Farming are thereby used to define focus within the wide-ranging term of architecture and facilitate the connection of Urban Farming and architecture. The tripartition of the phenomenon of Urban Farming is also applied to shed light on the potentials of the combination of architecture and Urban Farming from different angles of approach with the aim to secure a thorough display of the range of potentials. The foci of the tree characteristics – and not Urban Farming as a whole – will be connected to architecture within the corresponding field of architectural theory. Urban Farming will therefore be approached with focus on the constituent parts. and the investigations of Urban Farming in connection with architecture will as mentioned above be conducted under the headlines of:
- Architecture & Nature
- Architecture & Production
- Architecture & Place
As a consequence of this approach Urban Farming is not treated as a whole in connection to architecture. And as a further consequence of this approach the aspect of stormwater management in connection with architecture is treated indirectly in the theoretical investigation through the connection to Urban Farming. The explicit connections of the theoretical investigations to stormwater are in the design phase made applicable within the relation of architecture and water.

The formulation of research questions arises from the establishment of the three foci: The juxtaposition of a characteristic of Urban Farming and a corresponding tendency in contemporary architecture is applied in continuation of the approach of the overall method of the IDP: With the goal of reaching synthesis.
The aim of the three foci is initially to describe tendencies of contemporary architecture within the foci of nature, production and place and compare these tendencies to the capacities of Urban Farming within the given area. Attention is hereafter aimed at how Urban Farming can contribute to contemporary architecture within the given area – and it is here that the research questions of the three foci arise: In the search of synthesis of the contemporary state and Urban Farming's capacities.
The foundation and formulation of the research question are integrated in the three texts of Architecture & Nature, Architecture & Production and Architecture & Place.

Groat and Wang describe the demands for information gathered through research by establishing three demands:
- The information should address a specific topic – the core focus is at one topic.
- The result are to find its place in the larger domain of relevant literature on the topic – the results should be a contribution to existing knowledge related to topic in focus.
- The results should be able to stand alone after completion.
(Groat and Wang 2002: 45-46)
These three points are in this thesis addressed by respectively
- defining the three independent foci within Urban Farming on a specific capacity and thereby seeking to move from beyond the risk of cursory level of applying only one focus in the investigation of the total phenomenon of Urban Farming in the combination with architecture.
- utilising the three individual foci to define the areas of theory and to formulate research questions from these.
- implementing the three foci in three independent sections which can stand alone in the elucidation of the specific focus, but also enter into a joined analysis on the potentials of the connection between Urban Farming and architecture.
The double nature of the third and final point becomes of pivotal importance as it is the intention that the conclusions of each of the three foci are shedding light on the corresponding area, but at the same time are able to contribute to a joined description of the connection of Urban Farming and architecture. This challenge is approached by defining a common aim for the three conclusions: The formulation of strategic approaches within the foci.
The intention is thereby to make the interaction of Urban Farming and architecture tangible by facilitating a further synthesis in the design phase and facilitating a compilation of conclusions in a joined strategy on the connection between Urban Farming and architecture – emphasising the coherence of the theoretical knowledge in the project. To elaborate on the coherence of the theories applied in the investigations an annotated bibliography of each of the three texts are combined in a map of knowledge presented in connection to the joined strategy text.

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Ill.12

ARCHITECTURE & NATURE

Woodland Chapel, Gunnar Asplund

Sustainable architecture in the time of climate adaption

During recent years the path of contemporary sustainable architecture has been challenged by the agenda of climate adaption as a trendsetting term: The debate on the impact of human footprint has with this agenda been expanded with new elements to the already existing demands of sustainable architecture. Sustainable architecture has during the latest decades been a many faced and even equivocal term – and with the addition of the aspect of adaption to climatic changes it seems another element is added: The relation between culture and nature are under the theme of climate adaption being further negotiated as the term of *adaption* indicates a closer and more dynamic relation between culture and nature.

One of the biggest current societal challenges at global, national and local level are the contemporary climatic changes causing a warmer, wetter and wilder weather. Despite a possible reduction of the emission of greenhouse gasses these changes will in a Danish context lead to higher sea levels, higher annual average temperature and more storms, floods and heavier rain (Can we design a new country 2013: 21). The big climate challenge in Denmark is based on the side effects of the higher temperature related the increasing annual mean precipitation – which is expected to increase by 7% until 2050. The increase in rainfall is not expected to be distributed over large periods but to occur at more frequent extremes in relation to heavy rains or longer lasting rains in large quantities (Task force Klimatilpasning 2012: 6).

This increase in heavy rain causes problems in Danish cities since they are not designed for the heavy rain falling in a short time – the problems can no longer be handled by the control of static approaches as the strains of the stormwater during peaks simple are to massive to be controlled.

With the new climatic changes and heavier rain a need for a new approach to the relation between nature and culture is necessary; a change towards an emphasis on working with nature and its processes instead of working against it by trying to control it. The conventional borders of culture and nature are in this approach being expanded from a line of clear separation to a zone of negotiation.

The boundaries that have existed between nature and culture have created a sustainable architecture that stands isolated and static: As a single track addressing energy optimisation. By bringing matters to a head it can be said that recent decades attempts to minimise the CO_2 emissions and focus on energy has been a losing battle – the climate is already affected as seen in the warmer climate, heavier rainfall, sea level rise etc. A call for shift of focus is therefore present! For sustainable architecture to continuously play a vital societal role it is necessary to address the challenges of the climate adaptation and not just aim at climate protection. This adjustment requires a greater focus on the dynamic climate which brings the relation between culture and nature into play as a determining factor.

How can the currently boundaries in contemporary sustainable architecture between culture and nature be approached?

Contemporary sustainable architecture

The theme of sustainable architecture has been investigated by many scholars during the years and wide range of opinions, approaches and definitions exist as a result of this. The School of Architecture at the University of Adelaide has in the beginning of the twenty-first century presented a joined description of sustainable architecture in the book *Understanding Sustainable Architecture.* As the authors dean Terry Williamson, professor Antony Radford and architect Helen Bennetts have sought to create a coherent theoretical framework for the discussion of sustainable architecture their work can serve to establish an overview of the main characteristics of sustainable architecture.

Williamson et al. state that the design of sustainable architecture in the past was to place a building in its context in such manner that the surroundings where utilised: Architecture's primary task was to protect man against nature's forces and climate, from wind and weather (Williamson, Radford & Bennett 2003:1). Architecture was usually adapted to its environment using a vernacular style optimised over the years and based on local climate premises and local materials (Williamson, Radford & Bennett 2003: 25-29). This mind-set can be traced back to the fundamental description of architecture by the architectural theoretician Marc Antoine Laugier. In his *Essay on Architecture* Laugier describes the establishment of architecture: Man settled down by the river and the green area where natural foods could be found; with time the explosion to sun and heat made the shade desirable; shadow was found under the treetops, but these could not provide protection from the rain; this protection was found in the cave which sheltered from both the sun and rain, but however did not provide sufficient light and fresh air; therefore man began to construct his own shelter of branches as pillars and leaves as roof to protect from rain and sun. Over time, man began to fill the sides with branches and leaves to protect from the cold (Laugier 1755: 9-11). Architecture as a shelter against nature's forces was born.
From here, architecture has evolved in many directions and styles reflecting diverse relations to nature over time, but for the term of sustainable architecture the Brundtland Report marks a pivotal change and also a change in the understanding of architecture's role in the relation to nature. Published in 1987 by the World Commission on Environment and Development the report made sustainable developments a global issue in the security of the future world: The primary focus changed towards climate protection and protection of natural resources (Williamson, Radford & Bennets 2003: 4, 23-24). By this change the view on sustainable architecture changed - it became a global concern. Williamson et al. state that the primary task for a building is no more "just" to protect man against the environment, but also to protect the environment from man and that the task of protecting nature from man created an emphasis on energy optimisation and control: An image of sustainable architecture which Williamson et al. designate the *technical image*, described as a search for technological solutions which utilise the control over nature to solve problems. In this approach hard facts and measurable values are seen as the keys to solutions and nature is in this process something that can be controlled through technique to achieve the desired results (Williamson, Radford & Bennets 2003:31-32).

In this *technical image* the buildings have become means to reduce the treat: With stricter rules within the energy consumption and ecological footprint the design of a sustainable building has become a complex technological undertaking. To navigate in the complexity it seems that one approach has become dominant: The assessment of success by primarily of quantitative character. Values of thermal conductivity, energy consumption etc. indicates the degree of sustainability found in a building. In this approach the complexity are often addressed by isolating elements in order to be able to understand and optimise them to meet the requirements. By applying this method the isolated elements have become optimised through continuous development and technology (Williamson, Radford & Bennets 2003: 9, 81).
Williamson et al. state that this segregation of individual elements and use of technological solutions for an optimisation of each element is the contemporary status of sustainable architecture – the *technical image* is dominating. Focus is aimed at development to optimise and utilise nature in order to benefit environmental protection: The belief is that a continuous development will solve future problems and thereby protect the environment and nature. Williamson et al.

stress that this belief in technological progress and development has created an image based on hard facts and on rationality (Williamson, Radford & Bennett 2003:31-32).

The conception of nature connected to the *technical image* can be traced back to rationalism and the thoughts of René Descartes in the seventeenth century: Descartes' conception of nature as objects in movement or rest obeying mechanical laws stems from the dualistic division of consciousness and body, internal and external matter. In this division nature is an extended matter and quantifiable and measurable in a system of geometric and mathematic rules. It is object of analysis and manipulation (Dallmayr 2011: 1). As the philosophy of Descartes has led to significant progress within natural science, the conception of nature as something that can be controlled has allowed buildings to approach a level of zero energy emissions through optimisation and thereby given a competent measurable answer to the need of protection of nature from culture. An important part of the future of sustainable architecture is therefore without a doubt continuous technological development, but it seems that the *technical image* has reached a point where the achieved technological capacities must soon be regarded as standard requirements to all future buildings: The legislation is starting to keep up and in Denmark it will from 2020 not be allowed to build residential houses with an energy use higher that 20 kWh/m^2 per year!
In the light of this development: As sustainable architecture as the *technical image* is approaching the declared goals of zero energy use etc. where is focus to be aimed at to secure a further development? Does the approach to nature by the *technical image* even allow another focus in the relation between culture and nature?

Concurrent with the compliance of the quantitative demands stemming from technical control over nature another peculiar tendency in the relation between culture and nature can be seen in contemporary sustainable architecture: The Mies van der Rohe award is every second year awarded from the declared goal to be *"a platform for investigation, development and implementation of sustainable architectural practice that promotes the social, cultural and economic benefits of sustainable growth."* (Mies Arch 2014).The two latest new built projects to have received the reward are the Norwegian National Opera and Ballet in Oslo by Snøhetta and Harpa Concert Hall in Reykjavik by Henning Larsen Architects. Both projects focus on an element from the nearby local nature and apply this in the architectural expression of the shape of the building: Respectively the image of a Norwegian glacier and the image of the basalt stones of Iceland.
The architects unfold these narratives of the projects as buildings closely related to nature: The Snøhetta office emphasises the connection of the building to the Norwegian landscape (Snøhetta 2013). Henning Larsen Architects likewise emphasises the connection to nature: *"As the rest of the building, the design of the facades is inspired by nature. In particular, the characteristic local basalt formations have provided the inspiration for the geometric facade structure"* (Henning Larsen Architects 2013).
These buildings serve as mimetic images of the symbiosis between nature and culture and stands as a modern pastoral landscape painting. Here the technological and isolating focus is hidden behind the mimetic history of the united nature and culture. However one can only speak of a unity when a certain conception of nature is applied; the opera is obliviously not a glacier – the white marble tiles do indeed hold different material qualities than the ice of a glacier. The techniques of contemporary building culture however allow the building materials to mine nature in an expression that at once both meet the quantitative requirements of energy consumption, but also display the control over nature in the creation of the building as a picture of nature.
The two buildings are examples of a clash of conceptions of nature which display the difficulty and complexity of the relation between culture and nature. The Oslo Opera and Harpa Concert Hall are both carriers of the rational understanding of nature connected to the *technical image*, but at the same time nature somehow also play another role.
To address the relationship between the technical image and nature it therefore seems necessary to ask the fundamental question: What is nature?
And which values of nature is to be embrace in order to achieve a further development from the *technical image* of sustainable architecture?

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Conception of nature

The difficulties, complexities and paradoxes in the understanding of the relation between culture and nature has been in centre of focus since the establishment of first societies, and to shed light on the conceptions of nature the descriptions of nature by the Danish philosopher Hans Fink are utilised as Fink gives and overview of this fundamental theme. The observations of Fink are applied in the investigation of the possibilities for a further development of the *technical image* through focus on the relation to nature towards a dynamic and climate adapted approach.

Fink describe five categorisations in his work on the conception of nature:

Nature as everything (a part of philosophy's conception of nature)
Nature as the rural and green (the urbanite's conception of nature)
Nature as the wild (the farmer's conception of nature)
Nature as the earthly and common (the priest's conception of nature)
Nature as the laws of nature (the scientist's conception of nature)
(Fink 1993: 72).

Nature as the wild is nature before and independent of human intervention and the touch of human hand subject the natural to machining and thereby remove it from the domain of nature (Fink 1993: 72). This conception is therefore troubling when addressing buildings in relation to nature as *nature as the wild* never can be brought into an architectural planning process without turning it into culture.
Nature as the earthly and common is a spiritual view on the nature and it separates earthly and divine as the decisive element. It sees the human body as a part of nature, but at the same time human is separated from nature by an immortal spirit that belongs the realm of divinity and not the earthly (Fink 1993: 78-80). These conceptions of nature have in contemporary societies almost outplayed their role however the remaining categories come to play a vital role when addressing the conception of nature by sustainable architecture.

The category of *nature as the laws of nature* is based on the before mentioned rationalism by Descartes and is thereby the conception of nature that is embossed in the *technical image.* Nature is here seen as a mechanical system following mathematical laws and nature is perceived as the essence of the world because of its physical, biological and chemical capacities: Nature is everything the natural science deals with - the rest which are not regarded objective is not a part of nature and in this conception the opposite of nature is the abstract, subjective, historical and cultural – everything not obeying the laws of nature, which is the decisive element in this conception.
Nature follows the laws without purpose and freedom in a pattern spun by coincidence and necessity. Intrinsic in this conception is an aspiration to incorporate as much as possible – and natural science is not resting


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until exhaustive explanation of the physical, chemical and biological capacities of flora and fauna is presented. This pursuit stems from the perspective that what is understood and following the natural laws can be controlled. Culture is in this perspective all that cannot be controlled, predicted or elucidated (Fink 1993: 81-82).

The conception *nature as the rural and green* is by Fink designated as the dominant in the urbanised contemporary society: The border between nature and culture exists in this conception between the fields and the city gates - the urbanites work in cultural places as offices and the farmer work in the nature. Nature is a landscape that begins where the urban settlements stop, and it has become the destination for excursions on Sunday strolls or vacation hiking. Fink describes nature in this conception as a recreational experience that is primarily visual as nature is watched and travelled through landscape (Fink 1993: 75). Fink however also stress that nature is not only found external of the cities: The borders also exists within cities as gardens and parks in urban areas are viewed as nature: The decisive element in this conception is therefore the green element as nature is everything green and growing as contrary of the dead and synthetic (Fink 1993: 76). Nature is in this conception considered as 'environment' separated from buildings: The environment is the natural – the air, water and earth that form the livelihood of human existence. The relation to the environment is somewhat paradoxical as humans strive to rise above nature into culture, but simultaneously nature is also something worth returning to because of the qualities that separates the nature from the cities: The fresh air, the silence, the green etc. (Fink 1993: 76).

The two latter described conceptions of nature are seen as mainly prominent and are both present in the projects Harpa Concert Hall and Oslo Opera. In the Oslo Opera the most prominent is the *nature as the rural and green* and this is not changed by the mimetic reference to the nearby naturally produced glacier: The building remain as a static element on Oslo's harbour front separated from the fjord which contains the values of *nature as the rural and green*. The building however stops where the water starts and there is a very clear distinction between what is perceived as culture and nature. At the same time, the building embrace another conception of nature; e.g. the large glass panels also embrace the values of *nature as the laws of nature* as the glass is created from a desire to control nature though integrated solar cells, shielding of the sun and as a light intake.
The Oslo Opera therefore delimits itself from values of nature in the conception of *nature as the rural and green* as it upholds two conceptions of nature at once, but separates itself from *nature as the rural and green* by applying a mimetic imitation and control instead of embracing the qualities found in the fjord or the glacier.

The remaining conception of nature described by Fink is *nature as everything*; here nature is an all-encompassing, united domain of totality; and no border exists between culture and nature (Fink 1993: 83). Instead of the distinction of nature and culture and focus towards a total control of nature as seen in the Oslo Opera *nature as everything* creates a holistic approach to nature and the built; a holistic approach addressing building and nature as a coherent unit. Could this conception of *nature as everything* contain a move towards the dynamic approach demanded in the climatic adaptation of buildings in the modern city?

Nature as a landscape of totality

The potentials for a further development of the *technical image* in the tension field between culture and the holistic conception of *nature as everything* can be unfolded within the frames of the work by the German Professor in philosophy Joachim Ritter who in the essay *Landschaft* describes nature as the image of totality. Ritter stresses that nature can first understood as something aesthetic - a landscape - when the human is placed in it *"The Landscape is nature that for a sensitive and sentient viewer's vision is aesthetically present."* (Ritter 1963:29). By emphasising this Ritter states that nature's true aesthetics and strengths can only be experienced when there is established a contact between nature and human.
Ritter further emphasises that nature cannot solely be understand by the senses - there must be a science-acquired knowledge to create a complete understanding of the totality. In the creation of a holistic understanding Ritter thus seeks to establish a foundation based on the rational logic-based nature science on which an approach of sensory perception is built – and Ritter is therefore moving towards an integration of conceptions of nature: The conceptions of nature that Fink described *nature as the rural and green* and *nature as the laws of nature*.
Ritter states that only when natural science understood the laws of nature, removed the invisible divinity and set the laws of nature to free spectacle, the human could experience the true landscape aesthetics:

"This creates a freedom for human, freedom from nature's power and thus the ability to grasp it as a sentient human being. By achieving an understanding of nature man is no more a slave of nature; it does not see the nature as frightening unknown territory. Natural Performance and aesthetic awareness of nature presupposes freedom and the scientific mastery of nature."
(Ritter 1963:35)

Ritter describes landscape as a nature sensed by a nature science-knowledgeable human opposed to solely examination and knowledge (Ritter 1963: 26). The landscape can be seen as the connection between nature and culture and becomes a totality when the human body is placed in it. In the line of thought by Ritter it is not a matter of replacing a rational conception of nature with a sensed conception – it is the idea that the two amplify each other.
In the perspective of the landscape by Ritter there are no boundaries between building and nature and each element is equally important and needs to be sensed by the sentient human to become a totality.

This landscape that Ritter describes is far from the idea of landscape that Oslo Opera seeks to embrace in the mimic of the glacier: The Oslo Opera is a single standing element – an architectural replica of the nearby countryside communicated as a diagrammatic caricatured symbolic image of nature. This landscape requires no human presence to be understood as the monolithic imitation can be communicated by a picture as well.
In opposition to the static and mimetic use nature is distilled in the *landscape of totality* and the processes are understood and implemented in the smaller scale; focus is on the actual processes of nature and not on a mimic.
This procedural mind-set of totality creates a dynamic landscape based on the integration of the built and nature in an equal relationship. To create an interaction of building and nature, an interaction that respects and cooperates with the nature and dynamic landscape and its environment it is necessary to create a unity that utilises the processes of nature, but also provides back and work with them instead of seeking refuge in a mere mimetic approach.
In order to move beyond the *technical image* it seems that a holistic conception of nature can be applied in order to move beyond the isolation of nature and culture towards an approach of wholeness intrinsic in the emphasis on landscape. Intrinsic in this holistic approach is an emphasis on coherence and equality as the culture is not placed higher in a hierarchy of control – nature and culture is understood as a holistic totality.

Hierarchical equality

The relation between the built and nature in a non-hierarchical equivalence is by the German philosopher and sociologist Georg Simmel described as equality between nature and culture (Simmel 1919: 259). The non-hierarchy between nature and culture creates a demand for both elements to be present and the building is thereby no longer an ornament in the landscape but is absorbed into a part of the immediate context; the building becomes one with its surroundings and a part of the landscape on same level as a tree or a stone. The building has over the years been adapted to its environment through attrition from wind, sun and precipitation, as well as of context given flora that have adapted to the conditions of the building and included it as a growth medium (Simmel 1919:261-263).
The culture has become a part of the landscape – a totality. In this integration of the nature and the building in a non-hierarchical symbiosis the strengths of *nature as green and rural* and *nature as the laws of nature* are all connected and can be sensed by the human body.
This dissolution of hierarchy described by Simmel creates the equality between nature and the built which Ritter describes in his landscape of totality. The dissolution of the hierarchy can according to Simmel be created by focusing on nature's own succession and thus use nature's own means to achieve equality.
The succession of nature is based on the existing elements of the place and its flora. This means that the dissolution between building and nature is based on the existing - the existing trees, shrubs and other properties of the given context. The dissolution thereby happens over time if the flora and properties of the given context is allowed to grow wild. This means that the building can be integrated as an existing element in the context, or it can integrate the existing nature of the context as an element in the building.

The dissolution of the hierarchy between nature and building can also be addressed by other powers than the existing succession of nature; Simmel describes it as something that also appears through a patina of building materials. The patina of the materials skin is as well a natural process obtained through attrition by the weather and the succession of nature over time (Simmel 1919:262).
Patina of a building material is in this context more than just a change in the material properties and thus the aesthetic expression. It is not simply the process of copper becoming coated with verdigris, but a continuous co-operation between the material and nature. The choice of material creates, for example, the possibility of growth for various plants or other natural processes. Therefore patina is a coexisting process that can be controlled, thus creating an equal expression in contrast to, for example, the patina at the Oslo Opera where the contact with water changes the white marble in a direction of dilapidation. This kind of patina is not dissolution of the hierarchy between nature and the built, but more an underlining of the total opposition. Here the unstoppable processes of nature is not embedded, but the building is simply placed near the water due to its picturesque location, so the green algae appear on the otherwise crisp white building appears as a foreign object working against the building.

Simultaneously the dissolution of the hierarchy can be addressed by means of human intervention and not only by natural succession and time: Natural elements embracing the values of *nature as the green and rural* can be applied through green facades, grass roofs, green plants etc. as a part of the building and compliment the succession of existing natural elements and the patina of the building materials. This means that the equality does not need to only rely on the existing nature – elements introduced by man have the same potential for dissolution of the hierarchy between nature and culture.
By establishing a non-hierarchical order and a view of landscape of totality based on the description by Ritter and all values in the conceptions of *nature as the laws of nature* and *nature as the rural and green* can contribute to a movement beyond the *technical image* towards a holistic conception of totality. Through the equality intrinsic in this conception of totality the possibility for dynamic can be found as nature is not sought to be controlled by nature. As culture and nature are working in interplay the demands of climate adaption can thus be addressed through this approach.
In continuation of this statement it seems necessary to ask how architects are to work with building design as a part of a landscape based on Ritter's thoughts on totality and based on the approach described by Simmel. To address this question focus is aimed at the approach and work of an architect not usually connected to the term of *sustainable architecture*, but whose work through the years have only grown in strength through the interaction of nature and culture and therefore to a great extend can be understood as sustainable in the light of theories of Ritter and Simmel.

Ill.19

Building and nature

The buildings of the Norwegian architect Sverre Fehn are designed from a desire for an increased interplay between the building, nature and human: *"When I build on a site in nature that is totally unspoiled, it is a fight, an attack by our culture on nature. In this confrontation, I strive to make a building that will make people more aware of the beauty of the setting, and when looking at the building in the setting, a hope for a new consciousness to see the beauty there, as well"* (Fjeld 2009).
Fehn's 1962 design for the Nordic pavilion in the Giardini Park of Venice can be described as a building in the line of thought of Ritter and Simmel as the building is more located *in* the site than *on* the site – as a natural part of the existing elements at the given site: A building that equates the nature and the building materials as the walls of the building are as important as the existing trees and slightly hilly terrain.
The most obvious example of the integration of nature and culture in the Nordic Pavilion is Fehn's approach to the existing trees on the site planted by Napoleon and today a rare characteristic in the Venetian lagoon: The roof structure and layout of floor plan are planned around the trees of the park and thereby secure succession of nature and interplay between culture and nature. In this approach to the existing nature Fehn sought to let the elements of nature become part of the architecture (Fjeld 2009:54).
The role of the trees are accentuated by Fehn in the design of the roof construction as the trunks stand as the only vertical elements of the open floor plan of the space: In addition to the two concrete walls integrated in the hill of the site the span of the massive concrete beams in the roof construction are only depended on a single point of support in the opposite corner of the floor plan. The building thereby enhances the values and characteristics of the trees.
The roof is also significant in one of the less blatant examples of the holistic approach of the Nordic Pavilion, but nonetheless the perhaps most idiosyncratic characteristic of the building: The pavilion seeks to facilitate a narrative of the special light of the Nordic skies as it is to represent Scandinavia in the context of the Venice Biennale. The roof construction therefore also plays a vital role in the filtering of the light of the sharp Venetian sun which creates a distinctive sensed experience of the space: The roof construction creates a well-lit room, but at the same time a certain atmosphere that reflects the quiet Nordic light (Fjeld 2009:59).
Both the single point support, the span of the beams, the free flow and the filtering of the light is secured by the understanding and utilisation of the laws of nature while experienced qualities of the trees and light are connected to the values of *nature as the rural and green*: The mechanical approach to nature therefore results in an enhanced sensed experience - the actual trees and light are sensed, not an imitation of them.
The pavilion rises from a holistic understanding and creates an awareness of the landscape as a totality as Ritter describes – something that only can be sensed by a human at the site. When standing on the threshold of the pavilion a feeling of nearness to nature arises and when moving through the building an immediate feeling of the trees is created as the light creates a special feeling of immersion.
With the location of the pavilion as part of the landscape a closeness and understanding of the place is created. The sun and light are felt completely different after visiting the pavilion: When walking through the calm bluish grey Nordic light created by Fehn the sense of the sharp Venetian sun is amplified through contrast.

This non-hierarchy creates the contact between nature and man which Ritter describes as a necessity in order to understand the processes of nature – to see it as a totality.
The Nordic pavilion does not stand as an infallible lodestar, but rather as an example that point towards capacities that the *technical image* does not embrace. The approach of Fehn utilised in the Nordic Pavilion points towards an understanding of the relationship between nature and culture that could be emphasised in the future development of sustainable architecture in the time of climatic adaptation. Through the architectural effects and the use of the already acquired knowledge in relation to optimisation and technological solutions focus could therefore be aimed at the use of nature's succession and what this procedural and sensual nature can contribute.

Partial conclusion

To address contemporary sustainable architecture in a dynamic relation the culture and nature need to be unified as a landscape of totality in a such manner that sustainable architecture move from utilisation and protection of nature to a reciprocal relationship with nature.
A means in this process is the dissolution of the hierarchy and the boundaries between architecture and nature to create equality. The dissolution is created by use and implementation of the natural succession into the architectural scale and design process; a use of the succession of nature based on the existing elements of the place and its flora.

The dissolution of the hierarchy addresses the non-hierarchical landscape by a use of the already acquired knowledge related to optimisation as a tool to dissolute the boundaries.
Dissolution of the boundaries is thus not possible if the already acquired knowledge is not used, but also not possible unless this knowledge is used as a means to push and dissolve the boundaries and not used as an final alone standing measurable answer. The dissolution of boundaries is to enhance an understanding of and use the natural succession which can contribute to the foundation for a dynamic relationship between culture and nature and thereby enable sustainable architecture to take a step toward in the adaptation to climate challenges.

Strategy of Architecture & Nature:
Dissolution of hierarchy

The thoughts behind Urban Farming facilitate a strategy seeking other values of nature than mere productive and where main focus is directed towards the understanding of nature's processes. The strategy address nature as a procedural element, an element not minimized to a simple static instrument but an element in close interaction with the architecture with an ability to facilitate social activity, educational and environmental awareness through its presence as object.
The interaction between nature and architecture aims at a spacious structure with a dissolute hierarchy of nature and architecture and an equal relation between the buildings and the wet ponds. The dissolution of the hierarchical order addresses the elaboration of a common space with architecture as the unifying force which in cooperation with water and the purification process creates a place for the human. By this trinity nature can highlight its qualitative features such as the health preventive properties, the procedural characteristics and the sensory properties related to water that activates the whole body's sensory apparatus.

The strategy includes the three approaches in dissolving the hierarchy.
The purification plant and building is addressed at Kjærs Mølle Dam as an integral element cooperating with existing water systems and natural elements and not just placed as an ornament in the landscape. The site is not a blank canvas but a place created during centuries – both natural and cultural – and this place is removed but integrated.
Choice of materials has a significant impact on the dissolution of the hierarchy, since nature has a major impact on the materials appearance during the lifespan of the materials – meaning materials are selected with focus on patina processed by nature during the years. The latter is the man-made solution. It is not only the existing nature to be included, new elements can be included during the building process. Plants and processes related to the purification plant are applied to optimise the processes and to integrate the purification plant into the existing water system.

ARCHITECTURE & PRODUCTION

Ill.20 Tate Modern, London

Ill.21 Nordkraft's kettlehall before transformation, Aalborg

Two contemporary tracks of industrial architecture

The current state of industrial architecture is the theme of the article Industriarkitektur efter industrialismen 1960-80 (Industrial architecture after the industrialisation 1960-80) by the associate Professor at Aarhus School of Architecture Boris Brorman Jensen. He states that with the transformation from industrial economy to experience economy the role of the industry in the city has shifted. In this process Brorman Jensen points towards two tendencies: The establishment of new industrial buildings at the outskirts of the cities and the reintegration of former industrial buildings into the city by applying new programmes. These roles are reflected in the economic development of Danish society: Contemporary society has both elements of production connected to industrial economy and elements connected to experience economy. In this development are the two tendencies – the segregation of the industrial architecture of the present and the city, and at the same time the integration of the industrial architecture of the past and the city (Brorman-Jensen 2010: 114, 128).
With these opposite developments it seems necessary to ask: Which qualities separate the industrial architecture of the past from the industrial architecture of the present?

Brorman Jensen gives a harsh description of the state of contemporary industrial architecture as he describes the production facilities at the outskirt of cities as an ocean of anonymity consisting of introvert, concrete monoliths with lack of illusions. A focus on consumerism and minimised production costs has according to Brorman Jensen neglected industrial buildings as an architectural area: The buildings are minimised to vapid boxes assembled by standard concrete elements with a large frame where the factory sign can be changed to match the company currently housed in the building. Brorman Jensen further states that not only the buildings are in a poor state – also the industrial areas are left to large pieces of patchwork consisting of squares of disjointed land with a cover of asphalt and grass, included a few trees and bushes in a forest of signs (Brorman Jensen 2010: 117). Brorman Jensen states that the dullness clearly is larger than the construction costs. As a consequence of this construction cost, low prices on land and connections to infrastructure have become the most important parameters for industrial architecture – and they are all found at the outskirts of the cities and near the highway. This tedious tendency is questioned by Brorman Jensen as he asks: "*Why must it be that boundless bleak?*" (Brorman Jensen 2010: 126-127)
The answer is perhaps that it does not necessarily need to be that boundless bleak; industrial architecture has since the mid-1800s played different roles in the societal development. These roles have been the focus of the Danish architect Jørgen Sestoft's investigation of the history of industrial architecture in his book Arbejdets bygninger (The Buildings of Work). Together with the article Fabrikken som arkitektur i Nordeuropa (The Factory as architecture in Northern Europe) by the historian Caspar Jørgensen an answer to Brorman Jensen's question is approached.
Sestoft describes the history of industrial architecture through a tripartition of the industrial periods: The first industrial period from middle of the nineteenth century, the second industrial period around 1910-40 and the last period from the 1950s and onwards. These three periods also represent three different views on industrial architecture, respectively: The image of progress, the image of functional beauty and the image of pollution (Sestoft 1985: 17).
The description by Brorman Jensen is inscribed in the latter period from the 1950s and onwards with industrial architecture as an image of pollution – and focus is therefore aimed at this period to elaborate of the state of contemporary industrial architecture.

Segregation and integration within industrial architecture

Jørgensen states that the huge construction boom after the end of World War II and a focus on getting the economy kick-started created an enhanced focus on the functional principles and mass production where function dominated and the architecture became a by-product (Jørgensen 2010: 92). Through these processes the architect lost his role in the building process of industry as it evolved to the consistence of large flexible boxes of production (Sestoft 1985: 160-162).
These foci and the exponential use of the car and explosive development of infrastructure fostered separation and large industrial areas were therefore planned and isolated from residential areas in the rural areas with cheaper rents and lower wages. The industrial typologies became - in the words of Sestoft - a picture of pollution.
The latest period of industrial architecture can therefore be characterised as an engineer-oriented industry where optimisation and production are the key notions: Industrial buildings as an industrial product isolated from interaction with the city to optimise cost; and cooperation between architect and engineer are minimised (Jørgensen 2010: 98).
To unfold alternatives to the current state of industrial architecture that Brorman Jensen vividly describes focus is aimed at the other roles of industrial architecture through history:
Industrial architecture has not always been ousted to outskirts of the city - the role of industrial architecture has shifted drastically during the years since the industrial revolution.
With the breakthrough of industrialism from the mid-1800s the industry was established as building typologies dedicated to a specific function of the given industrial production. These industrial buildings were often placed without regard to overall planning, as they were located at a site where the surroundings could be utilised in the production. New settlements were often located around or in immediate vicinity of the major industries to have the workers' proximity (Sestoft 1985: 74-75). The first period described by Sestoft has thus a high degree of integration between industry and city.
The development created new urban areas with industry at the centres: Where the cities previously had been built around the church they were now centred around the industrial buildings.
According to Jørgensen the industries created a pressure on the hierarchical architectural subdivision and the architectural profession designed several private industries (Jørgensen 2010: 69).
In the end of this period the industries started to focus on optimising of production and process methods and the engineer became more and more important to the industrial buildings (Jørgensen 2010: 69-75).
In this first period the industrial architecture was regarded as a sign of progress and the buildings of this period are characterised by integration with the cities, connection to the architectural mode of expression at the time and a change of hierarchy within architecture where production facilities climbed in prestige.
The design of industrial architecture was in the domain of the architectural profession – however as Jørgensen states this changed.

Ill.22 Remisen, Aalborg

Ill.23 Gabriel, Aalborg

Ill.23 Unicon, Aalborg

In the period of 1910 to 1940 the optimisation of production developed the industrial architecture into process plants which challenged the historical rules in relation to scale and proportions: These buildings no longer contained individual workers with isolated individual machines, but greater procedural machinery, where the flow and relationship between the individual machines were crucial to the production (Sestoft 1985: 92-93). These buildings changed the view on industrial buildings from carriers of symbols in the historic architecture to functional buildings that intrinsic had a beauty in the emphasis of function.

The functional focus facilitated a higher emphasis on engineering in the design of the building. The stringent simplicity of function and technology became part of the architectural vocabulary – architectural and engineerical consideration went together as cooperation in a modernistic future-oriented perspective (Jørgensen 2010: 86).

The collaboration between architects and engineers and the increasing focus on the industrial fabrication and production methods resulted in a focus on the fast-growing technology. The industry had become the flagship of the development of modern society; the building became a symbol of the future and the machine itself (Sestoft 1985: 127).

This focus on functionality and rationality simultaneously resulted in a segregation of industrial areas and residential areas – and functionally divided cities therefore arose as a result of this approach (Jørgensen 2010: 96).

Where the first period of industrial architecture was dominated by the segregation of professional competency with an architectural dominance and an integration of city and industrial buildings, the second period of industrial architecture was dominated by the integration of architectural and engineerical competencies, but also by the modernistic segregation of city and industrial buildings. The domains of segregation and integration can therefore be said to have exchanged places in the two periods.

The third period described by Brorman Jensen can with this in mind be described as an adoption of the aspect of segregation of the two first periods: The industrial architecture of the third period are dominated by the segregation of professional competencies with an engineerical dominance and the segregation of city and industrial buildings.

When Brorman-Jensen ask: "*Why must it be that boundless bleak*?" – perhaps the solution is rooted in the embracement of integration instead of segregation: What if the industry again became an integration of professional competencies and became integrated in the city?

Could this change of focus point towards a fourth period of industrial architecture where industrial architecture again claims the domain as societal co-generator of the urban scene?

As Brorman Jensen described two tendencies already exist in the state of contemporary industrial architecture: Segregation of industrial architecture of the present and the city and the integration of the industrial architecture of the past and the city (Brorman-Jensen 2010: 114, 128).

The renewed interest to the central location of the derelict industrial buildings and their attractive potential for future development of cities can be ascribed to the transformation from industrial economy to experience economy. The latter development described by Brorman Jensen indicates that the transformed industrial architecture has capacities suited for the unfolding of the experience economy – capacities similar to those contemporary industrial architecture needs to embrace in order to contribute to the contemporary urban development. In continuation of this consideration: Which capacities of the transformed industrial architecture are important and useable in a re-integration of industry into the cities built on the experience economy's requirements for architecture?

