The Design Process

A critical view on the design process

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Preface

This report is part of the graduation lab of SADD (Strategic Architectural Design Development), which focuses on architectural design development combined with urban design development and building technology development. The aim of this lab is to get a better understanding of the design development. The graduation lab ‘Strategic Architecture Design Development’ teaches students to work not only on the development of ideas and a conceptual design but also to seek strategic design input for this design development.

The design project is the UN Headquarters of Sustainability, or UN Environmental Council (UNEC). This will be the home-base for international coordination of sustainable measurements.

This following report is a reflection of the design process that I used during this design course. By discussing a specific topic I will try to explain how my design process works and if it was satisfactory.
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Introduction

SADD Studio
The graduation lab "Strategic Architecture Design Development" teaches students to work not only on the development of their ideas in a conceptual way, but also to seek strategic design input for the development of the design. It is the goal that student will experience making decisions in the design development on different levels and scales and learn to make the right decisions on the right moment.

UNEC - United Nations Environmental Council

Sustainable developments and measurements are being taken all over the world, in all sorts and kinds. Still many steps need to be taken and conflicting interests need to be solved, but the awareness and care for our environment has never been in better shape than today. This is a very promising and challenging development that would only work much more efficient and effective, if it were coordinated worldwide.

The UN Headquarters of Sustainability, or UN Environmental Council, will be the home base for this worldwide coordination of sustainable measurements. The UNEC can improve the global sustainable issues by its power to combine knowledge of the environment, technology and economy and supplying its product over the world in a political way and in an advising matter, through individuals, companies and governments.

This knowledge consists of four different entities:

- Collect: collect research material and publish reports;
- Produce: produce the policy for propagate and exchange of knowledge and reports;
- Propagate: propagate the knowledge to citizens, corporations and governments;
- Exchange: exchange knowledge with countries, regions, and science and commercial parties.

Problem statement and goals for the project

Problem statement:

- The UN Environmental Council will host different groups of visitors, like tourists, delegates and Employee’s of the UN. How can these different flows be separated within the building in a clear way?
- The building is the UN Environmental Council which deals with environmental and sustainable issues. The building should have elements of sustainable design.
- Within New York many buildings are built vertically. How can we design a building which is specific for this site. The structure of the city of New York is strict and the area of the United Nations is an exception to the grid structure within the city. The building should have a clear position within the urban context of the location.

Goals:

- The urban design must be a valuable addition to the public life of Manhattan;
- The urban design should give access to the waterfront;
- The building should have a clear position within the urban context of Manhattan;
- The building should have a clear and strict division between public and employees/delegates;
- Because this building is headquarter of the UNEC it should be considered towards sustainable designing;
- The building should contain unique and special places;
- The building character should be strong and authoritarian towards the international and local community.
Design Methodology

Studio’s methodology
The making of any architectural work starts with an idea. However, between the first notions and the final work lies an ocean of possibilities and choices. Design Development is about recognizing those possibilities and making the right choices, using the right tools and input, at the right moment, on a proper scale. As such, the design develops energetically and smoothly, and the work acquires a clear, mature coherence and expression. The chair of Materialization emphasizes the importance of the craft to develop ideas from paper to material reality.

In the basic circle of methodical approach, at beginning, after the analysis and the goals and starting points, it also uses the method of “black box” and the brain storm for the development of the design ideas. And after the reflection of the phase one, comes to the phase of divergence, develops diversity of the principle solutions for the project. In the phase of convergence, need to predict if the solutions and formulated criteria out of the goals and need to check if they still follow the goals and the starting points of the beginning. And after the process of refine in the convergence, decision needed to be selected and the most important criteria needed to be checked again if they still reach the starting point goals.
Research for sustainability

In the framework of the studio I needed to get a better understanding of the general principles of sustainability and what it means for me as a designer. Within the realms of sustainable design there are many directions that a designer can take. With this research I wanted to portray the vision and means that I think could work and could be useful in a design process. It is important to use all the mentioned techniques and organizations in a balanced way. I say this because the sustainable experiments that are developed in the current architecture climate mostly are focusing on singular interventions of sustainability and this could cause a less sustainable building in the end.

What is sustainability?

The definition of ‘Sustainable’

The most used definition is that of the Bruntland commission from their report of 1987: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

The main objective for a building is to provide an environment that is protected from the elements, this environment according to the Bruntland commission should continue to protect without having a negative effect on the environment. For us this definition means that a building development is usable for the time which it is designed and constructed, but also will be usable or re-usable for next generations.

