Personal Reflection

The restoration of marble monuments with glass covers several fields within the architectural world. It involves material science, production techniques, building connections, and heritage. This large variety of topics is eventually what convinced me in choosing this research project. During my previous four and a half years at the Faculty of Architecture and Built Environment, I always enjoyed the courses which had a lot of overlapping between the several professions within architecture. By choosing this topic I hoped to find this same mix of overlapping professions. Moreover, since my first encounter with glass as a building material, in the Structural Design course, I was intrigued by the possibilities of using glass in other places than window frames. This, combined with my fascination and admiration for classical architecture, has pulled my interest in researching this topic for my graduation thesis.

The large amount of different working fields results in a big variety of topics that need to be studied. During the research phase, it turned out to be quite difficult to prioritize the amount of work per topic. It was hard to find the right balance between the heritage and technical sections. The main part of the thesis is about how glass can be used for the restoration of marble, but to make the correct design decisions, it is important to know the background of the principles of conservation. However, with the countless different opinions regarding conservation and whether it is appropriate or not, it was hard to position myself in that debate. During the literature study, it was important to find balance in this ethical debate where the extremes go from conserving anything you can against all costs on one side, till not preserve anything at all on the other.

My position as designer in this debate was crucial in the further development of the design process. It would be the main assessment criteria for deciding whether design alternatives would be appropriate for the chosen case-study or not.

Choosing this case-study in the first place was rather complicated as well. It was not possible to travel to Greece to collect data and information about a specific case study, so we were dependant on whether and what kind of information we could get. Initially, the chosen case study was the Temple of Poseidon in Sounion, Greece and digital models of a column would have to be made manually. However, after consultations with the authorities of the Acropolis restoration project, we received a scan of one of the large outer columns of the Parthenon. The case study thereby changed from Sounion to the Parthenon, although it is, again, explicitly mentioned that I am not making a design for the Parthenon. The temple is only being used as an example of how this new method of conservation with glass could be applied in practice.

Till this point, everything kind of went according to plan. I am not eager to make a very strict time planning, because it simply does not work for me, so I prefer to work with milestones. These milestones cover several weeks so I can improvise a lot, thereby having a lot of freedom. This approach turned out to be quite useful because three weeks after P2, I unexpectedly had to undergo a knee surgery to heal an injury I suffered in October. Till the very day of the surgery, I did not know how long I had to recover. It could take only one day or six to eight weeks. Luckily the surgery went well and it took only one day before I could walk again. So after all, it did not affect the process of my thesis.

From the first unexpected obstacle during my thesis, we almost immediately fell into the second one. The outbreak of the Covid-19 Pandemic has affected everyone's normal lifestyle and all things that were planned for the rest of this year, including graduation projects. All faculties were closed until at least the first of June, and it is doubtful whether this period will

be extended or not. But even if the faculties open again, it will not be possible to do any kind of practical work there. This makes that all the planned practical work, which has to be done at the labs or modelling halls of the university, has to be postponed and possibly even cancelled. This really affected my process since it was not possible to produce prototypes or test specimens on strength or transparency. These experiments would have been very valuable for the assessment of the design alternatives. In future research into cast glass restoration, this testing should definitely be included in the design process. It does not only give valuable information that can help to make design decision but it will also prove to the public that this type of restoration is safe.

Many people from outside the engineering world are still afraid of glass being used as a structural material. Famous examples are the various glass bridges in China that span large valleys at an enormous height. Despite the structures are proven to be safe, people still have a lack of trust in the glass floors. The same trust problem will likely occur when glass is used in heritage conservation projects. People will doubt the strength of glass when it is used in vulnerable monuments. With extensive testing, scientific evidence can be gathered to convince the conservative would of conservation seeing cast glass as a proper and safe alternative for the conventional restoration materials.

Looking at the results of the thesis, I think that this is still only the beginning of the principle of glass restoration. In this thesis, only the first explorations of using large monolithic pieces of cast glass have been researched. However, in the past, several projects have been done with smaller cast glass elements and other types of glass. With the rising popularity of using glass in other applications than windows and the development of new production techniques like the 3D printing of glass, the possibilities of using glass in restoration project only seem to increase and diversify.

During this development of glass as restoration material, the increasing desire for sustainability and circularity in the built environment will demand more attention. Glass is currently not seen as a sustainable material given the high carbon footprint of the production process and the limited possibilities for recycling. Besides switching to a more sustainable power supply, there is little room for changes in the production process of glass. The high working temperatures of glass require a lot of energy, something that cannot be easily be reduced.

The potential of making glass more sustainable lies more in the reuse and recycling of the material. Nowadays glass is often bonded with adhesive material, which makes it extremely hard to recycle. So there is a common desire between glass technology and the architectural conservation to make the connections between glass elements reversible. Nowadays, recyclability or reusability is not a hard criterion in glass manufacturing and design, making it subordinate to other design criteria. However, in architectural conservation reversibility is one of the most important values. When using glass in conservation projects, there is a strong demand for reversibility, requiring new types of connections. This development could be a catalyst for making reversible glass connections in other applications. This would increase the recyclability of glass enormously, thereby reducing the carbon footprint of its production process and making glass a more sustainable and future proof material.

Looking back on the past months, two main periods stand out; pre-corona and post-corona. At the beginning of the process, I really enjoyed working at the studio in the faculty. Sharing ideas and thoughts with fellow students helped me develop my own design. Also the consulting sessions with my mentors Faidra and Marcel were both very productive and enjoyable. I really liked the group sessions we had with our "cast glass" group. It was useful to see the work of other students and the problems and solutions

they had. I think that participating in these discussions was way more useful than individual sessions would have been.

These workflows changed dramatically after the outbreak of the SARS-COV-2 virus. The pandemic forced all students to work from home. This had several downsides like the lack of social contact and quick discussions you could have with other students. Also, the design consults with my mentors completely but I want to compliment and thank them for improvising and keeping up the consultations as normal as possible by using Zoom. If I had to mention a positive lesson learned from this change, it would be about the preparation for these consults. Given the distance and time, you are forced to prepare yourself better for these consults. Organising the things you want to show and ask was essential for a productive Zoom session and I think these lessons could also be applied in futural 'regular' consults.

There is still no clear vision on how the near future will look like but the chance that any experimental work can be done at the faculty is zero. In the period after the P4, it will thereby only possible to work from home. Despite this, I would love to make a prototype of the final design. It will not be possible to do this with the correct materials but with gypsum and transparent resin, the appearance of marble and glass could be approached quite well. I think that with this prototype, the design can be brought to the next level. A level which cannot be reached with only Rhino.

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