Ill. 24 Tate Modern, London

Lessons from the transformation of industrial architecture

The capacities of transformed industrial architecture are investigated in the research project *"The Experience City".* The research project investigates the cultural grafting of former industrial areas in the Danish cities that has been unfolding during recent years: New cultural centres deliberately linking cultural institutions, information centres and milieus of experience in act of transformation (Marling, Kiib, Jensen 2009: 11-12).
The Experience City focuses on the connection between the cultural centres of the experience economy with different programmes – commercial and free of charge. The motivation for the link of different cultural programmes is often of financial character as the cultural programmes alone has not been able to fund the projects. Links between educations, productions of knowledge and experience have arisen as a consequence of this in the larger provincial towns of Denmark. The research project mentions these as hybrid cultural projects and stresses the potential of these projects for more than mere entertainment and for the inclusion of diverse groups of the society (Marling, Kiib, Jensen 2009: 12-13).
The architecture of these hybrid projects is described as *"experience-architecture"* which reuses and reinterprets heritage of industrial architecture and lend scale and typological diversity in the transformation to facilitate the cultural programme (Marling, Kiib, Jensen 2009: 15, 83). As Brorman Jensen the research project emphasises the importance of the central placement of the former industrial areas as they re-enter the cities, and in addition to this the research project emphasises that the large volumes of industrial architecture also are subjects of interest for the experience economy as they are carrier of historical references.
The buildings are of high spatial quality and consist of a typological diversity of labyrinthine structures that makes them a perfect match for cultural use founded in experience (Marling, Kiib, Jensen 2009: 89).
The Experience City refers to Tate Modern as an exemplary transformation with these capacities: The former power plant at the south bank of the River Thames have by Herzog & de Meuron been transformed with a prospective approach where a prosaic reuse of the industrial architecture is combined in interplay with constructive and aesthetic additions – the contrast of the melanised concrete to the elements of glass, steel and wood strengthen the narrative of the transformation where the key concept in the transformation is the preservation of the vast space of the Turbine Hall of the power plant (Marling, Kiib, Jensen 2009: 91).
In continuation of these descriptions of *The Experience City* it seems that intrinsic in industrial architecture are potentials of experience and identity that reach beyond values of production.
To unfold these potentials it seems necessary to address the challenges of the adaption by industrial architecture to the agenda of experience economy. The values of production, cost optimisation and logistical connections are essential for a production rooted in an industrial economy, but they cannot stand-alone if these buildings are to contribute to the contemporary urban scene.
To elaborate on how industrial architecture is to develop focus is therefore turned away from the demands of the industrial economy to the demands of the experience economy – keeping in mind that industrial architecture also have to meet the essential demands of production, cost optimisation and logistical connections. The element of optimisation of production will always be a key design parameter for the industrial architecture – but the further investigation of this section will not focus on means of further optimisation, but on how the industry can embrace the experience economy. In the same way the key design parameter of integration - between both professional competencies and also between city and industry – will not be exhaustively addressed as the focus will be on which capacities contemporary industrial architecture needs to contain to contribute to urban development. To approach this focus the demands of the experience economy are addressed. This is done by aiming attention at the foundation for the experience economy: The creation of experiences – and the role of architecture herein.

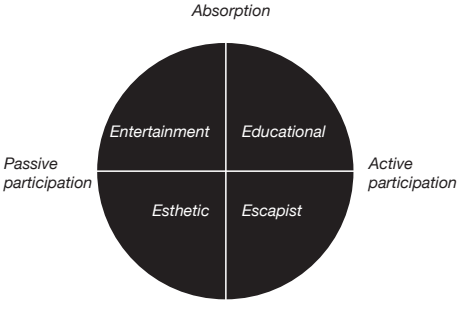
The design principles of the experience economy

The two American economists B. Joseph Pine and James H. Gilmore introduced the term of experience economy at the end of the twentieth century: The term describes an economy based on experiences as the latest successor in a row of agrarian economy, industrial economy and - most recent - service economy (Pine and Gilmore 1999: 6-12).
The approach of Pine and Gilmore has a commercial focus and as the maximisation of profit is the main focus not all of the considerations are transferrable to architecture. However the core of this economy is – obviously – the importance of experience and this aspect can according to *The Experience City* be utilised to shed light on the role of industrial architecture in contemporary society and to unfold the phenomenon of experience.
Pine and Gilmore operates with four experiential realms and five design principles to create experiences; the four experiential realms of the experience economy are: Entertainment, educational, escapist and esthetic. The realms are characterised by two key dimensions: The level of participation and environmental relationship; and it is in the coupling of these dimensions that the four experiential realms arise (Pine and Gilmore 1999: 30-31).

The experience of entertainment is characterised by passive participation and absorption as environmental relationship. Absorption is described by Pine and Gilmore as *"occupying a person's attention by bringing the experience into mind"* as opposed to a physical involvement which is characterised as immersion. Entertainment is thus a passive absorption of the experience through the senses: The participant is an observer (Pine and Gilmore 1999: 30-31).
The educational experience is also a mental experience – however it is an act of active participation: The mind is actively engaged and absorption of the unfolding events occurs as the participant is actively engaging (Pine and Gilmore 1999: 32).
The escapist experience is a physical experience in contrast to entertainment and education and this means that immersion occurs instead of absorption. The result is the completely immersion of the participant in the experience as an actively involved participant – the participant is able to affect the actual performance. A level of escapism thus occurs as the participant immerse in the act of participation (Pine and Gilmore 1999: 33-34).
The esthetic experience is as the escapist experience rooted in a physical immersion, but is of a passive nature. The participants have no or little effect on the event or environment.
Pine and Gilmore state that the most important factor for entertainment experience is *to sense*, *to learn* for the educational experience, *to do* for the escapist experience and *to be* for the esthetic experience (Pine and Gilmore 1999: 35).

Pine and Gilmore stress that experiences can be enhanced by blurring the lines between the four realms, and that the richest experiences include aspects of all four realms: The design of a rich, compelling and engaging experience encompass the experiences of entertainment, educational, escapist and esthetic – not necessarily at once, but emphasised differently during the process of the overall experience. Only when the interplay of the four realms is unfolded within the same experience is it possible to create *"a distinctive place"* – in contrast to what Pine and Gilmore describes at plain space. Staged experiences that unfold over a period of time need the sense of place to keep participants in the experience; the goal is according to Pine and Gilmore to create mnemonic places: Places that produce memories which will invite the participant to return to the experience again (Pine and Gilmore 1999: 38-39, 42-43).
To design distinctive, mnemonic places which embrace all four realms of experience Pine and Gilmore list five design principles: Theme the experience, harmonise impressions with positive cues, eliminating negative cues, memorabilia and engage the five senses (Pine and Gilmore 1999: 46-60). Theming the experience, harmonising impressions with positive cues and eliminating negative cues can altogether be described as the creation of a consistent universe of experience – or as Pine and Gilmore state: A mnemonic place.
The element of memorabilia which is to provide a tangible artefact seems difficult to apply to architecture, but the latter principle - engagement of all five senses - continues the focus on memory: The degree of which an experience includes all senses determines how memorable the experience will be for the participant. Cues can strengthen an experience through a single sense, but also detract value from an experience if not matching the overall narrative. Pine and Gilmore stress that architectural and technical skills are needed to ad sensory phenomena to experience in the creation of *"experience with senses that make sense"* (Pine and Gilmore 1999: 59-61).
The parameters of the creation of experiences can therefore be said to consist of the creation of mnemonic places in the inclusion of the four realms of entertainment, educational, esthetic and escapist experience and the engagement of the five senses.
With these overall aims of the experience economy it however seems necessary to ask how these parameters can be approached - which elements in the creation of experience is contemporary industrial architecture to aim at to embrace the potentials of the experience economy?

To answer these questions and to transfer the principles of Pine and Gilmore to a spatial context focus is aimed at the Danish/Icelandic artist Olafur Eliasson who has conducted in-depth investigations of the relation between the utilisation of all senses and the creation of experiences in works of spatial character.



(Pine&Gilmore 1999: 30)

Ill.25 The Weather Project, Olafur Eliasson

From observer to participant

Olafur Eliasson has through his work addressed the aspect of multisensory awareness within the experience economy and in the 2004 interview book *At se sig selv sanse (To see yourself sense)* he states that the commercial part of the experience industry is one of the only places of contemporary society where the individual sensory perception is the centre of focus. In continuation of the focus on sensory perception Eliasson ascribes the understanding of subjectivity as one of the main areas of his work (Pedersen 2004: 47).
Eliasson states that he approaches the mechanisms of experience by trying to dematerialise and de-objectify the work of art; the focus is a transgression from the creation of "the right experience" for the spectator through the object to allowing the subject to become constituent for the work of art: The decisive element for Eliasson is the dissolution of the clear boundary of object and subject in a process where the observer becomes participant (Pedersen 2004: 47-49).
Eliasson hereby suggests that experiences arise from the dissolution of the boundary between subject and object and the change of the role as mere observing subject to an engaged participant as a consequence of the dissolution. This transgression between body and setting lies in continuation of the consistent all-embracing universe of mnemonic place described by Pine and Gilmore. This approach of Eliasson thus emphasises the active participation over passive participation in the four realms of Pine and Gilmore – meaning that the educational and escapist realms are emphasised over the entertainment and esthetic realms in the creation of powerful experiences rooted in the dissolution of opposition of subject and object.
Eliasson has focussed on this relation between subject and object in numerous projects among this *The Weather Project* at Tate Modern in London where the spacious understanding of the large turbine hall of the former power plant was changed by placing a large, bright, artificial sun at one end and a large reflecting mirror on the ceiling. These interventions changed the space from a cool, cold and hard entry hall of dimensions of a cathedral to a place where people grouped themselves and lay down on the concrete as the sun and the mirror created a sense of intimacy and intermission – a place to linger (Pedersen 2004: 59).

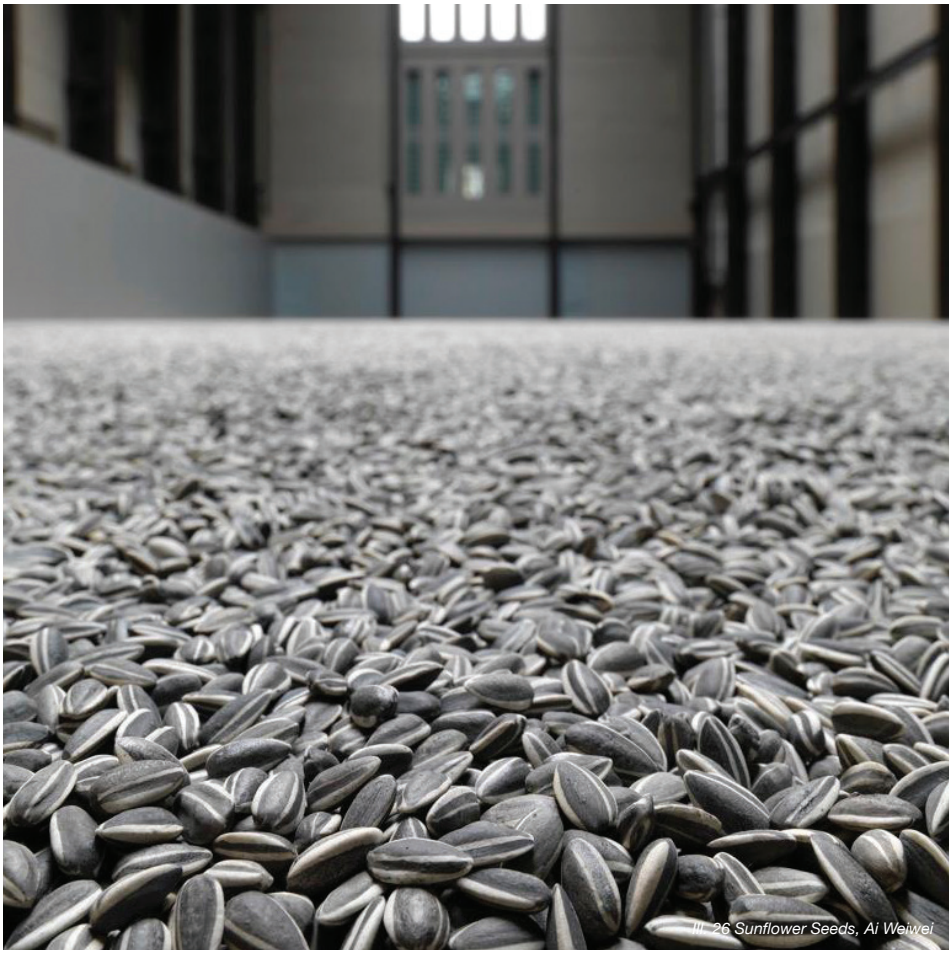
Eliasson states that in the process of the dissolution of the border between subject and object the vision is only one sense among others to contribute to the creation of the experience: Perception is connected to all areas of the body and consciousness - and that the role of spectator is only connected to vision. He states that the approach of focusing on isolated vision therefore is stridently limiting in the creation of experiences (Pedersen 2004: 49).
The call of Pine and Gilmore for engagement of all senses is by Eliasson not only emphasised, but also further extended: Eliasson seeks to create what he describes as *inertia* and thereby enhance the intellectual potential of motoric skills. Eliasson states that a reduced ability to hear, touch, see, and smell; the absence of memory or anticipation; a reduced balance etc. is highly influent on an experience (Pedersen 2004: 61-62). Eliasson thereby suggests that the sensory apparatus is extended beyond the classical five senses of sight, hearing, taste, smell and touch – balance, distance, sense of time and dimensionality are equally important (Pedersen 2004: 136).
Eliasson stresses that this multisensory awareness is cornered in the western world where man is regarded as a rational being and as a consequence of this the consciousness of sentiments has been placed at the very end of the course of cognition: The sentiment of the situation is understood as something successive of the process of engaging in a situation and forming an opinion of the situation. In this line of thought a sentiment of the situation is reached afterwards. The goal of Eliasson is to turn this process upside down so the sentiment comes first and the rational conclusions follow thereafter. By doing this Eliasson strives to let sentiments constitute the surroundings instead of being products of them (Pedersen 2004: 57-58).
Eliasson states that by reversing the approach of the rational natural science where the senses are mere receptors for the environment it is thereby possible to see the senses as producers of the environment. He states that the senses constitute the environment and through this dialog with the environment they also constitute us – a sort of double dialogue thus exists. The senses are completely relative to the situation – a new position forms a new situation and a new perspective (Pedersen 2004: 136).
The perception of experiences is thus according to Eliasson founded in the dissolution of the opposition of subject and object where the change from spectator to participant is at the centre of focus. The realms of the educational and escapist experience are thereby emphasised. The importance connected by Pine and Gilmore to the five senses is extended and in continuation of this the emphasis on sentiments in the beginning of cognition is accentuated.
As the mnemonic place, four realms and the five senses are linked through experience it seems that the accentuations of Eliasson are related to an undefined element connected to the interaction of subject and object sensed by all senses as a sentiment.
Keeping the architectural capacities of the transformed industrial buildings such as Tate Modern in mind: What is this element that also seems to be intrinsic in industrial architecture according to conclusions of *The Experience City*? And how can it be further approached in an architectural discourse?
To transfer the conceptual consideration of the creation of experience by Pine and Gilmore and the spatial consideration of the creation of experience by Eliasson into an architectural context the philosophy of Gernot Böhme, professor of philosophy at the Technical University of Darmstadt, will be utilised.

Atmosphere as a space of bodily presence

The relation between architecture and the interaction of subject and object has been the theme for investigation of Gernot Böhme: The vaguely defined element that Eliasson addresses in his work is by Böhme clearly defined as atmosphere: In the essay *Atmosphere as an aesthetic concept* Böhme bluntly states that atmosphere is something between the subject and object.
The notion of atmosphere is by Böhme problematised as it is of a colloquial character – it is highly ambiguous and is connected to vastly diverse thing. Böhme however stresses that atmosphere always concerns a spatial sense of ambience, and he therefore describes atmosphere as a prototypical "between"-phenomenon (Böhme 1998: 112):

"Atmospheres fill spaces; they emanate from things, constellations of things, and persons. The individual as recipient can happen upon them, be assailed by them; we experience them, in other words, as something quasi-objective, whose existence we can also communicate with others. Yet they cannot be defined independently from the persons emotionally affected by them; they are subjective facts."
(Böhme 1998: 112-114)

Böhme continues by stressing that atmospheres are characteristic manifestations of the co-presence of subject and object (Böhme 1998: 114).
Böhme emphasises that the character of atmospheres make them an aesthetic concept – where focus is changed from the prevalent aesthetic emphasis on what is perceived to how it is perceived; it is not about what something represents, but how it is present (Böhme 1998:114). This establishes a focus on sensory perception – as opposed to judgement - and Böhme thereby continues the emphasis on sentiments by Eliasson.
Böhme states that atmospheres address aesthetic as its original meaning - as the theory of perception (Böhme 1998:114): *"In order to perceive something, that something must be there, it must be present; the subject, too, must be present, physically extant. From the perspective of the object, therefore, the atmosphere is the sphere of its perceptible presence. Only from the perspective of the subject is atmosphere perceived as the emotional response to the presence of something or someone. Aesthetics thus becomes the study of the relations between ambient qualities and states of mind, and its particular object consists in spaces and spatiality"* (Böhme 1998:114).
The concept of atmospheres thus changes aesthetics from something passively beheld into something that creates a spatial sense - objects are something that changes the room by their presence. Atmosphere is first and foremost something that recreates spatiality - it focuses on a physical presence and a sensory perception.
Böhme states that the goal of the aesthetic of atmospheres is that which lies between – the space! The role of the architect is according to Böhme to shape space from consideration to confinement and expanse, direction, lightness and heaviness. In connection to this three



Ill. 26 Sunflower Seeds, Ai Weiwei

notions are especially important: Radiance, impressions and suggestions of motion (Böhme 1998:115).
In an interview with the Danish architectural journal *Arkitekten* (*The Architect)* Böhme describes the rehabilitation of the senses and a rediscovery of the human body as general tendency in contemporary society as a consequence of the experience economy - the popularity of physical therapies such as yoga and tʚai chi or more physical forms as cross fit and parkour are examples of the change of viewing the body as mere object to experiencing it from within (Bisgaard & Friberg 2006:11).
This tendency within the experience economy is for Böhme an evident opportunity to aim focus at a greater sensibility to the atmospheric qualities of spaces: The emphasis on experiences calls for a focus on how the human is situated in spaces and an emphasis of senses over intellect (Bisgaard & Friberg 2006:11).
Böhme describes atmosphere as the core concept in the way man perceives and finds him in a room – where atmosphere is grasped by a bodily presence. Böhme therefore sees atmosphere as an obvious concept in future focus in the experience economy with the prominent focus on the user experience quality. By going from a society based on production economy to a society based on experience economy – focus has shifted from basic needs to the desire of rediscovering body and learning how it works and reacts (Bisgaard & Friberg 2006:11).
Böhme continues Eliasson's critique of western tradition of cognition and elaborates on the link between a multi-sensing participant and the emphasis on sentiments in the beginning of cognition in the creation of atmospheres by architectural means. The sense of space created by atmosphere is at the centre of attention and the bodily presence is according to Böhme decisive.
Böhme states that the description of a room on the basis of an atmosphere departs from a subject's subjective description: A subject that has been placed in the enclosure and perceived the tangible presence, proportions and given elements placements in the space. By describing space in such a manner the concept of space can be described as a space of bodily presence (Böhme 2007: 30-31).
As an example of this Tate Modern's Turbine Hall cannot be described by mere dimensions or the relation to the human body – the same space can be experienced in very different way even though the dimensions of space and man do not change: Where the Turbine Hall was experienced as a space of intimacy during exhibition of the Weather Project by Eliasson, the same space of the Turbine Hall radiated a sense of distance during exhibition of *Sunflower Seeds* by Ai Weiwei in 2010, where millions of unique porcelain sunflower seeds covered the floor of the space.
The space of bodily presence is the space which is experienced due to the spatial presence and the space which therefore is sensed with our body – it therefore has an anisotropic character as it is centred around and defined by an absolute: Where the body is (Böhme 2007:31).
This suggests that the characterisation of a space is determined not only by where, but also by how the subject is present in space. This experience of how the subject is present is the decisive factor for the characterisation of the space – and Böhme stresses that this can be described as atmosphere (Böhme 2007:31-33).
Böhme states that as a consequence of this architecture is classified as an art of space – and not as a visual art as it is often described: The true means of creating experiences for architecture is to create bodily awareness of the situated space (Böhme 2007:34).
Böhme is thus eye to eye with Eliasson as he ascribes the senses of the body decisive importance: The spatiality of atmosphere is registered by all the senses of the body as a space of bodily presence – and atmosphere and multisensory awareness is thus closely related.
The change from spectator to participant via the dissolution of the opposition of subject and object can therefore be related to the creation of space as bodily presence – and the creation of experiences within architecture is therefore closely connected to the creation of atmospheres. Even with the connection between experiences, participation, space as bodily presence established through the term of atmosphere - the term is still at an abstract level: How are architects to approach atmospheres and sensory perception in the creation of experiences within industrial architecture? To approach an answer focus is aimed at a protagonist of sensory awareness within architectural theory.

Atmosphere and peripheral perception

The Finish architect and theoretician Juhanni Pallasmaa has during the past two decades been an proponent for a higher degree of multisensory awareness in architecture – and has in his latest phenomenological writings also addressed the theme of atmosphere: Pallasmaa describes the human capacity of grasping the essence of atmospheres as an instantaneous and all-encompassing capacity moving from the wholeness of complex and comprehensive images towards the single elements of the images (Pallasmaa 2012: 18). In the 2010 essay *On Atmosphere – Peripheral Perception and Existential Experiences* Pallasmaa suggests a definition for what he denotes as experiential atmosphere:

"Atmosphere is the overarching perceptual, sensory and emotive impression of a setting or a social situation. It provides the unifying coherence and character for a room, space, place, and landscape, or human encounter. Atmosphere is "the common denominator", "the coloring", or "the feel" of the experiential situation. Atmosphere is a mental background, an experiential property or characteristic, that is suspended between the perceived object and the subject" (Pallasmaa 2012: 239-240).

Pallasmaa states that man is cable of grasping the essence of a place before understanding it intellectually by identifying the details – and even though one is perhaps not able to speak of the characteristic of a situation a firm sense, emotive attitude and recall of the situation are still created (Pallasmaa 2012: 240). A greater importance is thereby attached to the immediate understanding than to the conscious analysis – and Pallasmaa is thereby in accordance with very similar consideration of sentiments by Eliasson and sensory perception by Böhme. To elaborate on how this immediate understanding is at work Pallasmaa aims focus at the multisensory awareness: Pallasmaa stresses that the environmental characters are not of mere visual perceptual quality, but of multisensory qualities: An environment is grasped immediately as an overall atmosphere, feeling, mood or ambience rising from a complex fusion of countless factors (Pallasmaa 2012: 238-239). Pallasmaa emphasises in concordance with Eliasson that these factors are understood by use of more than the five Aristotelian senses as orientation, gravity, balance, stability, motion, duration, continuity, scale and illumination are involved in the immediate reading of environments. All of these elements are perceived in a peripheral manner and not as conscious observation (Pallasmaa 2012: 239). Pallasmaa emphasises that every significant experience of architecture is multisensory; he accentuates this by quoting Merleau-Ponty: *"My perception is [therefore] not a sum of visual, tactile, and audible givens: I perceive in a total way with my whole being: I grasp a unique structure of the thing, a unique way of being, which speaks to all my senses at once".* Pallasmaa remarks that this description is also a perfect characterisation of the atmospheric perception (Pallasmaa 2012: 248).

The terms of *atmospheric perception* or *peripheral perception* is according to Pallasmaa

essential for the all-encompassing and instantaneous perception of atmospheres - *peripheral perception* is unconscious, unfocused and encloses and enfolds in an embrace of atmospheric space. Opposed to this perception is the focused, analytical vision connected to perspectival spaces which leave us passive and separated from the sensed (Pallasmaa 2012: 249):

"Focused vision makes us mere outside observers, whereas peripheral perception transforms retinal images into a spatial and bodily involvement and gives rise to the sense of an engaging atmosphere and personal participation. Peripheral perception is the perception mode through which we grasp atmospheres" (Pallasmaa 2012: 250).

The term of *peripheral perception* adds a nuance to the preceding writings of Pallasmaa: In his extended essay *The Eyes of the Skin: Architecture and the Senses* from 1995 Pallasmaa advocates for an emphasis on multisensory aspects within architecture as he states that the bias towards vision has become increasingly concerning (Pallasmaa 2005: 9-10). Pallasmaa states that this ocular bias never has been as apparent as during the past decades – architecture has aimed at creating striking and memorable visual images and has therefore become image products far from existential depth and sincerity: *"Instead of experiencing our being in the world, we behold it from outside as spectators of images projected on the surface of the retina*". Pallasmaa continues: *"As buildings lose their plasticity, and their connection with the language and wisdom of the body, they become isolated in the cool and distant realm of vision. With the loss of tactility, measures and details crafted for the human body – and particularly for the hand – architectural structures become repulsively flat, sharp-edged, immaterial and unreal"* (Pallasmaa 2005: 30-31).
In his writings on atmosphere fifteen years after the publication of *The Eyes of the Skin* Pallasmaa elaborates on the consequences of the hegemony of the visual perception for architecture: *"Our culture of control and speed has favoured the architecture of the eye, with its instantaneous imagery and distanced impact, whereas a haptic and an atmospheric architecture promotes slowness and intimacy, appreciated and comprehended gradually as images of the body and the skin. The architecture of the eye detaches and controls, whereas haptic architecture engages and unites. Tactile sensibility replaces distancing visual imagery through enhanced materiality, nearness, and intimacy"* (Pallasmaa 2012: 249).
The importance of the multisensory is thus evident according to Pallasmaa - however latent in the latter statement of Pallasmaa seems to be a contradiction as Pallasmaa connects the focused vision to "instantaneous imagery" but also connects the *peripheral perception* to the ability to grasp an atmosphere instantaneously.
Two instantaneously understandings thus exist – and it is therefore important to stress the difference of the instant focused visual understanding of architecture and the instant unfocused bodily understanding of architecture: Architecture as picture and architecture as atmosphere – the first creating distance and the latter creating experiences within architecture.
In addition to this it seems that a paradox exists in the line of thought connected to atmosphere: Atmosphere is both related to an instantaneously understanding, but at the same connected to a gradually appreciation and comprehension of architecture resulting in slowness and intimacy. It therefore seems that intrinsic in the term of atmosphere and therefore also - according to Pallasmaa - in haptic and atmospheric architecture is two paces of perception: One that allows the human body to instantaneously and with all senses to grasp the identity of a space, place or situation as an atmosphere; and another of an inexhaustible character that cannot be grasped, but engages and unites.
Pallasmaa elaborates on this as he states that strong and overpowering atmospheres are of haptic nature – and almost have material presence as if they are embracing (Pallasmaa 2012: 248). In continuation of this line of thought a focus on atmosphere can be seen as the point of departure for a dismantlement of distance and segregation in contemporary industrial architecture and the creation of multi-sensory experiences within industrial architecture through atmospheres.

Partial conclusion

In order for industrial architecture again to contribute to urban development of cities in the experience economy the creation of experiences is a pivotal element and in this creation the terms of atmosphere and *peripheral perception* stand as the key notions for industrial architecture.
The emphasis of the sensory awareness is a consistent element by both Pine and Gilmore, Eliasson, Böhme and Pallasmaa in the creation of experiences: Pine and Gilmore advocate the inclusion of all five senses, Eliasson connects a multisensory beyond the five senses to sentiment; Böhme emphasises sensory perception in favour of judgement in the understanding of space as bodily presence; and Pallasmaa connects the extended sensory apparatus to *peripheral perception*.
The latter term stands as a designation of the way atmospheres are sensed: An inseparable relation exists between the *peripheral perception* and atmospheres which are closely linked to the dissolution of the opposition between subject and object in the creation of participation.
The creation of experiences can therefore be concluded to be closely linked to the creation of atmosphere within architecture – and the task of contemporary industrial architecture can therefore be defined as not only production and integration between city and industry - but also the creation of frames for atmosphere. These three parameters stand as the key aspects that contemporary industrial architecture need to embrace in order to again claim the domain as societal co-generator of the urban scene.

With the importance of participation introduced by Eliasson this means for industrial architecture that the realms of educational and escapist experiences come to play a key role: Where the transformation industrial buildings of the past embraces aspects of authenticity, identity and transparency the industrial architecture of contemporary society could facilitate experiences by introducing aspects of learning and recreation.
In the connection to the two participatory realms of experience the industrial architecture has the possibility to utilise the intrinsic capacities of an industrial production: The transparency of construction and process can be linked to the realm of learning in a manner where the public is not precluded from the industry, but integrated to a degree where both production and communication of production are possible in urban areas.
The inclusion of the public has in addition to the educational capacity also the possibility to create an escapist experience as the accessibility of the production can supplement the absorption of learning – to use the term of Pine and Gilmore: As the visitor moves around between the elements of production a level immersion can be created - and visitor can become participant. These means towards the creation of experiences are bound together by the architectural means of atmosphere in the creation of a coherent contemporary industrial architecture emphasising production, transparency of production, integration with context, multisensory awareness and atmosphere in the creation of experiences within the cities.

Strategy of Architecture & Production:
Experiences through peripheral perception

The strategy seeks a purification plant as more than mere production and purification. It seeks a plant calling for experience and knowledge addressed by water and the related processes, a plant focused on an educational and recreational perspective for daily users, school classes and researchers.
As an easy accessible plant it is placed in the immediate urban context of Aalborg, embedding itself in the site as part of the overall planning, creating a coherent planning blending various typologies creating a varied cityscape.

The spacious understanding of an architecture and stormwater management combined structure is sought created through opportunities for participation to invite the guests and users in the area of Kjærs Mølle Dam into the purification process and the buildings. The participation is focused on the spacious image of the architecture, water and purification understood through a physical presence as the space is understood as bodily presence. Participation not based on pure activity-characterised participation, but where the body constantly is made aware of where it is in the space and how it relates to the water. Participation does not necessarily mean physically active but also peripheral perception; it is about to dissolve the boundary between the object and the subject to create a sensual atmosphere. Dissolving the border between body and water to create an experience and knowledge based area focused on senses beyond the five Aristotelian senses - a complete sensory apparatus is activated.

Ill. 27

ARCHITECTURE & PLACE


Ill. 28


Ill. 29


Ill. 30

Architectural place as outsider in the hegemony of space

In the aftermath of the modernistic emphasis on abstract architectural space arose on the international architectural scene an emerging concern with the role of the specific place in architecture. With the theories of Aldo Rossi, Kevin Lynch, Christian Norberg-Schulz etc. the universality of the International Style was challenged by enhanced considerations to the tangible and intangible specific context of architecture: The qualitative place gained ground at the expense of the quantitative space of modernity.
The emphasis and outspoken focus on architecture's local anchorage in places has thirty years after Norberg-Schulz published *Genius Loci* gained a revival: During the past years place has gained a growing role in areas of contemporary Nordic architecture with projects such as the *National Tourist Routes* in Norberg-Schulz's home country of Norway: By use of architecture this project emphasises special points of interest along 18 scenic roads in the Norwegian landscape – architectural elements such as service buildings, viewpoints, car parks, furniture and paths are introduced to articulate a specific place along the routes (National Tourist Routes in Norway 2014).
Similar initiatives are seen in Denmark where the project *Steder i Landskabet* (Places in the landscape) in a similar manner is concerned with the specificity of places: The project focuses on the potentials and possibilities anchored in outskirt areas of Denmark by focusing on concrete physical projects – architecture in relation to the potentials tied to the specific place in question. The project is similar to the Norwegian project and the aim of *Steder i Landskabet* is to create a mediation of the place through visit facilities of minimal intervention and high architectonic quality (Stedet Tæller 2014).
The approach to the relationship between place and architecture seen in the two projects has been addressed by the Norwegian professor of Architecture Mari Hvattum in the article *Stedets Tyranni (The tyranny of place)*; and as Hvattum suggests with the title the approach to the relationship between place and architecture currently seen in Norway and Denmark is far from unproblematic.
Hvattum points towards Norberg-Schulz as the most distinct protagonist of the theory of place within architectural thinking in the post-war period and states that Norberg-Schulz's focus is to establish an authentic relation between the architecture and the place; to materialise the spirit of the place – *the Genius Loci* – and thereby create a meaningful world of local anchorage (Hvattum 2010: 34).
Hvattum describes this focus as problematic as intrinsic in this approach to place is an understanding of place as something authentic and essential and therefore also a static nuance: If architecture's role is to visualise the spirit of the place then *the Genius Loci* must be something determined once and for all – which means that all development and progress are ruled out. As a consequence this static understanding of *the Genius Loci* focus is aimed at the authenticity and essentialism of the existing characteristics found in the place – and architecture is reduced to a mere mimetic prolongation of the already existing. The static understanding is in itself problematic,

but Hvattum stresses that the mimetic role of architecture is further problematic as it results in an emphasis of the visual characteristics of the place (Hvattum 2010: 39, 42-43).
This approach to place and architecture can not only be seen in the theories of Norberg-Schulz, but also in the abovementioned contemporary projects: The approaches in the two projects are to a high degree dominated by a static and visual understanding of places. In both *Steder i Landskabet* and *National Tourist Routes* the landscape is perceived as a visual element – and the role of architecture is to blend in and to facilitate the visual experience – the view. A striking example of this is Carl-Viggo Hølmebakk's *Sohlbergplassen Viewpoint* at Stor-Elvdal where the architecture frames a view to the mountains miming the motive of one of the most famous pictures of the Norwegian painter Harald Sohlberg's *Winter Night in the Mountains* (Hølmebakk 2014).
The static and visual ideas of Norberg-Schulz on place and architecture can therefore be said to still influence the contemporary approach of place-orientated architecture – which is also why Hvattum raises the critique three decades after Norberg-Schulz wrote *Genius Loci*.
The understanding of place as something static and visual becomes further problematic when other contemporary challenges are brought into the question of the relation between place and architecture: In the time of climate adaption one of the greatest challenges for architecture is to provide meaningful solutions to global challenges with palpable local impact: E.g. the local incidents of flooding, heavier rains etc. as effect of the global climatic changes of dynamic characters. The static and visual approach to the local is at best deficient if not completely insufficient is connection to these challenges – a framed view is not solving any problems...
The challenges of a global world can with modernistic means be answered with universal and abstract solutions – reflected in the understanding of the world as a consistent space. But as architecture qua its tangible thingness cannot escape a level of local foothold in places questions arise to how global challenges are to be addressed through the local place when this is not reduced to a static and visual phenomenon: Has the dominating approach to architectural place thinking left architecture capable of providing meaningful solutions to the local impact of global challenges?

When the static and visual approach to place does not suffice – which values is contemporary architecture then to embrace in the purveyance of pertinent answers on both local and global level without returning to mere retrospective, vernacular means in search of local anchorage?

To address these questions focus is firstly aimed at the root of the problem: The architectural theories of Norberg-Schulz and especially the ontological foundation for these.

