Reflection - Computational toolkit for early-stage cost assessment and optimisation of BIPV façades

Tolga Özdemir - 20.05.2020

The aspects that drove me to begin this subject were my eagerness to learn more about computational design and optimisation, and at the same time seeing the practical applicability of the renewable energy generation.

This study aimed to find a cost-effective energy-generating façade concept for the most significant academic hospital in the Netherlands, AMC Amsterdam. AMC is almost a century old now. It started not being able to comply with the energy-efficiency regulations and needs refurbishment. On the other hand, the hospital currently generates most of its energy with its CHP plant running on gas. The Netherlands seeks ways to exchange gas for renewable sources for energy generation. The argumentation of the study was that it might be a good time to make use of the building-integrated photovoltaics if and when the façade of the AMC would be renewed.

Photovoltaics are commercially preferable, although their efficiency is not the reason for the choice. The technology is developing so fast that any investment can lose its competitiveness in a short time. The advantage of the system is that the elements can be applied on different surfaces and replaced without much effort. In the AMC case, one of our goals was to discover the potential of customisation in such a large scale by comparing the added benefits with the added financial burden. Although standardised photovoltaic modules are getting cheaper in time, they can fall inadequate when a retrofit is in question. We could cover almost 65 per cent of the façade area with standard 72-cell modules. The initial feedback from my mentors was towards understanding the architectural dimensioning of the building. When considering the dominating rhythm of the façade surfaces, this ratio was raised to 85 per cent. AMC has a building mass with a lot of indents, and not every façade is equally beneficial in terms of photovoltaic generation. The custom modules helped us to make more use of better façades.

Maintenance was another factor considered. The current rain-screen façades are usually installed in a way that to replace one; many other panels should be removed. These systems may be cheaper as the engineering has already been done and the feasibility is proven. However, rapid repairability is equally essential. A façade system inspired by an existing product was thus proposed. In this system, instead of hiding the fixing screwed-joint of a panel under the consecutive panel, the fixing bracket is screwed from between the panels.

The human factor is a crucial aspect when designing. Façades of buildings have great opportunities both in terms of architectural expression and social interaction. Designs in human scale would add much of architectural quality in a building. We proposed to add planter boxes on the balconies together with the living wall façades as parts of a broader potential green strategy in the building complex and showed how such energy-consuming systems could be financed. However, the architectural layout and the connection of the balconies and the possible programming still carry a lot more potential which could have been studied further in longer time or can be studied in future.

Engineering economics was another field that I was introduced to, in order to conduct the cost-effectiveness studies. I found the chance to start seeing monetary flows from the investor's eyes, and this gave me the insight of why a concept which feels favourable for the consumer may or may not be realised by the sector. Many risk factors and are present unknowns for the investor and without being able to predict or control these, environmentally friendly projects are difficult to be brought to life.

Having experience neither in coding nor optimisation, asking the right questions to a computer software was extremely difficult, as strict precision in the maths and even wording was necessary. This difficulty taught me very much in problem formulating and solving. In the optimisation part of the study, our trials started with simple problems with fewer restrictions. For instance, we started with an unlimited budget, and in that phase, I learned about how to interpret data. Following additional steps, an algorithm giving the optimised results was written.

Despite all the difficulties I faced in this process, I learned a lot about the market aspect of architecture and the use of computation in design. There is no doubt that these would change the way I see my surroundings and give me the opportunity to become a better designer.