Highly Connected Framework.
*An Algae Eco-Platform for Venice.*

Anna Marcassoli  
Student number: 4182472  
annamarcassoli@gmail.com

**PROJECT DESCRIPTION & PROBLEM STATEMENTS**

This architectural project is set in Venice and it is an attempt to save this town from flooding and the collapsing on itself. The strategy of the project is mainly based on the use of the invasive algae that are growing in the lagoon creating ecologic disequilibria to produce energy and other kind of goods. The main focus of the project is the endeavor to protect Venice from being damaged further on an ecologic and social level trying to involve and sensitize also the population.

For these reasons the project includes not only functions connected to green strategies and the treatment of the algae themselves but also facilities for tourists and the Venice population’s itself. In order to reach the aim of the project the building should answer to the ecologic disequilibria in a dynamic way. For this reason the theoretical background of the project lies in the capacity of the design process to act directly upon form in real-time investigating computational processes in non-standard and interactive architecture, starting from behavioral simulations (System thinking).

The main approach applied in the whole process from the research till the design can be easily expressed through the main questions that have driven my work.

- **Which are the main requirements a building should have to answer to the environmental and dynamic problematic that affect the city of Venice?**
  
  In this sense the first aim was to be able to generate programmatic and architectural answers to the environmental problematic that affect a particular city, in this case Venice. Environmental issues and green strategies are in fact one of the main topic in architecture nowadays and they make the theme of the project particularly relevant.

- **How is it possible to design a building in a way in which its functional and spatial organization can respond to the dynamic changes of the system itself and also to external and environmental influences?**
  
  This question is strictly connected with the approach of the Hyperbody studio in general and it falls under the umbrella of the interactive and non-standard architecture. This query has brought to the attempt in my design to develop a multi-agents simulation analysis that could help me to translate the environmental information I had into a first design proposal.

- **How the obtained diagrammatic spatial organization can be converted in an architectural form?**
  
  This is the last aim of the project that is to propose a form-finding process that moves directly from the analysis and simulations outputs. In practice it was an attempt to convert a real time analysis that can be used in different circumstances into a specific and unique design process.

- **How this form finding process can be relevant in the architectural practice and how it can be applied in other circumstances?**
As explained before this represent an important phase of my research. Despite the fact that my project is really ‘site specific’ the process can be used in different location with different building program.
The proposed process in particular represents an attempt to design a building in the same way in which ecological systems generate themselves. There is an environment consists of a complex external factors that act upon the system itself and determine its articulation and development. The same again can be applied to different environments with different conditions.

APPROACH CHOSEN AND REFLECTIONS

In this writing the main intent is to retrace all the steps of my process and reflect on my approach and the way it worked or not and to what extent.

The general topic proposed for the design studio of Hyperbody this year was “the co-evolution of urban agriculture/integrated/experimental green strategies together with the comprehensive usage of computational design techniques”. The choice of the setting for my project has been Venice because of its issues connected to the environment like the flooding, the invasive algae growth and the lost of the marine biodiversity. The first part of my work was based on a deep research into these problematic that affect the town and the attempt to connect them all together in order to develop a unified strategy to cope them at the same time. The answer was to generate a positive loop in the usage of the algae that can help to solve all the problems connected with the wellness of the lagoon.
The main idea of using the algae to produce energy and good like food or paper is still embryonic idea in the word of the green strategies and it has just few applications that usually are mostly connected with the design of farm and factory. In this sense the main challenge of this project was to try to integrate these innovative technologies in a building with a more extensive program that could involve also the population of the town and the tourist. In practice the point was to find a way to make green strategies more attractive for people and in particular way to integrate them more deeply into the building program and structure.

The second phase basically answers to the necessity to fulfill the programmatic requirement of the building. First of all a set of main functions was chosen and they were categorized based on their necessity of accessibility, flows, sun radiation, and other environmental parameters. In parallel I have investigated these aspects in the selected area for the project. The methodological approach is focused on creating real time analysis system, which should work as a form finding machine, giving different outputs based on specific parameters setup. In practice this process was based on the use of a particular software, processing, to generate a multi-agents simulation capable of distribute the functions (agents) in a preset space (the location) based on the environmental parameter analyzed (accessibility, sun, etc.). This simulation had the main goal to find an optimal spatial organization of the functions through the use of a self-organized system. This bottom-up approach has the incredible characteristic of being very flexible, that means that the same definition could be used for a different project just changing the value of the parameters and the desired functions. In this case the Processing application represents the main computational tool, which can allow the interaction in real-time with the generated form and play with multi-agents environment. As already stated the great possibility of this approach is the the possibility to reuse it but of course it has also some problematic. During the simulation phase the most difficult task is to decide when the simulation should end and
which of the output is the best one. In this sense the architect still have an important role in the final design. In my case I have developed a method to classify, exclude or select a particular output. This strategy was mainly based on the circulation in the building itself. In fact one of the main task in designing a building is not just about the relation between the building and its surrounding but also the functioning of the building itself.

The next step is related to the morphological process, the bottom-up approach in fact opens up many paths to convert the “starting topologies” in a proper design. Based on the programmatic requirements of my building like the necessity of hybridization of different functions and a high degree of physical and visual connection I have decide to investigate the topic of the minimal surface in the field of architecture. Minimal surface are geometries that locally minimize their area: in other words they have a mean curvature of zero. This characteristic makes them really efficient on a structural level. Another characteristic is their porosity.

My research was based on the attempt to generate a process to assembly them based of the need of space and connections in my building. In order to do that Rhino and grasshopper were used and in particular a minimal surface plug-in for Grasshopper.

The previous phase of mine design was basically based on geometric experiment while the final one is an attempt to come back to the architectural needs of the building: in particular way in last months I have focused on the skin and the structure of the design. Coming back to the main topic of the algae production this phase is an attempt to integrate this aspect in the skin and structure of the building that in my case almost coincide. Considering that the main issue connected with the algae is the bioreactors system the first step was to analyze in Ecotect the sun radiation on my building surface in order to locate them in an optimal position. Next step was to integrate them and their system of tubes in the structure itself. This part of my approach can be the most experimental one because there are no existing examples in this sense.

The idea of integrating the bioreactors’ technology into the building’s skin is still an embryonic idea and in my project is still possible to understand that some problems need to be solved.

To conclude these reflections I want to add that on a socio-cultural context the project is relevant thanks to the connection between architecture and urban strategies and the attempt to involve the community through adapt and attentive development of the project itself. By the way the project is more interesting in a scientific context with regard to the development of new real-time analysis strategies developed with processing and structural researches that deal with the minimal surfaces. The urban multi-agents analysis could in fact be applied to different contexts while the structural part of the process can be a relevant contribution to the architectural practice in relation to the design and digital fabrication of complex shapes.