Ill. 32

The reduction of place

In the description of *the Genius Loci* Norberg-Schulz states that since ancient times *the Genius Loci* has been recognised as the concrete reality man has to face and come to terms with in his daily life. Architecture's task is therefore first of all to visualise *the Genius Loci* – and the task of architects is in this optic to create meaningful places whereby he helps man to dwell (Norberg-Schulz 1980:5).
Norberg-Schulz states that the term *dwell* in connection to place stems from the thinking of the German philosopher Martin Heidegger and that existential roothold and dwelling are synonyms – and dwelling therefore in an existential sense is the purpose of architecture. Norberg-Schulz emphasises that when dwelling occurs an environment is experienced as meaningful – when man is able to orientate himself within and identify himself with an environment. Dwelling is therefore something more than shelter and it points towards that the spaces where life occurs are *places* in the truest sense of the word (Norberg-Schulz 1980: 5). This true sense of the word *place* is further described by Norberg-Schulz: "*What, then, do we mean with the word 'place'? Obviously we mean something more than abstract location. We mean a totality made up of concrete things having material substance, shape, texture and color. Together these things determine an 'environmental character', which is the essence of place. In general a place is given as such a character or 'atmosphere'. A place is therefore a qualitative, "total" phenomenon, which we cannot reduce to any of its properties, such as spatial relationship, without losing its concrete nature of sight*" *(Norberg-Schulz 1980: 8).*
This approach to place of Norberg-Schulz stems especially from Heidegger's essay *Building Dwelling Thinking* (Norberg-Schulz 1980: 5-6). In the essay the philosopher addresses the relationship of building, dwelling and place. Heidegger introduces a distinction between buildings and dwelling – as not all buildings secure dwelling: "*Residential buildings do indeed provide shelter; today's houses may even be well planned, easy to keep, attractively cheap, open to air, light, and sun, but – do the houses in themselves hold any guarantee that* dwelling *occurs in them?*" (Heidegger 2001: 144).
In continuation of the conclusion that building do not equal dwelling Heidegger states that the fundamental and decisive character of dwelling is connected to the act of sparing and preserving (Heidegger 2001: 147): "*Real sparing is something* positive *and takes place when we leave something beforehand in its own nature, when we return it specifically to its being, when we 'free' it in the real sense of the word into a preserve of peace. To dwell, to be set at peace, means to remain at peace within the free, the preserve, the free sphere that safeguards each thing in its nature*" (Heidegger 2001: 147).
In this approach are the first steps towards the emphasis on authenticity, essentialism and architecture's role of materialising the intrinsic static *Genius Loci* – and thereby also the mimetic character of place-orientated architecture. However Heidegger operates with a more nuanced relation between architecture and place than the interpretation of Norberg-Schulz. An understanding of this relation can be approached by engaging further in Heidegger's connection of dwelling and building and address the rather complex conceptual framework of Heidegger in which the aspect of *sparing* and *preserving* are key notions. The two terms of *sparing* and *preserving* are connected to *the fourfold* – which is a term introduced by Heidegger to cover the earth, the sky, mortals and the divine (Heidegger 2001: 147-148): "*Mortals dwell in the way they preserve the fourfold in its essential being, its presencing. Accordingly, the preserving that dwells is the fourfold*" (Heidegger 2001: 148).
Heidegger states that dwelling serves as preserving in the stay with things (Heidegger 2001: 147): "*Dwelling preserves the fourfold by bringing the presencing of the fourfold into things*" (Heidegger 2001: 149).
Heidegger states that this especially occurs when the mortals nurture the things that grow and construct things that do not grow (Heidegger 2001: 149). Dwelling is therefore connected to the construction of things – i.e. architecture. After concluding this connection Heidegger asks what a built thing is and by doing this he brings the connection of architecture and place into the discussion: Heidegger uses a bridge as an example of a thing and he states that a fundamental property of the bridge is the ability to gather – which is etymological rooted in the word thing.
The property of the bridge as a thing is not something that is attached, it rather gathers *the fourfold* in a way that allows a site for *the fourfold* – and Heidegger stress that this is only possible for things that are in themselves locations (Heidegger 2001: 149-151):

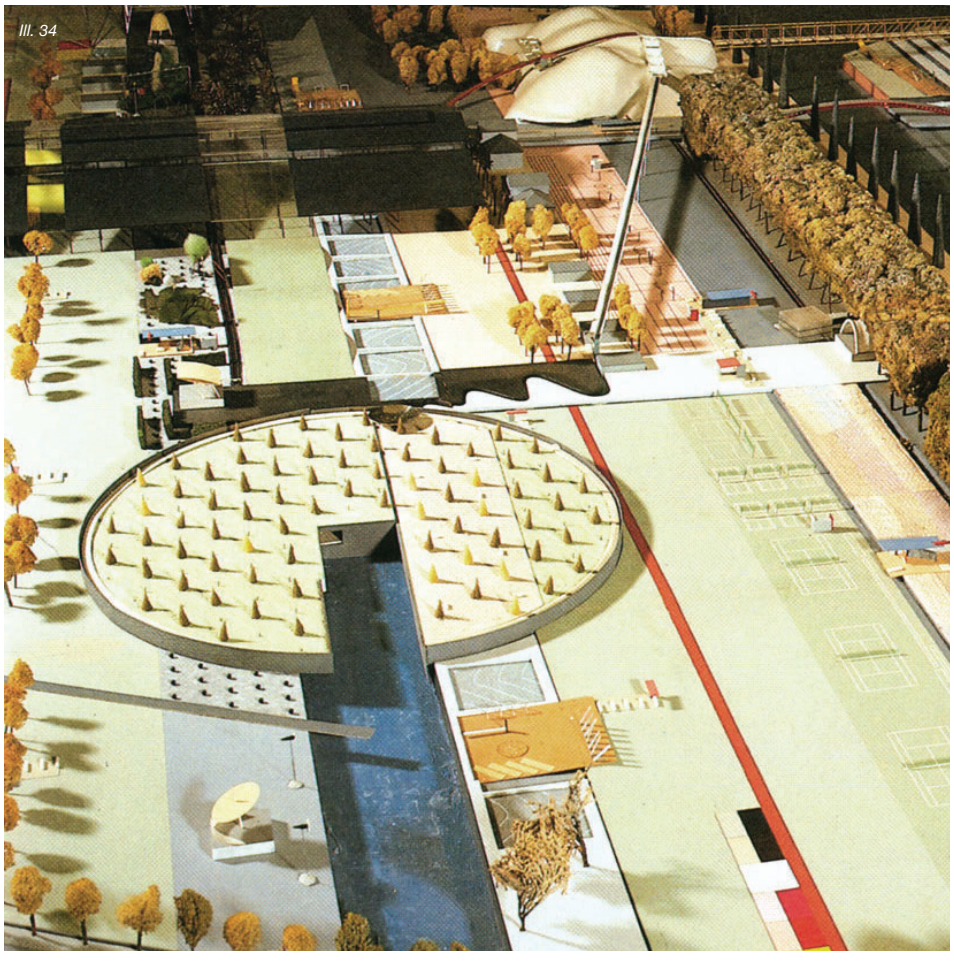
"The location is not already there before the bridge is. Before the bridge stands there are of course many spots along the stream that can be occupied by something. One of them proves to be a location, and does so because of the bridge. Thus the bridge does not first come to a location to stand in; rather, a location comes into existence only by virtue of the bridge"
(Heidegger 2001: 151-152)

This aspect sows doubt about the unilateral interpretation of Norberg-Schulz where architecture arises from the characters of places. An opposite dependence from architecture to place – or location and built thing to stay in the heideggian terms – is present in the thinking of Heidegger: Places arise because of architecture.
Heidegger further stresses that human experience of place is facilitated by architecture as he elaborates on the built things (Heidegger 2001: 152): "*The relation between location and space lies in the nature of these things qua locations, but so does the relation of the location to the man who lives in that location*"' (Heidegger 2001: 152). Heidegger thus operates with a causal relation with a hierarchy where the built thing presides the location and location presides space; and the built thing – the architecture – is the decisive liaison between space and location.
Heidegger states that this space is something that has been made room for within a boundary, and this boundary is not defined as where something ends, but as where something begins its precensing. Space arises as a consequence of this from the location due to the built thing:

"Accordingly, spaces receive their being from locations and not from 'space'"
(Heidegger 2001: 152)

The notion of "space" is by Heidegger used to address the conception of mathematical, analytic-algebraic space which stems from space as *spatium* where nearness and remoteness between men and things are reduced to distance and *extensio* where the manifold of the three dimension reduce distance to extension (Heidegger 2001: 153): "*The space provided for in this mathematical manner may be called "space," the "one" space as such. But in this sense 'the' space, 'space,' contains no spaces and no places. We never find in it any locations, that is, things of the kind the bridge is*" (Heidegger 2001: 153).
That spaces receive their being from locations adds nuances to the relation between place and architecture as architecture is a spatial phenomenon: Not only do places arise from architecture – architecture also arises from places. A nuanced reciprocal relation between place and architecture thus exists according to Heidegger.
In conclusion of these considerations to Heidegger's thinking on place it seems that Norberg-Schulz has emphasised one side of a reciprocal relationship between place and architecture: Architecture's facilitation of place to man in order to create meaning and existential roothold. This however disregards Heidegger's emphasis on the place's dependence on architecture which points towards exchange between place and architecture – a reciprocal relation in which it does not make sense to speak of static places as places are constant negotiations.
Heidegger's approach to place is however far from all-encompassing: The thinking on place by Heidegger can be criticised for ignoring several vital aspects – two of the most distinct disregarded aspect are the role of the sensing human body and the social aspect of places. These points of critiques are put forward respectively by the philosophers Edwards Casey and Henri Lefevre. Casey argues that places arise between the landscape and the body – and Heidegger is missing the human body in his approach to place. Lefevre likewise criticises Heidegger as he states in *La Production de l'espace* that every place is socially defined and as it is created by humans it is also constantly changed by history (Ringgaard 2010: 29-31).
An exhaustive discussion on the human body, the landscape, the historical aspect and social aspect in connection to place would be an extensive task and will not be addressed here – however these points of critique point towards that Norberg-Schulz is not alone in making a reduction of place – Heidegger is in spite of his emphasis on a reciprocal relation between place and architecture also making a reduction of place. The points of critique therefore only underlines that place is not static nor can it be reduced to visual characteristics: Place is a dynamic phenomenon with many shades.
With the points of critique in mind the consideration on the dynamic character of place serves as the point of departure for the further investigation on how architecture is to address place in order to provide meaningful solutions to the local impact of global challenges in contemporary society.

Ill. 33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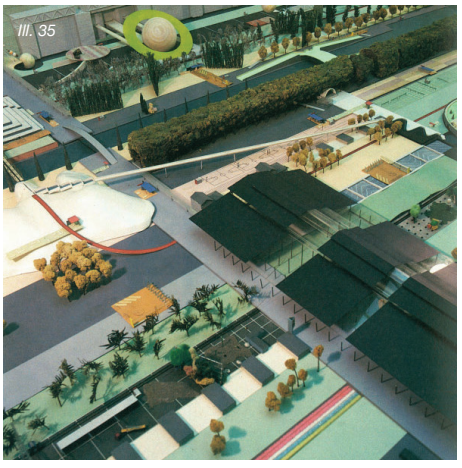
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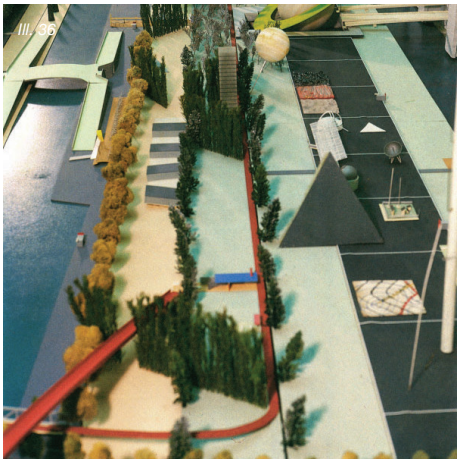
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Ill. 37

The dynamics of The Generic City

The approach towards architecture as a dynamic element based globalism has been a trademark for the Dutch architect Rem Koolhaas during recent decades. In his essay *What Ever Happened to Urbanism* Koolhaas argues as Norberg-Schulz against the abstract space emphasised during modernism as he states that this century has been a losing battle with the issue of quantity: The promise of modernism for a transformation of quantitative to qualitative through repetitions and abstractions by use of space and the free plans was a big mistake (Koolhaas 1995: 961).
Despite the similar starting point distinct differences exist between Norberg-Schulz and Koolhaas in the approach to the problems connected to the modernistic space: A pivotal difference is the orientation as Norberg-Schulz mainly focuses on architecture as introvert element concerned with the close context. Koolhaas on the other hand focuses on architecture as extrovert through urbanism. A city based solely on alone standing elements of architecture is by Koolhaas describes as '*a refuge in the parasitic security of architecture*'; where urbanism has lost its livelihood due to the retreat to enclosed architecture (Koolhass 1995: 967).
To change this degradation of urbanism and the excessive focus on architecture as permanent monolithic objects Koolhaas believes that the city should be seen as a dynamic planning medium: Focus change from a position of permanent objects to a position concerned with processes in global perspectives, blurring of boundaries and exploring new hybrids. The city is hereby changed into a manipulated image of "*intensifications and diversification, shortcuts and redistribution – the reinvention of psychological space*" (Koolhaas 1995: 969).
Koolhaas describes these ideas thoroughly in his essay *The Generic City* where he asks: What if the contemporary city is a homogenised city built on the global and capitalistic perspectives?
The supposition Koolhaas sets in *The Generic City* is founded on an understanding of the world as capitalistic, where everything is the same and place and cultural understanding is based on marketing potentials. This supposition restores a city based on human requirements and opportunities; it is man who is at the centre (Koolhaas 1995: 1251-1253).
Hvattum compares Koolhaas' *Generic City* and Norberg-Schulz´s *Genius Loci* and she argues that both create reduction in the dissection of their own procedural world and reduce architecture into a product of pre-defined factors - one of capitalist market values and the other of the spirit of the place (Hvattum 2010:41). Hvattum further states that regardless of approach the understanding of the place is all about seeing and understanding places as dynamic spaces for action, and not as already pre-programmed static spaces (Hvattum 2010: 42-43). Hvattum believes that there should be "*focus on practice rather than on the shape, on space for action rather than visual expression*"' (Hvattum 2010: 43).
Both the introvert approach to local anchorage behind *the Genius Loci* and the extrovert global approach behind *The Generic City* are based on a reduction of the context and therefore both end in a discussion based on the visual output and simultaneously without creating a local impact to the global challenges. Still, there is a greater focus on the dynamic of *The Genetic City* and some thoughts by Koolhaas can be used to move away from the stagnancy of the Genius Loci towards a dynamic place-oriented architecture.
To address a dynamic architecture with roots in the local and foci on practice and action focus is aimed at the thoughts of James Corner, MVRDV and Kenneth Frampton to broadly discuss different solutions arising from the tension field of processes between globalism and local roothold.


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Landscape Urbanism

The American landscape architect James Corner describes a move from landscape with focus on the pastoral appearance, towards landscape as an active element. This change he calls Landscape Urbanism which is a theory based on thoughts presented by Koolhaas in the projects Parc de la Vilette and Melun Senart.
In the unfolding of Landscape Urbanism Corner uses the understanding attached to the German word *Landschaft*, which means an environment of buildings, forests, meadows, fields and other elements of nature and the built. Instead of a stationary scene based on the visual and staged theatrical production attached to the English word "landscape", *Landschaft* is a dynamic image containing all the aforementioned elements and occupation, activity and space (Corner 1999: 154).
Corner states that by reducing landscape to something seductive and visually beautiful it looses its ability to influence the contemporary society; the picturesque use of nature in the urban landscape does not restore or improve the public life (Corner 2006: 32).
Corner explains that this loss of – what he calls – imagination is caused by the optimised rationalism during the modernism. The imagination should be "*informed and stimulated by the experiences of the material world*" to change the public space into "*containers of collective memory and desire, and secondly they are places for geographic and social imagination to extend new relationships and sets of possibility*" (Corner 2006: 32).
Corner describes *Landschaft* as opposed to "landscape" as a generator for the city and as a desire to see architecture as part of a greater planning – an exercise in designing site-specific structures that are intimately tied to the larger context and interacting with its processes in terms of flow, infrastructure and natural processes . Focus is changed from alone standing monoliths with own identities to foci on processes, dynamics and the poetic (Corner 1999: 16, 159).
To accomplish this Corner stresses the importance of an interweaving of the *Landschaft* and urbanism, an incorporation of the overall strategies and tactility to create a connection between vast scales and proximity, the closed square and the wild forest etc. (Corner 2006: 33).
The change of focus towards a *Landschaft*-based approach can contribute to a change of the static image of place intrinsic in *the Genius Loci* by emphasising the connection of the place to a larger overall image and viewing places as elements part of an overall infrastructural and procedural picture.

In continuation of the entanglement of the single place to neighbour places focus is aimed at the even larger picture of the integration in the architectural scale of global and local parameters through the method of *Datascape* developed by the Dutch architectural firm MVRDV.

Datascape

MVRDV uses the analytical approach *Datascape* as a response to the global trends-based architecture by Koolhaas. They go against the trend they describe as the architect's obsession with the unique and individual, which minimises architecture to an individual project closing on itself. MVRDV seeks to slip the formalistic and self-closing tag and emerge as part of the solution by addressing the spatial on the basis of current agendas and in-depth data collection (MVRDV 1999: 16-18). *Datascape* is thereby a response to the shape and visual-oriented architecture and seeks to utilise specifications of each local context as their contribution to a global market where each region or locality is part of the global requirements. A way to maximise the use of limited spaces, to address densifications and to minimise transport and use of square meters and thus optimise the cities and architecture (MVRDV 1999: 16-19).
MVRDV describes *Datascape* as a way to again address architecture as idealistic – as a way to showcase or solve global problems in the locale. A method for involving mega-scale and global issues in an architectural scale without staying within the four walls of the building as the architect may also involve research on subjects such as education, climate, entertainment etc. (Patteeuw 2003: 141-143). *Datascape* is in the light of this an extension of the thoughts Koolhaas describes in relation to a necessity in the use of global trends, but instead of following these trends MVRDV handles them analytically and compares them with national and locale data. They analys the global and large-scale issues with an individualised output and creates a projects where "*the individual meets the collective again*" (Patteeuw 2003: 145-147)
This approach blurs the boundary between architecture and its surrounding society and the analytical research thus creates an architecture that is not minimised to a static function or a visual image, but an answer to local questions. This results in an architecture based on a regional and global scale sought embedded in its locale context (Patteeuw 2003: 13-19).
Datascape is a way to create an architecture that is not just is a visual sculpture but a more idealistic architecture; a search for a solution or as a way to showcase problems. *Datascape* thus deprives the static focus on place and integrates the place as a part of the solution to both near and global challenges: Global challenges are anchored in the local context as local conditions are considered.
The approach of connecting global elements to a local anchorage has also been the focus in a significant different approach to architecture: The architectural historian and theorist Kenneth Frampton's writings on *Critical Regionalism*. Frampton's ideas are in continuation of *Landshaft* and *Datascape* addressed to seek a more detail-oriented adaption of the anchoring the global challenges of architecture into the place.

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Critical Regionalism

Kenneth Frampton has sought to formulate a nuanced approach to place and globalism though an architecture with resistance to withstand the modern space and universality. Frampton emphasises the importance of a local roothold in continuation of Heidegger's description of a boundary from where precensing begins: "*…we are, when confronted with the ubiquitous placeness of our modern environment, nonetheless brought to posit, after Heidegger, the absolute precondition of a bounded domain in order to create an architecture of resistance. Only such a defined boundary will permit the built form to stand against – and hence literally to withstand in an institutional sense – the endless processal flux of the Megalopolis*" (Frampton 1983: 24-25). However instead of converting this heideggian border into an introvert orientation as Norberg-Schulz Frampton instead seeks to create both local roothold and global outlook at the same time: In the 1983 essay *Towards a Critical Regionalism* Frampton argues for the embracement of both local and global aspects in an architecture neither lingering in a vernacular retrospective approach, nor disappearing into the anonymity and optimisation of universal technique. The goal is a resistant, identity-giving architecture that utilises the advantages of universal technique (Frampton 1983: 20-21): "*The fundamental strategy of Critical Regionalism is to mediate the impact of universal civilization with elements derived indirectly form the peculiarities of a particular place. […]Critical Regionalism depends upon maintaining a high level of critical self-consciousness. It may find its governing inspiration in such things as the range and quality of the local light, or in a tectonic derived from a peculiar structural mode, or in the topography of a given site*" (Frampton 1983: 21).

As an example of this type of architecture Frampton refers to Bagsværd Church by Jørn Utzon: The church's floorplan follows a regular grid that allows the use of standard concrete elements, but tension and contrast to the regular system of walls are created by the curved reinforced concrete shells as a part of the building's roof (Frampton 1983: 22). The concrete shells create a distinctive intake of the light from the Northern sky – and the universal and rational is in interplay with the particular and irrational in the creation of connection between world, place and architecture. Frampton stresses that the pivotal element in the creation of architecture of the like of Utzon's is the emphasis on tectonic which differs from technique by being more than mere simple revelation of construction: "*The tectonic remains us today as a potential means for distilling play between material, craftwork and gravity, so as to yield a component which is fact a condensation of the entire structure. We may speak here of the presentation of a structural poetic*" (Frampton 1983: 28).

Tectonic is by Frampton closely linked to the tactile and in favour of a unilateral visual approach to place he therefore points towards emphasis on tactility in architecture: "*The liberative importance of the tactile resides in the fact that it can only be decoded in terms of experience itself: it cannot be reduced to mere information, to representation or to simple evocation of a simulacrum substituting for absent presences. In this way Critical Regionalism seeks to complement our normative visual experience by readdressing the tactile range of human perceptions. In so doing, it endeavors to balance the priority accorded to the image and to counter Western tendency to interpret the environment in exclusively perspectival terms. According to its etymology, perspective means rationalized sight or clear seeing, and as such it presupposes a conscious suppression of the senses of smell, hearing and taste, and a consequent distancing from a more direct experience of the environment. This self-imposed limitation relates to that which Heidegger has called a 'loss of nearness'* " (Frampton 1983: 29).

The approach of *Critical Regionalism* is thereby an approach to places in a global world emphasising a double orientation towards the local and global at once where the areas of focus are the interplay between concrete and the abstract, tactile and visual, tectonic and technique.

Partial conclusion

In continuation on the approaches of *Landshaft*, *Datascape* and *Critical Regionalism* it seems that the reduction of place to a static and visual phenomenon is far from sufficed as an answer to contemporary challenges e.g. climate adaption on both local and global level. As the introvert approach of *the Genius Loci* reduces place into a static and visual element without possibilities for further development the global extrovert approach of *The Generic City* reduces place to visual and formalistic outputs. Answers are neither found in the extremes of the solely local place nor the in the flux of the global world – the answers to the global and local questions of contemporary architecture are found in the tension field between the local and global.
The search for an approach of an architecture based on local tangibility in places and a wish to prove meaningful solutions to global challenges therefore points towards a multi-pronged dynamic understanding of place:
An approach where the visual appearance of the place and the market values are just part elements in an overall image embracing the reciprocal relation of Heidegger, the dynamics of The Generic City, the connectivity of Landscape Urbanism, the societal investigation of *Datascape* and the double orientation of *Critical Regionalism*.
Place is a constantly negotiated and changing phenomenon. Contemporary architecture therefore needs to embrace the connection of globalism and local roothold in the purveyance of pertinent answers to the local impact of global challenges.

Strategy of Architecture & Place:
Local and global emphasis of place

With an analytical strategy as point of departure architecture can be integrated in its specific context as more than a mere visual output. Through an analytical strategy the site-related issues as flooding and stormwater management is combined with issues of national and global character, such as climate changes and educational foci and processed together with site-potentials, thereby reducing focus on pure form and visual output and thus addressing architecture as part of tomorrow's solutions.

The analytical strategy seeks more process-oriented integration to embed the purification plant in the biological and city-structural systems. Creating a spacious understanding arising from the spirit of Kjærs Mølle Dam and the physical appearance as well as the spacious processes and flows of Aalborg and the green wedges. A spatial understanding and experience addressing interaction of the place and city flow as a more dynamic area where each individual element is part of the context and contributing to the areas activities - both social and individual, physical, educational, and of a more recreational and immersive character.

This strategy requires a purification plant established by the premises of the surroundings - paths, flows, nearby building, typology and physical elements - to create a place understand as a totality and as part of the city and nature.
This is highlighted by a regional architecture that anchors the building through a tectonic detailing based on the context and a processing that require contact with the environment and the user. Creating a space that is not mere architectural but involving the site, the city and the natural processes.

JOINED STRATEGY

Transition as strategic element

The tree characteristics have through the theoretical investigations resulted in the formulation of three areas of strategic focus, respectively: *Dissolution of hierarchy, Experiences through peripheral perception* and *Local and global emphasis of place*.
A common feature of these is the element of transition.

Dissolution of hierarchy between nature and building – between the stormwater and the architectural frames for stormwater management – stresses the importance of equality to bring the full spectra of nature's qualities into play. A vital element on the path towards this equality is the transition and transgression of the conventional borders between nature and culture: Transition occurs when architecture moves into the domain of nature and vice versa – and to establish blending of domains the element of transition is decisive.

In a similar fashion is a transition of the borders of domains sought by the focus of *Experiences through peripheral perception* as the peripheral perception is aimed at the sensing of atmospheres arising from the dissolution of the opposition of subject and object. In the creation of experiences and thereby also the facilitation of knowledge transition between the experiencing subject and the experienced object is decisive.

In *Local and global emphasis of place* transition describes the approach to place: Place is not reduced to single, static, closed term in the same manner peripheral perception is concerned with more than the mere use of vision.
For place to move beyond a static and visual notion parameters of local and global origin in all scales are considered. A dialogue of vastly different influences occurs as place is neither static nor dynamic, but constantly renegotiated, and transition between the influences arises.

In the approach of letting the characteristics of Urban Farming – and Urban Farming as a whole – contribute in the interplay with architecture emphasis is therefore directed at the strategic element of transition which means that focus in the design will be aimed at the borderlands in architecture where transition is intrinsic.

VISION

The project seeks to facilitate a narrative of stormwater management as more than a technical installation or a pastoral landscape element in an urban context by creating a treatment plant with delay basins and purification processes. In the context of Kjærs Møllesø the treatment plant seeks through architectural means not only to function as a problem solving installation or a recreational green element, but to facilitate a holistic understanding of the problems and potentials of stormwater management in the times of climate adaption.
The treatment plant seeks to shed light on how the global agenda of increasing heavy rains is to be addressed by means of local foothold – showing how the problems of the cities' paved areas could be turned into potentials for local prosperity by focusing on integration instead of segregation.
The project seeks to facilitate a positive story of urban water management in contrast to the images arising from the segregated contemporary treatment plants at the outskirts of the cities – the projects aims to create a treatment plant which is welcomed as a neighbour!

The processes of the treatment plant are planned to be open and accessible and thereby aim to display the story of the heavy rains and the journey of the stormwater from the initiating polluting process of surface run off in the catchment areas of Kærby and Håndværkerkvarteret to the final direct discharge of the purified stormwater water to Østerå – the main stream of the area.
The architecture of the treatment plant thereby seeks to be a facilitator of knowledge of the processes of delay and purification and a contributor to a stabile and clean stream that on the way towards the Limfjord adds sensed quality and higher degree of biodiversity to Aalborg in the future scenario of an opening of Østerå.
The treatment plant seeks to unfold the narrative of stormwater management.

The treatment plant seeks inclusion of the context by addressing participation on several levels: The purification processes are in different degree made accessible for the public and the openness and flow through the plant is addressed by integrating existing and planned connection of infrastructure for pedestrians and cyclists: The link between the city and the green wedge ending at the site and the planned connection between two major urban areas of current transformation – Godsbaneområdet and Eternitten – through the site. The intention is to create an open environment where the movements of water and inhabitants flow through and interact.
The treatment plant seeks to include the dynamics of the context.

The plant also seeks to establish facilities for pause and stay on the site: The participation of visitors to the plant are addressed on levels of different engagement – from the visual contact of passing through to pausing at the basins, receiving information of the plant, studying water samples during school class visits, eating the plant by-products of the purification. By integrating the visitors as participants the plants seeks to facilitate knowledge of the water circuit system, natural processes and water as a generator in society. The purification plant seeks to transgress the borders between nature, building and visitor by creating a problem solving, recreational area open to the public with an educational effect in an urban context.
The architecture of the plant seeks to function as a connection between the measurable values of delaying the heavy rains and purifying the stormwater together with the unmeasurable and sensuous values created by contact to water and the biological processes of the purification. By applying this approach the aim of the architecture of the treatment plant is to function as a facilitator of stormwater management by focusing on both knowledge mediation and experiences of stormwater delay and purification and the biological processes attached to the purification.
The knowledge mediation and experiences related to the purification process and the delay basins are sought by addressing the visitors and users of the area as participants to create an interaction with the water through bodily participation with a full sensory palette.
The purification plant seeks to facilitate knowledge and create experiences of stormwater in the process of adressing the challenges of delay and putification of stormwater.

How can architecture be a facilitator for the experience and mediation of knowledge of urban stormwater management as a holistic answer to climatic challenges in the context of Kjærs Møllesø by focusing on the notion of transition?

PROBLEMSTATEMENT

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CONTEXT ANALYSIS

Strategies of Aalborg municipality

With the global and national challenges of stormwater management introduced in the motivation focus is aimed at the regional context of Aalborg to shed light on how which frames are established to address the challenges: The municipality of Aalborg has approached the theme of climatic changes and prospect of extreme weather conditions both a Physical Vision for Aalborg anno 2025 and in a Climatic Strategy. These will be the point of departure for the further investigations.

In the Physical Vision for 2025 the municipality approaches the challenges of the climatic changes by planning new dwelling areas high in the terrain or by adapting the new dwellings to the extreme weather. The latter approach is identical with the strategy for existing dwellings. The focus in this adaption is a different approach to the design of the immediate environment than the approach currently applied: Focus is to be shifted towards using the increased amounts of water as a recreational element in urban contexts. In this approach the establishment of green urban spaces playes a vital part in the delay, evaporation, purification and use of stormwater – turning the element of water into an advantage and recreational resource for city of Aalborg (Fysisk vision 2025: 14, 27, 29).

This vision for Aalborg is concretised in the municipality's Climatic Strategy of 2012-2015: A decrease in the pressure on the sewers is sought by the implementation of local stormwater management in urban settings by alternative and supplemental initiatives to the conventional management. Future district plans will outline how local management of stormwater can be implemented – the strategy for both existing and new dwelling areas is a separate sewer system combined with decentralised management of stormwater by primary the passive solution of evaporation and delay of water (Klimastrategi 2012-15: 10-12).
This strategy is a continuation of a vision for the sewer system in the year 2100 - a collaboration between the municipality of Aalborg and Aalborg Forsyning. The goal is a total separation of the sewer systems where wastewater is managed at the existing two sewage treatment plants and stormwater is managed locally.
The goal is thus separate sewers with centralised wastewater management and decentralised management of stormwater.

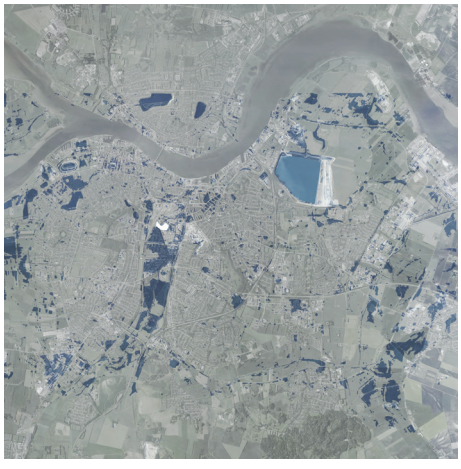
In the transition towards these goals the management of stormwater is focused on local diversion, delay and – if necessary – purification of stormwater before discharge to recipient (Vision 2100: 18-22).

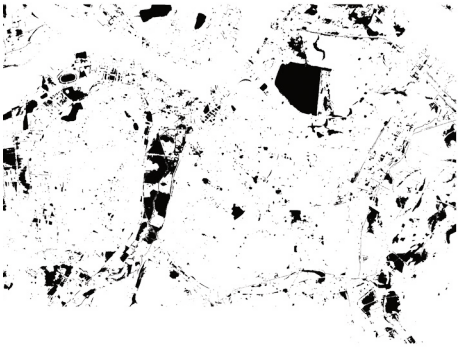
Aalborg Municipality has therefore established a strategy for the climatic changes that embraces the recreational use of storwater in the urban spaces and where stormwater and waste water is separated. The decentralised approach to stormwater is here of pivotal importance.
The thesis operates in continuation of these strategic focal points of the municipality.

The Municipality of Aalborg has identified six special critical geographic areas in connection to the risk of flooding as consequence of the climatic changes. Two of these are situated in connection to the city center of Aalborg: The central harbour areas and Øster Å . The remaining four are Hasseris Å Romdrup Å, Lindenborg Å and the summerhouse area in Hals/Hou which are all situated outside the city limits, but within the municipality limits (Klimastrategi 2012-15: 9).
The challenges of the central harbour areas are mainly related to the expected global rise of sea levels and the local extreme flood tides of Limfjorden (Klimastrategi 2012-15: 36).
As the aspect of stormwater is therefore not crucial for this geographical area and the thesis seeks to address the challenges in an urban context focus is therefore turned towards the challenges connected to Øster Å.

The site for the treatment plant is located in connection to Østerå with the main focus to address the challenges of stormwater in the city of Aalborg. As the urban areas connected to Østerå are in high risk of flooding during the extreme rains the stream of Østerå is chosen as the physical point of departure for the design. This main reason is supplemented with the additional consideration that Østerå is the recipient for most of the stormwater washing of central areas of Aalborg – and the purification of stormwater is therefore here of utmost relevance. The specific site is located at the northern end of two distinct areas separated by Østerå: The residential area of Kærby consisting of single-family houses west of the stream and the industrial area of Håndværker-kvarteret east of the stream. The choice of site will be further elaborated through the analyses.

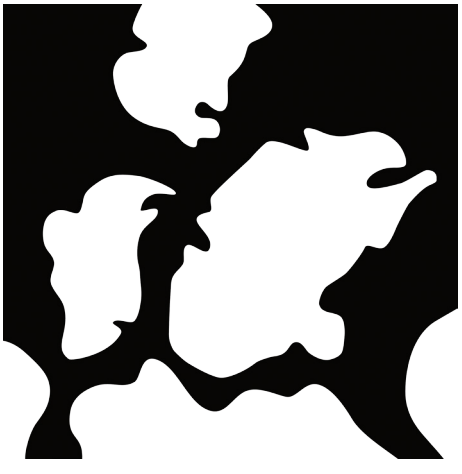
Østerå
Østerå rises south of Aalborg in the Municipality of Rebild and is connected to Limfjorden. As a consequence of this stream has a massive hinterland of 130km^2.
Østerå has historically been is an important part of the development in Aalborg: Originally Østerå runs through the city center via Mølleplads and Østerågade and when trading was the dominant economy in Aalborg the stream was dominant in relation to the image of the inner city with the large trading houses at Østerågade. When industry became the dominant economy Østerå was piped from Kjærs Møllesø – just north of the site – due to heavy pollution from the large industries among these the textile factory Gabriel next to Kjærs Møllesø (Teknik- og miljøudvalget 2009; 3).





Risk of flooding
The appointment of Aalborg municipality of the six focus areas in connection to the existing and future problems has been conducted by COWI: The choice of the areas – including Østerå – is based on simulations on a detailed model of heights and water flow for Aalborg displaying the areas is risk of flooding because of rise of water levels and because of gathering of water in low areas.
The areas along Østerå forms a connected pattern displaying the challenges connected to these areas.
The site is located immediately north of the afflicted areas and thereby in close contact with these areas in danger of flooding during heavy rains.
(Klimastrategi 2012: 9, 25).

Landscape topography
The challenges of the areas connected to Østerå is closely related to the overall landscape of Aalborg. The ancient landscape created during the Ice Age is primarily flat landscape with some prominent hills where Trandersbakken, Hasserisbakken and Sundbybakken by Nørresundby are the dominant. Østerå runs between two of the hills which with means that the water entering from the southern hinterland is supplemented with the waters running downhill towards the low areas of valley which Østerå runs through. This shape of the landscape thereby contribute to the problems during heavy rains as the water is accumulating in the lowest areas as bottlenecks are created in the sewers and piping of the water ways.

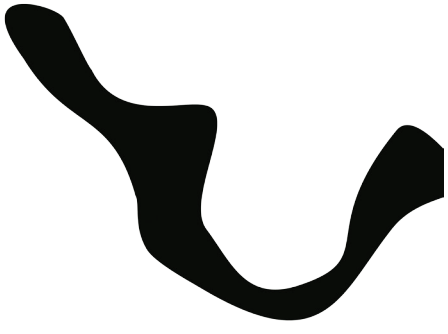


Not suitable for percolation
A strategy for the problem of accumulating water is to let percolation be the main means for addressing the problem. This is however not possible in the areas connected to Østerå: The water engineering firm Envidan has conducted investigations related to Aalborg's soil conditions, groundwater levels and protection lines in relation to future LAR solutions. These studies have mapped the situation in and around Aalborg related to the soils percolation capacity - how suitable locations are to LAR solutions. These studies show that areas connected to Østerå are not suitable for percolation as these areas are low-laying and close to the ground water while the soil is not suitable for percolation because it is too saturated (Envidan 2014).

Blue elements
The identity of Aalborg has been built around water during the years, especially the fjord. But also the small streams that cuts through the area have been a major factor in relation to the planning of the inner-city. The contemporary focus of Aalborg has shifted towards utilising the recreational water-related potentials (Fysisk vision 2013:16-17).
The areas of Kærby and Håndværkerkvarteret connected to Østerå are separated by Østerå, but also framed by two ditches – Østre and Vestre Landgrøft – running parallel with Østerå of respectively the west side of Kærby and on the east side of Håndværkerkvarteret. This means that the two districts are surrounded by waterway creating increased vulnerability during the rains.

Green wedges
Aalborg is a city surrounded by green areas of various biotopes and these green areas cut into the city as green wedges creating recreational facilities and opportunities for physical activity and outdoor activities. There are mainly four green wedges in Aalborg where the site of the thesis is located at the end of the one of the largest and most used compared to outdoor recreation and walks. The physical vision describes the green wedges as essential to the city's biological specifications and should be supported, inter alia, with nature restoration. With the location of the site the possibility not only to utilise the recreational potential of Østerå is therefore present: The project is placed in the joint between city and green wedge creating a gateway to green areas.

Urban growth axis
Aalborg has established a focus on a high-density urban growth axis created with an eye on green development of urban areas, squares and buildings. The new developments seek to connect recreational areas, both new and existing areas in the outskirts with the city, creating a green city (Fysisk Vision 2013: 13). The Physical Vision describes an aim to connect Aalborg with the open country by a network of paths placed in the green wedges to improve the dispersal corridors and wider biodiversity (Fysisk Vision 2013: 38).
The site is placed in the growth axis and a focus is to establish not only connection between city and land, but also to be inscribed in the development of the urban areas of Aalborg.



Development areas
Aalborg is a city which in recent years has undergone development from industrial to knowledge society - a development which among others is based on education and knowledge facilitation which is reflected in the statistics where Aalborg is the city with the largest construction rate of youth housing. Areas under the greatest development are the old industrial areas - Godsbanen, Eternitten and the harbour areas - which embrace education, housing and business in a contemporary development (Fysisk vision 2013; 2.6).
The site is placed between Godsbanen and Eternitten and as the Municipality of Aalborg is focused on the connection of the areas in development the thesis is therefore inscribed in the connection between these areas.

