REFLECTION PAPER

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Prologue

What is sustainability?

This question derives from the observation that the term sustainability in the built environment is often accompanied by numerous issues and uncertainties. The majority of the time sustainability is addressed in a later stage during design development, which often turns out to be too late. Contradictory when the sustainability issue is addressed in an earlier stage or serves as a starting point for the design it often leads to an unattractive stereotypical architecture. In other cases a sustainable solution is perfectly integrated in the architecture of the project itself, but this solution is then not validated by rating systems because it can not be calculated within these systems. In the worst case scenario's these kind of solutions are then replaced by more conventional and less appealing alternatives to receive a higher benchmark rating. So how does one define sustainability? There are many different definitions for sustainability from multiple fields. Dictionaries alone provide more than ten meanings for the word sustain, the main ones being to maintain, to support or to endure.[1] In broad context the most quoted and also the most clear definition of sustainability and sustainable development comes from the United Nations. On the 20th of March in 1987 the Brundtland Commission defines sustainable development as: *“sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”*[2] *This definition was directed at people, planet and profit.*

Lack of authority

The United Nations headquarters along Manhattan’s East-river in New York houses the general assembly and three specific councils, the security council, the trusteeship council and the economic & social council. These councils mainly aim on two aspects of the Brundtland Commission namely, the people and the profit. Although the UN has implicated sustainable design initiatives around the world, the increasing climate change and its negative effects on our environment are currently not addressed by a worldwide authority. The sustainable development programs of the UN are currently fragmented and divided over all the councils and separate organisations which means that the problem doesn't receive the attention that it deserves. In order to overcome this fragmentation the United Nations should have a specific council for environmental aspects, the United Nations Environmental Council (UNEC). UNEC will be a new council building within the United Nations territories in New York. Supported by a network of sustainable embassies UNEC will give the problem the attention that it deserves and will be the coordinating entity to solve environmental difficulties in energy, waste, pollution and biodiversity. It needs to be an icon of sustainability that will represent the necessity for sustainable environment.[3]

1 Onions, Charles, T. (ed) (1964). *The Shorter Oxford English Dictionary*. Oxford: Clarendon Press. p. 2095.
2 United Nations General Assembly (1987). *Report of the World Commission on Environment and Development: Our Common Future*. Transmitted to the General Assembly as an Annex to document A/42/427 – Development and International Co-operation: Environment. Retrieved on: 20-05-2012
3 Bennekom, H. v. (2012). *SADD Reader MSc 3/4 Architecture*: Chair of Materialisation.

Figure 1. overview of the United Nations headquarters

The relationship between research and design

Security

The design task for UNEC contains security challenges internally as well as externally. After the attack on the WTC towers in New York on 9 September 2001, the security of the UN compound was strengthened because this building compound also classifies as a potential target for terrorist attacks due to its authority, its influence worldwide and its symbolic representation. One of the main security implications is a screening tent for visitors in front of the monumental general assembly. Needless to say this is functionally as well as architecturally not the most promising solution. In order to cope with this issue a new security border was designed which was integrated in the architecture of the compound. Research was done on new security systems ranging from people scanners to various degrees of separation. The most important study regarding the security of the complex was analysing what exactly happens during the General assembly when al the world leaders are in the same place. During this event the direct surroundings are under lockdown by homeland security. Roads are blocked and barricades are placed. The delegates are housed in different hotels in New York. A large portion of the VIP's stay at the Waldorf Astoria hotel. The routes of the motorcades from the hotels to UN are never the same. After investigating these aspects a new division was made on the plot.

The result was a partially opened plot which houses a public accessible park, the surrounding building entrances contain security checkpoints with advanced people and equipment scanners. These scanners can scan up to 300 people in an hour without any privacy issues. The internal checkpoints replace the hideous security tent in front of the monumental general assembly.

Figure 2. security tent in front of the general assembly

Furthermore the compound is exposed to car bombs under the council building due to the FDR highway underneath the structure. This is a risk that has to be resolved on the scale of a new master-plan for the area surrounding the compound.
This new masterplan had the potential to not only eliminate the risk of a car bomb from the highway but also to create a more fluent traffic flow between the city and the FDR by moving the FDR into the East-river as an underground construction.
Furthermore this master-plan is linked to another master-plan called the Manhattan Greenway which is a public green strip around Manhattan's shores.
In order to establish a link between the two master-plans which both could benefit from each other, a part of the plot had to become public accessible as mentioned above.

