AQUATECTURE
Integration of Water in Architecture

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Graduation Plan

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Studio

INTECTURE (Architectural Engineering)

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Architecture is about combining state of the art technology to solve various spatial and social problems in an aesthetic way. INTECTURE appears to reflect this attitude and so is the logical choice for my graduation studio.

Title

AQUATECURE: Integration of Water in Architecture

Graduation Project

Problem Statement

In the Middle East, the abundance of fossil fuels has caused an over-reliance on air-conditioning in buildings that as a result fail to adapt to the local climate. Ancient techniques where water was celebrated in playful fountains and streams which simultaneously resulted in the passive cooling of both the interior climate and the urban environment appear to have become redundant. Concurrently, existing aquifers that have in the past provided a reliable source of potable water are being depleted with the ever increasing strain from the growing population of cities in a region where fresh water is very scarce.

There are many reasons as to why research involving water and Architecture is valuable. Water as a symbol of life and abundance is the vital component...
in all living ecosystems. We drink it, water our plants with it, clean ourselves and our environments with it, play in it and yet most of our interaction with it occurs through opening the water tap. The actual importance of this all-vital substance is tremendously understated in our built environments resulting in a tendency to undervalue and become wasteful with our water. Furthermore, with the earth's population increasing at its current rate, the availability of fresh, clean drinking water has already become a pressing issue in many corners of the world. Where most of our efforts today are focused on sustainable energy, in future, they may be directed towards sustainable water.

The Netherlands can teach the world many things on how to deal with water. Many of these solutions concern flood management systems (keeping the surplus water out of our urban areas) and floating or amphibious buildings (building out onto the water). But also the ability to provide a secure source of potable water and to discharge treated water back into the environment is knowledge that would benefit, especially hot, arid regions of the world.

Objective

The Oasis symbolizes a spot where life can flourish within a barren landscape. Where resources can be replenished, the oasis played an important role in the desert routes of trade and transportation. The urban oasis shifts the context from the arid desert landscape to the congested urban center, where both situations share a common longing for water: for consumption, for climatization and for recreation. Of particular relevance to this topic is a site in a hot climate as this is where the oasis would be needed most and would simultaneously have the greatest impact in terms of making a statement and creating awareness with regards to our relationship with water.

Therefore, the main objective is to reintroduce the value of water into the public consciousness by demonstrating the many ways in which living with water can improve our lives. This can be broken down into three main goals:

1) Consumption: To design a water cycle that provides fresh drinking water and treats and discharges wastewater (sustainability)
2) Climatization: To use water as the main climatic driver (passive and active) of the building and surrounding urban environment (function)
3) Exposure: To apply water in ways that it improves our daily environments by becoming an entertaining feature (aesthetics)

Overall design question

How can a building implement the use of water sustainably, functionally and aesthetically to improve an existing urban environment?
Intuitively, when designing with water, one immediately thinks of water as a context, i.e. an aquatic site such as the coastline or the harbor. This project is about the integration of the various aquatic systems within a stadium design for the 2022 FIFA World Cup in Qatar. The tournament received much skepticism due to the harsh climatic circumstances of the Arabian Gulf where temperatures reach up to 50°C in the summertime which would have great implications for athletes and equally the fans. This problem presents an ideal opportunity for the implementation of water as a cooling mechanism which can simultaneously provide a source of entertainment for fans and the general public. The geographical context also provides little sources of freshwater as most of the potable water produced in the region is desalinated seawater.

The design will explore the hypothesis of providing an urban oasis where water is celebrated (once again) as the all-vital, sustainable and aesthetically beautiful substance that it is. The building programme will address the specific requirements of the FIFA for world-cup stadiums and the objectives of the host nation to provide sustainable, cool stadiums and fan-zones, leave behind a legacy for future generations to enjoy even after the tournament and to present itself to the world from its best side.

Technical focus will lie on the generation of clean drinking water, the treatment of used water and the use of water for cooling a building and the surrounding environment in a hot climate. Emphasis will lie on the integration of these systems in such a way that they become a visible architectural feature of the building.

**Technical Research Question**

How can the design of a closed water cycle be optimized to integrate the consumption, climatization and architectural exposure of water in hot, arid regions?

This can further be divided into several sub-questions:

1) What quality of water is required for a given particular use?
2) Which methods are the most suitable for producing potable water? (Explore alternatives)
3) What are the total water demands for a building of a particular size?
4) How can water be an integral part of the buildings' climatic strategy?
5) How can water consumption be minimized and where can it be made to serve multiple functions per single use?
6) What are the different categories of waste-water and what is the best way to treat them on the scale of a building?
7) In what ways can the exposure of such systems be aesthetically pleasing and create a space for recreation?
Methodologies

Several research methods will be implemented to produce the desired results for the design. These are:

Literature

Books, magazines, journals, articles and websites that provide information about: existing architecture that uses water in an inspiring, interesting way; water management; natural water-cycles; producing potable water and treating waste water.

Courses

By taking part in the TU Delft-led EdX course 'CTB3365x - Introduction to Water Treatment' and the course 'WM0939TU_Boat Week_Engineering for Sustainable Development' I will gain valuable insight in the world of water cycles and learn to apply this knowledge to a technical application.

Consultation

Speaking first hand to Industry professionals in the field of water treatment and University Professors with expertise in the subject.

Research by Design

Drawing schematic water cycle plans and optimizing them to the needs of the functions and building programme until a desirable result is achieved. Similarly, an optimal site and building orientation can be derived in this way. The result should provide a tool-box of options that graphically illustrate the implementation of a water-based system within a building or an urban context that addresses at least one of these issues: Consumption; Climatization; Recreation.

The research is conceived as a combination of external sources that are reviewed and discussed. The contribution comes in the form of integrating these systems in an efficient manner as to satisfy the consumption and climatization needs of a particular building (integration) and how these individual systems can be exposed to the public in an aesthetic or recreational manner. The results should be such that it can provide a toolbox for a given design application where water plays a major influence.
Planning

See Appendix A: Planning Schedule for Details

Relevance

The research topics addressed in this design find their value in the water-conscious design of buildings in future as to minimize the strain on the large hydrological cycle to ensure an efficient and sustainable use. Architecture will increasingly be confronted by the question of how our urban centres can be improved while providing for the needs of an ever-growing population. This design aims to provide one such vision in which Architecture and the element of water can co-exist to the benefit of the inhabitants, the urban realm and the ecosystem as a whole.

Literature

A initial list of literary sources has been compiled that addresses the subject. This list is not exhaustive and further literature will be added during the research phase.

6) Fletcher, M. 2009, *Islands: Contemporary Architecture on water*, Ullmann publishing