

Graduation process-

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How is your graduation topic positioned in the studio

Nowadays, the reduction of energy consumption is more acute than ever. The Netherlands have set the goal to improve the energy efficiency by 33% in 2020 compared to 1990 (Ebbert, 2010) and expects a CO2 emission reduction of up to 88-91% by 2050.

The building sector, consuming 40% of the materials entering the global economy, is the biggest energy and natural resources user (Asif, Muneer, & Kubie, 2005). The supply of crucial raw materials is limited, and additionally, energy consumption and carbon emissions have increased dramatically. The Circular Built Environment Studio aims to tackle these problems through Circular Economy principles.

Waste reduction by remanufacturing windows, an element that is integrated in every building is therefore an important step. Through a design for the resealable Insulated glazing units they can be used for a longer period which results in saving materials, embodied energy and money.

How did the research approach work out (and why or why not)? And did it lead to the results you aimed for? (SWOT of the method)

The results of the literature review were divided into three different parts: Façade design, circular economy, and Insulated glass unit components. For this literature was conducted but also taking interviews with companies and experts. After the literature research the design process had to start, during this also experts were asked for information about certain processes.

Weaknesses: Doing this thesis at a company could maybe have helped to gain more insight in (their/ practical) way of working and using the correct ways of drawing and manufacturing.

The only test I wanted to do, failed because of lack of skill and because lack of time there was no chance to redesign the whole test. Furthermore to really test the system on air tightness a real mock-up should have been built, unfortunately it was not possible to manufacture the real butyl sealant, maybe with conducting this thesis at a company It would have been possible. Because of the time of the graduation project, the research was limited to just the seal of the IGU. And for example not the spacer bar or even optimisation.

Opportunities: Testing glues, Further studies on reverse logistics and business models, warranties, upgradability to three layered glass or with structural glazing, life cycle analysis, further optimisation of the other components of the IGU(e.g. a more flexible design for the edge to tackle the atmospheric stresses).

How are research and design related

Before designing I first had to gain knowledge about different topics. After gathering information, I had to study it to make connections, understand the contradiction, make principles and requirements for my design. After this the design process could start. There was lacking information about rubber forms so I had to experiment myself with for example form- studies for rubber components. This was done in collaboration with the LAMA lab for 3D printing with flexible material. I wanted to test the gas tightness of a glued connection, no information is available on this topic. Therefore I went to civil engineering to ask equipment (manometer) and did a test to know if my design assumption was valid. It proved wrong and so I adapted my design based on this gained knowledge. Right now I am in a stage where I need a simulation in order to verify my design and to see how it works so it can be tweaked.

Did you encounter moral/ethical issues or dilemmas during the process? How did you deal with these?

Lots of information from companies are secret, for example I was not allowed to take pictures at the AGC company in Friesland and also composition of rubber elements was secret. Also talking with Shüco about rubber sealants and how they produce them is not information I was allowed to know/share.

Societal impact

To what extent are the results applicable in practice?

The result of this research could form a phd topic that can develop this concept into a real working prototype. But to be able to have an evolved version of this product on the market, a circular business model that ensures economic viability, new guidelines for the architectural sector and an open market should be developed.

To what extent has the projected innovation been achieved?

It is just the start to think about re-manufacturable windows and it should be developed even more to become an impact full product.

Does the project contribute to sustainable development?

yes, In a time that also the building industry has to reduce its energy consumption and that many projects concerning energy efficiency in buildings are agreeing that less materials and elements have to go to waste, it is strange that most projects only focus on the façade and don't consider the IGU. With this thesis a design for the IGU is made to change this linear economy product in a more circular design concept.

What is the impact of your project on sustainability (people, planet, profit/prosperity)?

Traditional linear consumption patterns ('take-make-dispose') are coming up against constraints on the availability of resources. Currently glazing panels are coated with all different sorts of function giving critical materials: including Copper, Titanium and Cobalt. These coatings cannot be removed from the glass for recycling (F.Veer, 2017). Extending the life time of the glass reduces gaining of critical materials. Shifting to a circular economy implies a more responsible use of resources, and understanding the value on them. However, the transition to it seems to be highly complex, as it needs a lot of investment in research, money, and effort and will be seeing only in the long-term for the planet. This research focusses on a circular design for a product that could mean new sort of companies which results in more jobs for people while for the client this means easier remanufacturing what makes it more attractive to refurbish the building (sooner). In this way more buildings can continuously have a better energy performance which results in saving energy and energy bills and offering a comfortable space. Especially now that there are a lot of glass buildings are built.

What is the socio-cultural and ethical impact?

The outcome of (this) product eventually would create more and other job opportunities but also mean a different role for the glass panel industry. Less new window panels have to be manufactured. Furthermore it will have a big impact on the ('take make dispose') market and enhance a circular economy.

What is the relation between the project and the wider social context?

The linear economy of current glazing systems is based on based on large-scale production, using large amounts of materials, resources and energy while generating significant amounts of CO₂. This cannot be sustained in the 21st century. IGU units are currently not refurbished, because the industry has not developed the required business model, logistics, technologies processes/operations and design to make this possible.

New circular business models, innovative circular designs and technologies have to be adapted from other industries and this could form a basis for different products as well in the building industry.

How does the project affects architecture / the built environment?

It will let the architecture branch rethink the challenges of a fully glazed façade and shows the environmental impact of a totally glazed façade.