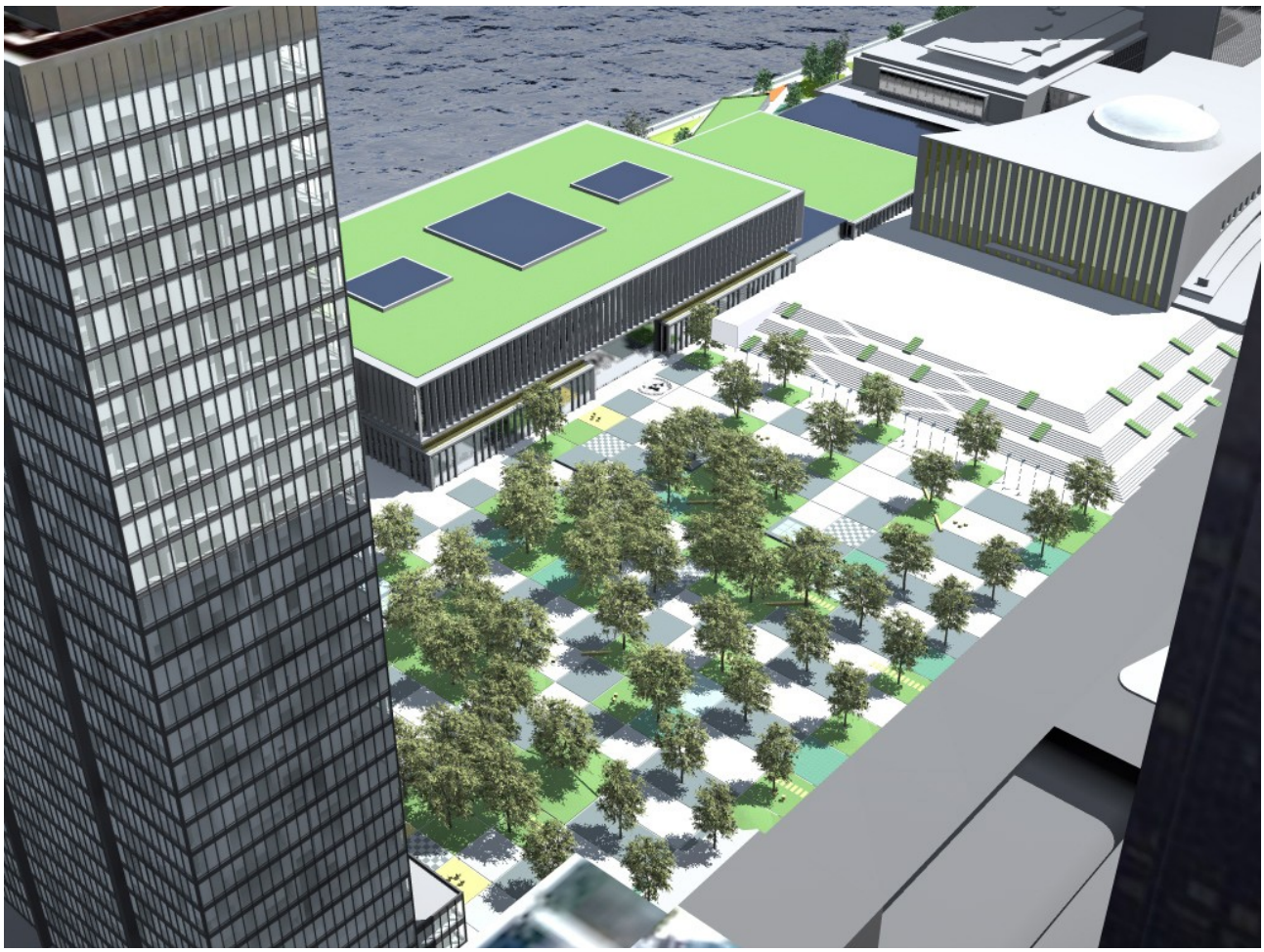

Figure 3. UNEC design with new master-plan

Internally it was mandatory to separate the flow of the different building users. The users can be specified as delegates or VIP's, employees, researchers, visitors from the business world which can contribute to the sustainability debate, secretariats, press and guests. The main group that has to be undisturbed by external factors are the delegates and VIP's, this means that it is necessary to keep them completely separated from the other building users with the exception of the spaces where they have to come in contact with press, public or office personnel. The office personnel which include researchers and secretariats should also be separated from external factors at their place of business. Office personnel, press, visitors and guests are permitted to come in contact with each other in the circulation areas. The people flow separation was a complex puzzle which was solved spatially in the design. In order to solve this complex task an analysis was done on the existing building complex. It was important to understand how this user separation currently takes place. By analysing the existing building it became clear that the main aspect of separation is the use of differed levels. The congress building is divided in a delegate level with an public level on top. This configuration is repeated.

Sustainability
In this design task the United Nations was considered as the client, demanding a zero energy building or even better a building that generates more energy than it uses. To get its message across the building also needs to be an architectural representation for sustainability. The required functionality regarding the security risks, separation of the user flows and its implication for the surrounding area should be clearly defined.
The main design challenge for UNEC was the representation of sustainability and its sustainability features. The new master-plan already contains E-turbines, which are windturbines that generate energy from the FDR traffic and tidal-turbines that harvest energy from the East-river current. These are clever solutions but they don't represent sustainability in an architectural manner.

The goal was to visually integrate sustainable features in the architecture of the building itself in order to create an eco-system that channels the flow of resources like heat, energy, waste and water in order to recycle them.

This representation had to address both the expert and the layman, this means that at least a portion of the recycle process has to be visible on the in and outside of the building. The first order of business was to research sustainable solutions with an architectural value.