Contemporary views

The first oil crisis and the report of the club of Rome were a turning point. We discovered that the oil supplies weren’t endless and that raw materials could also run out. A new awareness was created, the awareness of thinking sustainable. This became apparent in the 70’s when the emphasis lay on the ecological aspects of environmental thinking. In the 80’s and 90’s the energy efficiency was the main focus, limiting the damage.

Ir. Kees Kaan sees the current time of modern architecture in a state of climate autism. He claims that a building is a sovereign object with a autonomous climate. In the last 150 years we aren’t designing with contextual values like orientation, wind directions or seasons. The shape of a building, the type of facade, the use, everything is free for interpretation. Everything is possible with the right installation.

Ruurd Roorda describes in his "great spaces" article that there are three important criteria to a building in order for it to be sustainable in a architectural sense, ‘Robustness, excess and the presence of a ‘great space.’ The robustness makes sure that the buildings aren’t used up, worn down or have collapsed. Because of the excess, a building can be used for multiple purposes throughout its lifetime. Excess can lead to a purpose that has long surpassed the original program and concept, for which no program could have been written.

Great spaces are grand, valuable inner spaces that are overwhelming by their beauty or trough their other quality: the ultimate. Because of the universal experiences that these inner spaces provide, they become sustainable and are conserved.

Contemporary architectural firm BIG, also presents an interesting point of view. Bjarke Ingles of BIG states that functionalism and modernism were driven by rational analyses and the art of engineering, it focused on analyzing what qualities a building should provide and subsequently solving each one of these requirements individual. Gradually a larger and larger portion of the construction budget was spent on installations, and a larger budget to run these machines. According to Bjarke Ingles
this results in boring boxes with big energy bills. Bjarke thinks that a new wave of functionalism is possible, not based on accumulating machines but rather shaping buildings and choosing materials so the inherent properties of the architecture will provide the necessary qualities.

The contemporary views provide us with sustainable architectural directions. Kees Kaan states that nowadays there are no contextual preconditions within architecture. Roorda describes possible tools for designing a building to give it sustainability. The building needs to be over dimensioned in structure and layout in order to be flexible and should consist of a uniqueness quality to make it special enough to withstand the ages. In addition to this Bjarke Ingles suggests that a building should use it’s context and shape and organization to achieve the right technical and architectural quality.

**Sustainable possibilities**

In order to make sustainability more precise I tried to introduce possible techniques that could be implemented into a building design. Before I can do this it is important to create a list of aspects that will help me to divide the possible techniques. These aspects have a relation to the contemporary views of Kaan, Roorda and Ingles.

First of all the individual and combined energy qualities that buildings can have and secondly the building as a whole, how it’s energy is dealt with, what is the durability and what is the adaptability.

- The energy of buildings on a larger scale;
- The energy of a building on building scale;
- Technical solutions

For this paper I will explain the energy of a building on building scale because this is most relative to my design. In the original research the energy on larger scale and the technical solutions are also included.

**The energy on building scale**

When zooming in on the building level a couple of topics are important. The pursuit of energy conservation, which we discussed earlier on, durability and adaptability. The main objective of building design should be to provide a building which meets the requirements for functionality, durability, adaptability, energy conservation, and aesthetics in a balanced way. This means that the pursuit of one goal should not compromise the possibilities of achieving the other goals of the building design.

In order to quantify the afore mentioned fields of building design the following topics will be handled.

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Durability and adaptability

Spatial issues: flexible planning of the layout

The layout planning means the placing of activities in a particular position in the building and taking in account the relationships between the different activities, main communication routes and the individual environmental requirements for specific activities. When planning for adaptability you take in account that the layout of the building can change and even the whole function of the building could change. This means that the design of the layout is to be considered as one of many possibilities within the building plan. To achieve this there are a couple of design preconditions:

- Avoiding too tightly designed spaces which accommodate only present day requirements. Both the plan surface and floor-to-floor height need to be considered. The plan depth and floor-to-floor height should be optimized regarding the day lighting and natural ventilation in order to reduce the need for electrical lighting, mechanical ventilation and air-conditioning.
- Vertical communications and vertical ducting of services should be located in such a way that horizontal communication and distribution lines are not too long, and that they are not an obstacle in the reorganization of layout.
- Wide structural spans will allow a flexible layout, but then the structure needs to be robust and to be designed for extra loads. Robust structure is also designed to cope with known hazards considering both risk and consequence.\(^7\)
- The initial building use may not require very complex and sophisticated services. However, adaptable buildings should have the spatial capacity for the installation of new services, if needed in future.\(^8\)

Design of the building envelope for durability, adaptability and energy conservation

In the process of defining main spatial, structural and services parameters, the building envelope also needs to be considered. Design of a building envelope to be durable, adaptable and which will contribute to energy conservation needs to consider the following:

- Good design of details which affect durability. Apart from robustness, good detailing contributes to the durability and appearance of buildings. For example, water penetration is the main cause of faults in buildings. This can be prevented by good detailing of the roof and eaves, building envelope, windows and exterior doors, basement walls and floors. Special care is needed in designing the joints between building components. In addition, building components which have mechanical parts (for example, movable shades for passive solar systems) and which are regularly used need to be very robust and simple to operate.

