Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences
Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

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<tr>
<th><strong>Personal information</strong></th>
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<tr>
<td>Name</td>
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<td>Student number</td>
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<td>Telephone number</td>
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<td>Private e-mail address</td>
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<th><strong>Studio</strong></th>
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<tr>
<td>Name / Theme</td>
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<td>Teachers / tutors</td>
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<td>Argumentation of choice of the studio</td>
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<th><strong>Graduation project</strong></th>
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<th><strong>Goal</strong></th>
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structure. When making a structural glass three-dimensional geometry the chance of buckling will decrease. But other problems will occur, like; the element size, safety and transparency. Next to this there seems to be a disagreement between architects and structural engineers; architects would like to have an open space without any interruption in light and view, and the structural engineers would like to have enough loadbearing elements (walls and columns) to transfer the loads safely to the foundation. Columns normally give an option to keep the open space with some interruptions in view and light. When these columns would be transparent, a good compromise between architect and structural engineer would be made. In this research and design process solutions to the different problems will be found and an all-around design for a glass column made with cast glass elements will be proposed.

Research questions and

Objective
The goal of this research is to contribute to the innovation of glass structures in general. In this case, this will be done by using interlocking structures of cast glass elements to create a column. Next to this, this research can help the architect and the engineer to a design which will suit both parties in any desired construction.

Research question
How can we design and produce a safe, engineering-sound, transparent, re-stackable, free-standing column made of cast glass components?

Sub questions
- What size should the components be in respect to the limitations of the casting process?
- What are the possibilities in the shape of the column and its
components?
• How will the components be connected to each other?
• How can redundancy be included in the design of this column?
• How can we make this column fire resistant?
• How will this column be connected to the levels underneath and above (external connection)?

This design is based on literature research of glass, glass columns, interlocking structures and glass structures. In the design I would like to focus on the production of cast glass elements, the safety of a cast glass structure, considering the sustainability of the column, placed with solid details attached to the location in the glaspaleis and still keep the column as transparent as possible.

Process

Method description
This research will be done in different phases. The first phase is literature research in different subjects that will be met to come to a design of a cast glass column: glass as a material, glass columns, cast glass structures and interlocking geometries. After which a conceptual sketches will be made considering design principles and challenges of this literature research and the context of the Glaspaleis in Heerlen (case study).
In the second phase, the design phase, the options of the design will be further explored. Together with the design principles and challenges different designs will be made with an hands-on approach. Ending this phase with a final design of the column and its elements.
In the testing phase this design will be tested with hand calculations, FEM-calculations. Later, the adjusted design will be manufactured and tested physically. The physical testing will be about how the elements will break. This could be done either with glass or ice. After this conclusions will be drawn about the research and the design.

Literature and general practical preference
Akerboom, R. (2016). Glass columns, the potential of free standing glass columns assembled from stacked cast elements. TU Delft.


Man, G. de (Gerrit), & Eldik, C. H. van. (2001). Overspannend staal. Dl. 2:
Construeren A. Bouwen met Staal.


Reflection

Relevance
The data found to create a cast glass column made of interlocking elements can be used as a database for technologies in the structural glass field, interlocking glass elements and any architectural research in making a building more transparent. The directions that will be chosen in the design could help other designers in cast glass interlocking structures to make their own decisions based on the results of the design.

Furthermore, the design of the column that will be made can be applied not only in the Glaspaleis, but in any other building. When applying this column physically in a building, big steps will be made towards the realisation of a completely transparent building. The application of this column can set an example for other buildings. Next to this, applying structural glass more and more, the regulations of structural glass should become easier applicable and therefore more used.

Time planning
In the phases between the presentations there will be a focus on different parts of the research. To end up with an optimal glass column design for the location, the force-flows and the aesthetics.

P1 – P2: Research
In this phase, literature research was done in the elements that would have anything to do with the subject glass column made of interlocking elements in the Glaspaleis (glass, glass columns, cast glass structures, interlocking geometries, case study). With this information the design principles and challenges were formed, the concept-
sketches of the design was made, and the research questions are asked.

**P2-P3: Design**
Specified research is done in different comparable designs of elements and structures. Different designs will be made, keeping in mind the design principles. This will be a hands-on approach of designing. Ending this phase with a final design, this design is the best combination of the answers on the research question(s)

**P3-P4: Testing**
This phase will consist of calculating and testing the final design. This will be done with hand-calculations, FEM-calculation and later physical testing. The physical testing consist of testing how the elements will break, rather than on which force they will break. It will be done either with glass prototypes or prototypes made of ice. These tests will either way be done at the faculty of civil engineering at the TU Delft. After the testing, evaluations will be made and the design will be visualized.

**P4-P5: Presenting**
During this phase the focus will be on the report and the presentation. There will be no further developments in the research itself. In the report possible future continuation researches will be suggested.