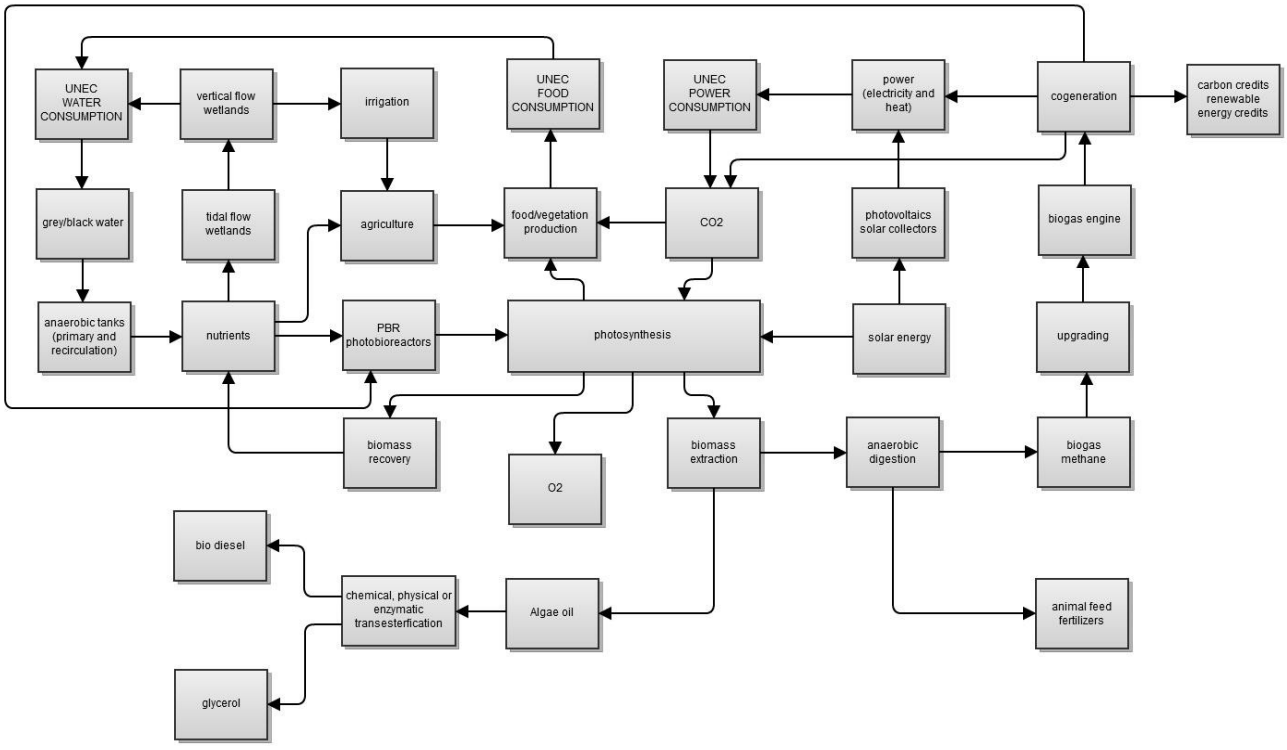

Figure 4. sustainability schematic

This schematic contained aspects of the recycle process that also could create a strong architectural solution. The schematic became a guideline for the spatial design.

Waste water could be recycled using living machines, these living machines are gardens which filter the waste water making it suitable for toilet flushes, irrigation and cooling water. An investigation was done to establish how these living machines function.
The waste water is stored in anaerobic tanks after which it goes trough different garden wetlands which filter the water, the filtered water is then stored in an other tank and distributed to the building aspects. Not only does this system filter the water it also looks green and attractive and can play a vital role in the buildings architecture.

A proven method to store the buildings excess heat and cold is inter seasonal storage. With this method heated or cooled water is stored in a basin underground to be used when needed another time.
In order to investigate other possibilities the design of Villa Flora was analysed and used as a reference study. In this design greenhouses play a vital role. The greenhouses have a lot of excess heat, this heat is stored in the ground using inter seasonal storage. The construction of the building (a Holcon system) is responsible for transporting the excess heat and cold to the inter seasonal storage system. After analysing Villa Flora it appeared that a combination of the living machine system in greenhouses was viable within the design and also created a strong architectural experience.

Phase change materials or PCM's are used to create latent heat and cold storage, this basically means shifting the mismatch between supply and demand regarding the cooling and heating of the building. By doing this the solar heat gain can be stored in the material during the colder days to reduce the heating demand. In the summer the PCM's can be exposed to night ventilation to store a colder night temperature and use this the next day to reduce the cooling costs.