- Specification of durable and maintainable materials and components for the building envelope. Poor exterior appearance of a building may decrease the building value and contribute to its early obsolescence.

- Design of the building envelope for adaptability. Modular elements which allow changing of solid and void/glazed surfaces on the building envelope can contribute to better adaptability of the building interior. Extensions to the building may be easier if the building envelope or some of its elements can be easily demounted.

- Design of the building envelope for energy conservation. Adequate U-values, shading against overheating, double glass skin for natural ventilation, use of thermal mass for passive
solar heating systems, and other strategies for energy conservation can be applied in the design of the building envelope.\textsuperscript{9}

Energy conservation and (durable) generation

Within energy efficiency, there are two general approaches: conserving energy and generating energy. These approaches used together provide the opportunity to reduce the energy demand from the commercial grid. In order to conserve or generate durable energy there are different techniques possible. We will describe some techniques that are used in the current building practice.

Energy conservation

Thermal mass of the structure or building envelope as regulator of thermal behavior of a building
Thermal mass will provide a building with the ability to absorb the sudden input of solar gain. The energy stored in heavy weight walls will help delay the demand for heating as the outside temperature drops. And the thermal mass also slows down the overheating of a building, and if overheating occurs the fall of night can provide the cooling down of the building.\textsuperscript{10}

Solar orientation
For a building to effectively use thermal mass for solar gain or for insulation, it has to be orientated advantageously. This means that the best orientation for a building is with its major axis running east-west, so that it can have passive solar apertures facing south and offer an insulated barrier with fewer openings to the north.

Surface to volume ratio
A factor as fundamental as a building’s overall mass and shape can be significant as well. Since heat loss and gain occur through the building’s envelope, it follows that a building that has less exterior exposure will be more efficient. The goal is to have a low surface to volume ratio, that is, as little exposed surface relative to the amount of interior space as possible.

Insulation
It is important to insulate a building skin as much as possible. This is to prevent heat or cold to escape or penetrate. What in its way reduces the need to cool or heat with energy using installations.

Reuse and collection of water
Water reuse systems can be deployed within a building that are using recycled water like the toilets. And rain water collection can be useful to reduce the stress on the urban water system and when treated the water could also be used in the building systems like the toilets.

Mechanical systems
Even super insulated passive solar buildings usually require supplemental mechanical heating and cooling in most regions of the world. With these building especially, controlled mechanical ventilation is needed in order to inject fresh air into their tight envelopes. Providing thermal comfort and maintaining indoor air quality beyond what can be achieved by passive systems are, in most types of buildings handled by HVAC systems. Heating and cooling are among a buildings most energy intensive functions. One way to diminish the energy needed is to move heat rather than to create it. Heat pumps can displace the energy from one location to another. The excess heat from for instance outside can be stored and use for winter and vice versa. And the excess heat or cold can also be extracted and stored to be used at another time.
Energy generation

Solar thermal collectors
Modern solar collectors circulate fluid through a series of heat-absorbent tubes, often covered with glass panels. The fluid is heated by the incoming, absorbed sunlight and used either directly or indirectly for hot water or space heating.

Photovoltaic's
PV panels use solar radiation to generate electricity which in its turn is fed through a converter or transformer to supply a building with electricity.

Wind energy
Expansive wind farms with wide blade turbines fanning out over dikes, fields or oceans are a icon of renewable energy. The smaller turbine that can be used at building scale is still a improving technology. But likely the cost efficiency and the energy effectiveness will increase in the near future. And when the cost and effectiveness is balanced out these turbines can start generating energy on the smaller building scale.
Facade development

As a case study I will use the design process of my facade.

