Abstract:

This thesis is motivated by the fact that today the building industry is a significant waste contributor. Especially at the end-of-life of the building it causes an enormous impact on the environment. Waste will be reduced by extending the lifetime of the short-term buildings, and therefore the facade replacement for the commercial buildings must be encouraged. Though the result of waste due to the mixture of materials remains a problem during the end-of-life process, this barrier mainly comes from current construction practices that view the assembly as a unidirectional practice with an end goal of producing a final facade/building. A more cyclic or closed-loop view recognizes the need to consider, at the design stage, the disassembly process as well as the assembly process. Design for disassembly expresses such need. These strategies, which are in this thesis applied to an example facade of Arup, show possibilities to reduce waste by redesign. Design for disassembly originates from industries in product design and is driven by regulations. In architecture, the disassembly process is undervalued and regulations are expected in the near future. Learning from the product design and applying design for disassembly strategies, more waste reduction is achieved by focusing on an element of the facade. In response, two studies are applied on the example facade to find the element with potential for improvement - end-of-life and life-expectancy study. The glass unit element has the most potential to decrease the waste by improving its end-of-life: The life-expectancy study showed that the primary sealing, between the glass and aluminium, keeps the glass unit airtight. The sealing is one of the weakest links. It is vulnerable to UV-radiation and has a limited elastic capability when heat expansion of glass occurs. The end-of-life results showed two critical points related to the glass unit: the glass is currently down-cycled due to the inseparable materials used within the unit and due to the integration into the container glass recycling process. Additionally, the float glass of the glass unit accounts for 61% of total waste weight of the facade. Taking the reduction of waste into account during the redesign, there are 4 objectives when applying design for disassembly strategies - adapting the glass unit by extending its service life, reuse of the glass unit, reuse of glass or glass recycling. The two studies showed that the most realistic objective for the redesigns is to change the current down-cycling of glass to a recycling process to decrease the waste. Results of the redesigns are visually presented in the end-of-life framework and give a clear perspective on the process. It shows that it is possible to integrate glass in facades for recycling, but not with the techniques that are currently applied on the glass unit.

End-of-life framework:

The end-of-life scenarios framework is specially developed for the purpose of this thesis. The main goal is to create an overview of the end-of-life and directly stimulate discussion on this field of work. The tool provides an overview of the raw-disassembly process of the Galeria Kaufhof facade. The shape depends on the separation methodology, three types are presented below. The framework should be read starting from the grey core to the outer layers. The core is the starting point (phase 0) and each layer around it represents the outcome of an end-of-life phase. The outcome of phase 1 (the outcome of the raw-disassembly process) is divided over 5 categories for example. The figure directly below shows the end-of-life study results for the Galeria Kaufhof facade.