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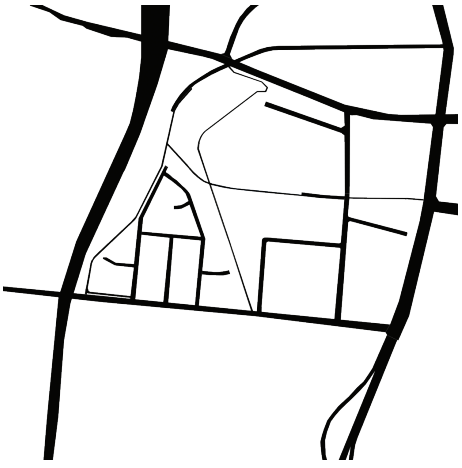
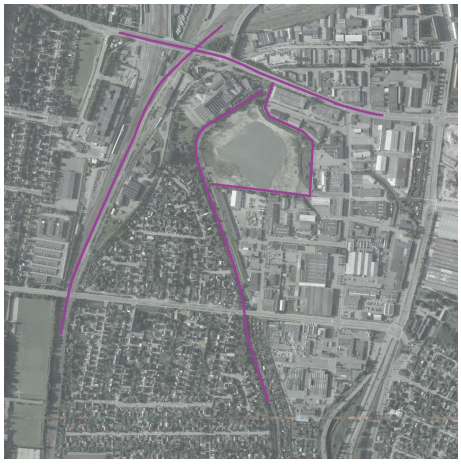
Site
Håndværkerkvarteret
(catchment area)
Kærby
(catchment area)

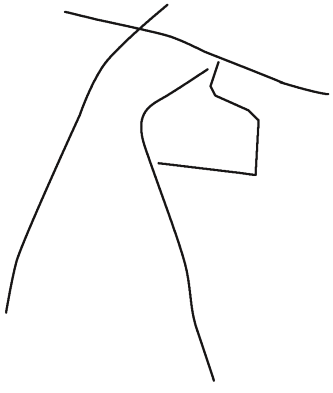
Catchment areas for site

The two areas connected to the stormwater management on the site are the residential area Kærby and the industrial area Håndværkerkvarteret. These two areas have common problems as these are often flooded after the heavy rains hit the city. The plans for separate sewer systems has not yet been realised in Kærby, therefore it is possible in a future separation to deduce all the stormwater to the site instead of the sewers. Håndværkerkvarteret has separated sewers, but the drainage for stormwater can be deduced into the site instead of discharge to Østre Landgrøft running east of the area. This reduces in the end the pressure on Østerå as Østre Landgrøft discharges to Østerå with flooding and pollution as a consequence because of the lacking purification.

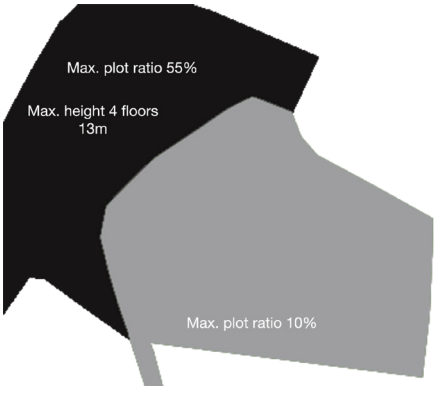


Infrastructure
The area is dominated and surrounded by large infrastructures with the railroad west of the areasas the most dominant because of the close relation to the main train station, the old freight area, the old remisse and a single old set of rails cutting through the site towards the old industrial areas of Eternitten
The site is facing a major road structures north of the site with the west/east running Østre Allé as a part of ring road that bypasses the center of Aalborg. The site is however not directly connected to Østre Allé as the road is elevated for the crossing of the railway.
South of the site a number of minor roads runs through Kærby and Håndværkerkvarteret and connects to the site in the southwest and southeast corners of the site.





Barriers
Besides the minor roads south of the site the infrastructural connections surrounding the site is not contributing to the connection to the city – the large infrastructural connections have on the contrary the effect of creating barriers that isolate the site from connections to the city.
The site therefore appears as difficult-accessible. On the one side the railway cut off the site from the western part of the city and to the other side the industrial area of Håndværkerkvarteret cuts off the site from the eastern part as the area turns its back towards Kjærs Møllesø.
Throughout the site Østerå is a dividing element that further create isolated part-areas on the site. The only bridge crossing Østerå in the line of the rails running for Eternitten is blocked so it cannot be used to cross the stream.

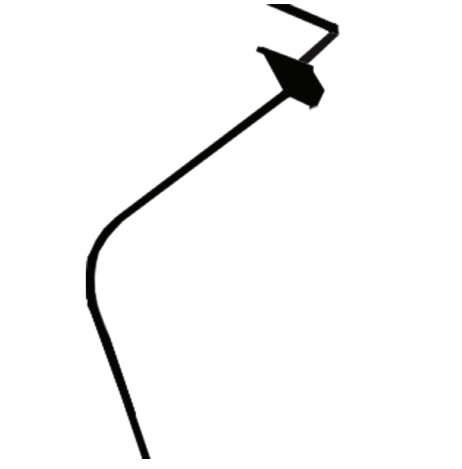


Aalborg local plans
The site is part of two areas in the local plans of Aalborg - Gabriel and Remissen (1) and the area centered around Kjærs Møllesø (2).
Area 1 is reserved for developments as education, recreation, technical installations and small industrial and planned with a maximum plot ratio of 55% and an approximately maximum height of 13m. Area 2 is reserved for activities and recreation with a plot ratio of no more than 10%.
The local plans also prescribes rules for water discharge to existing water systems: For new constructions of wet ponds or other ponds for cleaning and infiltration it is not allowed to discharge more than 1 l/s per. ha. to existing streams and ditches (Lokalplan 1-1-110 2010; 21).

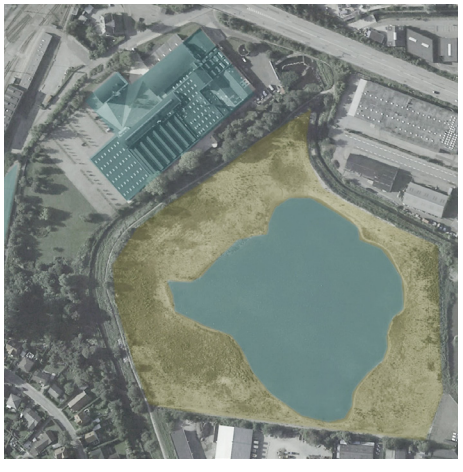
Industrial identity
The site is as described dominated by Østerå which also was the driving force for one of Aalborg's first industries - a textile factory at Mølleplads using water power (Birket -Smith 2002: 74). Over time this production was moved to the old Kjærs Mølle and eventually became Gabriel A/S just north of the site. Gabriel has during time closed part of its production down. Adjacent to the site on the east and south/east side is Håndværkerkvarteret - one of Aalborg's first mono-functional industrial areas with small production companies, craftsmen, mechanics, cement production and service.West of the site is the freight track area with the Remisse.
The project site is therefore characterised by an industrial heritage and identity.

Blue elements
At the site there are many elements related to the narrative of Aalborg as a city connected to the blue elements with both cultural historical elements and natural elements.
The two ditches Vestre – and Østre Landgrøft run along the borders of the catchment areas for the site; simultaneously Østerå cuts through the site and is the main and most prominent elements on the site. Vestre Landgrøft is along the site piped under the ground.
Adjacent to the site is Kjærs Møllesø – an old chalk grave eventually turned into a where future recreational development is planned.
Immediately northwest of the site is Gabriel A/S situated: An textile company which during the years has utilised the waterways for the production of textile.

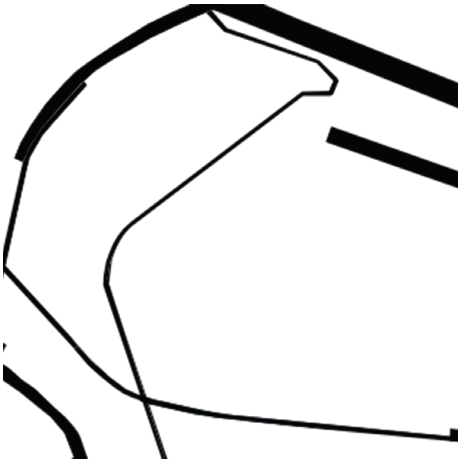
Vision Østerå
The Municipality of Aalborg has a vision is to reestablish Østerå as an open stream through the city: Østerå is currently open from its origins until north east of the site from where it is piped underground until its mouths in the fjord. The vision is to open the stream to establish it as a visible element in the city image and to create new areas for different atmospheres and landscape values. Simultaneously the restoration of Østerå establishes a link between the new waterfront, the restoration of Karolinelunden, Godsbaneområdet and the green Østerå wedge offer a new recreational connectivity and new kinds of experiences in water (Vision Østerå 2009:8). The site is the vision planned as a water culture zone facilitating experiences of water (Aalborg Municipality 2009: 34-35).



Water culture zone
Aalborg municipality has a vision to transform the site into a water culture zone: Transforming the old mining grave of Kjærs Møllesø into a recreational meadow landscape where school classes can explore and learn about the biodiversity in wet biotopes.
In addition to this the Municipality suggests a plant laboratory on the site to raise awareness about biological development and processes.
The cultural trails of the history of the site could in continuation of this provide a framework for new activities and developments in the area and appear as a part of the architectural narrative in the future. Another point of focus is to let the existing dikes of Østerå invite to more than passage by establishing facilities for stay at the banks (Aalborg Municipal 2014: 34-35).



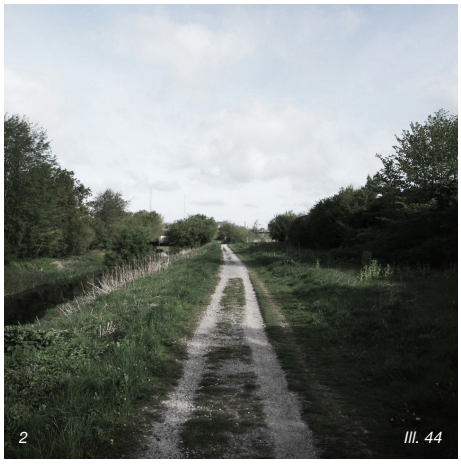
Paths and entrances
Located as a link between new developing areas, Godsbaneområdet and Eternitten and the large residential area Kærby, the site is placed as the first part of the recreational trail running from the city through the natural area of Østerådalen south of the site. The bike path on west side of the site connects the city center with Kærby and the footpath on the other side connects Østerådalen with the inner city. A third fragmented path however also exists on the site: The old railway track that connects Godsbanen with Eternitten and new residential areas to the east.
These trails are currently not very well connected with the city center due to elevation of Østre Allé, which splits the area and the city center in two disconnected areas.



Entering the site from south

As the site is approached from south the stream of Østerå is followed in a stringent linear course as the path runs along the dike on the eastern city of the stream.
On the right hand side the industrial area turns it back on the course.
The water of Østerå is continuously present and the bridge of crossing the stream at the southern border of the site is visible in glimpses as it is partly covered by vegetation.
As the site is reached the tracks of the former railway connection to Eternitten crosses the path. The rails are not visual conspicuous, but their presence are clearly detected by their contrast to the soft gravel as they are crossed. The metal of the rails provides a tactile encounter in the otherwise monotonous course of the path.


1 Ill. 43


2 Ill. 44


5 Ill. 47


3 Ill. 45


4 Ill. 46


Ill. 48 1

Østerå runs on the right hand side, but is hidden during spring and summer behind the vegetation. The stream is however present as the slight curving path is followed: The sounds of the water louder in this part of the stream as the velocity of the water is increased due to narrowing of the stream. On the left hand side a rampart covers the view to Kjærs Møllesø and only reveal fleeting looks over the large water surface. As the vegetation thin outs on the right hand a view to Gabriel's parc area is allowed as the path turns left before the site is encountered with a clear view to the blocked railway bridge crossing Østerå.
A view along the linear path leading south is come out at the bridge's crossing point. The slope of the dike elevates the path from Østerå and creates distance.

Entering the site from north


Ill. 49 2


Ill. 50 3


Ill. 51 4


Ill. 52 5

Entering the site from west

The old railway trail is marked by decay as is not used: The sense of moving through a large shrubbery is only defied by the railway tracks steadfastly showing a way further into the greenery.
The curvature of the course is sensed as the rails are followed – the curve is underlined by the trees on the right hand side: The high trees towards the residential houses of Kærby not only underline the progression of the curved path but also create an orientation towards the left hand side where a hill quickly lowers the level of the terrain if the course of the railway tracks is left in stray.
The sleepers of the railway bridge finally occur between branches, plants and trees as the bridge is reached – the dense thicket only allows sparse views to the bridge.


1 Ill. 53


2 Ill. 54


5 Ill. 57


3 Ill. 55


4 Ill. 56


Ill. 58 1


Ill. 59 2


Ill. 60 3


Ill. 61 4

Entering the site from east

As the site is approached from east the backside of the industrial area of Håndværkerkvarteret is sensed again – strongly underlined by a new addition to a storehouse where the concrete foundation marks a clear line. Kjærs Møllesø appears on the right hand side as a dominating element.
The path is stretch between two clear borders in a linear course following the railway tracks in the dirt: The backside of Håndværkerkvarteret and the banks of Kjærs Møllesø.
The path is narrower than the path running in north/south direction along Østerå – as a result of the missing link or destination in the east.
As the path eventually leaves the banks of the Kjærs Møllesø behind the heavy vegetation at the bridge crossing Østerå appears further ahead.


Ill. 62 5

Ill. 63

Ill. 64

Ill. 65

Ill. 66

Ill. 67

Ill. 68

Ill. 69

Ill. 70

Ill. 71

The site is to a large extend still influenced by the industrial heritage and the traces that remain in the close context: The buildings of Remissen and Gabriel are testimonies to the industrial development that has been unfolding at the site.
The large building bodies of the industry are anchored at the outskirt of the site as constant reminders of the narrative that once was.
The traces of this history are also found in the large unavoidable elements such as the now closed bridge for the railway cargo heading for or from Eternitten.

The traces are however also encountered in more subtle manners as the rails crossing the gravel paths or in the sleepers appearing scattered in the tall grass growing wild at the site.
Large and small traces share the characteristic of decay: Nature has gained a growing power in the site of a former cultural center of industrial productions.

Throughout the site this negotiation between the traces of culture and the onward march of nature is seen as a distinct feature of the site: From the curved rails aiming for the site from Godsbane to the massive concrete foundation for the bridge - the site is permeated by the linger of industrial identity slowly fading in an ongoing of gradual erosion by the forces of nature.
The site is an ongoing dialogue between industry and nature.

Ill. 72

Functions of treatment plant

The project is based on a fictional developer cooperation compiled from the approach to similar projects in Denmark of same type:
The establishment of the urban stormwater treatment plant is with inspiration from the cooperation of the Vandplus projects based on a partnership between the City of Aalborg and Aalborg Supply. This type of developer group there has emerged recent years throughout Denmark (klimatilpasning 2014).
The cooperation between municipality and utility company introduces different agendas and requirements: Aalborg Supply focuses on the handling of the sewers and is enabling requirements in relation to the implementation of separate sewer and discharge of stormwater – the functionality of the stormwater treatment plant is the predominant focus. Aalborg Supply would therefore have a supervisory role and to ensure the daily use of the treatment plant.

Aalborg municipality too is concerned with the purification process, but also aims to introduce recreational aspects to the stormwater management as introduced in the context analyses. The municipality aims to create public life around the inner city and Østerådalen with the thoughts of the aquaculture zone at Kjærs Mølleso and the opening of Østerå through Aalborg.
Aalborg Municipality is seen as the primary developer and as the primary owner and user of the treatment plant.
With these two different approaches to the stormwater treatment plant the thesis therefore focuses on functions relating to both productional and recreational value.

The treatment plant is therefore to contain facilities for:

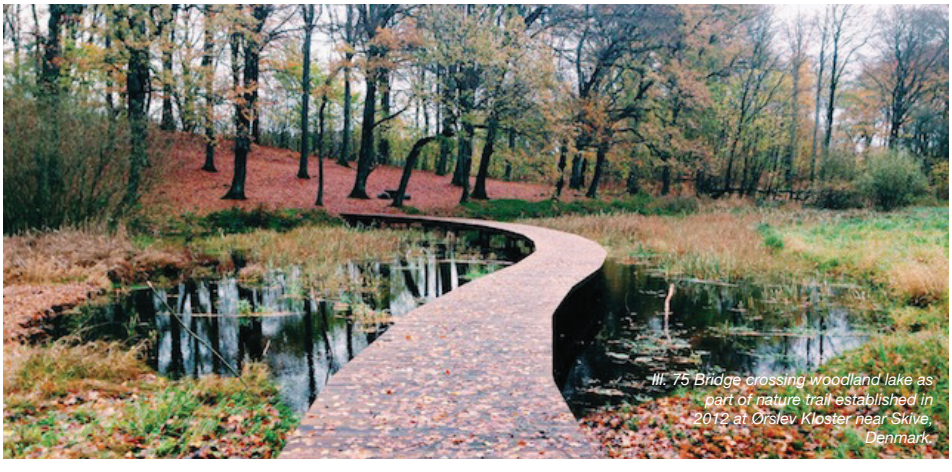
Purification of polluted stormwater

Delay of stormwater

Facilitation of knowledge and experiences of stormwater management

The former two aspects is connected the primary function of the treatment plant – the management of stormwater.
The latter point is infrangible connected to the two former aspects – with the emphasis on escapist and educational experiences a number of functions are introduced to the treatment plants primary functions of purification and delay: An approach of different levels of immersion and absorption is introduced by focusing on programming the site with functions of different levels of engament.
Visit facilities including research facilities providing the possibility for in-depth study during school visit ect., eating areas to consume the by-products of the production and urban spaces inciting stay.
The functions of the treatment plant are tied together by the introduction of a mediation walk connected to both the buildings and basins of the treatment plant. The mediation walk is introduced as element to facilitate the experiences of the treatment plant with inspiration from nature trials established throughout Denmark during recent years creating close interaction with water.

Ill.74 Nature trail established in 2012 at the mouth of Hansted Å near Horsens, Denmark



Ill. 75 Bridge crossing woodland lake as part of nature trail established in 2012 at Ørslev Kloster near Skive, Denmark.

Ill. 76 Bridge crossing stream to the castle ruins at Silkeborg, 2010, Denmark.

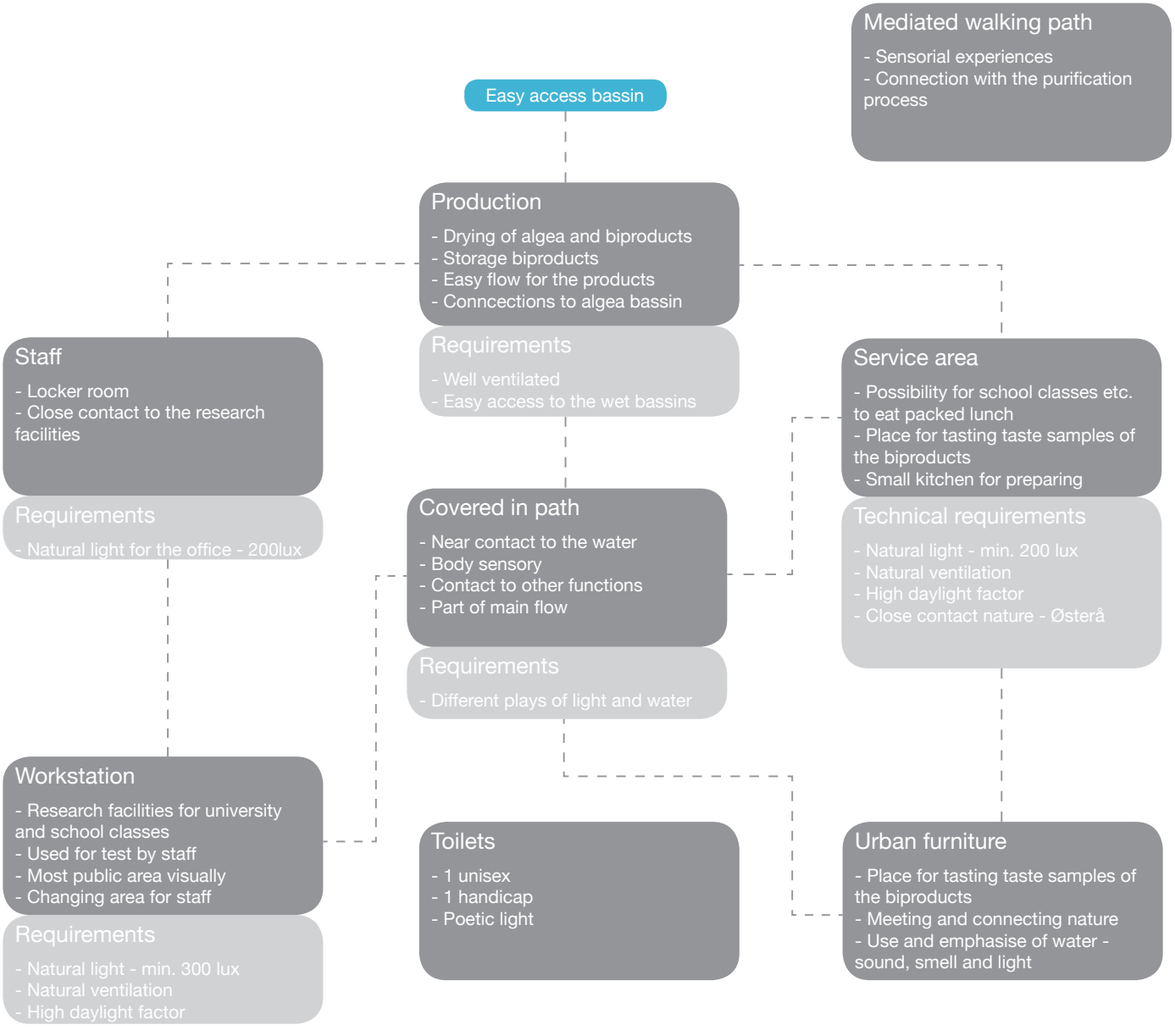
PROGRAM	NO.	AREA	FUNCTION	ACCESS	CONNECTION
Inlet during peaks	2	-	Inlets used only during peaks for heavy rains Safety valve	Public view	To the delay bassin
Inlet for wet ponds	2		Filter for oil and a grit chamber for filtering sand and granule	Staff Public view	To the 1st bassin
Delay basin	2	(12616)m^3	Reservoir for heavy rain and delaying stormwater during the peaks	Public/view	To to the inlet
Connection between basins	8	-	Link between basins Link between basin and recipient	Public view	
1st wet pond element	2	330 m^3 (west) 500 m^3 (east)	Sedimentation - suspended matter and heavy metal Max. height 2m	Public Staff	To to the inlet
2nd wet pond element	2	2000 m^3 (west) 1500 m^3 (east)	Water purification by plants Organic matter	Public Staff	After the sedimentation
3rd wet pond element	2	1000 m^3 (west) 3000 m^3 (east)	Water purification by plants Phosphor and nutrient	Public Staff	After 3rd bassin
Urban furniture	1	-	Bridge for crossing Østerå - Visuel experience of purification process and close contact to the nature and possibilities for stay	Public	Part of the mediated walk
Mediation walk	1	approx. 500m long	Experience and understand the history of water in the city of Aalborg Understand the ourification processes	Public	Programmed as part of the stormwater management facility
Covered mediation walk	1	62 m^2	Bodily and sensory connection to the purified water	Public	Part of the mediation walk
Research area	1	60 m^2 30 people	Work and research space for researchers, students and school groups related to water purification and biology	Public	Close to the research basins
Production I (west) Small depot	1	40 m^2	Processing the harvested plants. Depot for the producs	Public Staff	In close contact to the algea basin and to the work flow
Production II (east) Small depot	2	108 m^2	Processing the harvested plants. Depot for the producs	Public Staff	In close contact to the algea basin and to the work flow
Eating area	1	38 m^2	Taste the biproducts and the process of the biproducts Used for school classes during visit	Public Staff	Closely connected to the production I area
Toilets	2	7 m^2	Unisex and disabled	Public	Connected with the research and eating area
Staff area	1	6 m^2	locker room facilities	Staff	Connected to research area With bath possibilities
Total					
Building		(321) m^2			
Spaces		(7000) m^2			

SPATIAL PROGRAMME

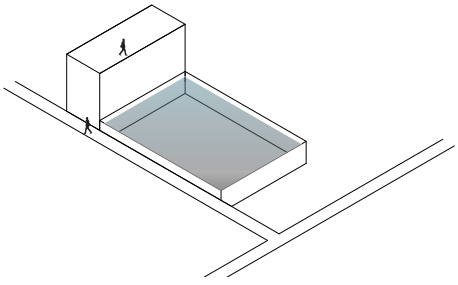
TECHNICAL	EXPERIENCE	WATER AND THE NARRATIVE
-	Visuel and in a closed pipe due pollution Articulated inlet	Wild and as a safety valve - water in cascades
No access for public due to pollution Access for cleaning	Experience how polluted the stormwater is	Calm water flow due the sedimentation process Only visuel and not physical contact
Open air Access for cleaning	Visuel and double programmed A safety valve	Changing during time - Sometimes full of water and near contact some times empty
Different flows	Experience the water floating from bassin to bassin	Differerent narratives to the connections and different sounds and experiences
Open air basin Easy access for vacumm tanker	Articulated link playful Closed feeling or difficult to access due to the heavy pollution	The water is only experienced visuel and as a polluted element not suitable for bodily contact
Open air basin - 1,5m water level Root-plants (willow) bulrushes - Macrophytes	Contact with the water. Inviting to experience through the wet meadow landscape and its fauna.	The water has the opportunity for movement and appears more like a wet meadow than part of a stormwater management plant.
Like a lake - 1,5m water level Algea and seaweed for accumulating nitrogen and phosphor	Bodily contact with the purified water. Focus on the biological treatment process and wildlife.	The cleanest water in the entire process, which is underlined. The focus is on bodily contact and physical activity - the purity is highlighted.
Outdoor	Visuel connection with the processes, nature, water and the buildings. Experience the site and its apperance from different perspectives and as a flow	Water is experienced as a part and the ruling element in the area Movements on the path is a movement through the narrative of water and it is bodily experienced
Railing for protection	Perceived as a part of the facility	The complete experience related to water and the purification process From visual til bodily experience
	Change during day and year according to the amount of water, the sun and temperature	The water is experinced by sound, taste, smell and felt on the skin of the body
Natural ventilation Light 300 lux Br2020 requirements	Tectonic detailing and local anchoring Active experience with the sun and the biological processes	Learning and experiential situation is based on a scientific understanding where the water and the plants is investigated
Natural ventilated Br2020 requirements	Easy useable for the staff Focus on the by-products	The story ends and water is the cleanest in the process The purification process creates an edible by-product
Natural ventilated	Easy useable for the staff Focus on the by-products	The story ends and water is the cleanest in the process The purification process creates an edible by-product
Natural ventilation Light 300 lux Br2020 requirements	Room designed as a box with everything integrated and close connected to the nature	Close contact to the outside nature and the purified water - Outside eating areas
Natural ventilated Br2020 requirements	Privacy An integrated part of the building	Foci on the sunlight as an poetic element
Natural ventilated Br2020 requirements	Privacy	Foci on the sunlight as an poetic element

FUNCTIONS BUILDING

BUILDING 1 - THE BUILDING ON THE WEST SIDE

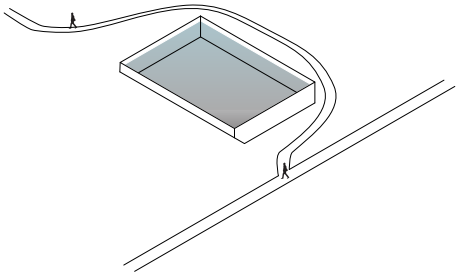


BUILDING 2 - THE BUILDING ON THE EAST SIDE



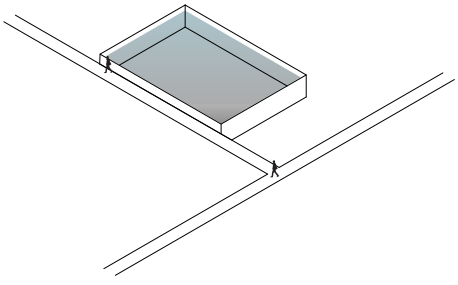
Above the water

Ill. 77



Around the water

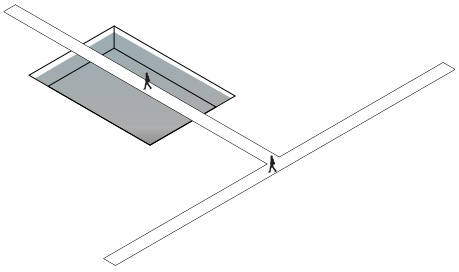
Ill. 78



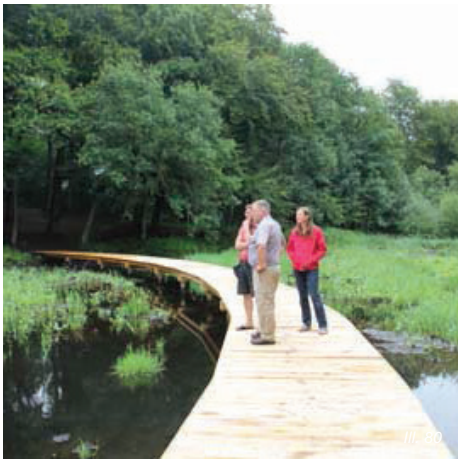
Along the water

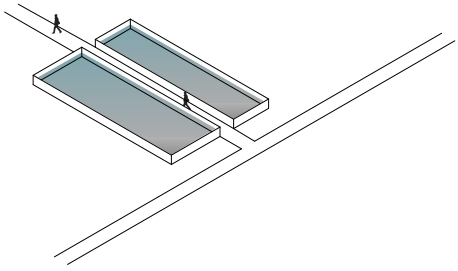
Ill. 79

NARRATIVE CONCEPT

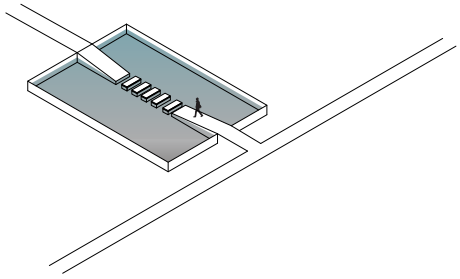


On the water





Through the water

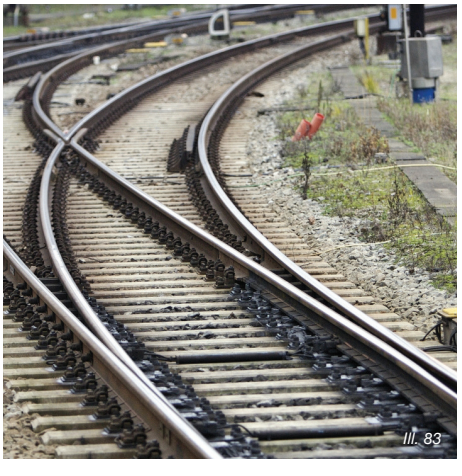


In the water

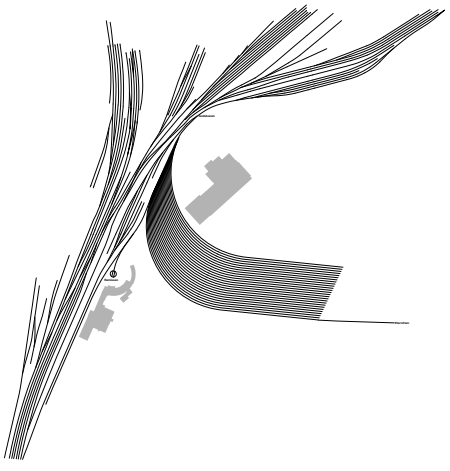
Towards an increased bodily interaction

A narrative concept is applied in the facilitation of the experience of stormwater management a to unfold the voyage along the mediation: As the walk is followed diverse experiences of the water is unfolded and the distance between the visitor of the treatment plant and the processes of production is gradually dissolved. An increased bodily interaction with the water is created as the contact with the water is constantly changing through the steps of the purification process: The first steps of the purification is connected to the steps of the walk with most intrinsic distance – and the final step of the outlet of the purified stormwater to Østerå is connected to the steps of the walk where all distance is dissolved and the visitor has moved into the increasingly purified water in a full sensory experience of participation.

ARCHITECTURAL CONCEPT



Ill. 83



Towards an increased bodily interaction

To unfold the narrative concept in coherent progression the architectural concept aims to establish both extern and intern correlation: The creation of coherence and connection is addressed by departing from the existing lines of the rail network west of the site. As the rails encounter the center of Aalborg's Godsbaneareal the curved linearity of the rails is expanded into a tension field of fragmentation and correlation: As some rails continue further north, some turn east towards Godsbanen and some ends the lines unfold fans of lines. The lines of the rails are extended into the site of the treatment plant with the single track running on the southern border of the site towards Eternitten in a clear curved movement creating both direction and demarcation for the site.

This curve is reiterated in the creation of a new fan of lines running through the site creating direction and coherence for the establishment of the basin borders of the treatment plant. Before the lines obtain linearity towards east they follow the curvature of the same circle; as the lines are staggered they meet in a gathering point of where the original track turns away from the rail network and towards Eternitten. The grid is finally dissolved in accordance to the demands of the treatment plant moving the overall layout towards a dynamic partly dissolved system of curves seeking internal coherence and connection to the context. The lines are cut through by Østerå which thereby claims a central position and leaves the curves further dissolved; reaching in a broken motion for connection across the stream.

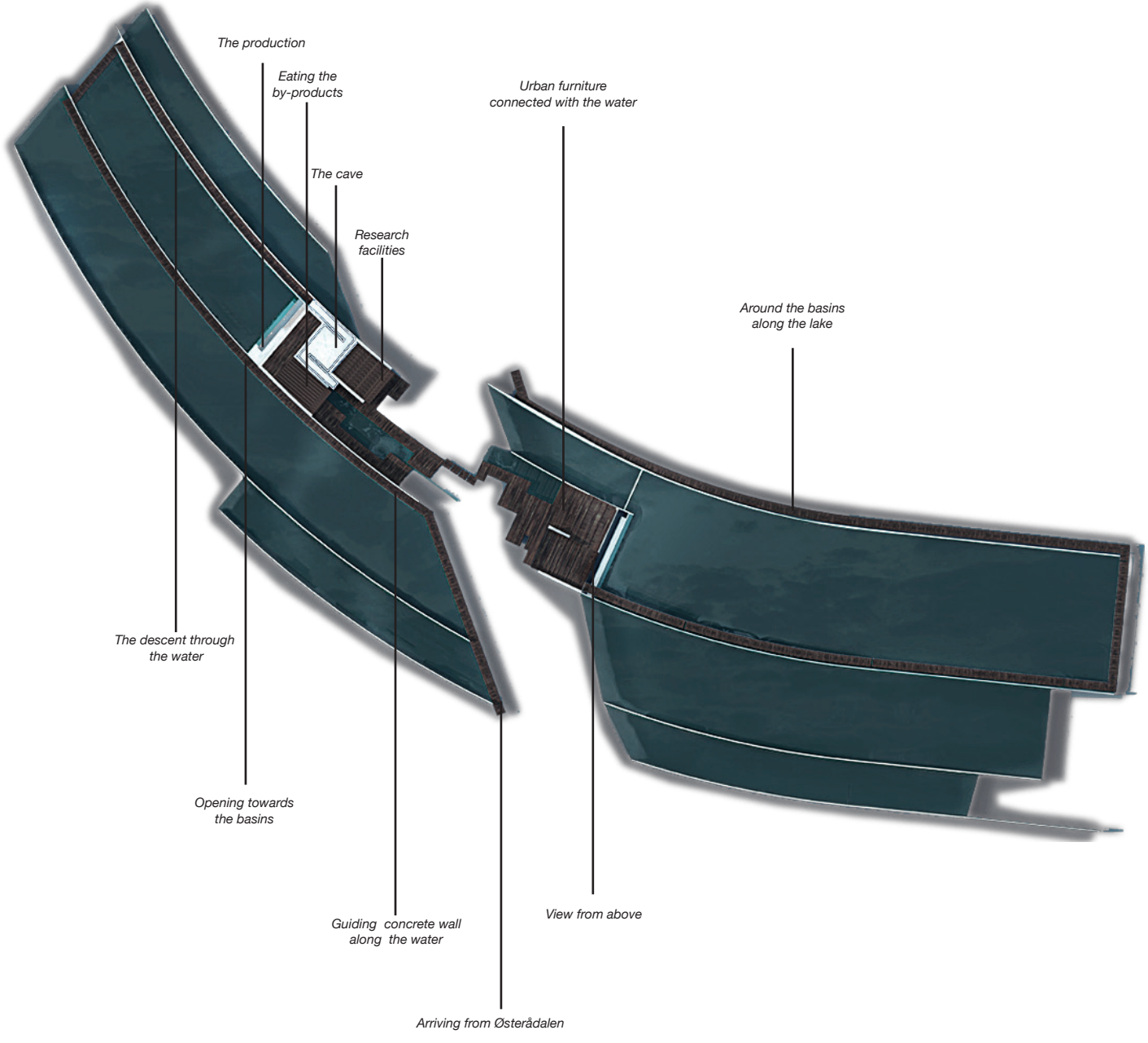
MEDIATED WALK

The walk as the narrative of the report

The narrative element of the thesis is the mediated walk that winds along the wet ponds, through the rooms of the building and tie together the physical elements in the context such as Østerå and Kjærs Mølle Dam.