Also the Holcon construction system was looked at closely, this construction system has a very short building time, it is demountable with minimum waste material, it can integrate the buildings transport installations in the floor and it has the ability to create large spans with high weight loads. The floor system works as large radiators that can heat and cool the building with a low temperature system.

Another reference study was the Green Climate Fund in Bohn. In this design micro-algae are used in the façade. After a deeper investigation in the subject of algae façades it appeared that these façades could have a number of benefits for the design.
Algae can also filter waste water, the residue of this system can be used as biogas on site. Algae façades could also be used as sun shading.

Algae in the bio-reactor façades grow faster in bright sunlight to provide more internal shading. The 'bio-reactors' not only produce biomass that can subsequently be harvested, but they also capture solar thermal heat – both energy sources can be used to power the building.[4]

Another benefit was that the algae could consume carbon dioxide from the FDR. Algae uses photosynthesis to produce lipids that can be turned into fuel preferably on site.

4 Miceli, M. (2012). Microalgae prove ideal for green facades Retrieved 6-03-2012 http://www.arup.com/Home/News/2012_09_September/14_Sep_Micro_algae_prove_ideal_for_making_green_facades.aspx

A façade filled with mirco-algae also known as photo-bioreactors can be a building aspect that can play a role in achieving the goal of visually integrating sustainable features in the architecture of the building since the photo-bioreactors are brightly coloured green.

Green is of course a colour that is associated with environmental friendly behaviour.
By creating a façade that is literally and figuratively green the message of UNEC will come across even stronger.

Figure 5. Algae in the façade provides the building with a subtle green glow (study image)

The roofs of the atrium and greenhouses (conservatories) feature integrated photovoltaic's , not only providing sun shading but also harvesting energy.
Different photovoltaic systems were compared to find the most suitable system based on the criteria that the photovoltaic's should have a minimum visibility and had to be integrated in the glass of the roofs.

