The main objective of my thesis work is to explore the design potential of algae farms as building integrated component. This can be achieved by looking into different photobioreactor systems and algae technologies. The project started with a full-scale urban algae farm, which serves as a prototype for a compact algae farm in a urban setting. The farm is designed to be integrated into an existing building, or stand-alone structure, and is powered by renewable energy sources such as solar panels.

The necessity of changing our industrial infrastructure might also emerge from the necessity of developing a more sustainable building. The algae farm is a sustainable solution as it can be integrated into the building's structure, providing both energy and material savings. The algae can also be harvested for use in various applications, such as biofuels and bioplastics.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.

The project is a part of a larger research program, which is being conducted by a team of researchers from various disciplines. The research program is focused on developing new building technologies, and is funded by a government agency.

The project is designed to be a prototype, which can be scaled up to larger systems in the future. The research program is also exploring the potential of algae farms in other applications, such as water treatment and carbon dioxide absorption.

The project is an attempt to address the need for sustainable and efficient energy production, as well as the need for new building technologies. The algae farm is designed to be a self-sufficient system, which can produce energy and materials simultaneously.
The intention is to involve human and environmental responses to create feedback loops that control the building systems. The public programme is very important, the hypothesis being that this will engage us and influence how the building should react in interaction with its human and unicellular occupants. The solar access is the single most important parameter for a good general design concept. The seawater cooling system consists of two main loops. In the first loop, centrifugal pumps draw cold seawater from the bottom of the harbour, and then circulate the seawater through heat exchangers that are located in the basement mechanical room of the power plant. The warmed seawater is then returned to the harbour floor. The second loop carries the building's cooling water, in this case the effluent from the waste water treatment plant. The mixed value chain concept allows for the production of the experimental, and the (for now) low economic value feedstock or as bio-fuels. Connecting it to a CO2 emission source, in this case Värtaverket and waste water treatment plant, is an additional heating pipe that can be placed. The walls and the foundations are concrete, which has a high capacity for thermal mass heat/cold storing, and all these layered systems are controlled by a control station. System diagram of building:

**INTERACTIVITY - FEEDBACK - CONTROL**

- architectural qualities: high importance
- overground, pbr exposed; exhibitions
- algae lab space type 4
- temperature: high importance
- natural light conditions: very high importance
- overground, pbr exposed; meetings, lounge area
- algae lab space type 2
- architectural qualities: low to medium importance
- overground, pbr exposed; harvest, light lab spaces
- algae lab space type 3
- temperature: high importance

**ENVIRONMENTAL CONTROL**

- architectural integration research
- chemical integration research
- photography research
- production research

**IMPORTANT FACTS**

1. 100 tons capacity tubular system = 80 kg/day
2. 1 gram of algae absorbs ca. 2 grams of CO2
3. That gives a algae medium volume of 500-800 lt for each or 10 times that for the whole building.
4. 10% of harvested algae can be converted to bio-fuels.
5. CO2 emissions can be used as bio-fuels.

**Feedback process analysing current conditions, desired changes and taking into account weather data and weather forecasting which is then aggregated and assessed to decide appropriate measures.**

**Productivity metrics (measured and perceived)**

- alumni involvement as part of the 'building research outcomes'
- sunangles for Stockholm, including in the figure below also the sunangles for other locations with uninterrupted sightline
- arch. integration research
- arch. integration research
- productivity metrics (measured and perceived)

**Phenomenon to be studied:**

- 100 micrometers of algae absorb CO2. 100 micrometers of algae absorb CO2. 100 micrometers of algae absorb CO2. 100 micrometers of algae absorb CO2.

**Additional heating pipes can also be placed.**

- The walls and the foundations are concrete, which has a high capacity for thermal mass heat/cold storing, and all these layered systems are controlled by a control station. System diagram of building:

**INTERACTIVITY - FEEDBACK - CONTROL**

- architectural qualities: high importance
- overground, pbr exposed; exhibitions
- algae lab space type 4
- temperature: high importance
- natural light conditions: very high importance
- overground, pbr exposed; meetings, lounge area
- algae lab space type 2
- architectural qualities: low to medium importance
- overground, pbr exposed; harvest, light lab spaces
- algae lab space type 3
- temperature: high importance
THE AREA CONSISTS OF 80% OF SMALL APARTMENTS. YELLOW HOUSES, VIOUSLY CHARACTERIZED THE
THIS WAS THE FIRST TIME
OUR CITY IS ALREADY
SITE BEFORE 1:4000 - annotate photos from and typlogies, topologies etc.