As the mediated walk is the main narrative medium the purification process, water flow and context is narrated and experienced through the architectural treatment of the mediated walk.
The walk is a twist on the existing path system in the area and it is thus a natural meeting in the area - no matter which direction you arrive at the site the ability to enter the mediated walk is present.
The walk attaches as an extension of the historic railway tracks and its sleepers - and the path is perceived as an extension of the sleepers seeking to create contact with the building.

The treatment plant's design is presented as a tour through the facilitis as experienced when the mediation walk is followed. A trip that in this exposition starts by arriving along Østerå - from Østerådalen walking towards Gabriel.
In the presentation of the design the different parameters that have informed the design are shown concurrently in an unfolding of the architectural treatment and articulation of water and purification processes.


The production
Eating the by-products
The cave
Research facilities
Urban furniture connected with the water
Around the basins along the lake
The descent through the water
Opening towards the basins
Guiding concrete wall along the water
View from above
Arriving from Østerådalen

MASTERPLAN

Masterplan 1:10000

Strategical planning

The site's current situation as a rear area focused on transit and Sunday strolls is to be changed in the fashion of a more integrated flow of dynamic range. The site is located between Aalborg's two largest development areas - Godsbanen which is being transformed into a city campus and residential area, as well as Eternitten transformed primarily as a residential area. The big existing residential area Kærby and the green recreational area Østerådalen is found south of the site.
This site is therefore located close to recreational areas and major development areas that eventually create a lot of new housing in the near context. Placing the project in this development is done with the aim to to create a link between areas as well as a kind of venue.

With the location at the end of one of the great green wedges the desing of the treatment plant seeks to continue this wedge and thus lead the green closer to the inner city. The site is seen as a connector between the nature, the countryside and the city to make nature a part of the city's everyday life. To create a biological corridor leading nature closer to the city and make it easier to get from the inner city to the natural area Østerådalen is an important part of the design.

The strategy for the future linkage between the areas is a use of the existing industrial elements from the past – the railway rails and sleepers. Thereby the industrial and cultural history at the site are maintained and reinforced as part of the narrative. The old connections between Eternitten's excavations and Gosbanens freight trains again becomes a main arterial road.
The close contact to the old Kjærs Møllesø, the Remisse and the old railway tracks is used in the architectural site-specific narrative and it is assumed that the old building next to the site – Remissen - will be transformed, re-enter the city and become part of the narrative and a site visit opportunity.

The project is part of the extension of Østerå and the visions to develop the site as a water-cultural area. An area that is part of Aalborg and its history related to water, and a place where amongst other classes can experience and learn about water and the processes in the nature.
The conversion to a water culture zone with focus on the stormwater management, the history of Østerå and the lake's narrative create an extension of the green wedge the treatment plant is a part of.
Strategically the area is a connector between the nature, the countryside and the city to make nature a part of the city's everyday life. To create a biological corridor leading nature closer to the city and make it easier to get from the inner city to the natural area Østerådalen.

SITEPLAN

Siteplan 1:500


N

THE SITE

Participant flow

Visitors to the site can arrive from different paths in the infrastructural system and then enter the mediated walk either by the start in the north near the lake or at the south near by the railway bridge.
If visitors come by bus or car it is possible to approach the site from Hjulmagervej and park at the west side of the site. From here either the rail track path can be used or the path that goes along the research ponds directly to the research room can be followed.

Work flow

The workflow through the building is primarily isolated from the path, however it crosses at the side of Kærby where the harvested and processed by-product is moved from the production part.
The worker can use the parking and from there directly go into the building through the research room.
The flow between the two buildings is located between Østerå and the basins and designed to always be in the same elevation to minimize the workload when driving with a pallet truck.

Flow through site

The flow through the site for the primary transit is changed to follow the old railroad tracks that connected the rail network with Eternitten. This path will act as a paved bike path and the fast connection between Godsbanen and Eternitten.
The existing recreational trail stretching from Gabriel against Østerådalen along Østerå is changed to go around the treatment plant. This leads one into the path through the basins, however, it also is possible to leave the path again and continue around the plant.

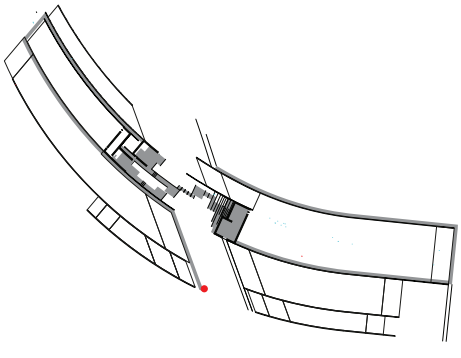
Access and fire access roads

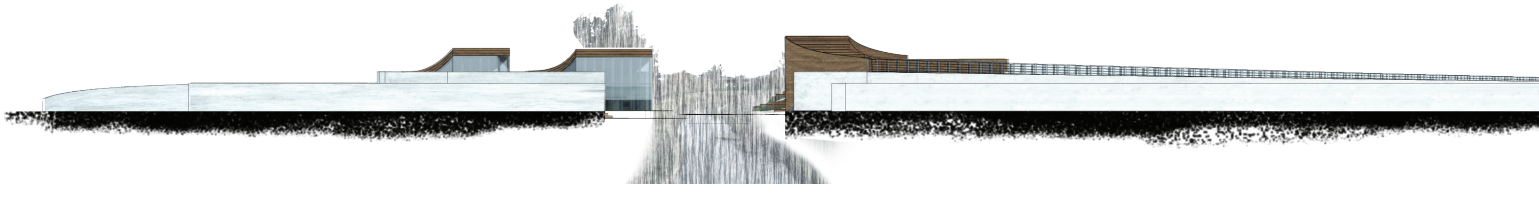
From Håndværkerkvarteret is an access road which follows the path of the old railway tracks. The access road is designed for collection of the by-products produced in the basins with space to turn a delivery truck .
This access road can simultaneously be used as a fire access road to the building placed on the side of Håndværkerkvarteret, and the part of the path along the old railway tracks located on the side of Kærby is functioning as fire access road for this part of the building. This part cannot be used as an access road for vehicles normally but only during fire.

Parking

Car parking is located in the westen part of the site with access from Hjulmagervej.
The car parking is located in the area reserved for delay basins.
Thereby is the parking lots flooded during heavy rains, however this is assumed not to be a problem as it rarely happens. From the parking there is a direct path to the building.

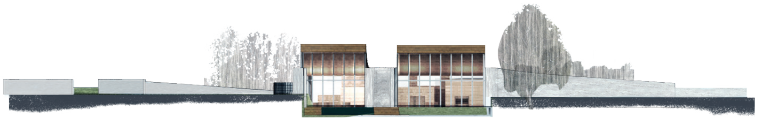
THE ARRIVAL



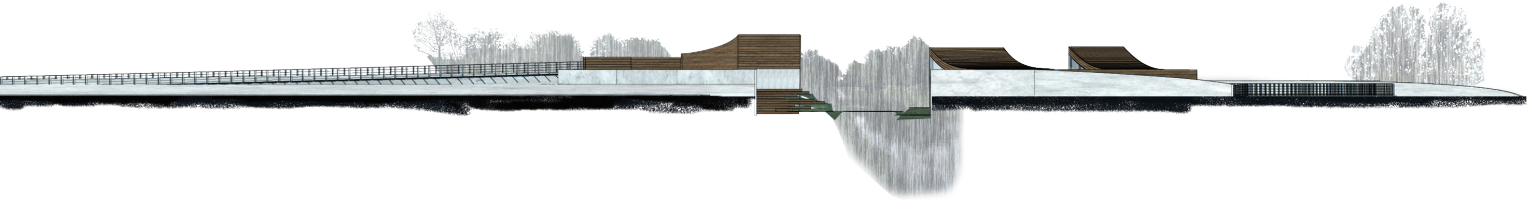


Elevation South
1:1000

Elevation East
1:1000



Elevation West
1:1000

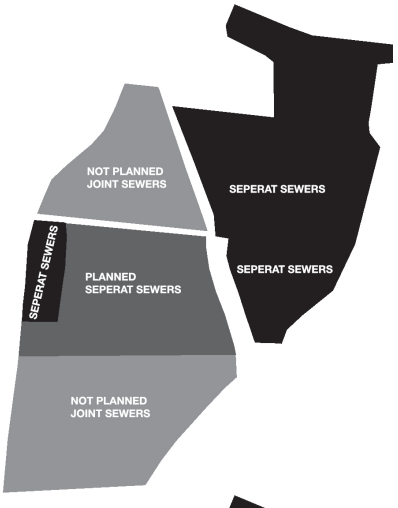


Elevation North
1:1000

THE PURIFICATION BASINS

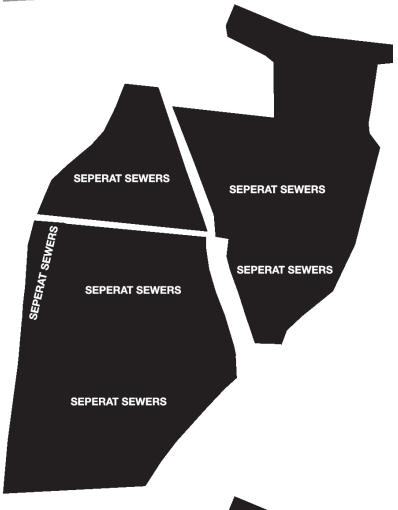
Contemporary state of sewers

At present, only Håndværkerkvarteret and a small part of Kærby have a separate sewerage system which means that in the Kærby area stormwater and wastewater run together which causing great problems during heavy rains.



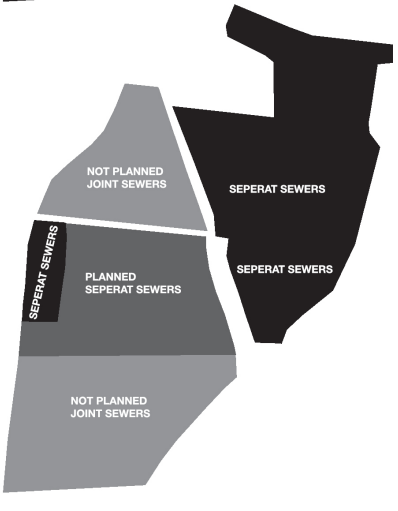
Future plans

The problems related to the heavy rains and overflow will be reduced by a separated sewer system with separate waste- and stormwater management. At present the plan is in the future to deduce the stormwater in Kærby to Vestre Landgrøft or Østerå and in the already separated system in the Håndværkerkvarteret the stormwater is deduced to Østre Landgrøft or Østerå. The establishment of a stormwater treatment plant in connection to Kærby presuppose the separation of sewer system so wastewater is never let to the decentral stormwater treatment plant, but instead to the central wastewater treatment plants of Aalborg. The establishment of separate sewer system in Kærby is therefore a condition for the treatment plant – which is also within the plans of Aalborg Supply's Vision 2100.



New outlets

Stormwater from Kærby is collected and passed through the separated sewer pipes to the upper northern corner from where the water is deduced into the site and from there managed - purified and deduced to the recipient.
Håndværkerkvarteret has at the moment pipes for deducing the stormwater to the recipients. These will be changed and placed by the red arrows to collect and handle the water on the site the easiest way possible.

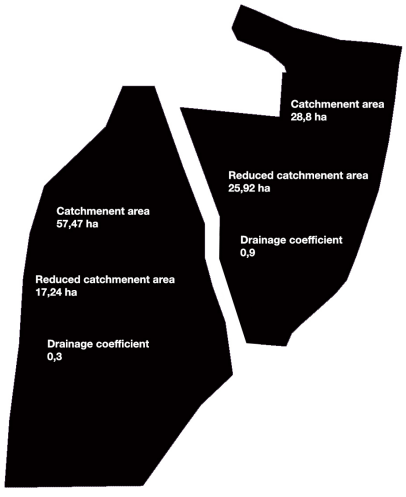


Dimensioning

Because of the focus on both purification and recreational values the method of wet pond is chosen as method for the purification as this type of purification secures a permanent water level and at the same time is efficient purification method for polluted stormwater where especially phosphor and heavy metals are sources of pollution. Wet pond lakes has high levels of purification in connection to this pollution (Winther 2009: 526, 533)

The basins for purification of the rainwater requires specific dimensions to cope with the challenges of the polluted stormwater. There are different requirements and optimal situations that need to be followed and used for the dimensions of wet ponds: The most important requirement related to the treatment of stormwater is to reach the optimal retention period - which in the Danish weather is 72 hours. Based on historical events and a desire for a maximum of 3 days during the year in which the period of 72 hours of stay is not obtained the optimum volume is 240 m3 per hectare of reduced catchment area (Life treasure 2007: 23-25). This volume is based on the desired requirements and examinations describing it as the most optimal volume.
In order to calculate the needed volume of the basins it is therefore necessary to determine the reduced catchment area.

This is term used to describe how large a part of the catchment areas is generating stormwater runoff because of pavement etc.; two factors influence the calculation of the reduced catchment areas:



The first factor is the drainage coefficient which reflects the degree of pavement of an area – which therefore varies from with the building typology:

Single family houses	0,3
Rowhouses	0,4
Blocks	0,5
Dense areas and industry	0,9

(Winther 2006: 221)

As both Kærby and Håndværkerkvarteret are dominated by a single building typology - respectively single family houses and industrial buildings only one value has to be connected to each of the catchment areas: 0,3 for Kærby and 0,9 for Håndværkerkvarteret.

The second factor is the hydrologic reduction of an area: The paved surfaces of the city do not produce a total runoff as the first part of the rains are tied to dirt, part of the rains are gathered in dips from, parts infiltrate through narrow openings of the pavement e.g. crack between footway slabs and parts of the rain evaporate (Winther 2006: 106).
The hydrological reduction is set to 0,8 as this value the maximal for the years average (Winther 2006: 118)

With these values the reduced catchment area can be calculated and afterwards the value of 240 m3 per hectare of reduced catchment area is utilised to calculate the volume of the purification basins.

Kærby	Area	Drainage coefficient	Hydrological reduction	Reduced catchment area	Volume required	Area required at 1,5m depth
	[ha]	-	-	[ha]	[m^3]	[m^2]
Single family houses	57,47	0,3	0,8	13,79	3310	2207

Håndværker-kvarteret	Area	Drainage coefficient	Hydrological reduction	Reduced catchment area	Volume required	Area required at 1,5m depth
	[ha]	-	-	[ha]	[m^3]	[m^2]
Industry	28,80	0,9	0,8	20,73	4977	3318

In the designed based on the given volume the parameter of depth is important as it is volume and not the surface area which effects the best purification performance – and especially in a wet pond the depth is important since a permanent water level is required for optimal purification (Vollertsen, Jacobsen, Nielsen & Gabriel 2012: 58). If the wet pond is to low it will eventually be over-grow with marsh plants. This will give an advantage from the extra-created area, but it will also increase the risk of waves stirring the bottom segment and it will simultaneously require more frequent maintenance. At the same time, it is important not to make the wet pond too deep as it will complicate oxygenation of the bottom and thus create oxygen depletion. There are many elements that come into play in relation to the depths but it must not be less than approx. 1m and preferably not exceed 3m (Vollertsen, Jacobsen, Nielsen & Gabriel 2012: 58).
The ideal depth is 1,5 meter and this level will be therefore be applied in the design of the basins (Vollertsen, Hvidtved-Jacobsen & Nielsen 2012: 5).

Purification processes

The wet ponds are for the purification process using physical and biological processes in a quiet pace without need of human management (Vollertsen, Jacobsen, Nielsen & Gabriel 2012: 5).
The processes of a wet pond are comparable to a small lake with sedimentation, plant absorption and biodegradation of bio-convertible substances (Vollertsen, Jacobsen, Nielsen & Gabriel 2012: 6). The design of a wet pond thus seeks to ensure a residence time of water in the pond that ensures a natural cleaning process. The cleaning process in wet ponds has several stages: The first is the sedimentation and accumulation of the particles that stormwater collects; here sedimentation of the particles heavier than water occurs. It is important that the basin is designed so the water flows through with a comfortable residence, while the inlet is not creating stir in the basin and thus a mixing of the contaminated ground segment (Vollertsen, Jacobsen, Nielsen & Gabriel 2012: 7-8).
After the sedimentation has precipitated the large particles primarily dissolved substance remains. These substances can be captures and decomposed by biological processes and rooted plants and algae is therefore introduced in the in the purification process. The biological process is based on plant accumulation of the substance as part of their nutrition. At the same time the plants increase the area of surface in the pond and thus creating greater opportunities for adsorption (Vollertsen, Jacobsen, Nielsen & Gabriel 2012: 8-10).
Before the stormwater is directed into the wet pond it is led through a grit chamber which collects all the larger particles such as sand, gravel, branches and similar items to minimise the ground segment of the sedimentation. The water also passes through an oil filter that filters the water for different oils collected along roads. The separation of the processes of coarse sedimentation and removal of dissolved substance limits the sedimentation the in the rest of the wet pond and results in concentration of the need cleaning of sedimentation in one place – access to this section the becomes further important for removal of sedimentation (Vollertsen, Hvidtved-Jacobsen & Nielsen 2012: 4). Removal of sedimentation is needed every 15-25 years (Winther 2009: 526). By introducing a separation a more frequent need for removal of sedimentation is created in a minor area of the wet pond - this approach is however still beneficial as the section is drastically reduced is size. Even though this means that the interval of removal moves towards 15 years this is regarded as an advantage because of the long stretch of the interval. A further division of the wet pond into section contributes to increase in the efficiency of the purification process (Vollertsen, Hvidtved-Jacobsen & Nielsen 2012: 4). The remaining part of the basin is therefore separated into two sections. To facilitate the harvest of the plants each of the two sections contains only one type of plant. The wet pond therefore consists of three sections: the 1st basin for sedimentation, the 2nd for willow absorbing the dissolved substance and the 3rd for algae removing nitrogen and phosphor from the stormwater.

Kærby	west section1:5	middle section	east section 1:5	total surface area	total volume
	[m^2]	[m^2]	[m^2]	[m^2]	[m^3]
1st basin	56,1	144	95,1	295,2	329,4
2nd basin	100,4	1194,4	117,5	1472,3	2000
3rd basin	-	666,7	-	666,7	1000

Håndværkerkvarteret	west section 1:5	middle section	east section 1:5	total surface area	total volume
	[m^2]	[m^2]	[m^2]	[m^2]	[m^3]
1st basin	71,8	268	58,5	398,3	499,7
2nd basin	157,8	861,9	118,5	1138,2	1500
3rd basin	-	1910,5	178,5	2089	3000

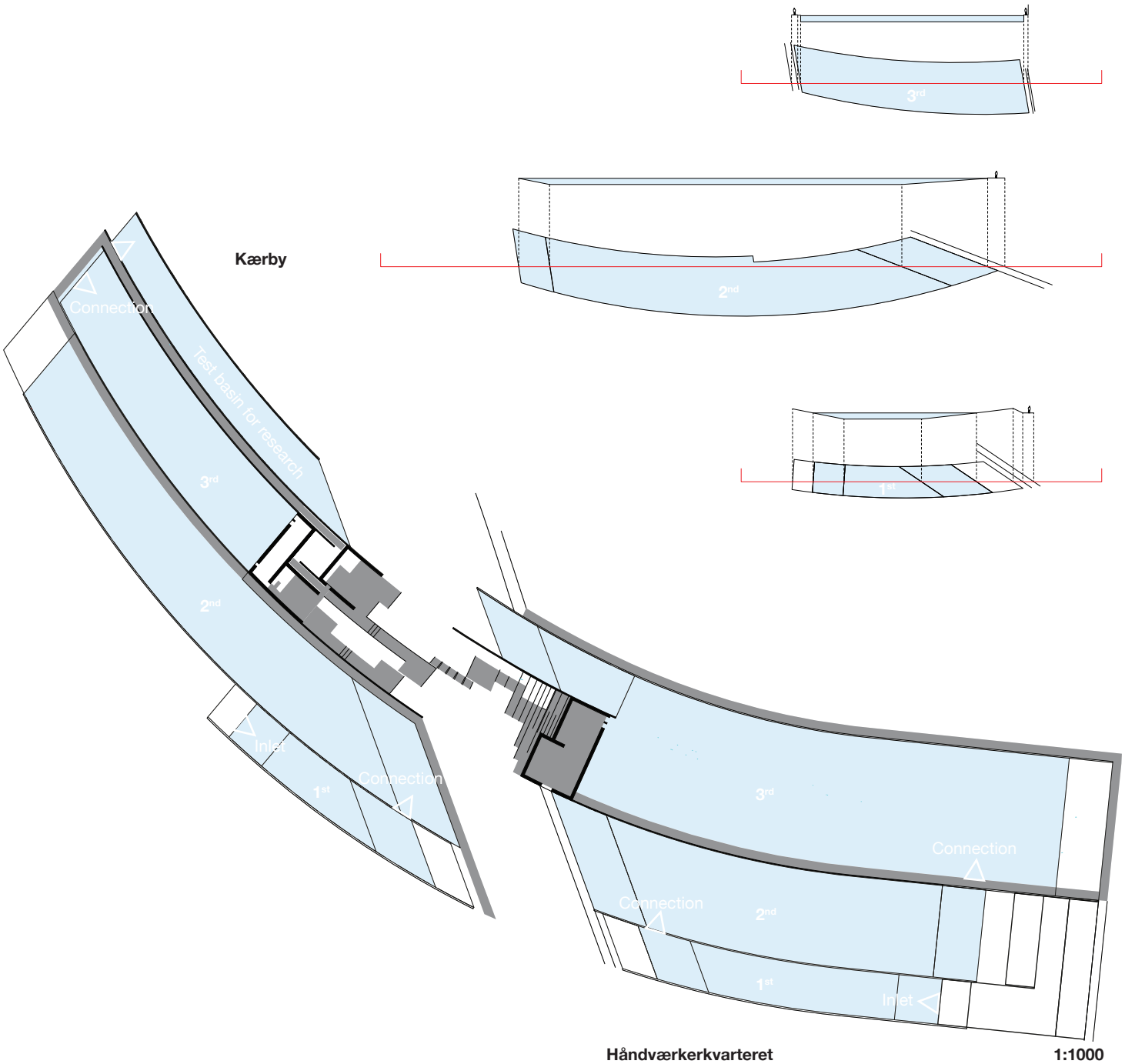
Demands for design

In addition the division into basin sections and the water level of 1,5m the wet pond needs to meet a number of requirements to secure an efficient purification process:

- The geometry of the basins have to secure that dead zones and flow short cuts are not created (Vollertsen, Hvidtved-Jacobsen & Nielsen 2012: 4). The basins are therefore connected in a zigzag pattern securing that the inlet to a section is placed in one end at outlet in the other and not facing each other.
To secure movement in the basins a width/ length-relation of minimum 1-2 is needed (Winther 2009: 529). The basins are therefore designed as elongated shapes.

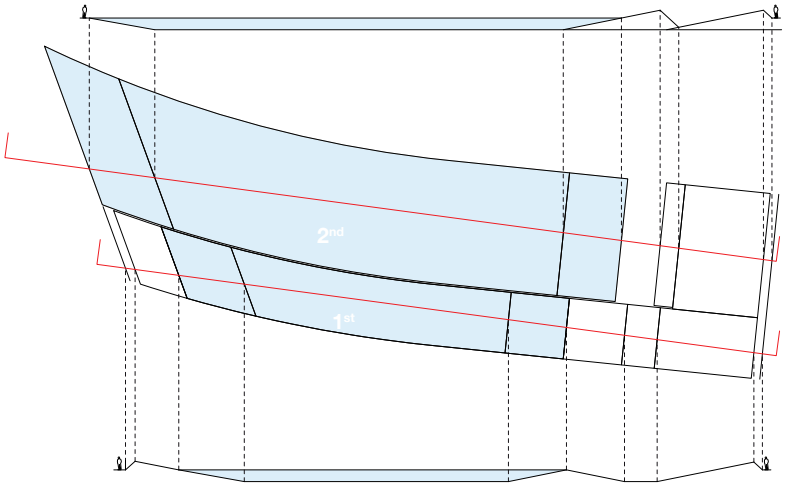
- The bottom of the basins need to be tight to secure that the stormwater do not percolate – however as percolation is not possible on the site this parameter is decisive for the design. Tightness is traditionally secured with a clay or plastic membrane (Vollertsen, Hvidtved-Jacobsen & Nielsen 2012: 4).

- If the basin sides have a slope of more than 1:5 railing is needed for security considerations. To underline the dynamics of the architectural concept of curved lines the basins are designed with concrete sides in west-east direction and no slope in these sides of the basins – which means that the railings is attached to the concrete walls when needed. The end of the basins facing west and east are designed with slopes of 1:5 with no need for railing and no border of concrete.

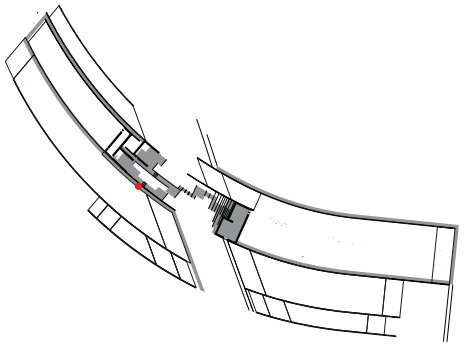


Test basin for research

The purification basins are on the Kærby side supplemented with a test basin for research purposes – where different algae and other biological purification means can be tested and measured for the ability for purification. The basin has a joined inlet with the 3rd basin from the 2nd basin on the Kærby side.
The outlet from the test basin are in a similar manner as the 3rd basin let along the mediation path before discharge into Østerå.
The test basin is not part of the primary purification process running at all time in the plant, but it is rather seen as a facility for the further development of the purification possibilities within stormwater management.
The design of the test basin is not approached further however the connection to the research facilities of the building is emphasised.



THE CONCRETE WALLS



Ill. 84

Concrete

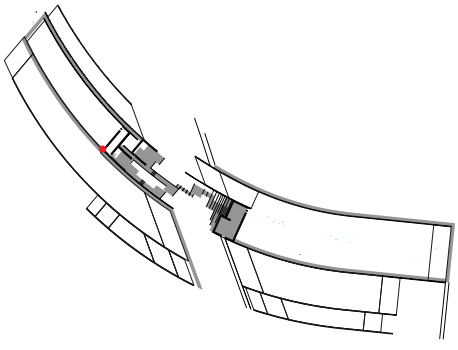
The raw industrial plants located as lines in the landscape cutting through the ground to meet in the middle of the stream signal a rustic and dynamic element there is anchored in the site. The lines cutting through are the structural concrete walls acting as the primary element in relation to the transition between water, stormwater management, site and the building.

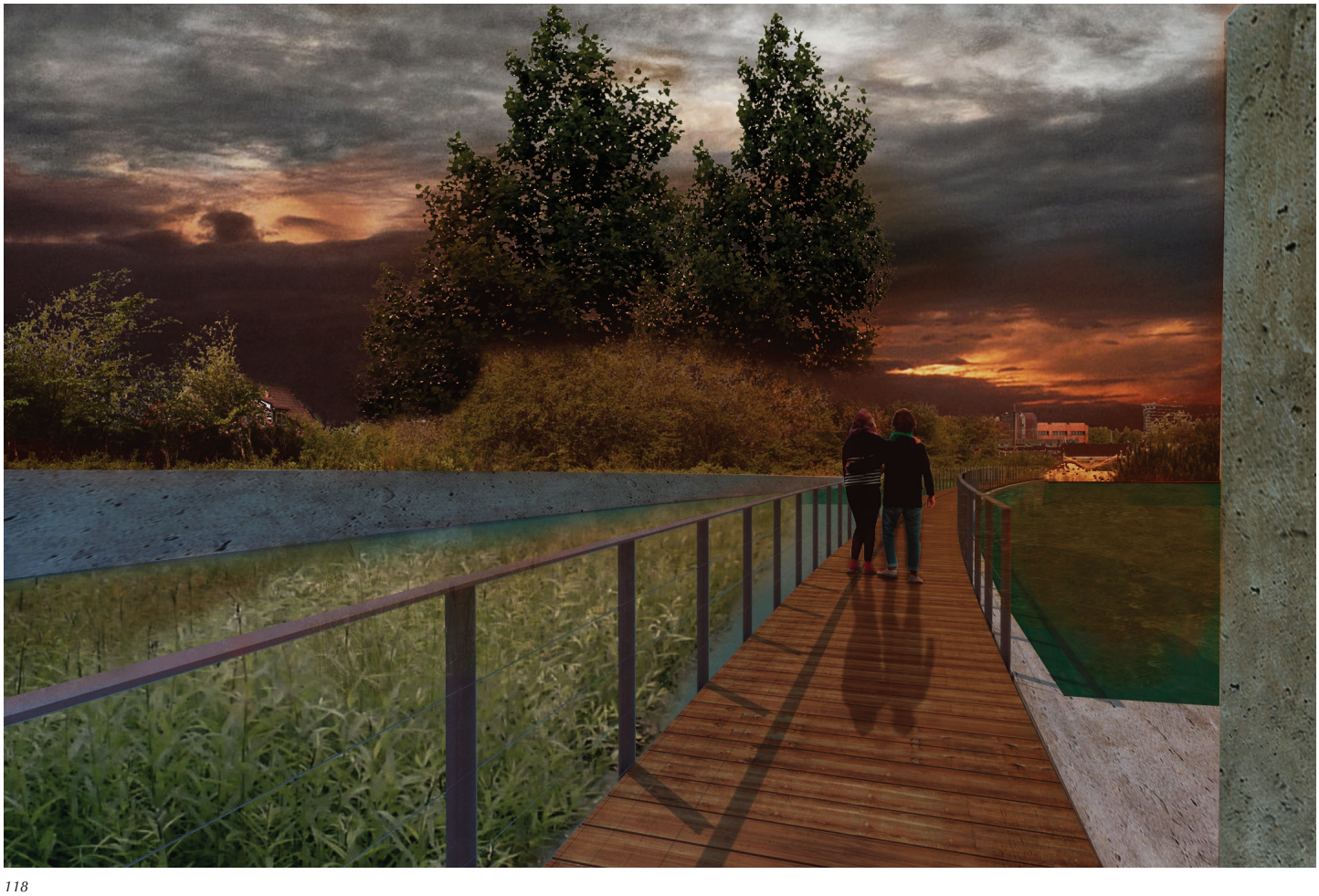
Concrete as a material is as described before chosen for its constructive ability but simultaneously also due to its ability to change in relation to the site and its impact. Concrete is a material that patinate in a way that its industrial look decompose and eventually integrate more and more like an existing item in its given context. This will eventually create a building that over the years will become obtain an expression of an landscape element. Concrete is simultaneously a material that changes colour and appearance depending on how the sun's light travels along the walls, this helps to highlight the colour and strength of the light at the place.

The concrete is a natural and historical element in the given context because throughout history have been used for excavation of lime which has been used to produce concrete. Close to the site is still a the concrete factory Unicon - the large tower of the factory can be seen from the site.

The concrete walls are cast in situ to create a homogeneous and smooth surface in order to emphasise the linear movement through the site.
The lines area designed as a part of the same circle, the radius of this could then be used to massproduce forms which will facilitate the process.

THE OPENING



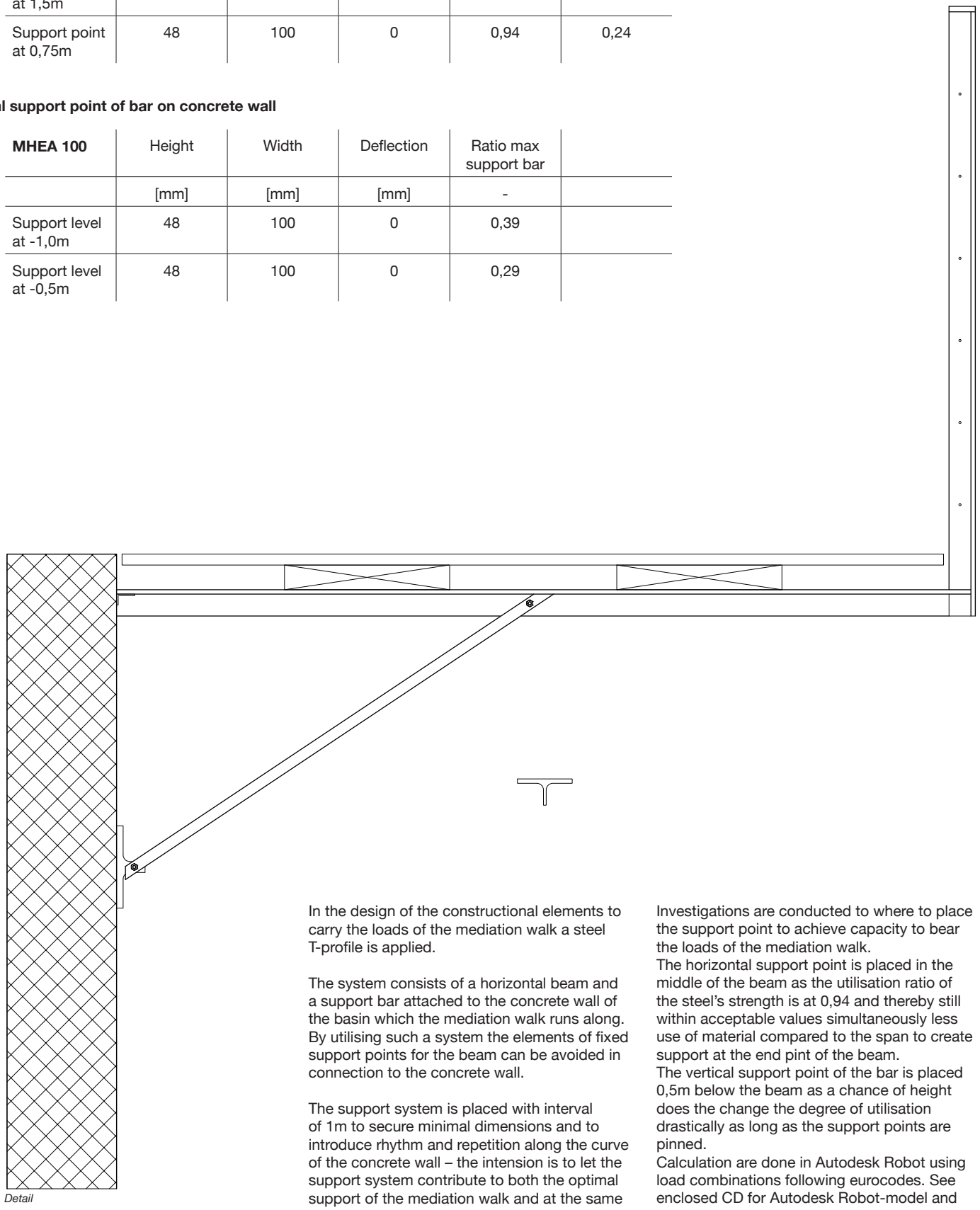


Horisontal support point of bar on beam

MHEA 100	Height	Width	Deflection	Ratio max beam	Ratio max support bar
	[mm]	[mm]	[mm]	-	-
Support point at 1,5m	48	100	0	0,73	0,39
Support point at 0,75m	48	100	0	0,94	0,24

Vertial support point of bar on concrete wall

MHEA 100	Height	Width	Deflection	Ratio max support bar	
	[mm]	[mm]	[mm]	-	
Support level at -1,0m	48	100	0	0,39	
Support level at -0,5m	48	100	0	0,29	



Detail
1:5

In the design of the constructional elements to carry the loads of the mediation walk a steel T-profile is applied.

The system consists of a horizontal beam and a support bar attached to the concrete wall of the basin which the mediation walk runs along. By utilising such a system the elements of fixed support points for the beam can be avoided in connection to the concrete wall.

The support system is placed with interval of 1m to secure minimal dimensions and to introduce rhythm and repetition along the curve of the concrete wall – the intension is to let the support system contribute to both the optimal support of the mediation walk and at the same time to the expression of the walk.

Investigations are conducted to where to place the support point to achieve capacity to bear the loads of the mediation walk.
The horizontal support point is placed in the middle of the beam as the utilisation ratio of the steel's strength is at 0,94 and thereby still within acceptable values simultaneously less use of material compared to the span to create support at the end pint of the beam.
The vertical support point of the bar is placed 0,5m below the beam as a chance of height does the change the degree of utilisation drastically as long as the support points are pinned.
Calculation are done in Autodesk Robot using load combinations following eurocodes. See enclosed CD for Autodesk Robot-model and data sheeds.

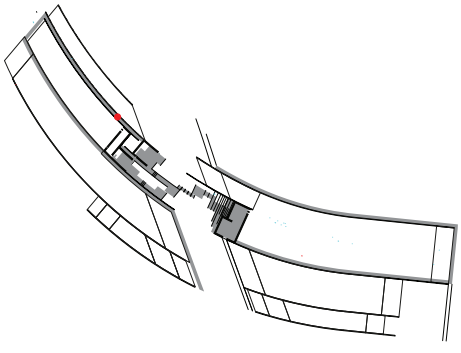
Concrete walls

The design of the concrete walls for the separation of the basins are guided by two elements: The need for structural capacity to detain the water, but as the top edge of the wall ruins along the paths of the treatment plant the wall is also to serve as an guiding element.