Phase 1 Exploration

The first stage of the method is the "Exploration" one where provisional analysis, goals and starting points are generated. Analyses are dry and factual and avoid every form of seduction or evocation but they are crucial to the gathering of a lot of valuable information based on which the architect will base decisions at the following phases. If a design features a location, it has a material (spatial, ecological, technical) and a social (economical, cultural, political) context. To be able to gather this information the architect needs tools and techniques so that he can extract only the important part he needs from the immensity of data available. As such can be regarded tools like diagrams, schemes, reduction drawings, sketches etc. Diagrams are especially useful for identifying the limits and character of the territory in which the design is situated, the trick is to use the diagram to define the limits of the area that you want to involve in your design. Further by making diagrams of the surface area and the net, gross and tare space, and doing studies of the measurements systems and ordering grids, the brief can be tested and deduced. For the topic that I have chosen to illustrate my process is have used a couple of general functions that a facade should serve.

It defines the architectural appearance of the building, provides views to the inside and outside, absorbs push and pull forces from wind loads, bears its self-weight as well as that of other building components. The façade allows sunlight to penetrate into the building while usually providing protection from the sun at the same time. It resists the penetration of rainwater and has to handle humidity from within and without. The façade provides insulation against heat, cold and noise and can facilitate energy generation. The sketch shows the complexity of the requirements to be fulfilled. These requirements need to be considered during all phases of the façade construction: during the conceptual phase, while working on the principles of construction, during detailing and lastly during construction. Basically I desire a structure that is as simple as possible yet carries out all these functions and is adaptable to changing influencing factors. It should be an adaptive envelope similar to the human skin, fulfilling several functions of the body. Today’s façade is based on developments spanning several millennia. The solutions currently in use result from tried and tested construction methods, the materials available and traditional production and assembly processes.
Phase 2 critical reflection

During this stage the designer uses the knowledge gathered from the first stage to strictly define the starting points, the problems and goals of the design. Important part of this stage in making it a cyclical one is the fact that critical reflection is appropriate on the devised starting points and goals using input also from latter stages of the method. This means that the information gathered and processed later will be used again to strengthen and sharpen those goals. The techniques appropriate here are similar to those in the first stage to which I would add text as a tool to bring better clarity in the aims, ambitions and values the designer has for the design. Nevertheless, words and their initial associations can bring about a new step in the design process only if they assume visual or spatial form. One way to do that is through models and sketches as they can be used to capture essential impressions for developing formal ideas, exploring massing possibilities or investigating a concept. Another very useful techniques is a mood board as it helps to research and express the intended emotional values of a design concept and the identity of the space. Precedent analysis also serve a great purpose as after a number of design researches in varying contexts have been carried out, one discovers a complex of characteristic properties, typical for a class of buildings, independent of context. From the first phase on I knew the basic principles that were demanded in designing the building facade. From these principles I derived subjects that were important for me as a designer and sharpened the focusing points that were going to be leading in the development of my facade design. For me these subject were composition, the face of the building which is the first encounter that the spectator will have in approaching the building. The orientation, the amount sun of penetration of the facade and the measures that you take to optimize this. The materialization, a little brother of the composition that helps to you convey a certain character that the building could have. The production, where all the components of a design come to a focal point, protection against water, wind, sun, load bearing etc.

In the images below we can see the different topics that are guiding in designing a facade according to Ulrich Knaack.
Phase 3 Divergence

The next phase Foqué calls "Divergence" and through it he suggests that as a reply and a consequence of the established in the second phase critical values and problems the architect should come up with a number of solution alternatives. This way a lot of ideas and concepts are generated which, even if they are rejected, at this 'loop' of the whole process they could be used in later stages. An important issue here is that the architect makes sure that a broad field of options is explored, options that come from different sides of the spectrum. By doing that you can keep an open mind when taking a decision and prevent 'getting used to' one of them. To come up with such ideas the architect can use inspiration from precedent projects and further, to demonstrate them, I can use sketches, physical models, 3D models, CAD-drawings, text etc. During this stage I developed solutions to the main issues set out in phase 2. The composition, the orientation, the materialization, the production.

The composition
For the composition I wanted to create several options wherein I could test a generic facade. This was important because a generic facade can work well within a repetitive production method. The choice for a repetitive production method will be made further on in the design process but because I switch between the level of production and composition I can make a decision here. By doing this it gave me information to make choices and make decisions that would influence the building design on different scale levels. Furthermore I tried to compose the facade in a way that it would have the most energy sufficient ratio between transparent parts and closed parts.

In the images shown below we can see a piece of the different topics that I researched within field of composition.
The orientation

The orientation of a building can provide valuable information that can influence the design of a building. In the most extreme manners there are architects that purely design in a vernacular way. I think that the context and orientation is an element that a designer can use to his advantage to create and design a building that can be more connected and have a more stable foundation in its surroundings. For the facade design I researched that sun paths and the sun angels and the effect they would have on the amount of penetration of sunlight into the building.

