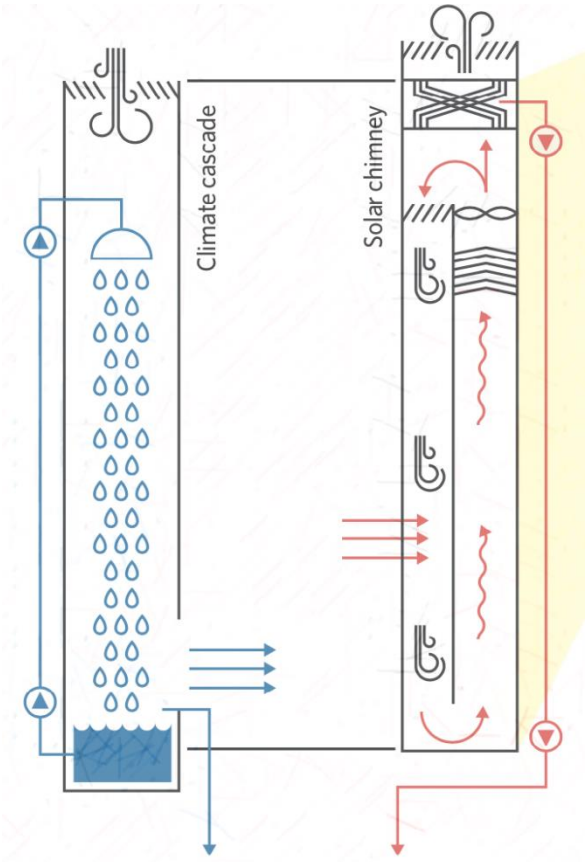
Refurbishment of an office building in the Netherlands using the Earth, Wind and Fire system.



Reflection

Building Technology Graduation Studio 2020-2021
Shriya Balakrishnan | 5048664

Delft University of Technology
Building Technology Graduation Studio
Name:
Shriya Balakrishnan
Student Number:
5048664

First Mentor:
Dr. R.M.J. Bokel (Building Physics and Services)
Second Mentor:
Dr. Ing. T. Konstantinou (Building Product Innovation) Cover photo:
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1. Introduction

The built environment is a central part of our life where we spend a large amount of our time. However, built environment is the single largest energy consumer in the EU and one of the largest carbon dioxide emitters. Within the built environment, the non-domestic sector is the second largest energy consumer of which office buildings are the highest contributors. 45% of the office buildings in the Netherlands show poor thermal and energy performance as the buildings are older than 30 years which signifies that the façade and technical installations reach the end of their life. Therefore, to improve the energy performance of the building, Energy renovation is instrumental. The total energy consumption and the CO_2 emissions can be reduced by 50% through energy renovation thereby making it one step closer to achieve the ambitious 2050 goals of the EU Commission.

Taking this as a starting point, this graduation project aims to improve the thermal and the energy performance of the office buildings in the Netherlands by utilizing the renewable sources of energy. The Earth, Wind and Fire concept (EWF) can play a key intervention to achieve these goals as the concept utilizes the environmental energy of earth mass, wind and sun to generate and supply energy throughout the building by eliminating the use of HVAC systems, thereby minimizing the total energy consumption of the building and providing a healthy and productive working environment.

2. Position in the Graduation Studio

The Building Technology Track has many disciplines namely, Climate, Façade, Structures and Computation, each of which allows of us to dive deep into the particular discipline. In the climate design discipline, we can evaluate the building performance on the basis of various factors like comfort, energy, and façade performance and improve the design of building. In context of this discipline, the graduation research focuses on the refurbishment of office building using forces of nature to ventilate the building. To meet the 2050 goals of the EU commission, it is important to improve the energy performance of the office building by maximizing the utilization of renewable energy sources.

The graduation project is in collaboration with the chair of Building Physics and services and façade and product Innovation. Evaluating a building for its energy performance largely depends on the building envelope and the process goes concurrently. Hence, the combination of these two chairs is relevant for the research topic under the big umbrella of architecture and built environment.

3. Graduation Process

The Initial focus of the graduation project was to evaluate the building performance and achieve a nearly zero energy building. This helped the project to keep in line with the current and the future goals and understanding the bigger picture. Simultaneously, the focus was also to understand the EWF system and determine the design strategies which will be essential while implementing the same in the chosen case study. Later, it was realized that this system has not been explored extensively so far and relies on the results of only 1 building in which the EWF system was implemented. This led to exploring deeper into the functionality of the system itself and determining if the system can be engineered efficiently to reduce the energy consumption by maintaining the thermal comfort of the users.

The research followed various approaches to provide a solution for the raised problem. Research through design methodology was followed during the process where the established design strategies were implemented in a case study building. The research approach was not straight forward as too many parameters had to be considered and it was important to define which parameters were essential in order to compare them with the existing situation of the building. As this system was recently discovered, the evaluation of the building with this system using dynamic simulation software is unexplored. In order to achieve accurate results, the existing HVAC system needs to be manipulated to imitate the operation of the EWF system. Thus, the results will majorly rely on the basic model calculations using the excel model which are static results.

In the initial stage of the research, it was established that the design will be implemented in one building. If two or more buildings of the same building type were considered, the results would have variations and it could have helped in establishing a set of guidelines to implement EWF system in a typical office building.

4. Societal Relevance

The research focuses on a concept that pushes for more sustainable and environmental friendly building technology. Since the concept has been put in practice for 1 building so far (Breeze Hotel, Amsterdam), it is early to conclude the concept's practical relevance. With the results obtained for this research, the EWF system does show promise with respect to reduction in energy consumption and better thermal comfort, although it's compliance with Dutch Green Building Council has not been met. Another reason for the doubts over the concept's practical relevance is the fact that there is no software designed specifically to simulate this system due to which another software had to be utilized for replicating the

system. This replication would mean that the results obtained cannot be validated completely.

While the world is moving towards eliminating carbon footprints, implementing the EWF system will be a major factor in doing so in the built environment domain. EWF also gives an opportunity to the real estate world to avoid green washing or implementing partially sustainable methods and with further research, the concept can be used to achieve net zero energy buildings by 2050.

5. Personal Reflection

After the completion of all the courses, finding a topic for my graduation thesis was challenging for me. I was unsure of the domain I wanted to focus on within building technology. The EWF concept came as a casual lunch lecture organized by BouT and ABT B.V after which I started gaining interest towards it. Post a few readings and discussions with my colleagues, three of us decided to go ahead with this concept, choosing a different objective individually.

Since the literature on the concept is nascent, there was initial struggle to find context through which I could arrive at my objective. However, there were 104 submissions made by previous batches as well as Dr. Ben Bronsema's Ph.D. thesis which enabled me to completely understand the concept and derive my focus. From the onset of the P1 meeting, the process was slow due to the holiday season approaching. The literature study was fairly straight forward because of the 104 submissions and Ben's thesis.

Post P2, I struggled during the methodology phase of the research due to a personal loss leading to a lack of motivation and vision to achieve my short term goals with respect to the research. After receiving immense support from my supervisors and colleagues, I managed to get back on track and have never looked back ever since.

The methodology phase of the research posed a lot of challenges with respect to the technical aspect of the EWF concept which was unfamiliar to me as an Architect. Discussions with Yamini and Puji, the two other students pursuing EWF, eased out pressure for all of us as well as helped in breaking down the steps required to be followed through the methodology process.

Consistent effort despite regular challenges enabled me in not only completing my research but also doing it well enough to be personally satisfied.