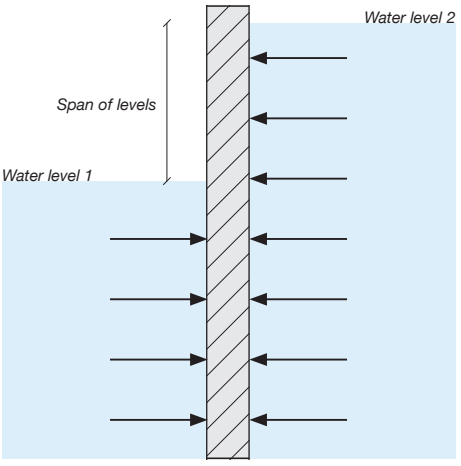
The volumes of waters on the side of the wall provide a pressure to the wall which is equal when the water levels are at the same height. However as the treatment plant utilises decreasing height of the water levels in the basins to create natural flow the concrete wall becomes exposed to bending moment as the higher water level provide pressure on the top part of the concrete wall.

As the maximum depth of the basins is 1,5m this distance equals the scenario where there is only water on one side of the wall.
This is regarded as the worst case and will therefore be the point of departure for the dimensioning.

Reinforced concrete is chosen as material as the width of the concrete can be constant, but the strength of the wall can be changed to meet the requirements of the different span between water levels in the basins.
A minimal width of the concrete wall is however needed – through iterations in the calculation the width is set to 200mm as this width in combination with different numbers of reinforcement bars meets the varying requirements and at the same time create the a robust edge running along the paths of the mediation walk serving as guiding line.



THE DESCENT



Material capacities

Acceleration gravity, g	9,82	m/s^2
Density concrete, ρ_c	2300	kg/m^3
Density water, ρ_w	1000	kg/m^3
Characteristic strength concrete, f_{ck}	40	MPa
Characteristic strength steel, f_{yk}	400	MPa
Partial coefficient concrete, γ_c	1,45	
Partial coefficient steel, γ_s	1,2	
Elasticity module steel, E	210000	MPa
Height concrete wall, $h_{\text{cross section}}$	1500	mm
Width concrete wall, $w_{\text{cross section}}$	200	mm
Number of reinforcement bars	8	
Diameter of reinforcement bars, ø	5	mm^2
Total steel area, A_s	157	mm
Thickness of cover layer	40	mm

Because of the close and constant contact to water the concrete is placed in environmental class E (extra aggressive) (Danskbeton 2014). The concrete for the treatment plant there needs to be of C40/50 strength with reference to DS/EN 206-1 and DS2426. This means a characteristic strength of concrete of 40 MPa which i.a. is produced by Unicon situated next to Kjærs Møllesø (Unicon 2014).

The partial coefficient of the concrete is set to 1,45 as the concrete is cast in situ. Standard values are used elsewhere.

Calculations

The design strengths of the concrete and steel is calculated using the respective values for the characteristic strengths and the partial coefficients:

Design strength concrete, f_{cd} : $f_{cd} = \frac{f_{ck}}{\gamma_c}$ = 27,6 MPa

Design strengh steel, f_{yd}: $f_{yd} = \frac{f_{yk}}{\gamma_s}$ = 333 MPa

The tensile force of the reinforcement, the level of pressure and the distance from bar to center of pressure is is calculated in order to determine the design moment capacity:

Reinforcement bar tensile force, F_s : $F_s = \frac{A_s}{f_{yd}}$ = 52 kN

Level of pressure, x : $x = \frac{F_s}{0{,}8 w_{cross\ section} f_{cd}}$ = 1,58 mm

Distance from bar to point of pressure, z : $z = h_{cross\ section} - \frac{0{,}8x}{2} - \text{t}$ =159,4mm

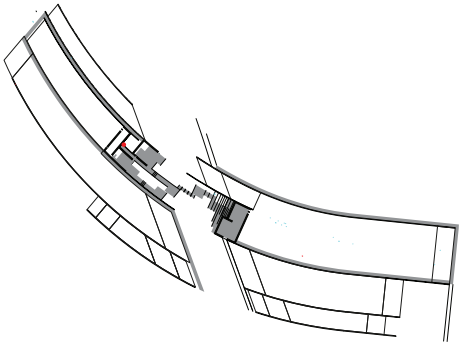
With these values the design moment capacity can be calculated; this values has to exceed the moment from the water pressure:

Design moment capacity, M_{Rd} $M_{Rd} = 0{,}8x w_{cross\ section} f_{cd} z$ = 8,34 kNm

Moment water pressure, M_{Ed} $M_{Ed} = \frac{g\rho_w h_{water,\,right}}{2} h_{water,\,right} \frac{1}{3} - \frac{g\rho_w h_{water,\,left}}{2} h_{water,\,left} \frac{1}{3}$ = 7,37 kNm

As $M_{Rd} > M_{Ed}$ the concrete wall can with a width of 200mm and with 8 bars of 5mm^2 withstand the pressure from the water in the largest span of water surfaces of 1,5m - which is water pressure from only one side.
The strength can be reduced by decreasing the number of reinforcement bars where necessary; e.g. 4 bars are needed at a span of water surfaces of 0,5m.

THE CAVE

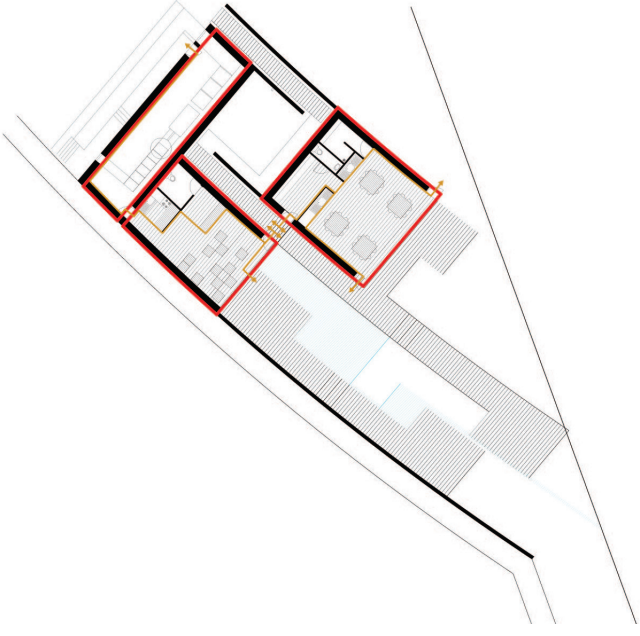


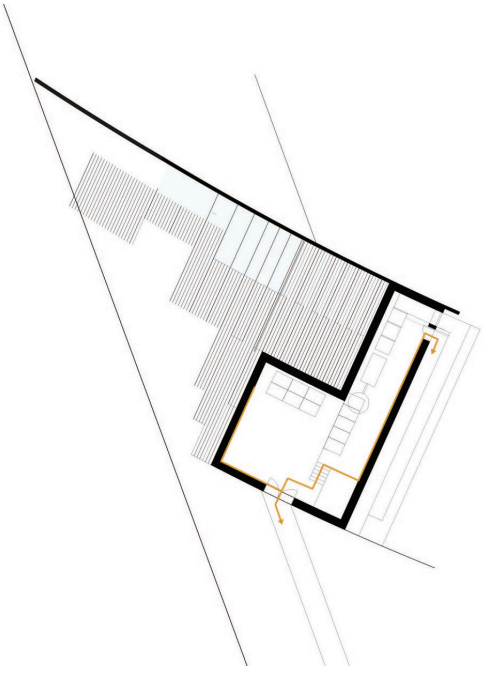
The cave

The cave is the first meeting with the building itself and the first encounter with the purified stormwater; a meeting created in a cave-like space with concrete on all surfaces. The concrete provides a feeling of enclosure and creates a hard acoustic receiving the gushing water to reverberate. The gushing water is purified water entering the building and running out into the room so the room consists of both an aural experience and a concrete floor where the water is collected and then render on. The water is controlled by small holes and bumps in the concrete floor.

The concrete walls has an indoor climatic effect related to the material's ability to accumulate heat and by using the concrete walls it creates an opportunity as an passive elements in an improved indoor climate. The walls have a high thermal output and works by absorbing heat during the day and thus reduce the temperature - This heat is released at night and thus creates a more balanced distribution of temperature through the day.

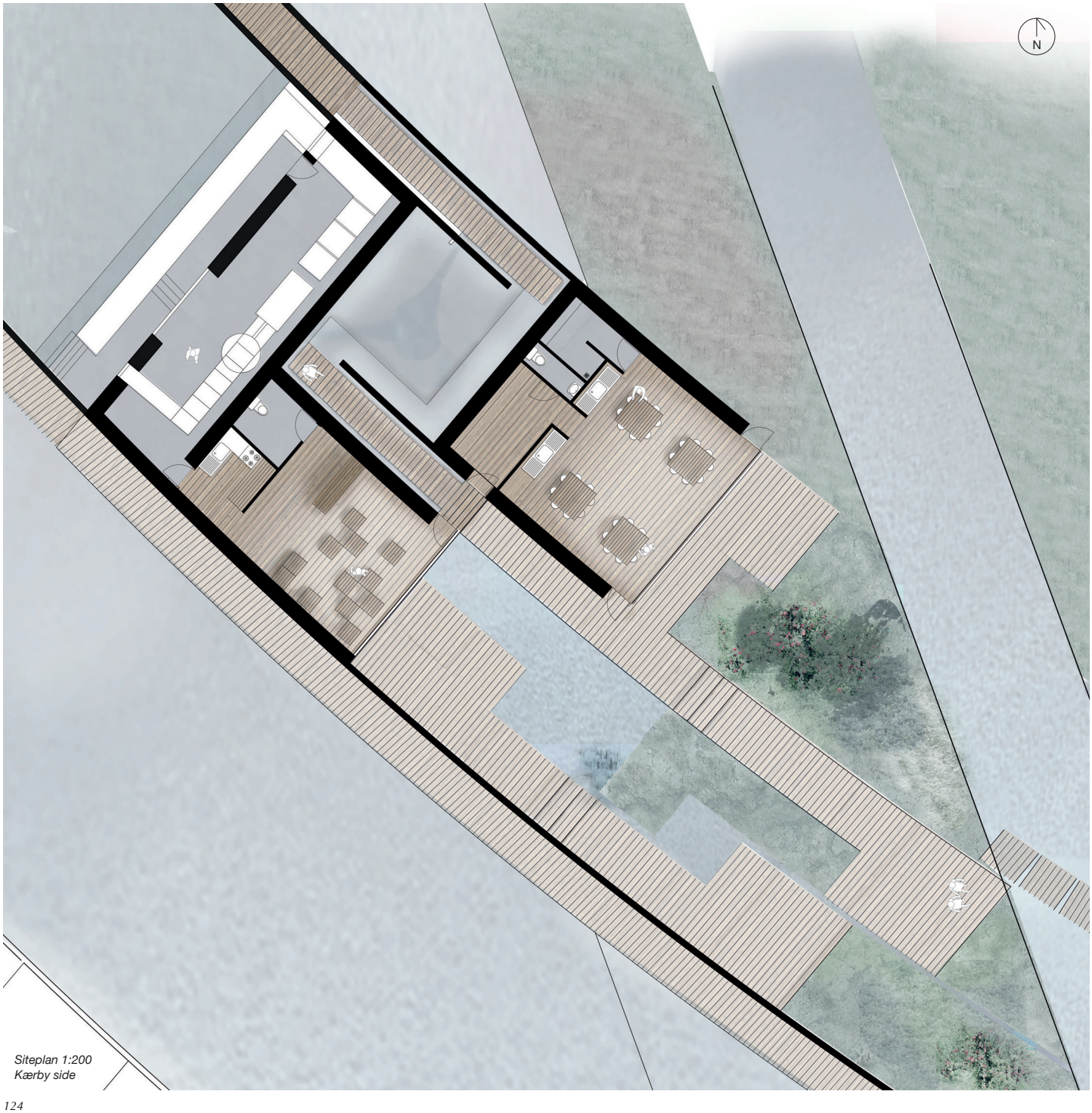
Concrete material's ability to accumulate heat creates a sensual effect in the experience of the path. When walking on the descent the near concrete wall faces south and is under constant sun exposure. This creates an area around the descent that is heated by the concrete. This creates a contrasting experience when walking into the cave because of the change in temperature, while getting from the hot dry area around the concrete into the cool cave.



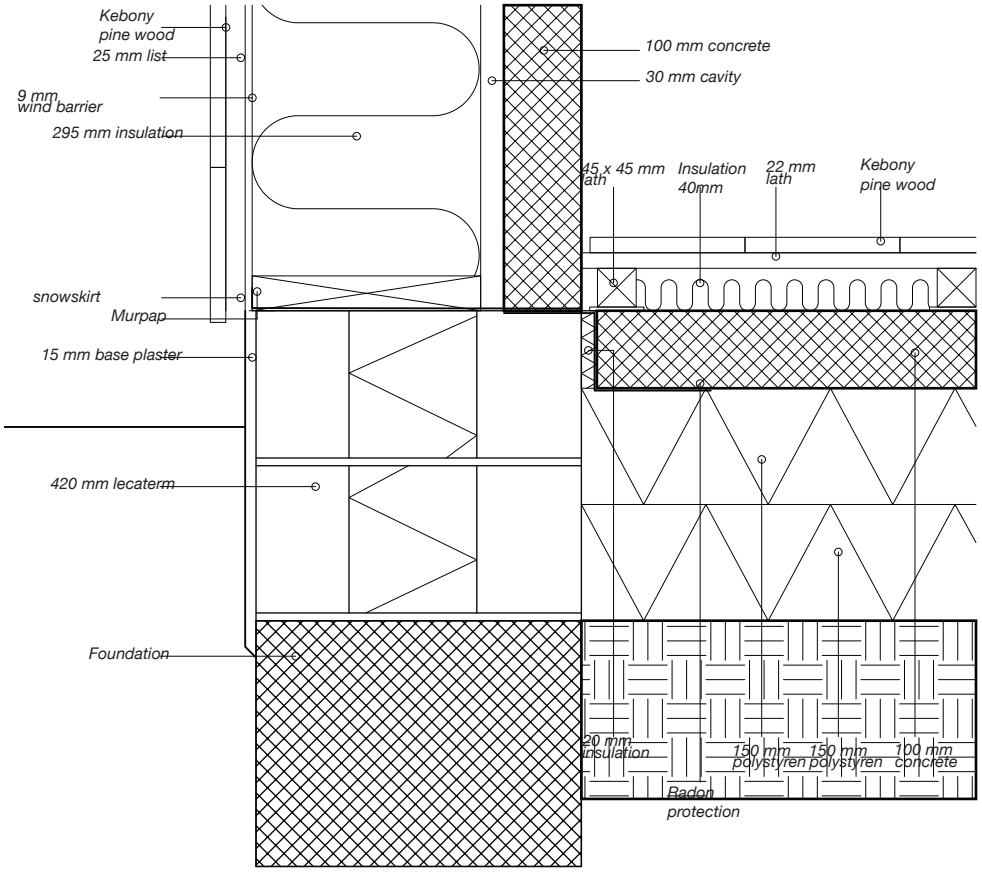


Fire and escape routes

The concrete walls serve simultaneously as part of the building's fire safety. The path cuts through the building and divides it into two parts and therefore also into two fire sections as all the walls contains of concrete which helps to ensure the rooms as fire cores. The dining area and the production is also divided into two fire sections since the walls here consist of concrete. The building on the Kærby side is thereby divided into a total of three fire sections.
The storage building on the east side of Østerå consist of a single fire section.
Each of these fire sections have at least two escape routes to the open space or one of the other fire sections and they are placed far below the requirements of no more than 25m to the nearest escape route (building codes 2014).



Siteplan 1:200
Kærby side



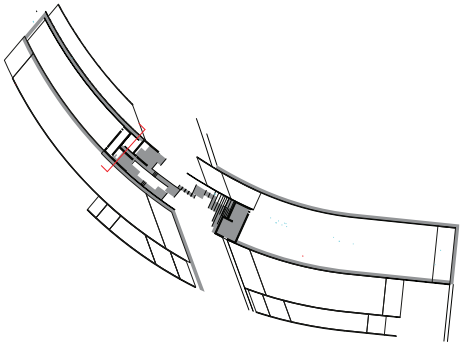
Detail 1:10

Energy performance

The building is designed with a focus on achieving the requirements for BR2020 with an energy frame of 20 kWh/m^2 and a maximum transmission loss of 3,7 w/m^2, the requirements is archived without mechanical equipment.

The cave room is used as an unheated room between the buildings spaces as it is warmer than the air temperature due to the water temperature, and it collects the heat from the building which reduces the possibility for the water to freeze and therefore it is assumed that the cave is warmer than outdoors. Along with the thick insulation in both walls, foundation and roof helps the unheated space to reduce heat loss from the building and to create an energy efficient building.

Energy frame buildings 2020	kWh/m^2/year
Total energy frame	20,0
Total energy requirement	17,7
Contribution to energy	
Heat	28,8
El. for operation of building	0,2
Excessive in rooms	0,0
Net requirements	
Room heating	21,2
Domestic hot water	7,6
Cooling	0,0
Transmission loss	3,1



Section
1:100

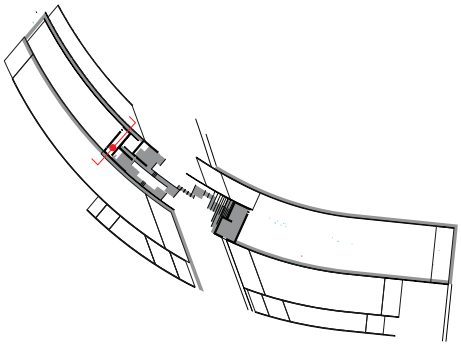
Ill. 85

Wood

As a contrasting response to the grey rough concrete material that cuts through the ground without resistance a soft and warm wood material is chosen.
The wood material is introduced as the locations where the participating user is in direct contact with the treatment plant. It is introduced for the first time as the material on the mediation walk and from there it moves along the basins until it meets the building from where it begins to transform and create different situations - as a floor for movement, ceiling and roof to shelter. Simultaneously the wood material sometimes is lifted and creates elements from furniture to toilet units, sightseeing spot or as an urban furniture.
The warm of the wood creates a desired interface for the user and guides the participant through the building with the wood material as the narrator describing the story and invite for various functions.

As wood are chosen a product from the company Kebony. This is a type of wood treatment that creates a durable and water-resistant material and at the same time it is maintenance-free. Kebony treatment is a method in which the wood is treated with a biological agricultural by-product and thus the material is sustainable and at the same time it is Svanemærket (Kebony.dk)
The product is simultaneously suitable for contact with water due to the treatment and the Kebony has been applied in piers and ship decks for several projects.
The selected wood is pine. The pine wood appears rustic with its prominent veins and knots that create an uneven play at the surface and at the same time its a type of wood that has a warm glow that creates a contrast to the grey concrete.
The material wills eventually patina to a silvery grey that highlights the veins and the knots but still maintain a shade of warmth.
The patina of the wood will be uneven through the plant due to the different influences that the tree is exposed. This uneven patina will help to highlight the natures influences on the same material.

THE PRODUCTION

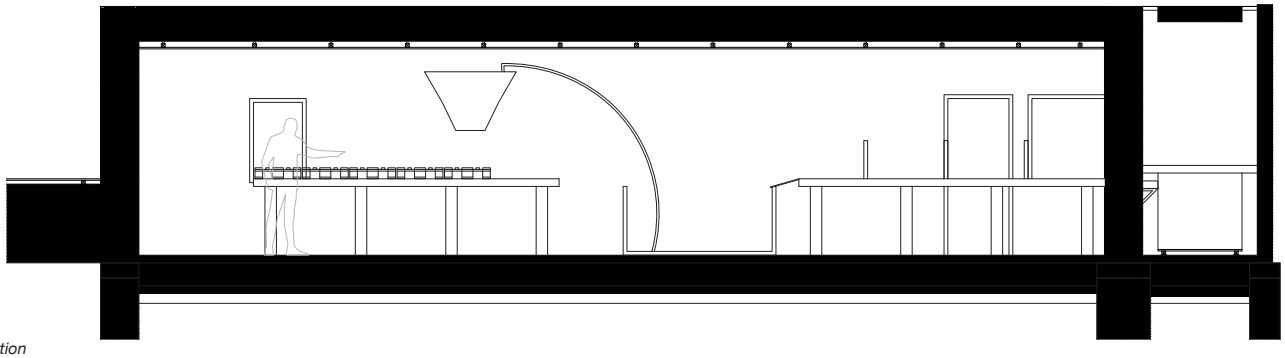


THE PRODUCTION

The production is designed based on optimisation of the workers flow and the flow for the algae product to cause the least stressful work situations.
The production facilities are located at the end of the algae basin to create a direct connection without having to transport the product. From the harvesting taking place through a fine meshed nets the algae is placed on a conveyor belt where it undergoes a cleaning and drying process as everything is done automatically by the use of the conveyor belt before it is vacuumed and placed on pallets.

The pallets are placed on the conveyor belt at the same height so the worker does not have to lift the item after it is placed on the conveyor belt. From the conveyor belt the pallet with the products is carried through a gate to path which is at the same height.

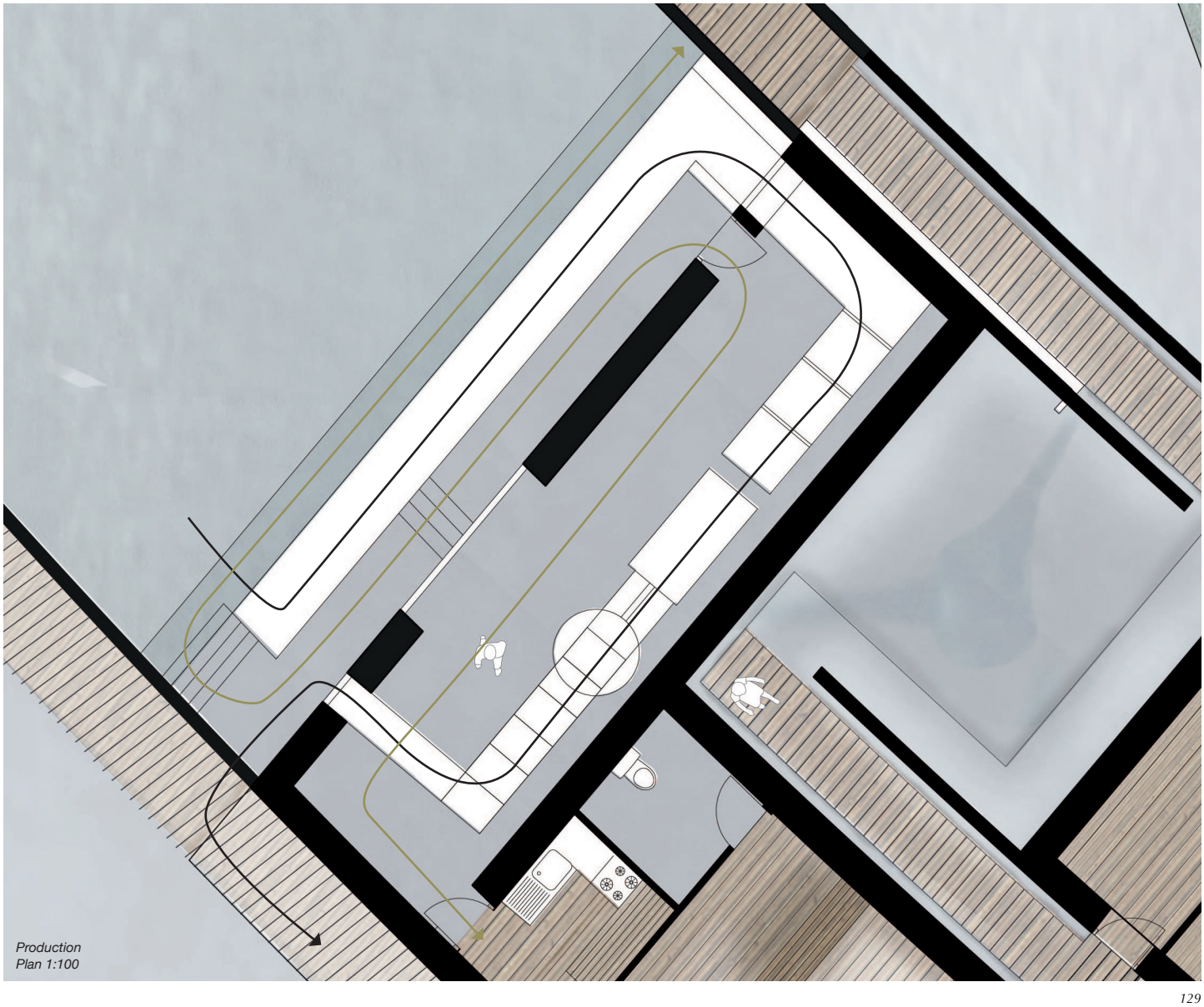
The worker's flow takes place along the conveyor belt, as he can access the conveyor belt both indoors and outdoors. During the harvesting is a repo he can descend in order to get to the same level as the conveyor belt and the water level.



Production
Section 1:100

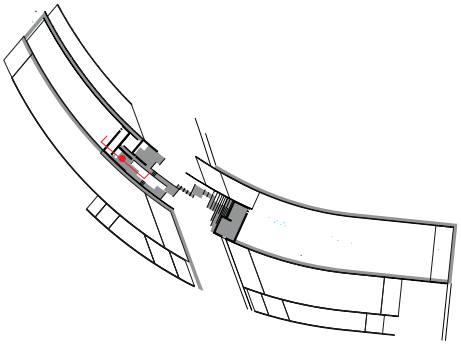
Flow of the product

Flow of the worker



Production
Plan 1:100

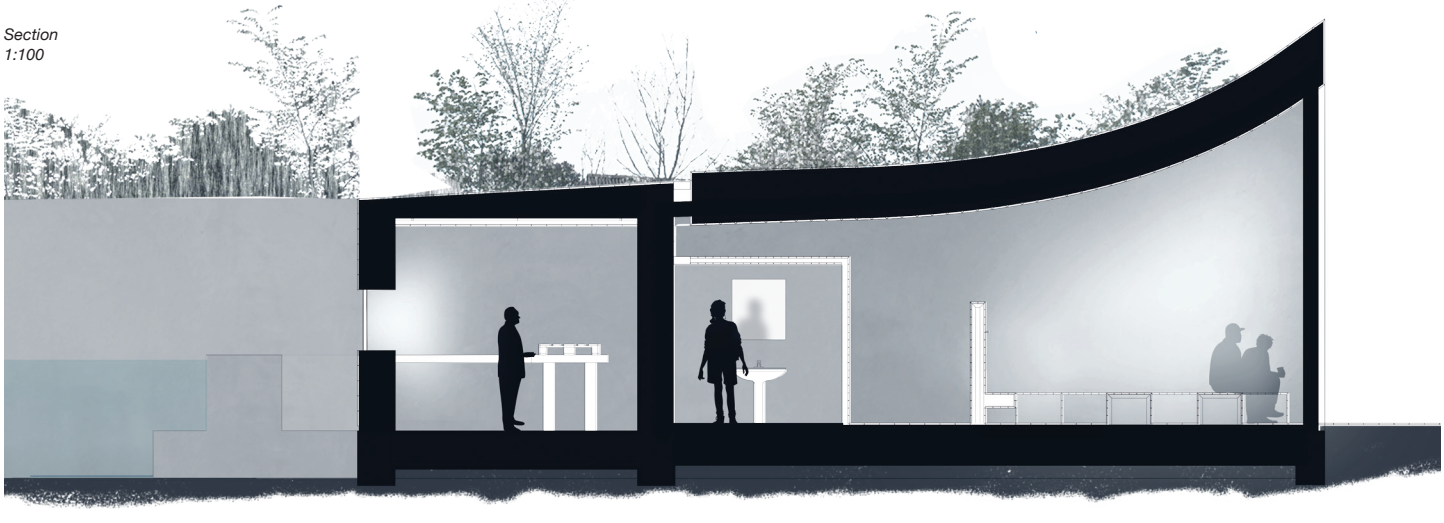
THE DINING AREA



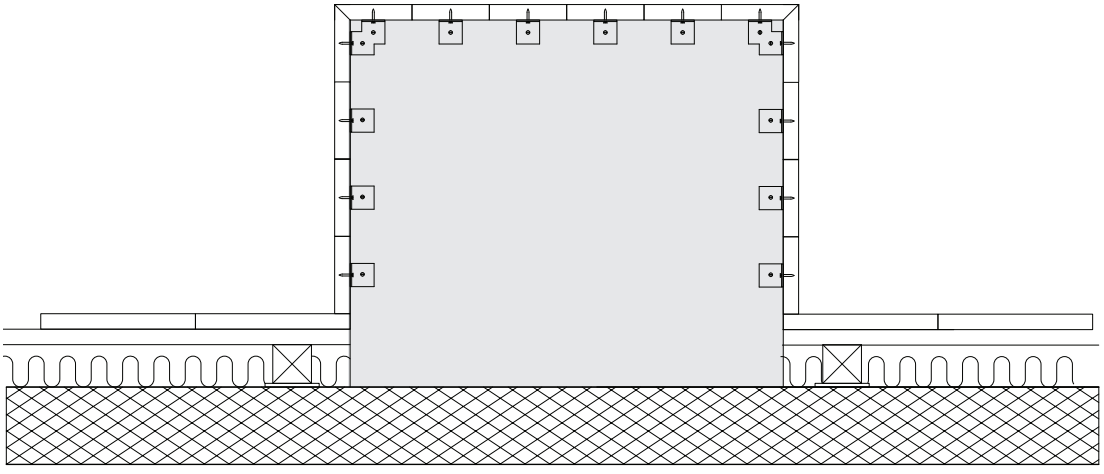
The dining area

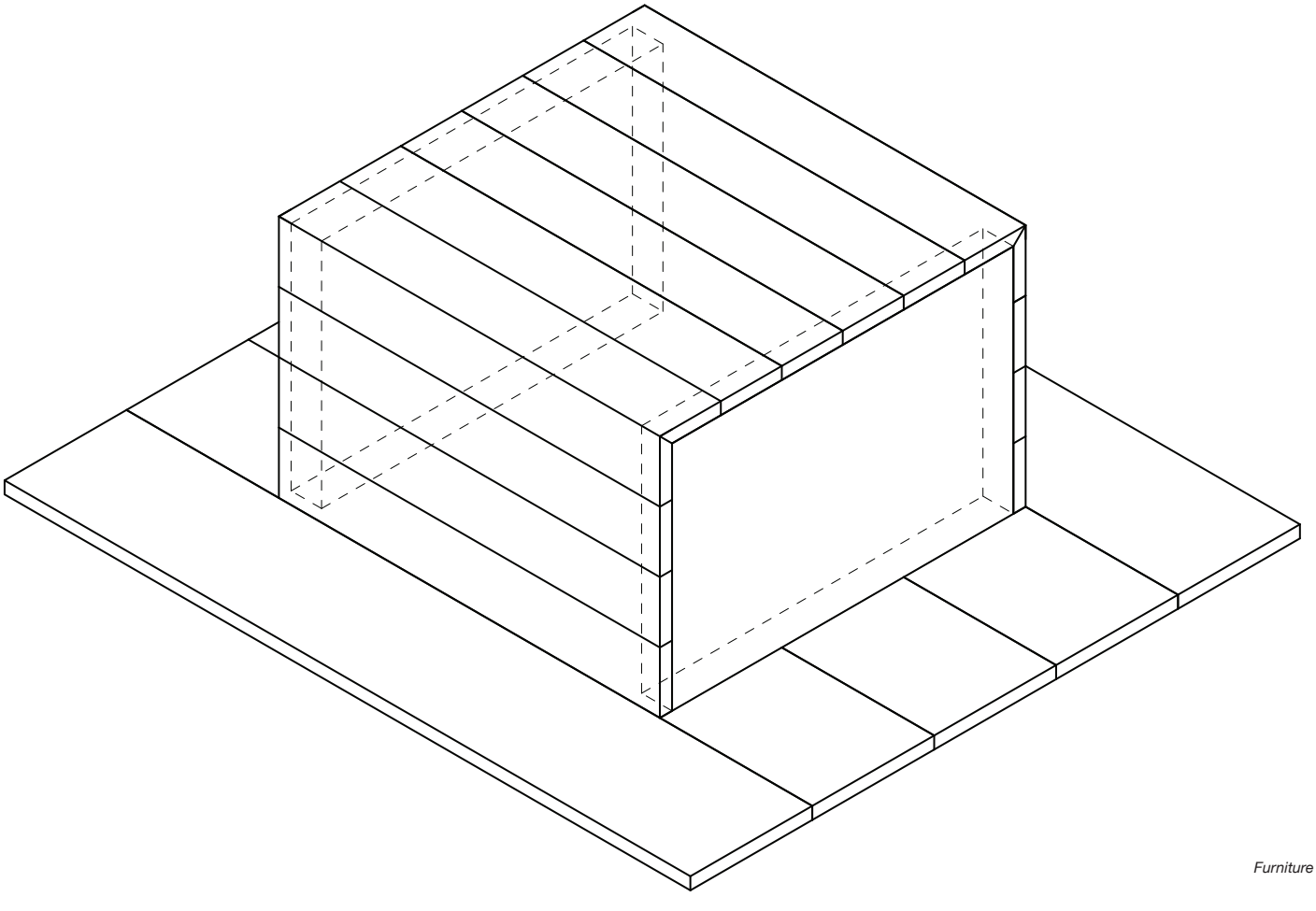
As the last step in the cleaning process is the consumption of processed by-products. After the different steps from the contaminated water to the meeting with the purified water the visitor can enter the dining area. A space of integrated furniture where it is possible to taste sample-products that has cleaned the stormwater running into into Østerå in front of the eating areas. The space consists of integrated seats – the path becomes the wood panelling. The two concrete walls that act as walls cuts through the space towards Østerå and between the concrete walls is the wood running as a rug that hugs the room and create different furniture and items, among others sitting furnitures and a wardrobe.

