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:

Personal information	
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Studio	
Name / Theme	Building technology
Teachers / tutors	Peter Eigenraam, Arie Bergsma, Christian Louter
Argumentation of choice of the studio	

Graduation project	
Title of the graduation project	L-shaped Connection of glass portal frame-Structural analysis and its application

Goal

Problem statement

Transparency is an attractive feature that designers are looking for in building designs, and glass has played an important role in offering transparency, light and lightness. However, glass has its weakness as structural material; its low resistance to tensile stress makes it a challenging material to apply in building structure. But with the rapid development of technology, using glass as a load bearing structure is no longer a dream. As the glass has limitation in size producing, weakness in tensile force and low resistance to concentrated stress, the connection between glass elements plays an important role in the glass structure. To achieve the functional purpose and at the same time maximize the transparency of a glass structure, the connection is wished to be design as small and less visual intrusive as possible.

From the research (Ate Snijder, Fred Veer, Rob Nijsse, Kees Baardolf, & Ton Romein, 2014)done by the Delft University of Technology, the connection of a L-shaped plate is developed for a 8 by 4 meter glass portal frame. It has the feature of remaining the transparency of glass structure offered, but at the same time serve as a structurally well-performed connection. However, the structural parameters of the connection has not been fully analyzed and tested. And a design methodology of a connection influencing the design of glass portal frame seems to be the next step.(F.A.Veer, Jamssen, & Nagele, 2005)

In the earlier research of a 8 by 4 meter glass portal frame and a connection has been developed and tested at the Delft University of Technology. By then the steel connection was consist of two parts: saddle and corner plate. From the research, the connection behaves more like a hinge rather than a rigid joint. And the test indicated that the outer plate plays a much more significant role than the inner plate in the distribution of the force. In a later research done by Eigenraam and Snijder, it is suggested

that the inner plate can be ignored to reach the maximum transparency and still has the good structural performance as a connection. In their research, the analytical prediction of a rotation point and the rotational stiffness is further analyzed. The aim of finding the rotation point and stiffness of the connection is to determine the other parameters in the structure, for instance, the rotation stiffness affects the level of bending moment of the beam, and will consequently affect the height of the beam. The theoretical prediction of a rotation point has been tested but needs further confirmation. However, a further research on the rotational stiffness needs to be worked on.
In this research, the rotation point will be further confirmed, rotational stiffness will be analyzed and tested and a design methodology of glass portal frame regarding to the parameter of this connection will be developed.

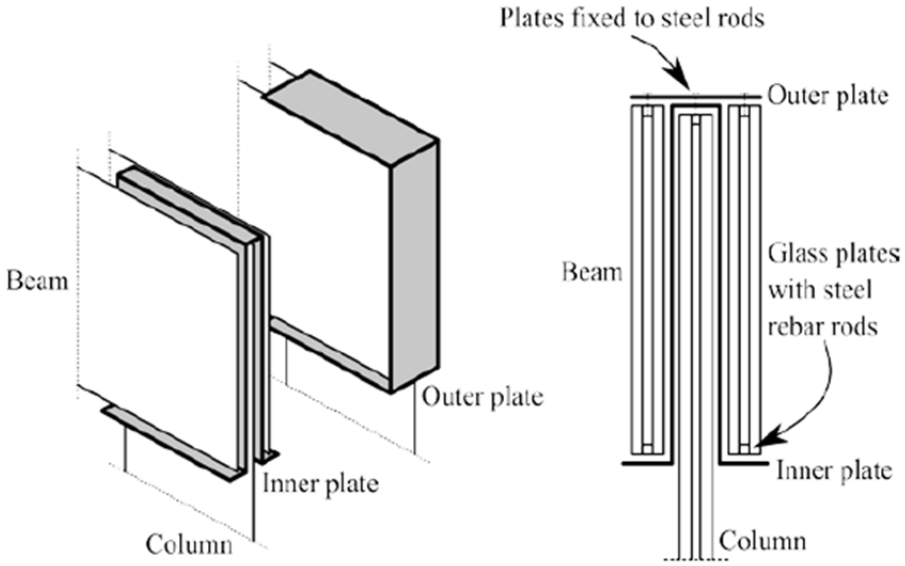


Figure 1.2 Connection principle (Eigenraam & Snijder)

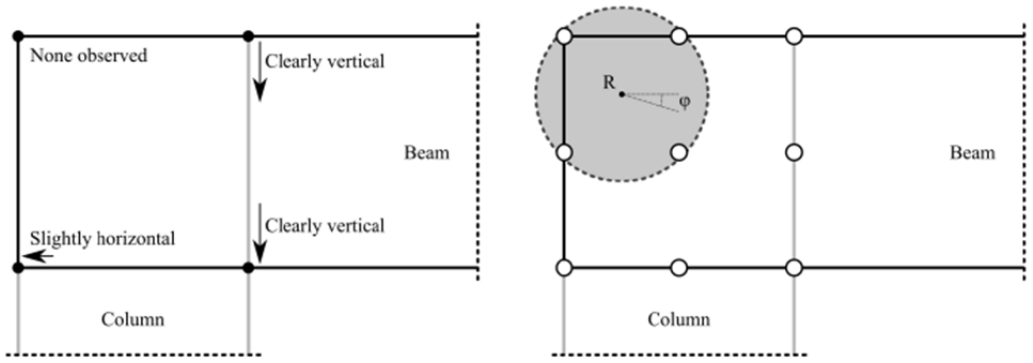


Figure 2. rotation point (Eigenraam & Snijder)