STOCKHOLM WIND DIAGRAM

THE VISION 2030
AND THIS POSITION WILL BE MANAGED AND ENHANCED.
ROYAL SEAPORT IS UNIQUELY WELL PLACED TO BECOME AN INTERNATIONAL MODEL FOR SUSTAINABLE AND QUALITA
NATURE, WILL BE A VIBRANT AND VITAL PART
LINKS TO KEY ROUTES THAT LINK SOUTH AND NYNÄSVÄGEN WILL PROMOTE EFFECTIVE CONTACTS TO THE SOUTH.

HISTORY OF THE AREA
HUSARNE AND SÖDERHUSARNE. THE ISLAND WAS QUITE HILLY AND HAD A SMALL FERTILE
IT WAS SURROUNDED BY WATER. ACCORDING TO OLD MAPS FROM THE END OF THE 17TH
AREA. THE ISLAND'S NAME COMES FROM THE PLURAL OF HOUSE, HOUSE, AND LEFT IN
FEATURED DEER PARK WAS IN THE 1100'S, AN ISLAND NAMED HUSARNE WITH VILLAGES
BEFORE THE FIRST REGULAR ROWBOAT FERRY LINE WAS INTRODUCED AND BEFORE THE
ROPSTEN HAS BEEN THE COMMUNICATION CENTER FOR THE TRAFFIC BETWEEN STOCK
STEN AND LIDINGÖ AND THE MAIN PORT FOR STOCKHOLM WAS BUILT IN THIS AREA FROM
SETTLED ON L

FUTURE PLANS FOR VÄRTAVERKET

THE BUILDING BY USING I.E. CENTRALLY PLACED TELEVISION SCREENS, HELPING TO RAISE AWARENESS OF THE POTENTIAL
T
NICHES, AND COSY CORNERS, INVITING BOTH STOCKHOLMERS AND PASSENGERS FOR A STROLL OR RELAXING MOMENTS,
PORTS. AT THE SAME TIME, THE TERMINAL HAS AN AMBITIOUS SUSTAINABLE PROFILE, CHARACTERISTIC OF THE ENTIRE
GYMS, CINEMAS, CONFERENCE CENTERS AND HOTELS. IN ADDITION, THE CULTURAL SCENES IN MUSIC, ART, DANCE AND

Date: 1st January - 31st December
**Study 1.0 - basic**

**A6**

**Basic configuration of a facade build up from standardized modules, each eventually aggregated and assessed.**

**Atrium style rather than outer facade? Wall vs. roof**

**More dynamic, following and/or shaping and orienting building.**

**NON-ADD-ON SYSTEMS**

Early basic studies, from the photobioreactors as facade add-on, to tests of a more architecturally integrated approach.

**P8 Restaurant/cafe**

**P7 Reading room - small library and study spaces**

**P6 Experiment rooms - science centre experiments**

**P5 Exhibition halls, situated at each end of the volume, are connected by a movement loop through the labs where you move between real world industry and the experiments and exhibitions featured in the science centre.**

The algae building is multifunctional, but its first and most important programmatic feature is integrated into, and eventually aggregated and assessed.

**A7 Flexible space for lab scale tests of different production systems can be compared during the year under identical settings, to observe effects on the algae species and their specific qualities.**

**A5 Start up cultivation room**

**A4. The control room.**

**A3 Offices.**

**A2 Conference spaces**

**A1 Open laboratories**

This includes:

**1 Partially open and independent and can be put to disposal for anyone with an interesting project for applied research.**

**2011 | KTH studio 11 Architectures of Interdisciplinarity | Subversive Resilience**

**Anna Teglund**

**PROGRAMME**

The algae building is multifunctional, but its first and most important programmatic feature is integrated into, and eventually aggregated and assessed. This includes:

**101 Exhibition hall 1 - Visitor centre for Värtaverket**

**P2 Exhibition hall 2 - colour centre for the Architecture/alga building**

**P3 Exhibition room - multipurpose for the algae research**

**P4 Exhibition room - science centre experiments**

**P5 Exhibition space - change center experiments**

This includes:

**1 Flexible space for lab scale tests of different production systems can be compared during the year under identical settings, to observe effects on the algae species and their specific qualities.**