Section
1:100

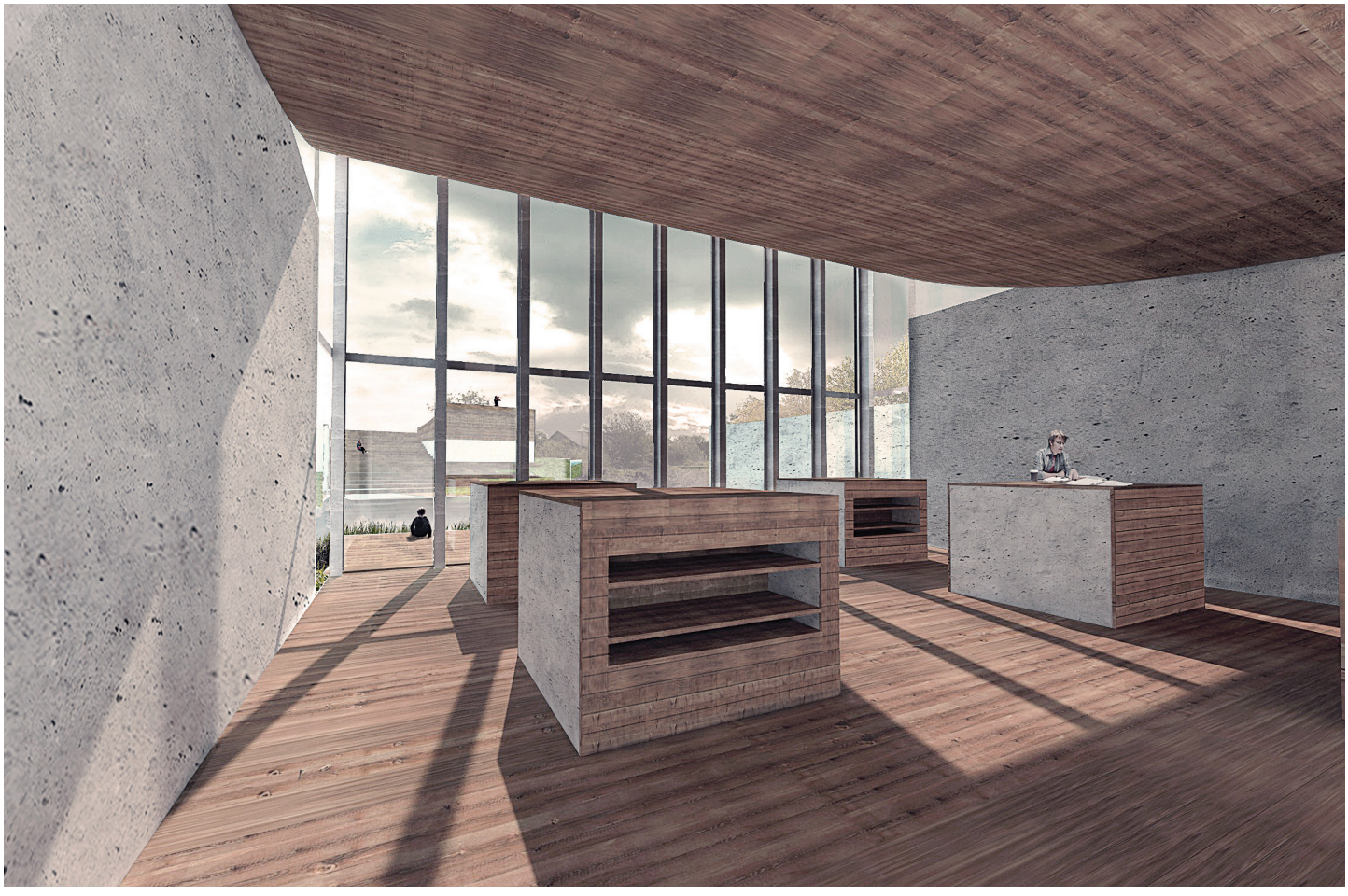


Furniture detail
1:5

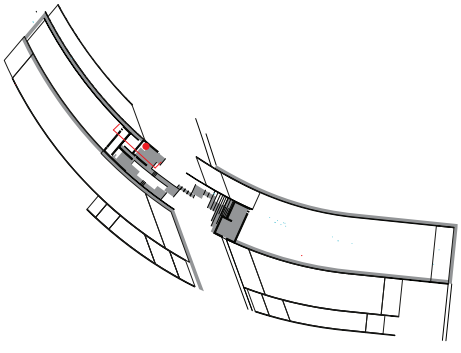




Furniture detail
1:10



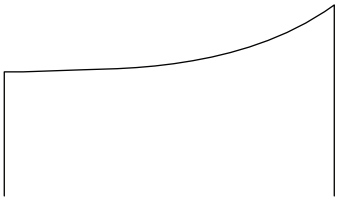
THE RESEARCH AREA

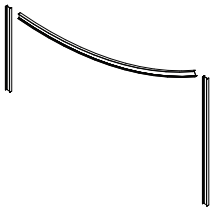


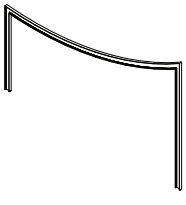
Structural system

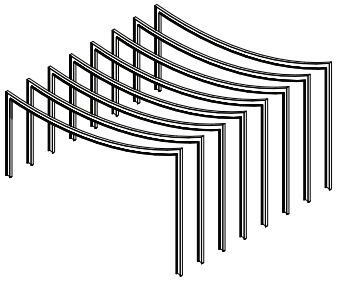
The basis for the structural system of the building departs from the connection to the basin walls. These concrete elements are extended to serve as walls for the buildings with disc effect. As the concrete walls running along the lines of the basins are supplemented by perpendicular concrete walls in the building stability is secured. An evident and simple extension of the disc system of walls is to let the roofs of the building be supported by beams transferring loads to the discs.
The intention with the internal spaces facing Østerå does however not allow this solution for the roof construction in these spaces:
The eating area and the research space are designed as the most expressive parts of the buildings as the roof constructions rise above the gentle incline of the concrete walls in a reverse curve of the concrete walls creating tension between concavity and convexity. The spaces of the building parts nearest Østerå rise highest above the rest of the treatment plant in an articulation of the building which stands in contrast to the otherwise tacit language of the bulding seeking integration between basins and building. The spaces thereby stand out and introduce further tension to the overall expression. Inside the building the spaces open up towards the stream and the spaces in front of the building; entering the space from the point with the lowest ceiling height the inclining height of the space creates a direction of the space and unfolds the narrative of connection to Østerå. The curve of the roof structure is designed with regards to external expression, internal spatial experience, light intake and ventilation. As it is desired that the roof rises above the concrete walls it is not possible to let the roof be carried by beams as no points of support can be establish as the curve rises above the concrete. The structural element of the frame is therefore introduced in the spaces. The concrete back wall of the spaces can therefore be reduced as it is not load bearing. As the research space has the biggest span the frames for this roof will be at the center of the further investigation into the dimensioning of the frames.
The roof of rest of the spaces of the building roof are carried by beams which will not be detailed because of the shorter span compared to the research area.
The frames are placed with an interval of 1m (c/c = 1m).

Section
1:100



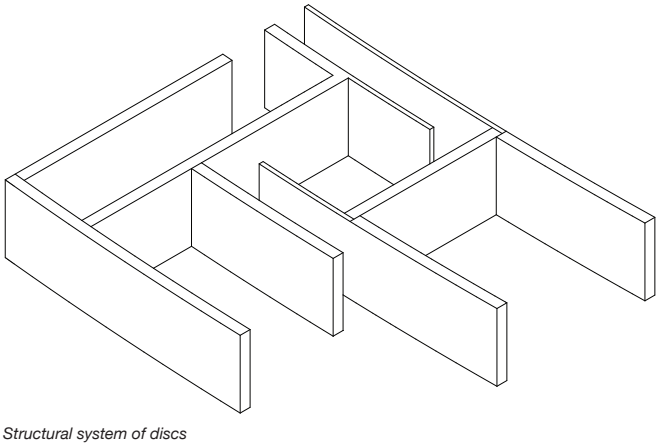


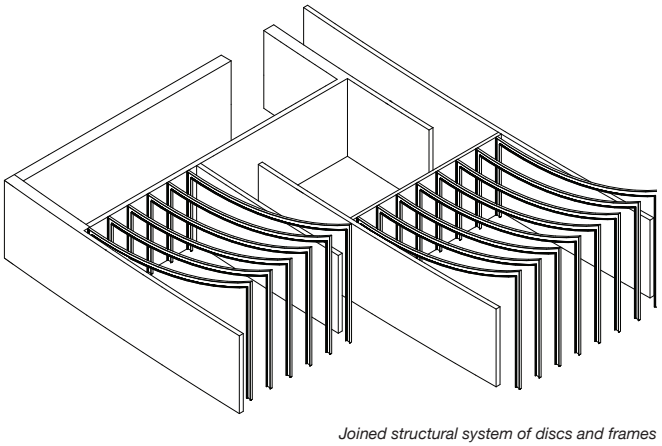




Geometry of frame 1:100

Establishment of system of frames

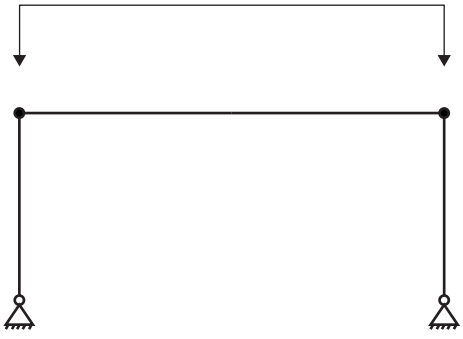




Structural system of discs

Joined structural system of discs and frames

Fixed joints at top of frame and pinned supports at bottom of frame



Loads

Loads are calculated according to pertinent Eurocode (EC0) (Teknisk Ståbi: 168):

Snow load (S): $S = \mu_i C_e C_t s_k l_{c/c} = 0,8 \cdot 1 \cdot 1 \cdot 0,9 kN/m^2 \cdot 1m = 0,72$ kN/m

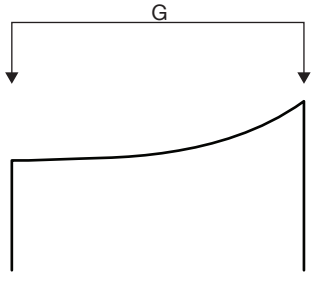
Wind load (W): The windload on the western part of the frame is disregarded as this part of the frame is in shelter.

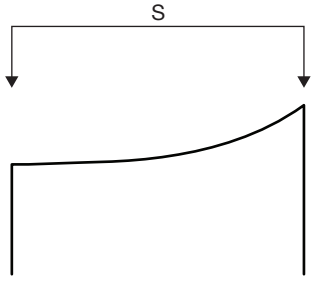
$W = q_{max}$ c l = $0,5 kN/m^2 \cdot 0,4 \cdot 1m = 0,2 kN/m$

Deadload (G): The deadload of the material of the frame is disregarded as Autodesk Robot includes the material deadload in the calculations. Standards of 0,5 kN/m² for light weight roof and 1 kN/m² for installations are used.

$G = 0,5 kN/m^2 \cdot 1m + 1 kN/m^2 \cdot 1m = 1,5$ kN/m

Live load (Q): As the roof is not accessible no live load will be calculated.



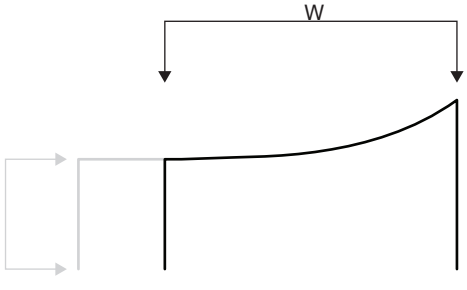


Load combinations

Load combinations are calculated according to pertinent Eurocode (EC0) (Teknisk Ståbi: 165):

Combination 1: Wind load as dominating load: 1,0G + 1,5Q · 0,5 + 0S + 1,5W
Combination 2: Snow load as dominating load: 1,0G + 1,5Q · 0,5 + 1,5S + 0,45W
Combination 3: Live load as dominating load: 1,0G + 1,5Q + 0,45S + 0,45W
Combination 4: Dead load as dominating load: 1,2G

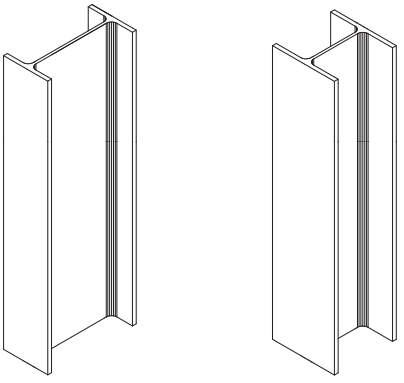
Combination 3 with snow load as dominating load gives the worst load combination and will therefore be used for further dimensioning of frame.

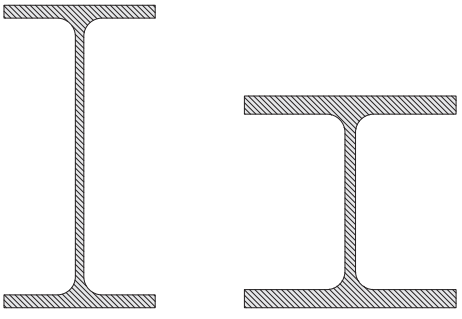


Choice of profile for frame

The criteria for choice of material is beside the ability to support loads also integration in the industrial character of the treatment plant and minimal dimension as column B will visible and be part of the window façades facing Østerå. Steel is with this in mind chosen as material for frame as joints and dimension can be minimised using the strengh of steel.
FEM-analyses are performed on the frame using the calculated load combinations. The geometry of the frame is built in Autodesk Robot to perform investigations into which steel profile is needed to support the loads. Investigations are performed on standard IPE- and HEB-profiles.
The calculations on the steel profiles are done with regards to both Serviceability Limit State (SLS) and Ultimate Limit State (ULS).
For SLS the deflection for the entire frame is tested – however focus is on the span from column A to column B as the deflection here is at maximum.
For SLS the maximum stress ratio (stress max) are tested for the entire frame – however several foci points are regarded here: The overall stress ratio are calculated, the stress ratio for the largest column (B) and the lateral instability for both columns.
The main result of the investigations are presented in the table below. Results exceeding the allowed values (22mm for deflection and 1 = 100% for stress ratio) are marked with grey. See enclosed CD for Autodesk Robot-model and data sheeds.

IPE200 *HEB140*





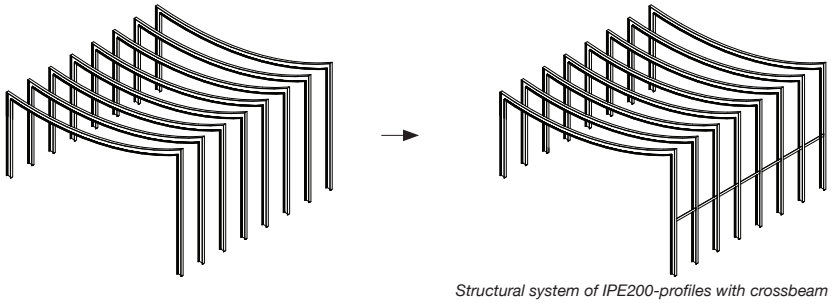
Section of IPE200 1:5 *Section of HEB140 1:5*

The maximum level of deflection is defined by:
Umax < L/400
With a span of 8800mm this leads to:
Umax < 8800/400 = 22mm

	Heigh	Width	Deflection	Ratio max $_{frame}$	Ratio max $_{column\ B}$	Lateral ins. $_{column\ A}$	Lateral ins.$_{column\ B}$
	[mm]	[mm]	[mm]	-	-	-	-
IPE100	100	55	165	0,94	1,24	1,26	1,94
IPE 120	120	64	90	0,62	0,75	1,08	1,66
IPE 140	140	73	54	0,44	0,51	0,94	1,46
IPE 160	160	82	34	0,3	0,36	0,85	1,30
IPE 180	180	91	23	0,24	0,28	0,76	1,18
IPE 200	200	100	16	0,19	0,21	0,70	1,08
IPE 200 $_{crossbeam}$	200	100	16	0,19	0,21	0,70	0,54
HEB 100	100	100	68	0,39	0,45	0,62	0,95
HEB 120	120	120	37	0,26	0,29	0,51	0,79
HEB 140	140	140	22	0,18	0,2	0,43	0,67

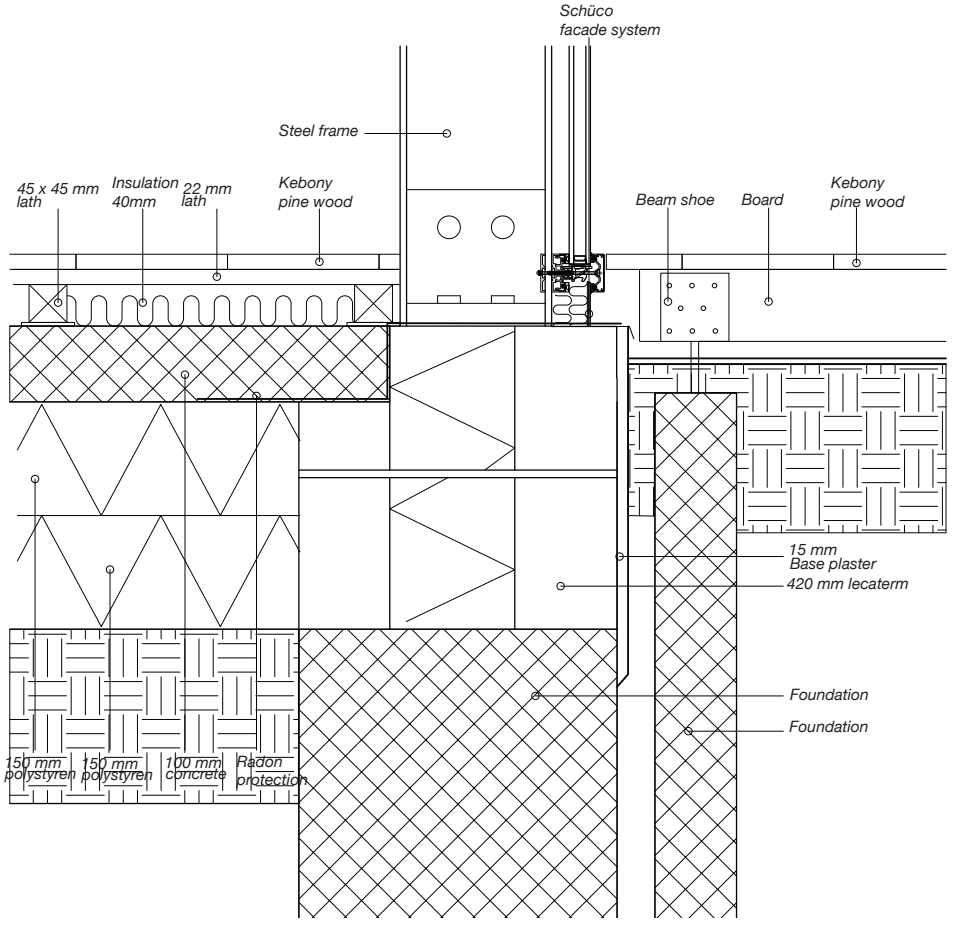
The analyses show that the weakest points in the frame for both types profiles are SLS and the lateral instability in column B.
An IPE200 profile is needed to secure the maximum level of deflection is not exceeded. The IPE200 can however not secure lateral instability alone in column B because of the high height/width-proportion and buckling therefore occurs.
The HEB140 profile can because of the larger width withstand buckling of column B and also meet the demands of a deflection of maximum 22mm.

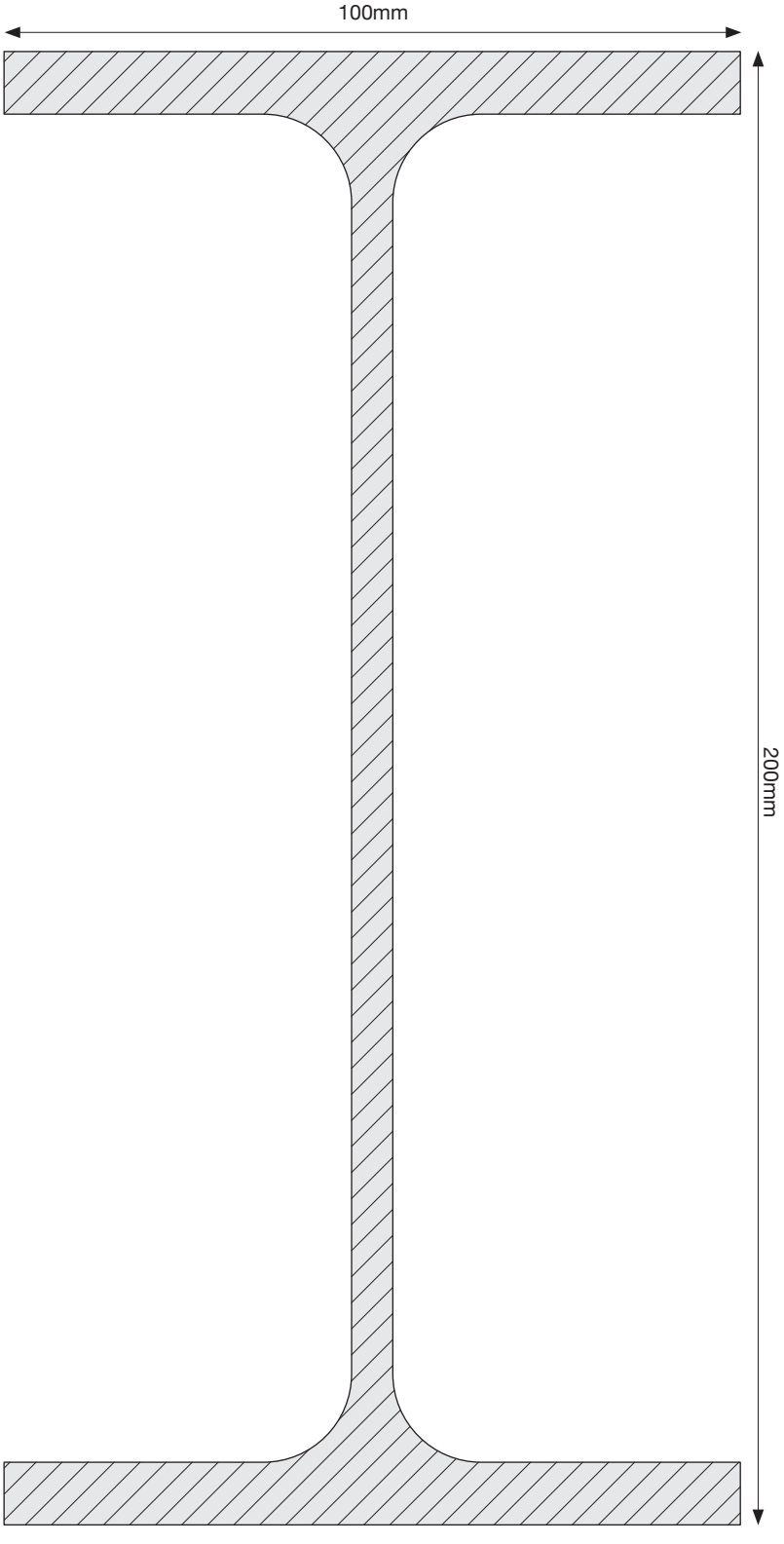
The window façades facing Østerå is however not desirable to spand from ground to ceiling as this would result in a window height above 5m. As a division of the window façade is needed the IPE200 profiles with a crossbeam is chosen to secure lateral stability, to secure a horizontal division of the façade and to secure minimal profile width of 100mm in the façade compared to the 140mm of the HEB140 profile.

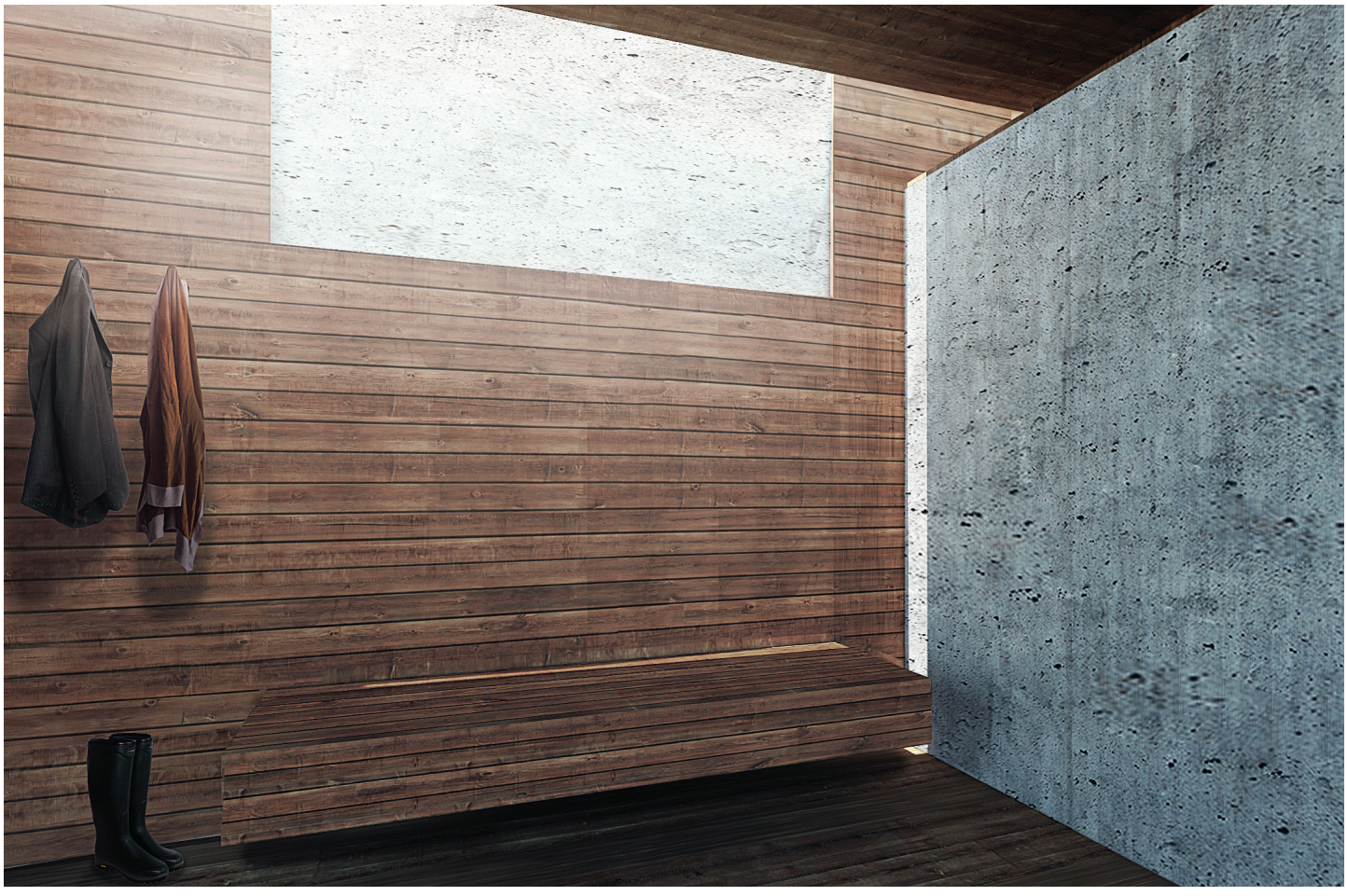


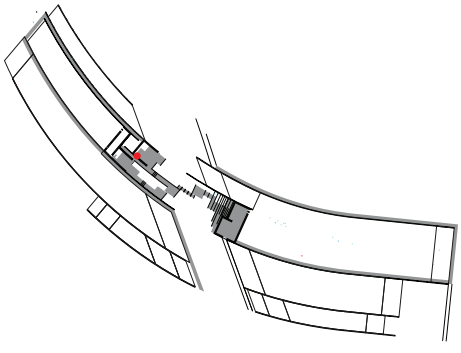
Structural system of IPE200-profiles with crossbeam

Detail
1:10


Schüco
facade system
Steel frame
45 x 45 mm
lath
Insulation
40mm
22 mm
lath
Kebony
pine wood
Beam shoe
Board
Kebony
pine wood
15 mm
Base plaster
420 mm lecaterm
Foundation
Foundation
150 mm
polystyren
150 mm
polystyren
100 mm
concrete
Radon
protection


100mm
200mm





Daylight

Designing the ventilation inlet as a window creates a better daylight and more value in the end areas of the rooms.
In the two large rooms the lighting are primarily focused on the two large openings in the facade that invites nature, Østerå and light into the building. In the opposite end of the open facades toilets and other sanitary features, as well as the kitchen are located to create a large free-lit area as possible and to get direct contact with the outdoor context.

In order not to create a dark end, a kind of back-area, a window in the roof can take natural light all the way into the toilets and simultaneously create a poetic illumination of the secondary functions.

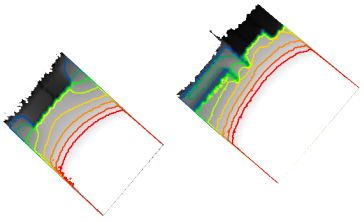
The window is placed in the roof as it is not desired to break the concrete walls. The use of ventilation inlet for window creates a homogeneous concrete surface without any interruptions creating an image of the concrete walls as the structural elements cutting through the basins and the building.

The skylight creates furniture for seating as through the day changes its appearance due to the sun's constantly changing rays and orientation.
The furniture is part of the entrance hall and cloakroom with possibilities to hang jackets or take off the boots after water samples in the facility has been collected before moving into the research room to do various tests or just to learn about the functions of the stormwater management.

THE FURNITURE

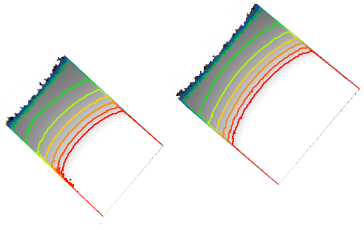
Without roof window

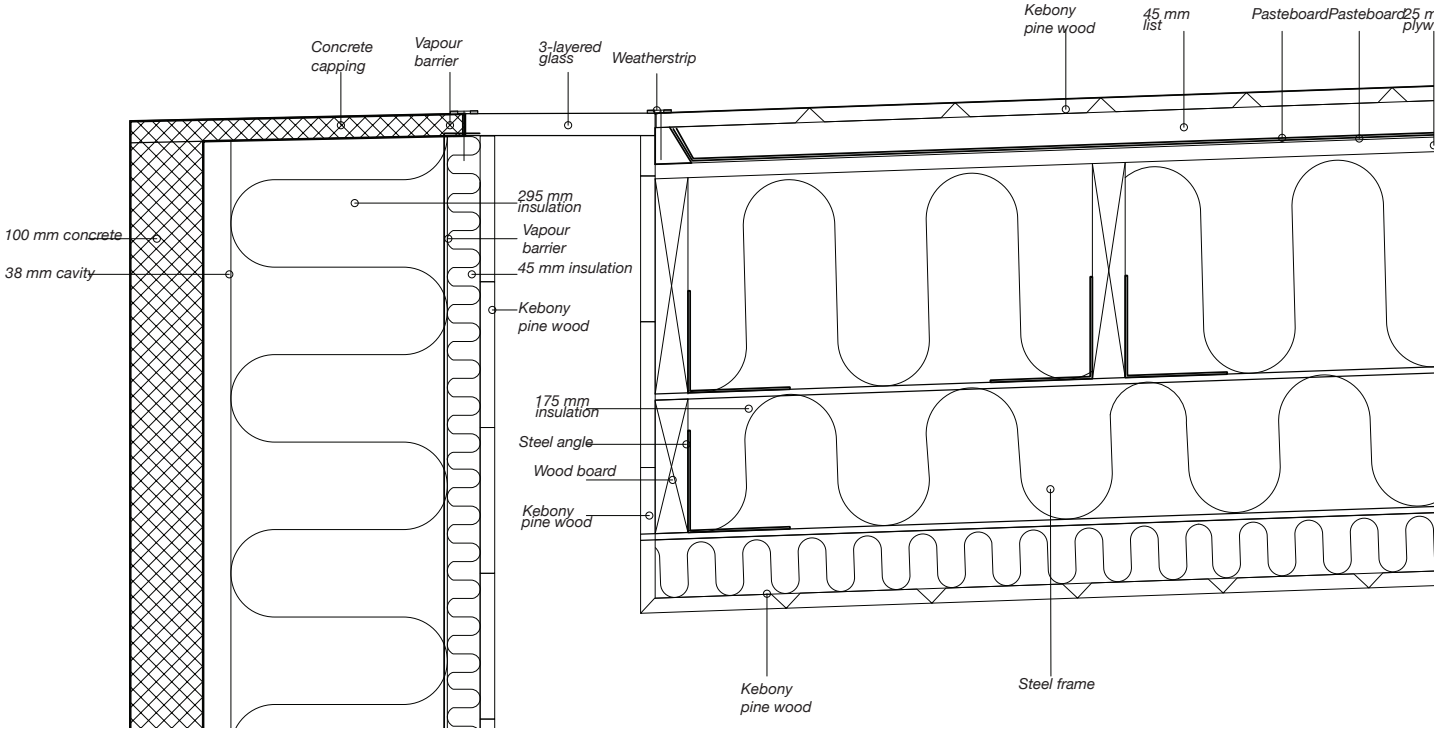
Without skylight the areas in the back are dark and the toilets appear to be enclosed boxes without natural lighting. At the same time the entrance to the research space appears as a dark area - like entering a backside.



Roof windows

The location of the skylight pull daylight all the way into the room and create a space with a minimum daylight factor of 2. The toilets have simultaneously an added value in the sunlight sliding down the concrete wall and thus illuminates the room in a light that changes throughout the day.





Detail
1:10

Ventilation

Design of the ventilation is focused solely on the use of natural ventilation and the wish to create an integrated ventilation system as part of the basic design. Foci on the use of solely natural ventilation stems from a desire to reduce the use of energy in building by utilising the wind pressure on the building and the orientation of the local wind. To optimise the ventilation system the inlet is placed in the top of the roof facing west creating a cross ventilation system optimising the airflow in the room and the primary winds from west, simultaneously the system and the location of inlet and outlet in the roof minimises the possibility for draft and creates an opportunity for a faster air change rate.
The air change is calculated to remove heat from the sun, internal heat load, users and miscellaneous equipment, since it is assumed that this change also is adequate to remove CO_2.
The design of the natural ventilation has been simulated to control that the given quantity can be ventilated in this building and how much there actually can be ventilated in the building, and if the needed sizes for inlet and outlet is sufficient. There is calculated the building pressure difference and hence the current air flow, the calculations is based on a system of wind pressure.
The air change rate per hour is calculated based on the equation.

$$n = \frac{\frac{Ø_{i,day} + Ø_{sun,day}}{24(t_{i,m} + t_{u,m}} - H_T}{H_{V1}}$$

Required air change rate

Solar radiation
$Ø_{sun, day}$ is the solar radiation at the windows and this is based on July because this month is the most congested in relation to activity and temperature. The air change rate is calculated to the peak and thereby it is estimated that it will be able to remove the heat rest of the year. The solar radiation is calculated based on the equation.

$Ø_{sun, day}=g \cdot f_ß \cdot f_{shadow} \cdot f_{glas} \cdot A_w \cdot I_{sun}$

The values g, $f_ß$ and f_{glas} are values based on the chosen window glas - here is chosen window glass from Rationel.

A_w is the size of the given window

I_{sun} is a standard middle value for suns heat exposure on a given facade according to its orientation

$Ø_{sun, day}$

July	Research 60m²	The eating 46m²
g	0,48	0,48
f_{angle}	0,9	0,9
f_{shade}	0,7	0,7
f_{shadow}	0,6	0,6
f_{glass}	0,85	0,85
$a_{window\ area}$	34	24
solar incidens	4716	4716
Total	24728	17455

Internal heat loads

$Ø_{i, day}$ is the internal heat load for the specific room. The rooms are calculated based on a scenario for a visit of a classroom with teachers.
The Research area is assumed to have different type of equipment and the equipment load is thereby the same as an office and double the dining area as the primary equipment is a small kitchen.

It is assumed that the building's main functions are in function in a maximum of 12 hours a day, as it is not expected to be use during night.

The heat load of the exposure is set to a minimum since the rooms as described above has a high daylight and it is expected that the lighting will be kept at a minimum.

$Ø_{i, day}$

30 persons	Research 60m²	Eating 46m²
Person 118W	3540W	3540
Equipment 6W/m²	118W	138W
Lightning 2W/m²	120W	92W
Total	4020W	3770W

Ventilation and transmission loss

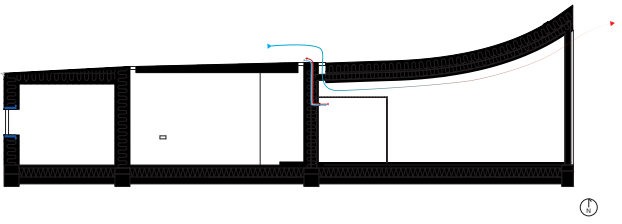
Through the facades and windows of the building there is a transmission loss that is read in the Be10 calculation and is based on the building facades according to isolation and their orientation against the outside or unheated rooms, the transmission loss depends on the structure's insulation properties and thus each building element u-value.
It is assumed that there is a loss of ventilation in the building, a minimum amount of ventilation which occurs automatically through the building and infiltration.

The ventilation loss is based on the equation

$H_V=P \cdot C_P \cdot q_v$
P=1,2 kg/m³ - air density
C_P=1005 J/kg° - specific heat capacity of heat

$q_v=0{,}001 \cdot A_W \cdot (ß \cdot q_{vb} + (1-ß) \cdot q_{vu})$
A_W=60m² - areal
ß=0,36 - service life
q_{vb}=1,2 l/s m² - ventilation during service
q_{vu}=0,3 l/s m² - ventilation outside service

	Research 60m²	Eating 46m²
Ventilation in m³ q_v	0,037	0,029
Ventilation loss H_V	44,97 W/K	34,47 W/K
Heat transmission loss From Be10	45 W/K	46 W/K
Air change rate h^{-1}	**2,14**	**1,62**



Wind pressure

The desired air change rate for the Research is thus 2.14 times per hour and the Eating area is 1.62 times per hour. To be sure that the building itself through natural ventilation can change the air at desired quantity to minimise overheating without the use of mechanical ventilation air pressure at the building is calculated as well as the sizes of inlets and outlets.
The calculations are based on the research as it is the most affected. This assumes that the dimensions in the eating area can be carried out using same calculations.

The wind pressure on the inlets is calculated based on the equation $P_W=C_P \cdot 1/2 \cdot P_u \cdot V^2_{ref}$

C_p - The windpressure on the building in a low density area
P_u=1,25 kg/m^3 - Air density

$V_{ref}=V_{meteo} \cdot k \cdot h$
V_{meteo}= 6 m/s - Mean wind speed in Denmark
k - standard for placement near buildings
h=3,1 - building height for the inlet
=0,25 standard for building in suburban area

	Inlet	Outlet
Windpressure - C_{p1}	1,08	-0,52
V_{ref}	2,4	-2,22
C_P	0,3	-0,2
k	0,3	-0,25

Internal pressure

The internal pressure is calculated to see if the dimensions of the inlet and outlet, and the location is consistent with the wished flow through building.This done to be sure that the pressure ensures the correct intake and outlet.

The calculation is based on the following equation.

$$P_i = \frac{A_1^2 \cdot C_{p1} + A_2^2 \cdot C_{p2}}{A_1^2 + A_2^2}$$

	Inlet	Outlet
Area (A_1, A_2)	0,6	0,5
V_{ref}	2,4	-2
C_P	0,3	-0,2
Internal presure P_i	0,14	

Air flow

The internal pressure and wind pressure is used to calculate the air flow in the room. It needs to the same for inlet and outlet to avoid generating positive or negative pressure in the building during ventilation.