The relationship between the theme of the studio and the subject

The theme of the graduation studio strategic architectural design development or SADD from the chair of materialisation is the aspect of strategically developing different design elements simultaneously. The process should not be a straight line but a cyclic iterative curve. By doing so the design process becomes much broader. It is often compared with a music mix table were the different drives go up simultaneously (and sometimes isolated from each other). The end result would be a rich piece of music or in our case a architectural design.

The relation between this studio approach and the subject of the United Nations Environmental Council is complimentary to each other since it is impossible to design the building using a straight forward process due to its gigantic size (30.000 square metres). What is necessary is to develop various building aspects simultaneously and let them influence each other. Opportunities often become apparent were the different areas of development overlap each other. This happens on multiple scale levels ranging form the urban context to the smallest building detail. Switching between these different scales is an important part of strategic architectural design development. During the process one has to zoom in and out contentiously. This can sometimes be frustrating but in my experience it benefited all aspects eventually.

The relationship between the methodical line of approach of the studio and the method chosen by the student in his framework

During my design process the SADD method of working ensured that a very large number of different aspects were investigated and developed. The sustainability scheme mentioned earlier, was nothing more then a well researched and thought trough tool. It was during the design development that this scheme was translated to a spatial form. The spatial form and the technical aspects gradually came together and formed quality spaces which could be called architecture.

Especially the sustainability aspects of the design can be compared to the drives of the music table, they went up and down trying to link them together. When all the drives were in right position sustainability wise the design drives influenced them which led to new possibilities. The process can be summarized quite easily after strategic models a building concept or framework was developed. The main concept was extending the existing complex in such a way that it would be in line with the vision of the board of design, the international group of architects that developed the UN headquarters under the supervision of Wallace K. Harrison. The board of design created a chart which shows in what way the complex should be extend based on the nature of the program that would be extended without compromising the existing composition.

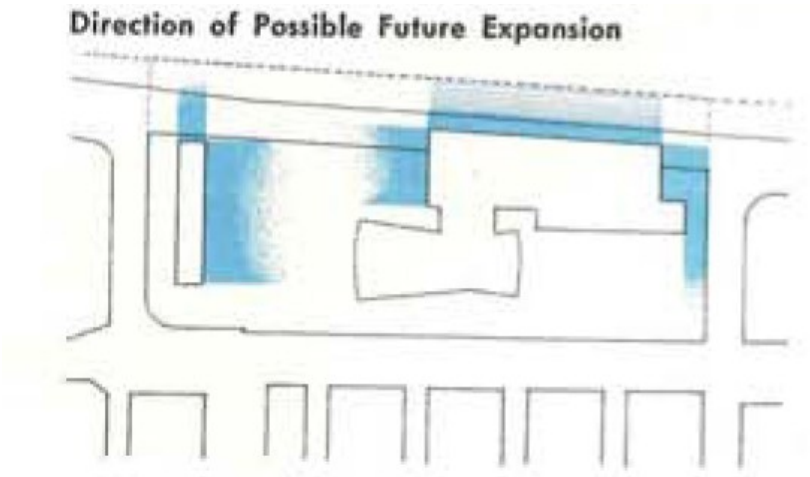

Fig 6. extension diagram

Extending the existing complex also benefited the sustainability aspect of the new design, because one would make use of what was already there. Furthermore the new design could form a closed cycle with the existing complex on various levels, namely: the user, resource, energy, waste and security cycle.

After this framework was in place, the different design aspects were developed as described above. Within the framework a lot of changes were made however the outline stayed largely the same.

Within this outline the the balance between the architectural experience and the building technology proved to be a challenging form of design development.

