

**FLEXIBLE AND ENERGY SELF-SUFFICIENT  
FLOATING CITIES IN THE NORTH SEA**

**REFLECTION PAPER**

Building technology track  
SUSTAINABLE GRADUATION STUDIO

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## **RELATION BETWEEN GRADUATION AND WIDER SOCIAL CONTEXT**

Nowadays architects and engineers are facing two main problems: urbanization and climate change.

Is expected that by 2050, 64% to 86% of the world population will settle in urban environment. Excluding seas, only one-eighth of earth surface is supposed to be suitable for humans to live in and the amount of available building ground in the vicinity of urban settlements is lacking.

While urbanization increases global warming represents another issue designers should consider for future and present days project. As anticipated effects of the global average temperature rise, we are expecting a sea level rise, a deserts expansion in the subtropics and a change in precipitations, bringing as well severe rainfall that put cities facing water at a higher risk of floods.

Both issues and climate change are encouraging architects and engineers to use water as building land, adopting floating structures as a favorable solution. Floating architecture not only could help coastline cities to develop through seas and face sea level rise, but present many other positive aspects that can't be ignored. Some of them include safety in case of hurricanes and floods, sustainable energy solution through water, scar less development, flexible urban components and the possibility to move the structure according to the outside environment conditions.

Example of floating architecture already exist in small scale and projects of big scale settlements, such as floating cities, have been shared in the current years. The idea of a big floating community is fascinating architects firms, although no real projects exceeding the size of a neighborhood has been realized yet.

The aim of this graduation studio is to disclose the parameters that could guarantee a sustainable floating city. Throughout this thesis construction methods, urban development and resources management are analyzed to form the basis for the design of a self-sustained floating city that would hypothetically be placed near the Netherlands' coastline.

## **PROJECT RELATION TO GRADUATION STUDIO**

As the graduation studio is meant to be related to sustainability, the research has been given particular importance on dwellings' energy efficiency and sustainable energy systems, through a series of energy calculations related to the design. On the other hand, attention has been given on technical aspects of floating construction, regarding stability, construction and material use.

## **RELATION BETWEEN RESEARCH AND DESIGN**

Literature research was useful to stipulate the basis of the simplified city model object of study. The research related to urban flexibility, construction and energy efficiency was applied to the model designed and was meant to reach conclusions that could answer the research questions.

## **URBAN FLEXIBILITY AND CONSTRUCTION**

By trying to develop a small town of flexible floating components, it was possible to see that such flexibility is not granted by the simplicity of water movability. In fact, urban flexibility will depend on the platform dimension, on the platform's shape, mooring typology and density of the city in relation to the preservation of the marine environment. A floating city will have a spread configuration, and will need fixed units (the mooring) to maintain the platform fixed in relation to the other platforms and external climate conditions. This comes with a set of

material and energy resources which are not usually contemplated when talking about the positive aspects of a movable component. Furthermore, the most important reason to build flexible urban components, is to have a construction which can fulfill its entire technical lifespan regardless the location in which it is set. It was possible to see by the study of material durability that their lifespan will in fact decrease when set in the open sea environment, but also that to maintain the longer lifespan possible, construction will require a high amount of maintenance and be very expensive

A flexible building, to be 100% flexible, will also need to consider other parameter, such as the water density and the external climate condition. A building designed for inland water might not be usable at sea, either because its structure and materials are not suitable for the marine environment or its shape will not resist the stronger winds of the North Sea. When changing its location the mooring typology and space available might also change its orientation, and if it was not designed to work well in all directions, this would have consequences on its climate behavior.

## **ENERGY**

It was possible to see that building energy self-sufficient floating cities is possible. There is although an amount of energy loss due to the process of energy storing itself, which is quite considerable; 60% of the energy surplus of used renewable energy sources. Moreover, the city will need to have a connection to an existing OWF to transmit its energy surplus to the existent grid connected to land, which would question the need to build a minimum of thirty-three wind turbines near the city. Considering the large number of turbines, they could be built directly as an addition to the existing OWF, which would then provide for both the floating city and inland cities. Another consideration to make, is the high maintenance that the turbines will require, and the space needed to store the hydrogen. More concrete platforms will need to be built just for the hydrogen air compressed containers.

For the location of interest water does not provide enough energy as it was expected. Wind and solar remain the main energy providers. The amount needed though is considerable and that would affect the look of the city with PV panels on all facades and a wind farm in the background.

As the sea does provide a large amount of space, having an external supply made out of solar and wind supply could be applied instead; this could improve the look of the city, but also increase the need of maintenance for the energy network to connect the supply to the city.

## **CONCLUSIONS**

As for now, urban flexibility makes more sense for small floating components anchored to inland territory facing waters. Dynamic geography of autonomous floating cities it is not worth the amount of resources which requires and also it is not applicable to its fullest. Floating cities will need to have a number fixed components which can then work with movable ones. The movable ones are also supposed to last more than an inland construction, and with the available materials such durability is not necessarily granted.

The natural environment can give a positive outcome in the energy production, but the natural resources used will depend on the location of the city, and will have consequences on the architectural design.