Reflection

Growing up in a hot and humid context of a fast-growing metropolitan of Bangkok, Thailand is one of the major drives to pursue my graduation project - *'Desigrate'*. Living in such context, air conditioning system becomes one of the necessities to provide indoor comfortability. Due to economical growth and rising temperature especially in summer, the growing demand for cooling is rapidly growing. This is visually evidenced from the condensing unit boxes hanging on the façade of houses and offices. We are stuck in a paradoxical situation, where greater demand of cooling is required, while carbon emission needs to be controlled.

'Desigrated' was developed under the COOLFACADE studio. The studio acts as a follow up on Alejandro Prieto's PHD thesis "COOLFACADE, Architectural integration of solar cooling technologies in the building envelope'. In his thesis Alejandro has conducted an extensive research to explore the possibilities and constraints for architectural integration of solar cooling systems in building facades to facilitates the design of architectural components for office buildings. The research has laid a solid groundwork for my project as it offers a comprehensive study regarding the solar cooling technologies in terms of its applications, constraints, and performances. It plays a crucial role in shaping the direction of my graduation project to explore the potential of a sustainable approach to provide an alternative system to facilitate or replace the conventional air conditioning system. The system is designed to serve as a façade component of office buildings. Therefore, the building technology aspect of climate, façade detailing, and façade assembly is thoroughly discussed, optimized and evaluated to provide a product which acts efficiently as a cooling system and enhances the insulation of the building. Hence serving as a cooling strategy both actively and passively. Furthermore, as the façade system is specifically designed for the hot and humid climate of Bangkok, both climate and cultural context are crucial aspects in designing the system. The design concept of the façade system is based on a vernacular approach to enhance the cultural value of the product which aims to reflects the "Thainess" identity to the built environment.

The project was developed with the 'disassembly – reassembly – integrating' strategy. The strategy is based on the line of inquiry imposed by the project main research question "How can the desiccant cooling facade system be integrated into the built environment to reduce cooling load of office buildings in a hot and humid climate?" and the COOLFACADE mentality to explore the potential of solar cooling technologies.

Disassembly

To bridge-in the knowledge gap regarding the solar cooling technologies and techniques, the research started off with the disassembly process. Primarily, the research is a comparative review based on literatures, experiments, case studies and market available products to understand the configuration of the different systems, and their performances based on different climate contexts.

Reassembly

While cooling and dehumidification techniques such as desiccant system and evaporative cooling has been widely use in industrial sectors for drying crops and humidity control in textile mills, it has a limited usage in building level, especially as a façade. Therefore, to reassemble the applicable systems as a façade component, literature reviews and researches become one of the most crucial tools in selecting the suitable system and strategy in designing the façade system. A comprehensive research base on the criteria of performances, applicability in hot and humid climate, and system configuration has been conducted. The constraints and results from experiments has been used as a framework in designing the façade system.

Integration

The final part of the research takes the form of a design process to integrate the façade system into a selected building which acts as a benchmark for evaluation. The performances of the systems are based on the assumption that the system would work under a similar condition and constraints of the experiments. The formulas and general calculations derived from the experiments were also used as a means of evaluating the system. Furthermore, to re-evaluate and verify the system performance, simulation software such as Ladybugs and Design Builders are used to generate the condition produces by the proposed system.

The project aims to explore the possibility of integrating a low-energy consumption technology such as the desiccant system and the dew-point indirect evaporative system into a façade component to offer an alternative cooling strategy to facilitates or ultimately replace the conventional cooling system. Therefore, it presents the possibility a system which would consume less energy and eliminating the use of refrigerants. It has the potential to resolve the growing carbon emission issues while providing serving the cooling demands. While the results and conclusion are merely based on assumptions and experimental constraints, the project could be use as a baseline for future prototypes in terms of system configuration and integration.

Due to the current efficiency of the systems, the 'Desigrated' system still fails to achieve its ultimate goal in eliminating the use of refrigerant system. In order to operate under high temperature and humidity the system still requires cold water (15°C) to operate efficiently. Moreover, further studies of solar radiation on a daily basis should be investigated to optimize the dependency of a heat pump. These additional researches could lead to a net-zero application in the future. Furthermore, due to the limited usage of desiccant system and dew-point evaporative system in building levels, most of the results and data are based on experiment results which are conducted in a small scale. Consequently, it doesn't guarantee that the system would perform as predicted in real life. Therefore, a prototype and further experiment is recommended.