

REFLECTION

Sustainable Graduation Design Studio

Sustainable Facade Refurbishment of Existing Tall Buildings in UAE using the Plug & Play approach

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Introduction

During the entire endeavour, I found that it is one thing to come up with any idea, but to validate it with critical reasoning and to make it practical, along with convincing others that the concept may be worth pursuing was a considerable challenge. Moreover, most of the time, I found myself to be open-ended with taking inspiration with many things I come across during my study and find opportunities to use them, which resulted in ambiguity in research focus. Thankfully I had the support of my mentors dr.ing. Alejandro Prieto Hoce and ing. Eric van den Ham who have been thoroughly evaluating my progress for almost about half year since the start of this programme and guide me to an area where the research was not only interesting but also feasible during the studio. Hence, over time my decision to pursue research in “Sustainable refurbishment of facades in existing high rise building using Plug and Play approach” allowed me to understand a lot in specializations of Façade and Climate Design.

Before the start of the exercise, I knew that there would be umpteen amount of challenges I have to deal with. Some might be entirely new that I may have to engineer it, and I was also quite aware that this entire proposal may be a bit jejune, with a high possibility of undesired results and failure. However, after discussions with the professors, sufficient backing from literature research and with some motivation we just said that Let us do it”. The premise was quite clear from then on, “To design a façade panel which is detachable from the entire grid of façade system, each panel which can have a certain functionality (Photovoltaic system for the scope of this research) and possibility to access individual elements to the component level, so as to keep extending and improving the life and performance of the façade system and then to the end of service life of the building itself”. The whole attempt itself would provide a high learning curve of what is possible and what is not. The most substantial part of the thesis was to comprehend the ideas which you knew existed before and understood some aspects of it. However, when you learn about them individually, it is immensely vast, that the new information tends to become overwhelming. Same was the case with me and most of the thesis.

Learning about the concepts such as active and passive design, shading systems, thermoelectric system, sustainable refurbishment, thermal calculations, nature of curtain walls, end-of-service life, life cycle analysis, vast amounts of HVAC design, types of facades, types of glass, how a solar thermal system works, how a photovoltaic system works, precise nature of façade engineering, the complexity of creating a detachable or disassemble façade, software's such as design-builder, grasshopper, simulations such as thermal modelling, and even up to using calculation operations in excel and many more was all new information for me. I cannot for sure confirm that I have absorbed all the values from these concepts and literature yet. However, I can, for sure, agree that I am happy to have spent my time to overlook these concepts and try and apply them in whatever way I could in the thesis.

Well, for starters, I knew that curtain wall façade systems have a smaller end of service life (ESL) in comparison to the life of the whole building. It was basically because some of the individual components had a smaller life in comparison to the whole system. The idea then was to figure out a way to access these failed components and either replace them or fix them without stripping out the whole façade itself. The general practice for the moment was to wait for the façade to fail entirely and then change it or sometimes even demolish the building itself both of which are unsustainable in various aspects such as reduced energy performance or wasting usable materials leading to increased carbon emissions as a consequence. Hence I tried to tackle just that, which was to make all components easily accessible, reduce the cost of maintenance and use specific elements as long as they can be used. Apart from extending the life the aspect of integration of certain functionality was to target two aspects, one - cost saving by making the refurbishment of façade to pay for itself by making it contributes to certain functionality of the building (such as energy production, thermal protection, etc..) and second to make it future proof by having demonstrability, repairability and expandability so that the performance of the façade will improve over time based on the possible technological advancement in the future.

Overview

The thesis was an opportunity for me to exercise my understanding of the sciences I learnt during my masters in a controlled environment. As for me and my thesis, I would say it was a success because what I did was identify an existing system with a shortcoming in it. In this case, were curtain walls and its poor performance over time and the reasons for it due to failing components with shorter lifespans. The solution was to apply a previously existing tried and tested concept. However, tailoring it in a way to suit the requirements of the posed problem. In this case, the Plug&Play approach allowed for disassembly, future proofing and improved performance.

It was necessary to study the how and why systems fail and learn from the experiences of others about what needs to be considered, applied, avoided and maybe the reason the results. This was an iterative process. Discussions with mentors, industry experts, other faculty members and even friends from the industry were all enlightening. At certain occasions, prototyping what was thought about also helped visualize the problem at hand to determine what could work and what could not. For example, one of the versions of the design was to twist and turn the façade

panel and detail design continued for a while before one of the external advisors suggested that twist and turn in a pivot contains a geometric problem which cannot be solved with conventional approach and there is a reason why facades do not have pivots in their design. This was an eye-opener. The design then was accommodated to a swing system due to the feedback received. Similarly, there were larger ambitions which did not address to the core of the design, and it was necessary for tailored guidance from my mentors to help me choose elements and aspects which reasoned for the design and the research instead of another task just done.

Thesis Summary

1. Sustainable refurbishment ensured that materials are not wasted before they reach their assigned end-of-life and as a result, the building itself reaches its potential end-of-life without premature demolition and hence wastage of all the materials and carbon emission contribution
2. Propose a solution to the part of the world which needs sustainable measures the most.
3. Economic analysis optimised the precise activity which would inflate the costs of the building, and the design approach was to abate it.
4. Plug&Play concept allowed for the integration of newer technologies in the façade and allowed for access to keep them functioning.
5. Simulations, calculations and various tests validated the hypothesis that proposed systems with required functions would work if implemented.

Relevance

Sustainable design is the call for the hour, and the reasons behind it is well known. It should be our earnest attempt as future designers and engineers to understand the effects of our contribution to the planet. Prudent design should not just be limited to the immediate function but also the consequences of the design in the future. My earnest attempt was to do just that with my thesis.

Ethical Issues

One of the aspects which kept me pondering was that research could only do so much, the design is of no value beyond the report post the graduation. However, it should be. The hardest part of any design is to convince the people that the proposal could indeed be helpful and solve problems. However, it has to be based on scientific reasoning and not a gut intuition or personal preference, of course. The Plug&Play approach elaborated in this particular setting would fare well as the design addresses many key concepts which are relevant, holds answers to certain aspects which needs to be solved pretty soon if not immediately. This thesis is not about identifying the precise tools to solve problems but to ask the right questions and seek answers; however, it may be. I cannot claim that the thesis has perfect results that can be adopted immediately. However, it will

trigger thoughts which can provoke future researchers to think in a line which could probably solve the questions asked here.

The following are some points that I think can be improved in my design and approach.

1. Working with a company or an association I feel would be better with this regards as it will create a routine instead of one making their own goals at once own conveniences.
2. It could have been that lesser courses could have been taken during the time of graduation thesis as it is necessary to keep oneself in a continuous workflow.
3. Discussions are critical as it allows one to think externally, and when one shares their thoughts is when one comprehends about how much one does know about the concepts they are discussing.
4. Case studies are hard to come by with approval. Hence it would be ideal to start with a concrete case before making assumptions.

In conclusion, I am content with the way the thesis analysis shaped up. I do agree, that it was a bit overwhelming to design and analyse even the small portion of the façade in a given time, and I had to speculate many uncertainties. However, this is part of any learning process I assume, and all I can say by this study is that I feel more confident than before to work with façades in the future.