REFLECTION

Knowledge gap

The graduation for the building technology track consists of a theoretic research regarding a building component and its application in the built environment. In the past, several studies have been done on thin glass. Starting with a single layer, finding ways to stiffen the panel through bending or using it as a stiff fabric in some cases even considered as an adaptive layer. Followed by research on sandwich panels and how the core works together with the outerlayers in order to provide stiffness. An investigation of the heat transfer through such a panel is the next step in order to determine if this could be a real façade component, with sufficient insulation.

Approach

There is a lot of literature regarding structural sandwiches. Using a sandwich structure is a proven method in aircraft building in order to provide a stiff but also lightweight structure. On the other hand, adding a layer between the two glass layers leads to a higher heat flow between inner and outer layer.

Literature research also led to different ways of calculating and measuring heat flow. Between them is a trade off between calculation heavy (numerical analysis) and low accuracy (simple analytical calculation). The results from different analytical methods is compared with physical measurements. Unfortunately, the physical test is not accurate and no conclusions can be drawn. The values are in a very small range, it is most likely the results are just inaccuracies of measurements. The magnitude is however in the right direction.

The initial idea was to use an optimization algorithm in order to create 'the best pattern'. Due to shortcomings of Karamba (unable to join beams and shells) this is changed into researching 11 different patterns and draw general conclusions based on heat flow results.

This workflow is also used on a microscale to define the most effective cross-section. The method consists of different variations of sections, which all are calculated with FEA. Based on the material use, moment of inertia and psi-value. This does not lead to the 'most effective cross-section' but gives directions on where to search such a cross-section.

Although the results lead to better understanding of the subject. The best way (when designing for thermal and structural only) is to create large elongated rectangles. These perform almost identical to a regular insulated glass unit.

In order to answer the research question; can we counter balance the energy in the production process, with that of the energy during lifetime. An energy model is built to calculate energy in use. The sandwich design is compared to a regular insulated glass unit in a standard office.

Practical

Glass is used more and more in de built environment, although it has the benefit of being one of the most transparent building materials. It is accountable for a bigger thermal load, high embodied energy and heavy panels. Next to that, it is difficult to recycle due to the coatings applied.

Based on this research a sandwich panel can counterbalance the energy during lifetime. The U-value is very similar to an regular insulated glass unit, but uses far less energy to produce and is lighter.

Therefore, a reduction in the dead load on the building is achieved leading to slimmer structural members. Based on these results, thin glass contributes to a much lower embodied energy, which opens opportunities to make quadruple sandwich structures that still reduce embodied energy during production and lead to less energy during lifetime.

Planning

Compared to the planning, the FEA-model took much more time than expected. At the moment the FEA-model works, but a full license, necessary for the complex calculations is not obtained yet. Preliminary results show the desired result and U-value can be measured/calculated.
Physical validation was planned halfway January, external delay shifts this planning to first week February. Most difficult part for me personally was the balance between research and report. It is very easy to get focussed on the research part, resolving issues in algorithms and producing results. Documenting them and support the next steps by conclusion was much more difficult.

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