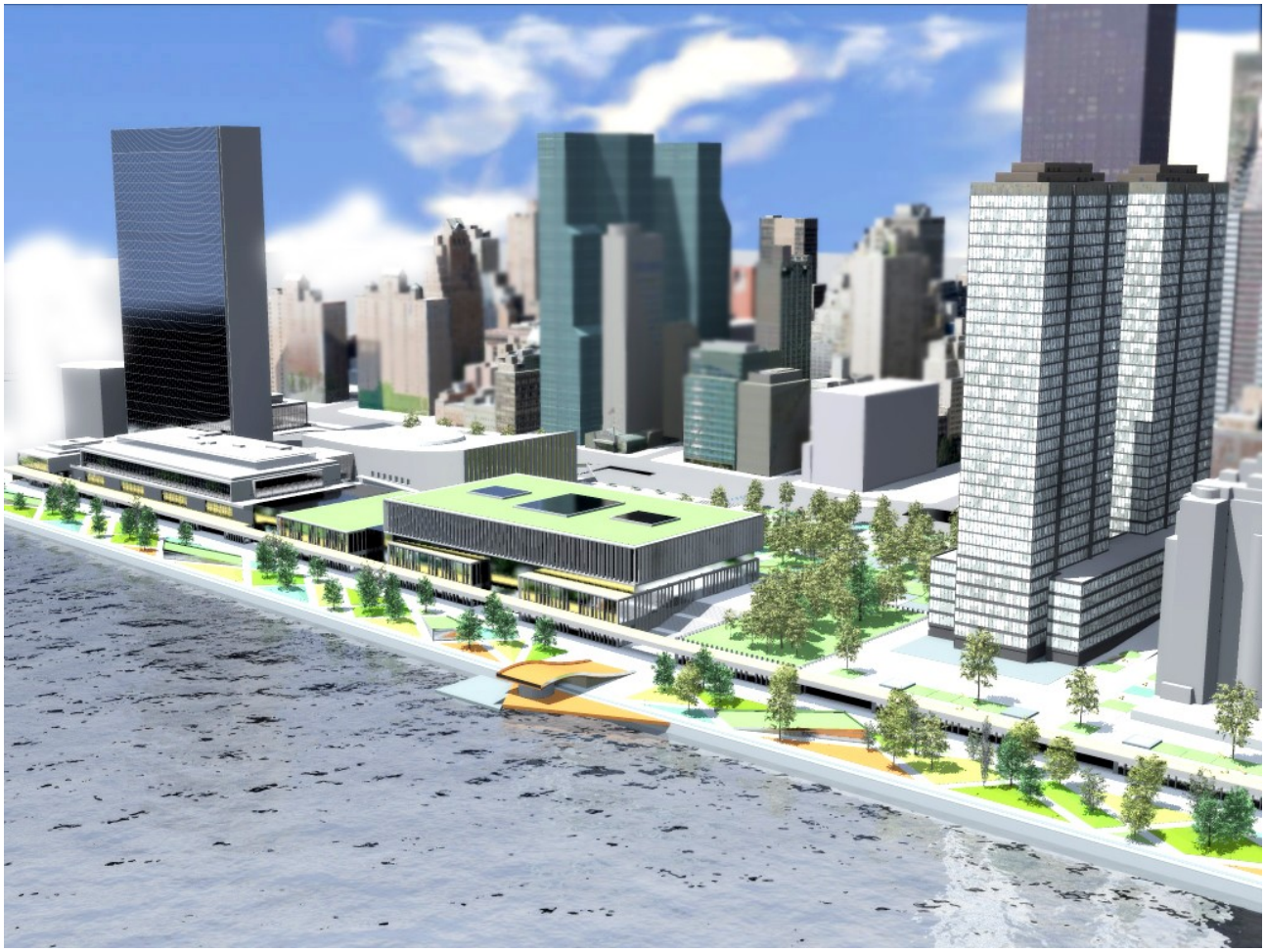

Figure 7. overview new design and existing complex

Façade investigation

Naturally there was the desire to connect with the existing monumental complex in a way that it would strengthen the composition. The façade plays a major role in this endeavour. The investigation started out with collecting reference images of solutions that could be a serious option for the façade for UNEC. A few examples are shown below.

Figure 8. overview digital façade studies

After the studies it appeared that the strongest connection with the existing complex was formed by using a vertical alignment in the façade since the General Assembly façade contains the same kind of alignment. It was the choice between a contrast or an addition. It became a challenge to investigate in what manner the vertical alignment should manifest itself. To connect with Niemeyers and Le Corbusiers design some of their projects where carefully analysed.