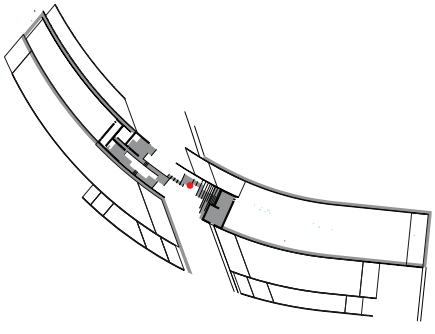
The air flow is calculated using the following equation

$$Q = C_{d1} \cdot A_1 \sqrt{\frac{C_{p1} \cdot P_u \cdot V_{ref}^2 - 2 \cdot P_i}{P_u}}$$

This gives the dimensions in relation to how much air enters the building and how much is released. These dimensions are converted into the number of times per hour the air in the room is changed, and thus possible air change rate.

It can thus be assumed that by placing inlets in connection with the skylights in the ceiling, the building with the use of solely natural ventilation create enough air circulation to prevent overheating.

	Inlet	Outlet
Air flow Q	0,13	-0,13
Air change rate	**2,4**	



Urban furniture

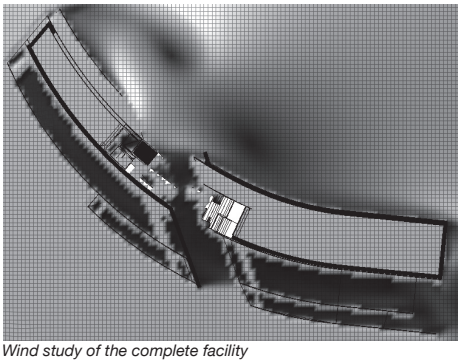
The staircase acts as a link between the buildings, purified water, nature, Østerå and the user and as a piece of furniture sliding over the building, along the water and through the building.
It merges with the water and nature creating different spots and stays.

The stairs is an urban furniture involving the users and site functions in a relationship with nature and its processes. It changes its appearance throughout the year due to its proximity to nature. When it rains and the stream's water level rises, the lower part of the staircase is being flooded and its role as a bridge going from physical to purely visual. This creates an awareness of the physical processes.

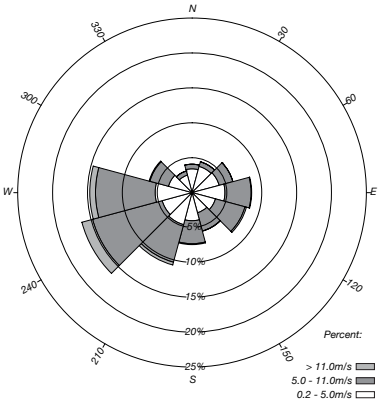
THE STAIRS

Wind

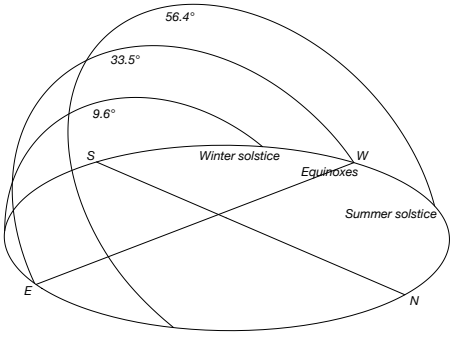
Seats on the urban furniture placed at the side of Kærby are all shielded from the site dominated winds coming from the direction between west and south.
The simulations on the side of Håndværkerkvarteret show that they are more easily affected by the wind but they are still protected by the building as it takes the largest share of wind. This means that most places are sheltered from the wind.



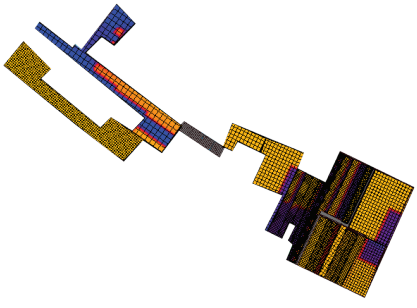
Wind study of the complete facility
Main wind direction in the area



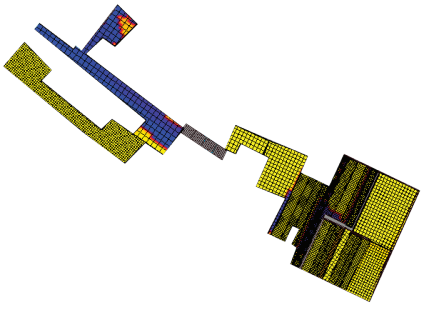
Wind diagram
Aalborg



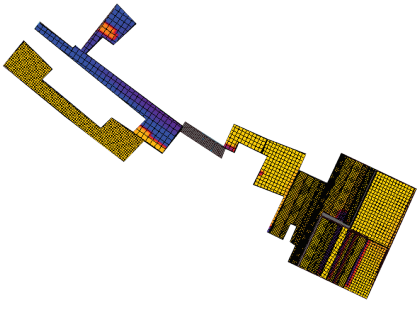
Sun diagram
Aalborg



Morning sun 9.00
Spring



Afternoon sun 12.00
Spring



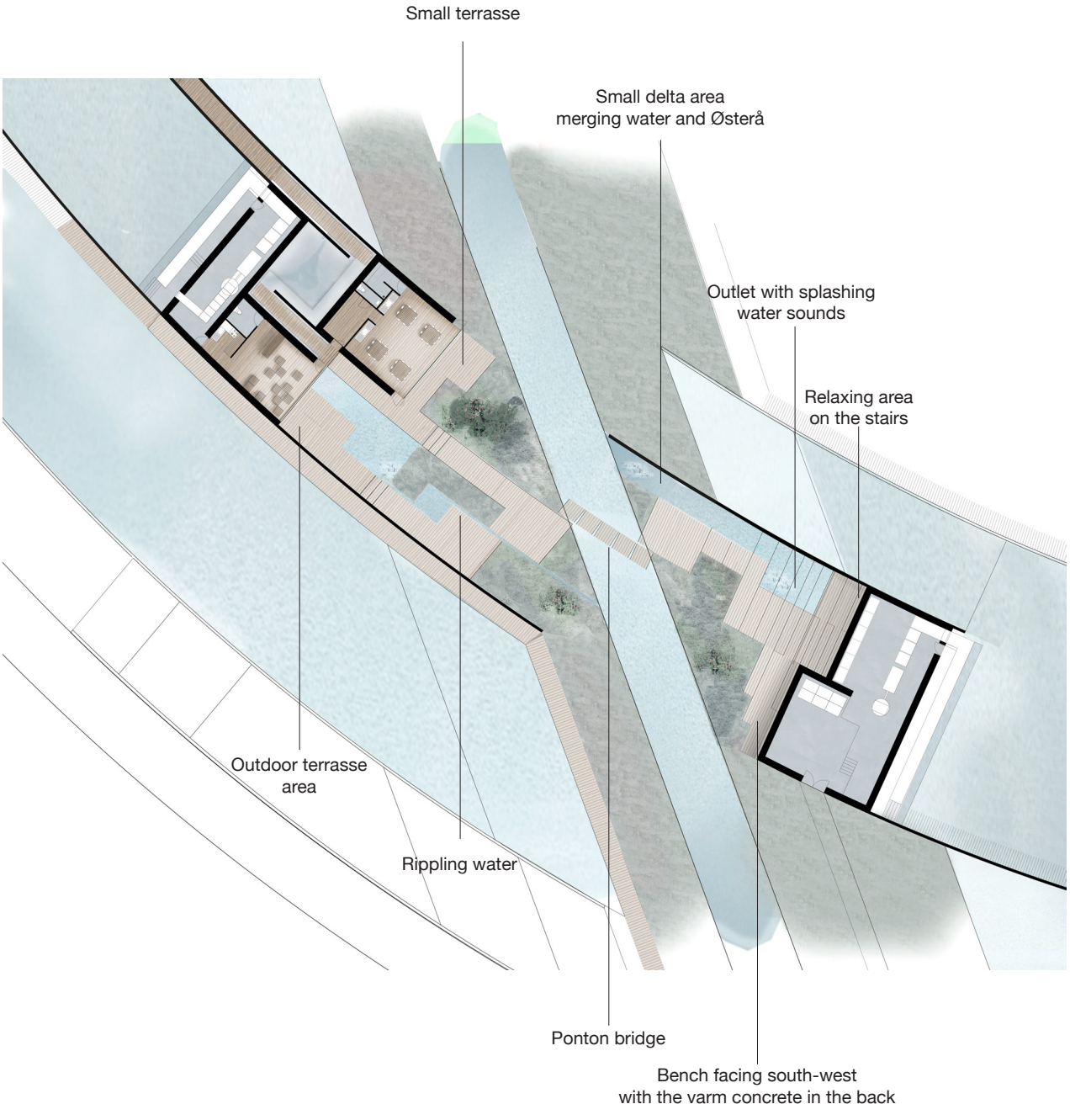
Evening sun 16.00
Spring

Sun

The staircase furniture merges across Østerå establishing opportunities for stay no matter the season or time of day as there will always be a place in the sun or sheltered from the wind. This creates a seating area to be used by visitors who have been following the mediation walk or students who are visiting the research facilities.

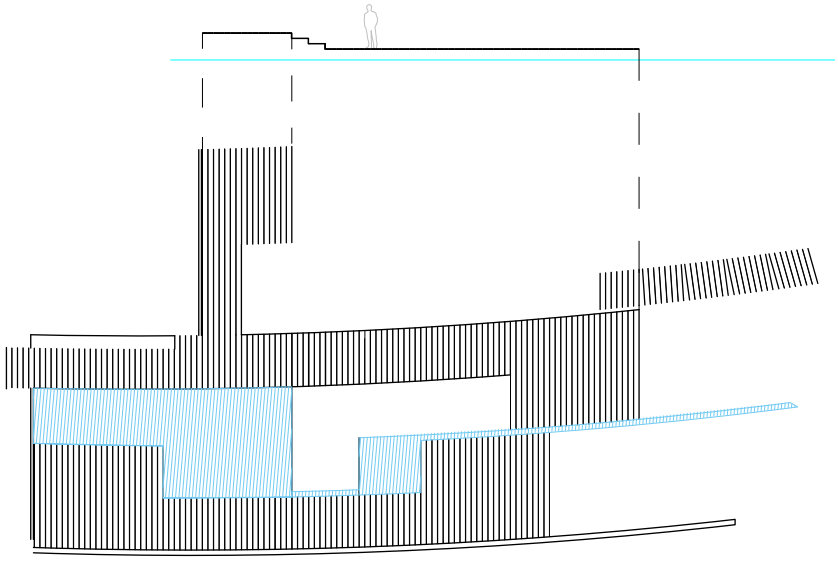
The main stay area is located on the grand staircase at Håndværkerkvarteret since this part is in the sun from both south and west and will thus be sun lit during noon, afternoon and evening.

The sun studies show a large sun exposure of the seats around the bench in front of the concrete surface and the sitting stairs along the concrete wall. The great sunlight and the concretes ability to accumulate and release heat creates a warm micro-climate around these areas and they can be used for a long period a year since as soon as the sun is out, these seats will be heated.

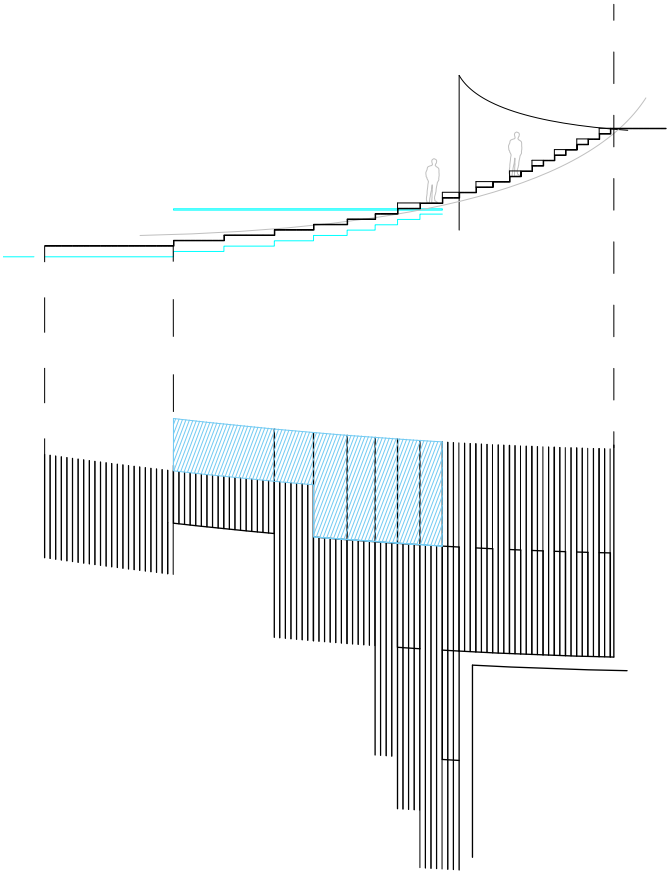

Small terrasse
Small delta area
merging water and Østerå
Outlet with splashing
water sounds
Relaxing area
on the stairs
Outdoor terrasse
area
Rippling water
Ponton bridge
Bench facing south-west
with the varm concrete in the back

Plan
1:500

The side of Kærby

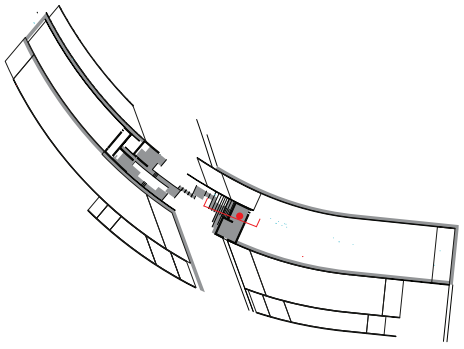


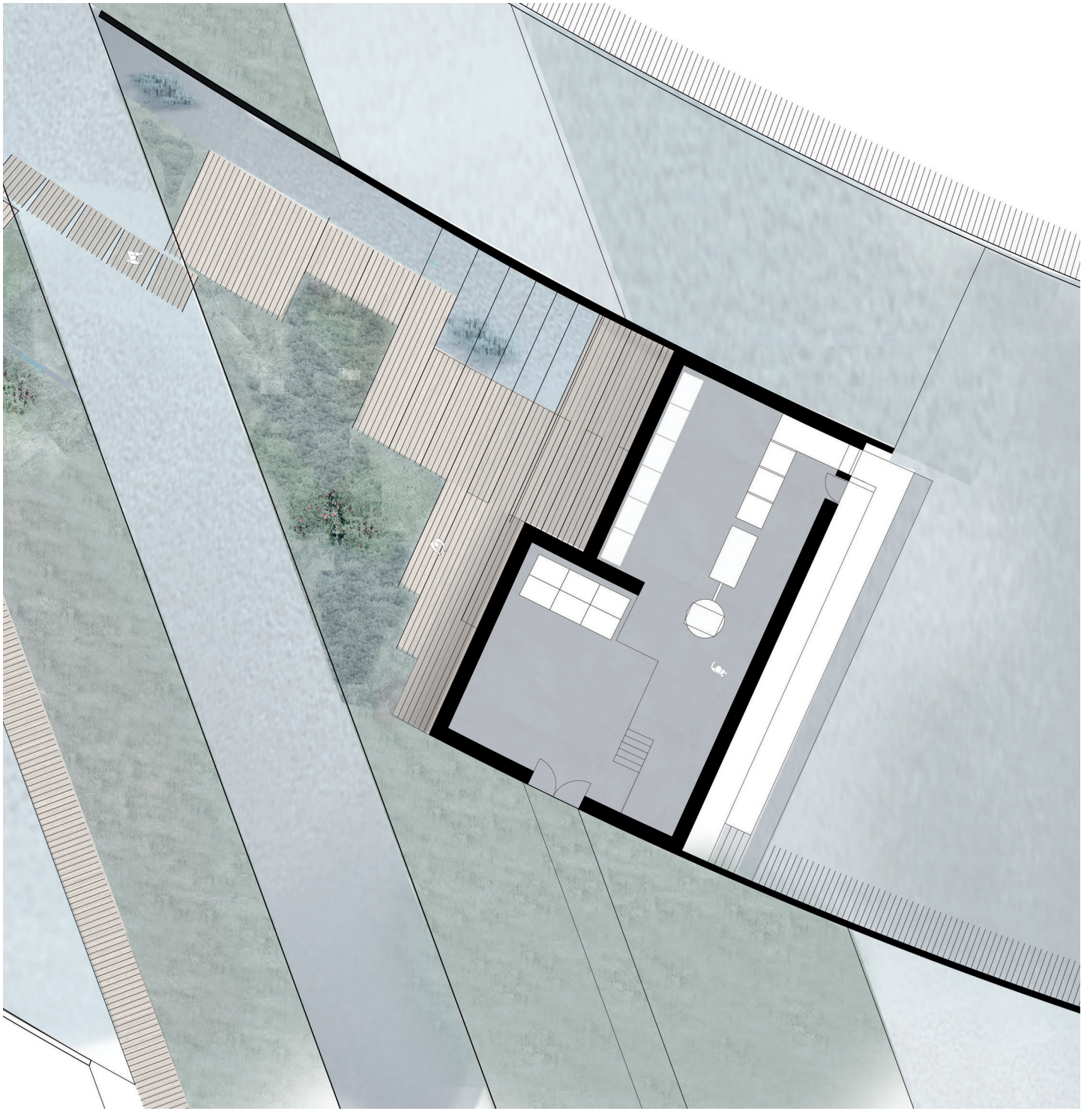
The side of Håndværkerkvarteret



Plan and section
1:100

PRODUCTION & DEPOT



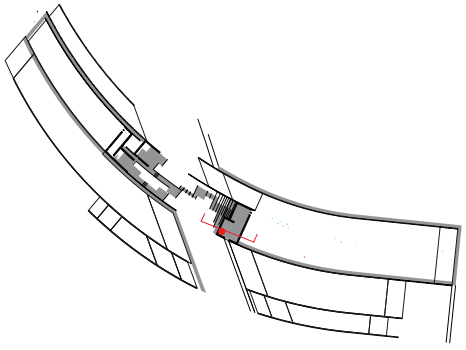


Production

The algae production on the side of Håndværkerkvarteret are optimised according to the same principles as the production on the side of Kærby with a focus on workflow.
The production on the side of Håndværkerkvarteret serves as primary storage space with easy access to the access road and the further transport of the product.

Section
1:100

THE VIEW



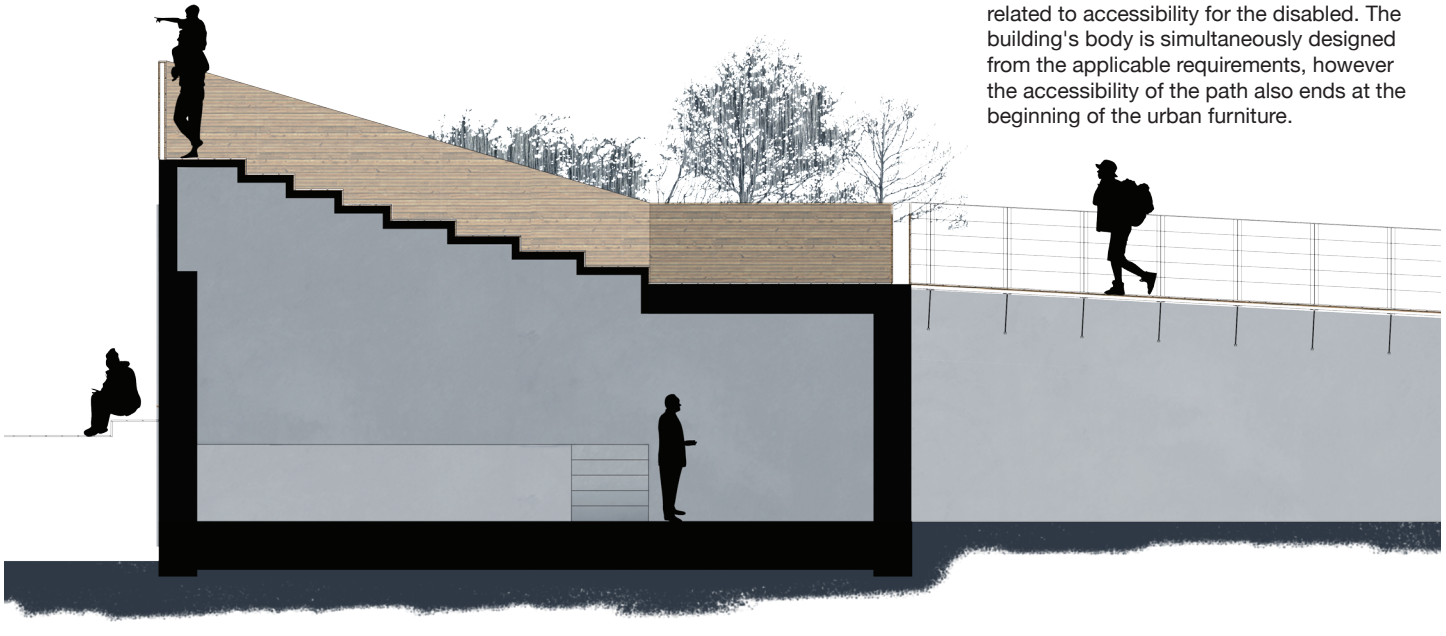
The view

The staircase as the urban furniture continues on top of the building and becomes the highest point from which everything can be assessed – where the movement of the concrete lines and its fusion with the railway tracks can be felt.
A connection and understanding to the larger contextual connection and site problems related to flooding is created - with the low placement of the site between the two large hills with Aalborgtårnet on one side and Eternitten on the other. At the same time the great landscape features with Østerå cutting through is sensed. At the same time, a quick overview of Aalborg's industrial history is created from the view looking against the industrial monuments of Eternitten, Remissen, Gabriel, concrete company Unicon, and the rail network.

Accesibility for disabled people

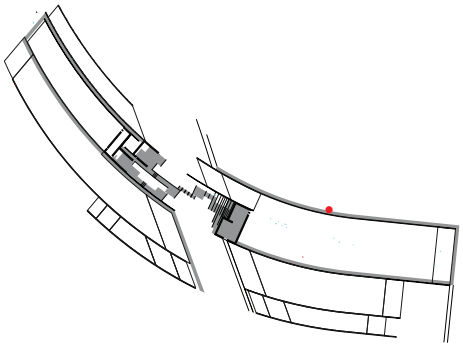
The ascent to the view is designed on the accessibility requirements for the disabled. Along the concrete wall that separates between two basins a ramp that leads up to the top of the roof is placed.
The requirements for accessibility describe a maximum slope of 1:20 that are observed with an increase of about 1:30. Therefore, it is assumed that the increase is so low that it is not necessary with in-between repos, as these are not desired since the pure slope as expressed in the concrete of the walls surfaces is desired.
The clean gently curved concrete surface continuing up to the building creates a tension between convex and concave with respect to the wooden arc that the roof creates. This helps to create a tension in the building and a clear articulation of the building expression.

From the vantage point it is not possible for disabled people to continue on as the urban furniture - sitting stairs - is not designed to be used for disabled as it is not possible for them to use the pontoon bridge.
The mediation walk on Kærby is designed based on all applicable requirements related to accessibility for the disabled. The building's body is simultaneously designed from the applicable requirements, however the accessibility of the path also ends at the beginning of the urban furniture.



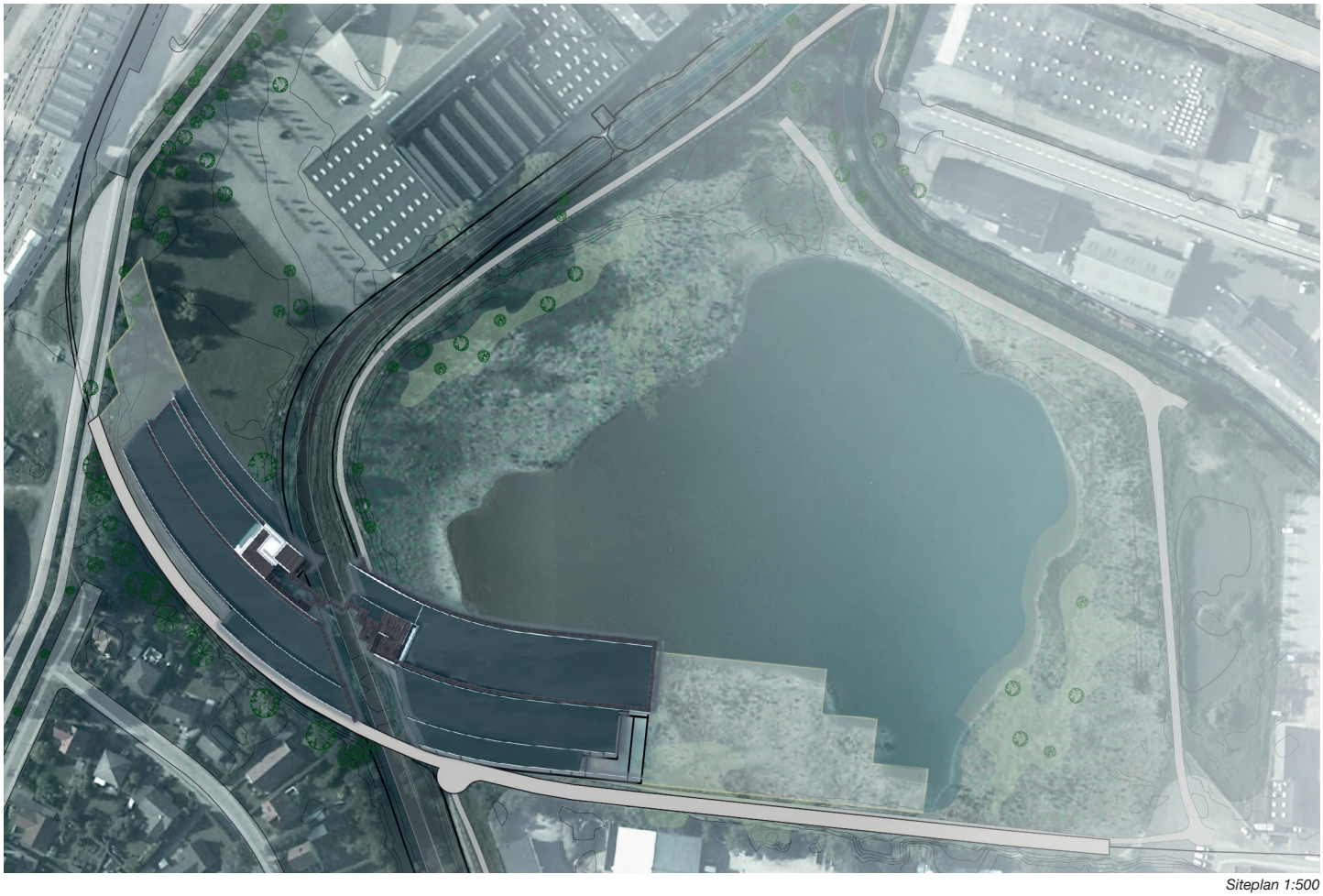
Section
1:100

THE LAKE



Delay basins

The mediated walks ends with a path between the lake and algae pond - an relic element from former industrial purposes and the new industrial function of the site - between the industrial derelict nature taken over by nature and converted into a recreational element to the contemporary industrial architecture involving the recreation element from the beginning.
By involving the lake as part of the walk and in close contact to the ponds and delay basins an opportunity to use the lake as a buffer-zone for rain events stronger than 5 years of incidents basins area dimensioned to handle is created.



Siteplan 1:500

Delay bassin

The dimensions for delay basins are based on formulas and graphs in *Afløbsteknik 6th edition*. They are sized by calculating the drainage by the following formula.

$$\text{Drainage} = \frac{\text{Max. diversion - Average diversion}}{\text{Catchment area x Coefficient}}$$

The number for l/ha is found in the graph for rain series and is multiplied with the reduced area (Winther 2011: 317).

Kærby	
Redudced catchment area	13,79 ha
Drainage	3,16
Read off (l/ha)	245000
Size (height 2m)	1689 m2
Håndværkerkvarteret	
Redudced catchment area	20,73 ha
Drainage	0,39
Read off (l/ha)	450000
Size (height 2m)	4619 m2

Soil of white chalk

The lake is placed in close contact to the basins to be included as part of the recreational use and the site narrative.
The lake and its surrounding area is an old chalk excavation area and the chalk is visible on the surface which gives the place a distinctive white colour and more yellow greyish plants as the surface is not particularly suitable as a green area.
The narrative of the chalk is highlighted around the lake and delay basins so the basins appear as distinct element in the area. This separate the two areas from each other, with Kærby appearing as a green refined area versus the area around the lake that appears raw and abandoned with its white chalk surfaces.

CONCLUSION

The thesis has approach the task of addressing the challenges of the climatic changes related to stormwater management by focusing on the design of a stormwater treatment plant under the theme of Urban Farming.
Focus has at once been aimed at the creation of functional frames for the purification of polluted stormwater and delay of the heavy rains simultaneously with the creation of frames for a knowledge mediation of the challenges and processes.
The treatment plant placed at Kjærs Møllesø has the adjacent areas of Kærby and Håndværkerkvarteret as catchment areas and thereby secures some of the most exposed areas from flooding and prevents discharge of polluted stormwater to Østerå.

The design of the treatment departs from Aalborg Municipality's strategies for climate adaption, Physical vision 2025 and the Vision for Østerå by approaching stormwater management with a focus on not only the water technical parameters, but also emphasising recreational values in the context of Østerå - one of six focus areas for the strategy on climatic changes.
The purification process of stormwater has been secured through the design of a plant consisting of two separate sections on either side of Østerå each consisting of three section: A basin for sedimentation, a basin for absorbing the dissolved substance through willows and a basin for removal of the remaining nitrogen and phosphor through algae. The latter two basins add energy and food by-productions of willow and algae to the primary product of clean stormwater. Process and storage facilities for the edible algae harvest are therefore introduced to the programme of the treatment plant. The willow is harvested as biofuel less frequently and as The delay of stormwater is secured by establishing frames the containment of a 5 year incident. The facilitation of knowledge and creation recreational values are combined with the functional qualities of the treatment plant through the design of a mediation walk, visit facilities and outdoor spaces inviting to stay at the banks of Østerå.
The theoretical sections of the thesis form the foundation for the approach to the design of the treatment plant. Departing from an analysis of Urban Farming three characteristics shared by Urban Farming and stormwater management guide the foci applied for the theoretical investigations for the connection to architecture.

The investigation result in the establishment of three strategic parameters: *Dissolution of hierarchy, Experiences through peripheral perception* and *Local and global emphasis of place*. Under the joined strategy of transition these foci point inform the design towards the creation of treatment plant seeking the embracement of natural values by dissolution of hierarchy and borders between culture and nature, emphasis on experiences through sensory perceptions and seeking integration in the context by addressing both local and global considerations to the site.
The strategic parameter of *Dissolution of hierarchy* permeates the design of the treatment plant as the domains of the water in changing manner interferes with the domain of the buildings and especially the mediation walk through the treatment plant.
The strategic parameter of *Experiences through peripheral perception* influences the design as knowledge mediation is sought through bodily experiences of the water throughout the entire treatment plant: Inquisitiveness to and dissemination of knowledge is emphasised through sensory perceptions of the stormwater.
The strategic parameter of *Local and global emphasis of place* has influenced both the approach to the design and the design of the treatment plant as the global and more intangible challenges have been addressed concurrent with the consideration to the tangible local characteristics and challeges of the site.

By utilising the strategy of transition of the treatment plant displays how Urban Farming can contributed to not only a development of contemporary architecture, but also to a distinct architectural expression and experience; the focus on the strategic element of transition has also shown how architecture can move Urban Farming beyond its traditional borders.
Through the theoretical sections and the design of the treatment plant the thesis has displayed how architecture, stormwater managent and Urban Farming together can contribute through focus on transition in a holistic answer to the climatic challenges.

Long thesis

The task of writing a long Master's thesis has been significantly different from the previous one semester projects completed during the education at A&D: The simple aspect of the duration has had influence on both the theoretical section and the design process. The extended project period has provided an opportunity for extended reflection in process: The theoretical sections were to be concluded at the end of the fall semester and a draft for the theoretical sections was therefore ready at the end of the semester. From this point the reflection on this part of the thesis was naturally not stopped causing challenges during the spring as the knowledge of the theory was to be applied in the design process, but at the same time the possibility for alteration of the theoretical parts was present. The number of iteration in between the sketching phase and the analysis phase of the IDP has therefore by far exceeded previous projects. As a consequence of this the theoretical section has during the spring been reduced to 2/3 of the written material in the process of condensing the theoretical section and creating increased foci in the sections. The sketching phase has therefore informed the analyses phase towards the formulation of tangible strategic parameters. The process of the thesis can with this in mind be divided in three periods: A period dominated by theoretical work, a transitional period and a period dominated by design where the transitional period has been extended in comparison with single semester projects. This extension has undoubtedly strengthened the project however there has been a disproportion between the first and last period as the theoretical period dominated the first semester while the transitional period and the design period both has been placed in the second semester. As a consequence of this the design has evolved over a shorter period of time and therefore the possibility of reflection in process has been reduced for the design period. This could have been avoided if the transitional period had been forced further back into the course of the first semester – which ultimately could have provided a more equal relation between the theory and the design.

REFLECTION

Stormwater management

It became clear during the fall semester that it was difficult to contribute with theoretical considerations to stormwater management on theoretical level matching the level of architectural theory that five years study of architecture after all form the basis for. The difficulty of escaping a perfunctory theoretical level contributed to the establishment of the approach of focusing on the three characteristics of Urban Farming and stormwater management. As a consequence of this neither of the two is held together as a whole with architecture. The approach was applied to secure an elaborated display of the connection to architecture, but as consequence of the tripartition the display of the connection also becomes more indirect than an explicit comparison. The implycity of the tripartition could therefore have been complimented with e.g. case studies of best practice to facilitate a more explicit connection.
The amount of time it took to approach the field of water engineering was underestimated however this process has however been chiefly beneficial in spite of what in the process has been experienced as study with no outcomes other than delimitations: The engagement into an unknown field of knowledge has underlined the interdisciplinary character of the A&D -profile and the ability and tools to engage in unknown areas has in through this process been strengthened. The learning process connected to the engagement in stormwater management has therefore not been limited to the actual stormwater management, but also includes an increase of the ability to obtain knowledge from unknown theoretical territory.

Integration of technical parameters

With the embracement of the water engineerical aspect connected to stormwater management the interdiciplinarity of the Integrated Design Process has been further extended: The foci applied in connection to the technical parameters has been to let the parameters inform the design equally. As the traditional technical aspects of the IDP are not excluded this means that the approach to the technical aspects has moved towards an approach of the generalist rather than the specialist – several technical fields has been addressed on more general level instead of a single technical area of investigation. As a result of this the approach has not been one alone standing technical area in center of investigations, but as the aim of the thesis to shed light on the combination of stormwater management and architecture it would not make much sense only to focus on e.g. the water engineerical aspects.
The link between the technical areas have however not reach a level of direct synergy: Water play a significant role for architecture in other climate zones where the water especially is integrated with aim of the cooling effects in warm and dry climates. The possibility for letting the water technical aspects be directly be integrated in e.g. the indoor climatic consideration has been adressed indirectly: The ventilation of the building utilises the by natural ventilation the dominating western wind blowing the cooled air above the basin surfaces to the air inlet of building. The water has also been utilised in the outdoor spaces to create different spatial identities emphasising sounds, temperatures and reflections of light in the water in micro-climatic considerations. However the outer walls of the buildings have formed a perhaps too clear border for the domain of the water as the water never enters the buildings. The thesis therefore has an predominant focus on how architecture can contribute to stormwater management and not how stormwater management can contribute to architecture. The latter aspect could have been further emphasised by direct integration.

Urban Farming as frame

The theme of Urban Farming has naturally has a decisive influenced on the thesis:
As emphasised in the analysis of Urban Farming the process of the production is an important element of Urban Farming; this means that the direct contact to the elements of production is of greatest importance.
This approach to the encounter with the world resonates within the epistemological ground of phenomenology which can be seen i.a. in *the turn to the things themselves* of Husserl and the emphasis of Heidegger on *thingness*. The architectural approach informed by Urban Farming has thus emphasised phenomenological considerations which is easily seen in the choice of theoretician for the thesis. The phenomenological foundation has however also influenced the architectural design where consideration to sensoric and experiential aspects has been a key element: In the design process focus has moved into the domain of mediation of experiences which gives rise to challenges and questions: The need for direct contact with the *things* can be problematic when experiences arise from orchestrated considerations. The danger of creating a scenography emerge – as seen in many examples of the Experience Economy; Pine and Gilmore refers as an example to coffee bars with jungle theme. The danger of Disneyland is therefore latently lurking when architecture enters the realm of intentional mediation of experiences: Nothing is however further from Urban Farming and phenomenology than the settings of a scenography. The decisive difference is the aspect of pretending opposed to being: The approach of covering something to make is appear as something else compared to the approach of uncovering something to disclose the thing in itself. A pivotal success criterion for the thesis has therefore been a constant uncovering of architectural elements with the intent to remove all blurring and unveil the composition of water, concrete and wood as naked elements. In this approach the mediation of the experienced has been sought as an encounter of silence between the subject and object where the architecture is at once mute and suggestive as opposed to vociferous and vapid. In this manner Urban Farming has imbued the entire process of the thesis – both the theoretical part and design part. The frames of the project have therefore not only demarcated the area of engagement, but also guided the narrative of the content.

Litterature

Corner, J. 1999. Recovering Landscapes: Essays in contemporary landscape architecture. 1st ed. New York: Princeton Architectural Press

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