In the following images I illustrated the approach that I have undertaken to analyze the sun, orientation and its consequences for the facade.
The materialization
Within my designs I primarily try to implement materials that will have the least impact and have the smallest energy embodied footprint. The choice of material however is never based merely on the footprint that is has, I experienced many factors that influence the material choices. For my facade the material choice had a strong connection with the way I constructed the facade and the way I wanted the facade to appear. A goal for my building design is that it should appear authoritarian and have a strong character towards the international and local community. For me this meant that the building color and the building itself should be powerful and distinguishing. For me the color black immediately arose. This color has the quality to distinguish itself from its surroundings, and that is a quality that I wanted to achieve with my building. The final cladding material choice fell on a black composite material that is made of recycled plastics.

The production
Within the field of construction there is a strong relationship towards the materialization. Like I mentioned before a chosen material should have a small as possible impact on it's environment. This philosophy also played a large part in constructing the facade. The research produced for the construction methods gave me starting points towards a preferred construction method and the composition gave me insights into the possibilities of creating a repetitive element. Within the design process for the production of a facade element I wanted to include a durable and renewable element. This narrowed down the possibilities for production for me. Also the local possibilities in construction gave me reasons to choose a certain production method.
The facade elements that I eventually designed are built up with a wooden frame that is cladded with a composite recycled material. The preferred method of construction within the USA is timber framing, this is because timber construction is cheap, fast, fairly easy and renewable. These aspects were very convincing to me when I made the choice for the main construction of the facade element.

Below we see the structure sequence for one facade element.
Phase 4 Convergence

At the next stage, the "Convergence" stage, an evaluation takes place of the different solutions by predicting their consequences and comparing them so that the number of choices can be limited to let us say three options. A parallel activity during this phase is the formulation of criteria out of the goals stated in the second phase together with the results of the consequences analysis. Further, the latter is used to sharpen the values and objectives formulated at the second phase in which way the interaction between the different stages is provided for. All this preludes the final stage of this method where the best option is chosen on the basics of an extended test of the three models to the most important criteria. The cyclic character of the method is represented mainly in phase two, three and five where a cross-evaluation is performed between the topics involved and a correction of issues such as starting points, goals, values, criteria and concepts takes place. Being part of a wider cyclic system this same approach can and should be used as well at the level of, for instance, developing the design’s main shape as at the level of a detail 1:5 and they both will influence each other. Of course this process method is more or less an ideal situation and using it does not guarantee on the one hand a smooth development with problems or delays or on the other that it will lead to the 'perfect' design. What it offers is, though, a very good basis for a wide and extensive exploration of a problem and the possibility for self evaluation and critical approach to one’s own work at regular intervals. For the facade design this phase almost blended together with phase three because within the development of alternatives and choice of materials only few possible combinations remained. And within these possible combinations the choices in material, construction, production influenced each other in a way which narrowed down the possibilities to a minimum.

Below we see a refining of the facade element in relation to the right ratio between open and closed in order to achieve a balance between composition, energy reduction and natural daylight penetration.
Phase 5 Decision

The final version of the facade was a combination of calculating the right ratio, choosing the right material and picking the right construction principle. When all these elements were combined the facade really fell into place together with the appearance and the character which I set out to achieve for the building.
Reflection

Before I started the SADD studio I didn't expect to be guided into a way of designing that would fit within my thinking process. I have to admit that at some points it was difficult to create alternatives when you feel that the design that you made for a certain component is the right one. But obviously when the word "feel" appears we tend to lose contact to the scientifically part of our education. And that part, I think, will always be difficult to quantify or to qualify within this field of study that we have chosen.

It is my opinion that the design process can be guided by ways and methods of approach, but ultimately a large part creating a concept, I think, is emotion. And on the other hand the process of developing a building from concept to laying bricks is so constricted by many factors. To mention a few that we don't even hold into account in this studio, budget, client wishes, economic circumstances, office capacity, planning, which eventually will make decision making harder or easier. Ultimately I am very satisfied and exited that I have chosen this studio and this way of designing. For me it gives a great pleasure to have some insight into my thinking process and the way that I can deal with certain design topics. The goal therefore will be to expand the research into my own design methodology and process throughout my professional life. I hope that I will be able to achieve this because often in an architectural practice it is difficult to create time wherein one can analyze and develop these topics. But for now I will keep this ambition and aim for the most.
notes

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