Figure 9. designs by Oscar Niemeyer

The images in figure 9. show two of Niemeyers designs, Niemeyers work contains a very successful combination of monumentality and modernism. This combination is exactly what is needed at the location of the UNHQ. After a deeper study it appeared that the monumentality in Niemeyers work is partly derived from keeping the space between his building volumes completely open. The external columns and their rhythmic create a representation of order and regularity.
Although Niemeyers columns are of an adapted language, their significance remains.
For the building entrances Niemeyer often uses ramps which create a frontal approach by most of his squared buildings, and spiral ramps in the majority of his free form creations. The two designs in figure 9 show a very interesting combination of a glazed box surrounded by vertical elements. This concept appealed to me and an analysis was done to see if this façade concept was useful to create a bioclimatic façade.

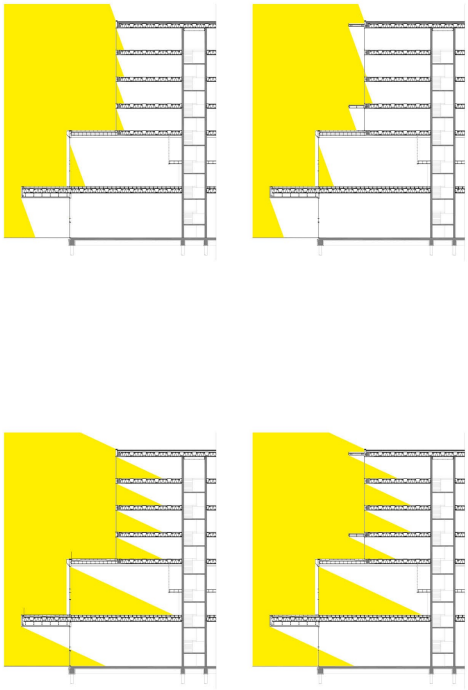

Figure 10. façade diagram for summer and winter

The image above indicates that this façade concept is in fact very bioclimatic, the canopy holding the vertical slabs keeps most of the sun out in the summer so the building is kept cooler, while in the winter the canopy doesn't block the direct incoming sun. The vertical slabs reflect the sunlight and create a pleasant diffuse lightning for the workers inside.
The façade concept Niemeyer used combined with the new technology of the integrated photobioreactors creates a modern version of the old master his enclosed glazed box.

