

## P4 Reflection

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### The relationship between research and design and the methodology

Based on the previous research done in Delft University of Technology, the L-shaped connection for the glass portal frame is developed; however, a crucial research in the development of this connection is not yet finished, which is the finding of its rotational stiffness and how other parameters change it. Therefore, I continue the research and the development of it and to develop the design process of the glass portal frame by using this L-shaped connection.

In my thesis, the approach is basically design by research. The finding and conclusion from the research stage is the element of my design, in this case, it is the design process of a glass portal frame and how to apply it in an all-glass building. The methodology used in this thesis starts from literature studies with case studies to have an overview and knowledge to understand the current development in both academic area and in practice. Throughout the process, I established my thesis objective that I want to focus on. Also from the literature studies, parameters for the design of the glass portal frame and L-shaped connection is then having a more clear definition. Because the starting point of this thesis is from the structural perspective, so the structural theoretical calculation, FEM analysis and laboratory test is performed to find and confirmed the rotation stiffness as well as to learn more about its structural behavior. Theoretical calculation and FEM analysis are to verify each other to see if either is not correct, and the laboratory test is the verification of both. For the design part, the design process of a glass portal frame when using L-shaped connection is designed from the conclusion and the input of the research stage. And this new design process is compare with the original design process in current practice. At the end of this thesis, the design process will be applied to the Dresden pavilion , to verify the result of the research and design process and to compare with the adhesive connection applied in this pavilion . Moreover, a table of comparison of different all-glass buildings using glass portal frame will be presented regarding different aspects, such as structural system, construction, aesthetic, transportation and safety, to show the advantages and disadvantages of using each different kind of connection, and that is to help the architects or engineer in the future to have an over view of what are the options and possibilities in that certain condition for that certain all-glass building project.

### Research and design Methodology

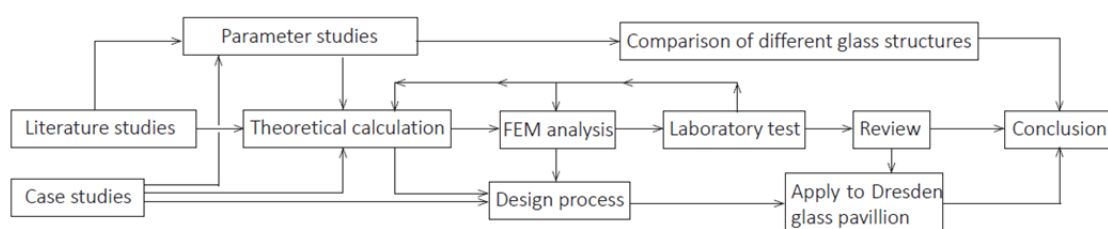


Figure 1: Research and design methodology

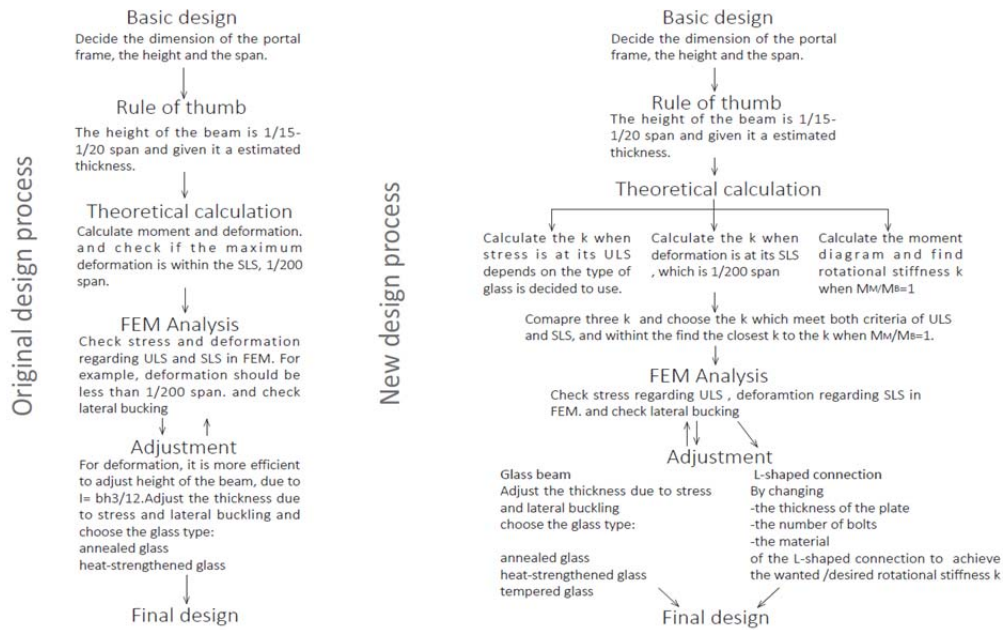


Figure 2: Original and new design process

### The relationship between the project and the wider social context

With its brittleness in nature and no warning of failure, glass is a difficult building material to build with. Because of it, safety is always an important issue in building an all-glass building, and also not an easy material to design with. Through this thesis, I hope to provide a connection design and its design process altogether with the glass portal frame that will offer higher redundancy in the glass building. And another contribution I hope to achieve is to provide architects and engineer an overview of the advantages and disadvantage of different connections for glass portal frame, to help them understand what are the options and possibilities for the all-glass portal frame design.

### Process reflection

From the beginning of my thesis until this stage, the focus and the objectives have been adjusted slightly along the research process, due to many findings and input from the literature studies, theoretical calculation and advice from my mentors. Personally, I think it is important in the thesis process to make different arguments and try different approaches at the beginning, and later on to know what works and what doesn't. So far the literature studies is the part I enjoy the most, I learn a lot during this process. I think the challenge I faced in the beginning is the hand calculation of a portal frame with spring connection, I've tried different methods that I've learned in my bachelor to solve it, but it didn't turn out correct. After studying and translating some Dutch structural text book, asking friends who studies civil engineering and asking teachers, the first important part of the calculation is finished. Moreover, in my design process, I was expecting the new design process will has less steps and more straight forward in the calculation then the original one, but now I found it maybe more complicated, however, the promising thing is that the design process and the calculation has already

considered and combined the L-shaped connection into it. The other thing which is not what I hoped for is that I thought this connection maybe able to connect many glass elements in one connection to maximize the transparency and increase the simplicity of building in the aesthetic point of view. But it is not a good solution due to many reasons.

In the hypothesis, it is assumed that the  $M_B/M_M$  can be made equals to 1 to achieve a smallest height of beam by adjusting the rotational stiffness to certain number. In the new design procedure I developed, it is successfully proved in the Dresden pavilion case I applied that this method can be applied to achieve the smaller height of the beam and integrate the L-shaped connection into the design procedure. However, from the lab test results, it shows that this L-shaped connection may not always possible to achieve the rotational stiffness we desired. But it is recommended to further analyze in the future research.

To see all the benefits from the L-shaped connection and the design procedure of a glass portal frame that integrates this semi-rigid connection. it can be concluded that the L-shaped connection has the potential of developing into a connection product for the future all glass portal frame in real life.