**2011 | KTH studio 11 Architectures of Interdisciplinarity | Subversive Resilience**

**Anna Teglund**

**METHOD AND PROCESS**

The basis of my project is design. Architecture as a practice deals with physical shaping of spaces, but it also deals with ethically, environmentally, or other concerns as a driver. With this in mind, the methods applied should ideally be derived from a classical design methodology. But it is also research-driven and testing the hypothesis that algal cultivation can be a mutually beneficial if integrated into architecture, in an urban setting. But even when testing a simple question to research and investigate architectural method base on these reflections require continuous process for feedback and design evaluation. This is the result of the hypothesis against get feedback data from.

**Considering this, it is a very design-driven approach. Feedback loops, revised and parameterized, applied to observe the design is accordingly, important.**

The question is: How can I create an adaptable building that can flexibly adapt to changing requirements, both functionally and aesthetically? The goal is to create a building that can change its form, function, and appearance in response to user needs and environmental conditions. The building should be capable of evolving over time, adapting to different functions and uses. The design process involves iterative testing and analysis, allowing for continuous refinement and improvement. The building should be designed to be adaptable and flexible, allowing for changes in function and use over time. This approach involves a combination of experimental and analytical methods, using data from various sources to inform the design process. The design process is iterative, involving multiple rounds of testing and analysis.
Intersection principles

The two main massing volumes, in cross-section a catenary arch, divides and articulates the main spaces in the building. Where these meet and intersect, a bridge over the building is located. This bridge leads people through the area or into the algae building. The streams of CO₂, O₂ and H₂O are located inside this bridge.

Three different principles of intersection are used for how the structure comes down to the ground; either as beams, opening up the two spaces to each other (A); as  concrete foundation as the bridge walls are allowed to continue all the way down (B); or as a hybrid where to one side the beams are visible but where the other side has solid walls (C).

A   B   C

0  M  1M  2M  8M

Section scale 1:50

UV-resistent glass facade

Steel structure

d=400mm

Tubular PBR

PVC plastic r=50mm

0  2M  4M  8M

Section scale 1:10

Artificial LED lights

Component layering

The photobioreactors are located closest to the participant moving inside the rooms, as to achieve a 3dimensionality and to really integrate them, letting these tubes shape and affect the spaces they encompass. They hang from the carrying diagrid structure, that also carries the outermost skin that is the triangulated glass facade. Installations that can not be located within the concrete walls, such as lightning fixtures, are also fixed to the beams, following the angled direction of the diagrid.

STRUCTURAL PRINCIPLES

The shape of the building, in particular the important south facade is crucial to be shaped so as to be exposed as much as possible to the sun. A horizontal massed arch generally has a higher use access level than a vertical, thus this shape is chosen. However, this shape also makes sense for the way it is stripped out of the bio - and this is the functional reasoning for the ‘blob’ shape, to go with the just as important formal reasoning.

The basics of a hanging chain

The two main volumes then each have a shape in which the cross sections take on the catenary shape. Arches and vaults are characterized by a thrust whose intensity and angle may disturb the stability of the whole. The thrust is the resultant of two forces: the weight of the voussoirs and the horizontal thrust. Thus, the thrust always points downwards and is the intensity of the horizontal thrust is generated by the weight of the voussoirs, which rest on each other, and the balance of the arch. The flatter the arch is, the more intense the horizontal thrust is. Arches can have various shapes and sizes, but the line of thrust always follows the shape of an inverted catenary curve, which is the cross section that forms the shape of the building.

A catenary is a curve formed by a uniform, flexible chain hanging under the influence of gravity. The centre line of the link, the line of tension, is an arch, the line of thrust is the line of compressive stress and forms the shape of an inverted catenary.

Diagonal bracing and structural expressionism

Combined with the structural efficiency of the catenary cross-section, the volumes are carried by a diagrid, a diagonal grid structure. The diagrid provides an unhindered flow of the load from the structure to the base while allowing the formation of various complex shapes and instabilities. Because of the use of diagonals this structural system more effectively resists sway and torsion than orthogonal systems, resulting in structural material savings and at the same time giving the opportunity of structural expressionism.

In this case, the diagrid is stressed and angled as to emphasize the shape of the volumes. Together with the PBR, the diagrid will define the visual in a way ornamental patterning of the building skin.