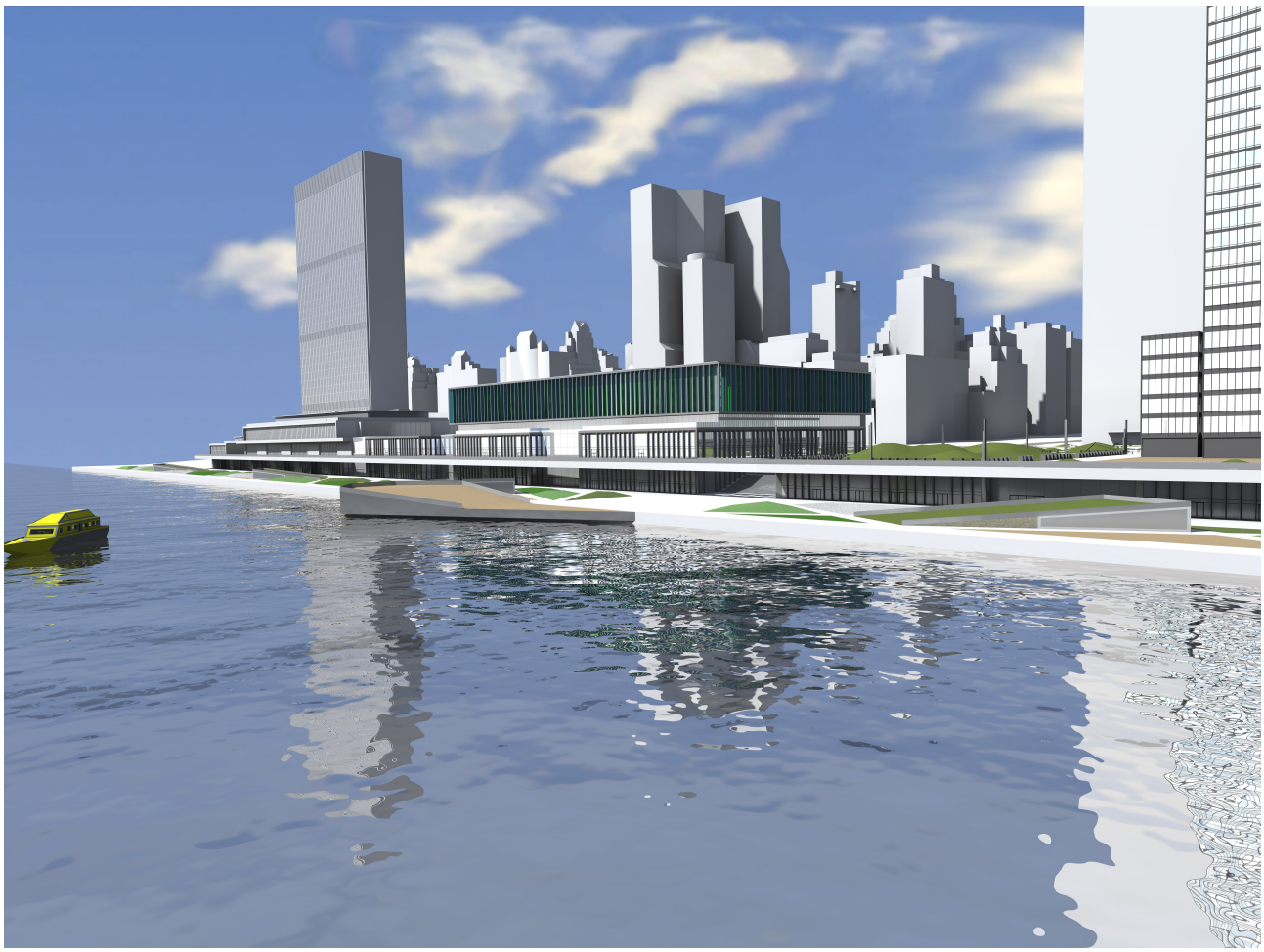

Figure 11. render of the final façade composition

The relationship between the project and the wider social context

This graduation project will contribute to the larger social and scientific framework as a demonstration of how new sustainable initiatives can be integrated in an architectural object that is related to a monumental architectural landmark. It can serve as a tangible example in the primarily theoretic sustainability debate which shows sustainability in a broader vision be creating a closed cycle eco-system in a building compound.

This project also has another objective, an objective regarding social sustainability, namely taking away the misconception that sustainability often means that we have to compromise on the qualities of our developments. The objective is to convince people that sustainability is about improving our existing quality of life rather than diminishing it.

The bottom-line here is the fact that everyone wants to be as sustainable as possible, but nobody wants to put effort into it and change their way of life to achieve it. This means that sustainability becomes a design challenge instead of a debate between ecology and economy.
With regard to technology it would be wise not to rely purely on technological innovations to solve our problems, but to minimise the expected problems beforehand using smart and bioclimatic design. It would be foolish not to use technological innovations but they should be used to enhance the bioclimatic aspects of a design and not in advance be selected to solve a problem.
Furthermore it would be recommended to simplify our building components, simplifying does not mean not thoroughly thought through, but creating building components out of as few parts as possible making them cheaper, easier to operate/maintain and able to be constructed out of fewer resources.
Nature contains a wealth of information and principles which can be used to create these kinds of next generation building components or designs that function as eco-systems with a closed cycle for their resource use.
Construction and its spatial form can be specified in the way we make use of our spaces and the qualities they contain. If a design can be used for multiple purposes it will naturally contribute to its life-span. In order to create this flexibility, the structure has to be robust and long lasting, and the space has to be designed with a certain excess space. Design rasters and grids are tools which can be used to create these one-size fits all spaces and achieve functional sustainability.

Architectural sustainability is achieved when a design not only contains functional sustainability and great indoor spaces, but when the project is also embedded and anchored in its context and cherished by its environment. The design has to fulfil a role in the context till the degree that it is worth it not to be demolished. These very qualities are lacking in most of the overcompensated sustainable design projects and they are therefore creating the general misconception that sustainability in the built environment often leads to the inelegant technological solutions. It is the role of the architect to get rid of this misconception.