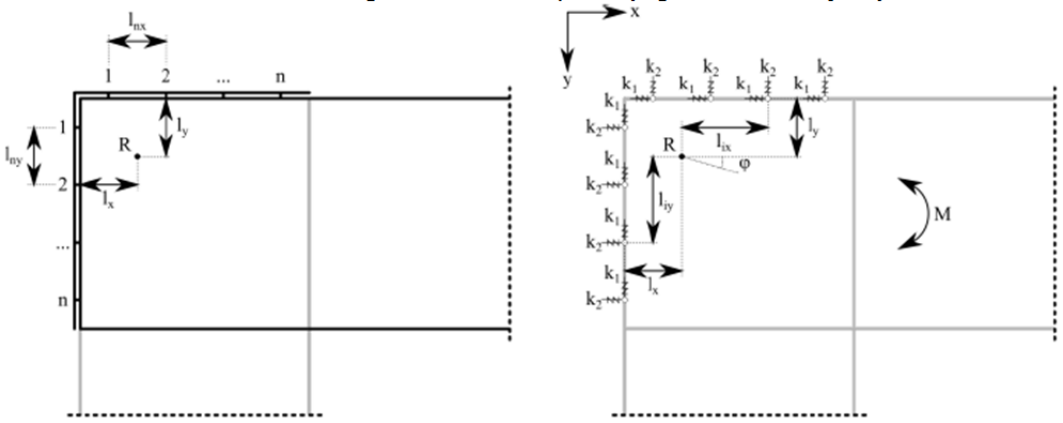


Figure 3. rotational stiffness (Eigenraam & Snijder)

Research question

Main question

“ How can we use the parameters of a L-shaped connection to determine the construction of a long-span all glass pavilion? ”

Sub question

“ What is the rotation stiffness of the L-shaped connection? ”

“ What parameters should be considered in the design of glass portal frame? ”

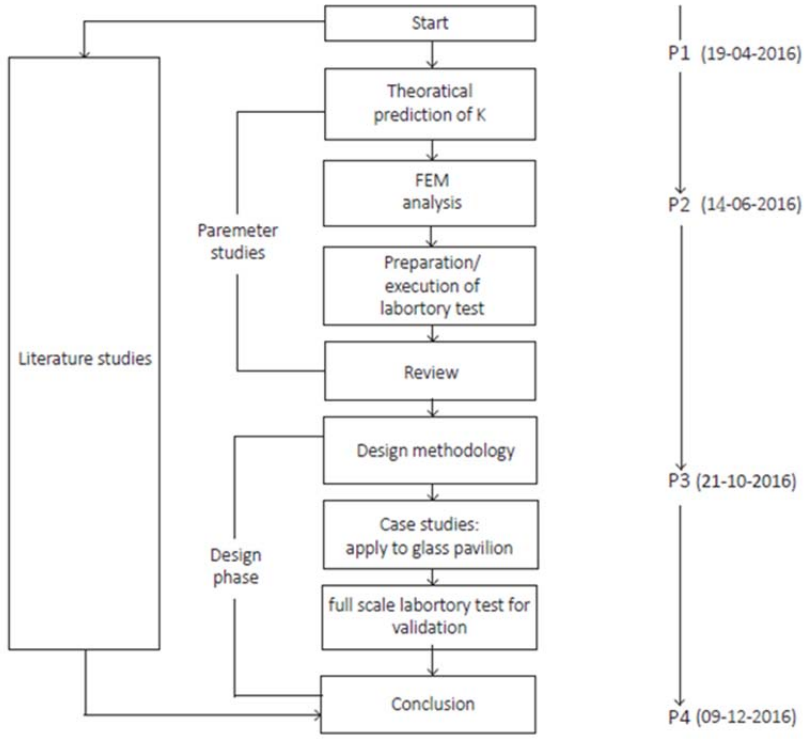
Research objective

- Glass portal frame structural behavior
- Structural behavior of the current L-shaped connection design
- Rotation stiffness of the connection
- The design parameters for designing a connection for glass portal frame and all-glass pavilion
- Other application opportunities of L-shaped connection.

Process

Method description

In the thesis, the structural analysis of the L-shaped connection will be based on a case study of the glass pavilion which plan to be built in Delft University of technology in the near future. First, before knowing how the L-shaped connection behaves in a glass structure, the literature studies will be focused on understanding the structural behavior of the glass structure and elements. After the first phase of literature studies. the structure analysis will begin with hand calculation and FEM analysis of glass portal frame, in this phase of analysis, the parameters will be found to be able to proceed in the next phase of analysis of the L-shaped connection. At the design phase, the design of transparency and the structural performance of this L-shaped connection will be optimized, and eventually find out other opportunities of applying it to other type of glass structure in building.



Literature and general practical preference

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Reflection

Relevance

In this thesis, the finding of the rotation stiffness of this L-shaped connection design for all –glass portal frame has the advantage of preventing overdesign of a glass structure, which eventually leads to reducing the cost of construction. Furthermore, the optimization between transparency of this connection in glass structure and the ideal structural performance will push the boundary of the latest glass technology to another level.

Time planning

	4.1(P1)	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9 (P2)	10	11	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8 (P3)	1.9	1.1	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.1	2.2	2.3	2.4	2.5(P4)	2.6	2.7	2.8	2.9 (P5
Literature studies																																							
Theoretical prediction																																							
FEM analysis																																							
Laboratory test																																							
Review																																							
Design methodology																																							
Case studies																																							
Full scale laboratory test																																							
Conclusion