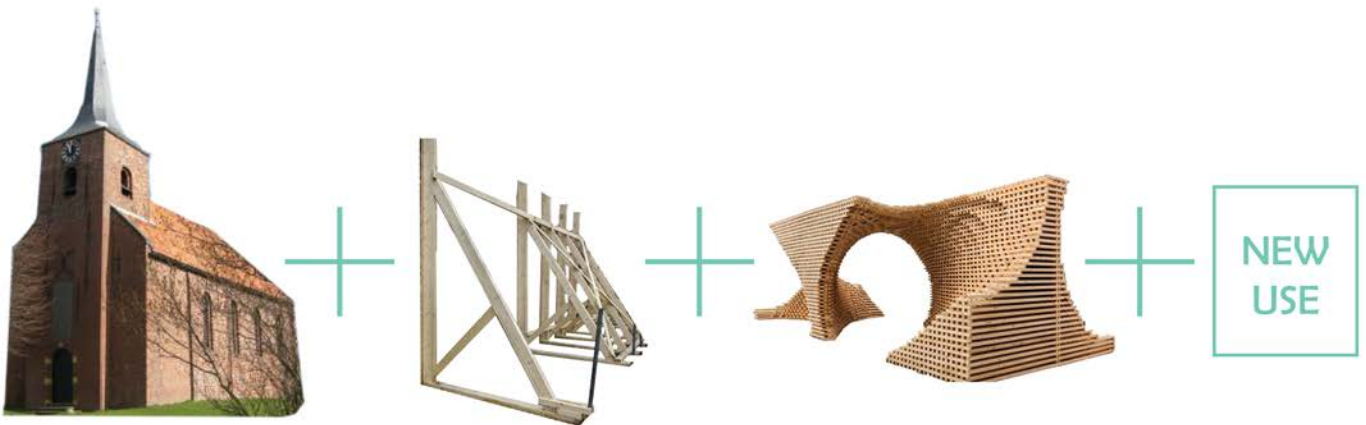


## Graduation Plan for AE students



### Personal Information

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## Studio

*Name of studio:* Architectural Engineering – Seismic studio

*Teachers:* Job Schroën  
Frank Koopman

*Argumentations of choice of the studio:*

I did my bachelor not in Delft, but on the Hogeschool Utrecht. This means that my bachelor was more technical and practical in comparison with the bachelor on the TU Delft. I started this particular bachelor to become a more technical based architect. In line with this, I choose to graduate on the Architectural Engineering studio. I hope this will contribute to a better starting position next year, when I will start working.

## Title

Religious heritage protected: the development of a temporary seismic-proof support structure in Groningen.

## Graduation Project

### Problem Statement

Since last decade the attention for the earthquake-related problems in Groningen grows and grows. Engineering firms develop solutions to protect existing and new houses from hazardous damage. Most of these solutions are meant to keep the inhabitants safe during seismic movement of the earth. The restoration of trust can be seen as the main goal of the contemporary interventions.

A topic what gets less attention is the protection of heritage in the province of Groningen. The problem of being safe in these kinds of monuments isn't the only challenge. It can be said even that it is equally important to preserve the heritage, because it's often a carrier of highly valuable knowledge in the sense of building technologies and cultural history.

The problem of this challenge lays in the contradiction of the prevailing desire to keep a monument in its current state, while earthquake-proof interventions often ask for rigorous interventions. Recently developed solutions are balancing on this contradiction, mainly because most of the interventions are initiated by heritage-minded institutions. The thing is that if you don't allow rigorous actions, the heritage can be destroyed forever...

## Objective

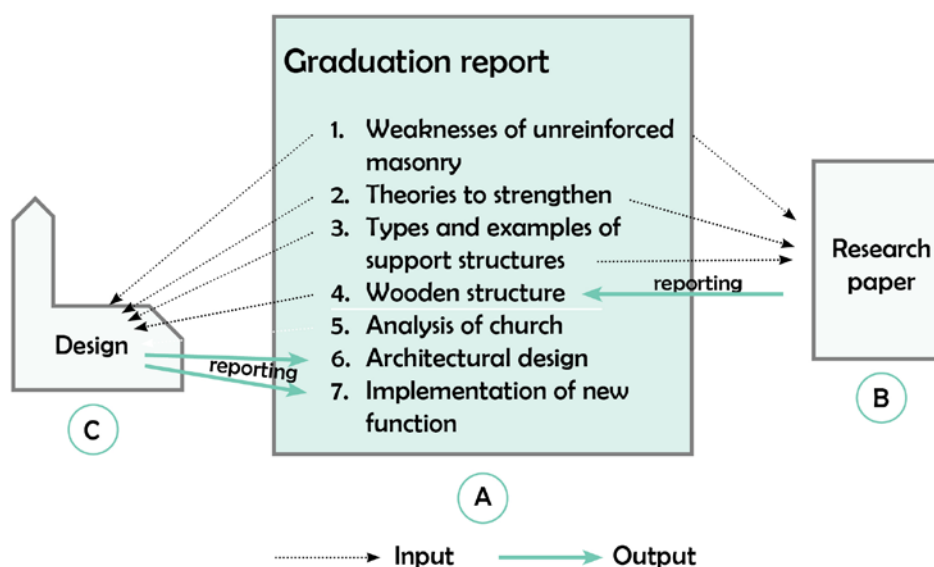
The objective of my research will be to come up with an earthquake-proof intervention for the monumental church of Heveskes, wherein the added support structure is embraced as a nice solution, instead of a solution which is partial hidden to suggest that nothing is done. Earthquakes can't be ignored anymore, so why do we want to ignore the necessary interventions? I want to search for a solution that doesn't change the building technology of the church irreversible. It is focused on finding a structure that supports the church temporary in order to provide more structural strength.

What makes a visible intervention even more viable is the expectation that the earthquakes won't show up for ever. At one time the gasfield will be empty and the earth will come to rest. When a temporary support structure is applied in such a way that it can easily be removed, the support structure can be seen as a temporary transfiguration for example for a period of 50 years. After this period the added structure can be disassembled, whereupon the monument shows up in all its glory again.

The focus will be on wooden support structures. That arises from the fascination of existing emergency interventions which are recognizable in the province of Groningen these days. A lot of houses and other buildings have wooden studs to prevent the collapsing of walls because of earthquake damage.

## Graduation process

The overall design question will be answered at the end of this graduation process. To come to this point, several steps need to be taken. Roughly, one could recognize three different products; a general study documented in a report (A), a research paper (B) and the final design (C) shown in drawings and models. The report serves as an overall documentation of the graduation process. The research paper can be seen as a replenishment of the report, while at the same time information, as described in the report, functions as starting points for the paper. The final design is a product on itself, but the choices and studies which are made to come to the design will be documented in the graduation report.



## Overall design question

When a wooden support structure is developed, the actual design question arises.

*How can the adaptive reuse of the church of Heveskes be done, in such a way that it is integrated within a temporary wooden structure that serves as a structural reinforcement in order to withstand seismic activity?*

This has to do with both the interior and the exterior of the building. The necessary support structure can be evolved and extend to a functional and striking installation-like addition which can be linked to the topic of earthquakes in Groningen. The new use should be related to the temporality of the added support structure. Besides this, the social context should be kept in mind. When the case study is for example a church in a small village, then the new use should add value to this village. Often these churches have a special place in the people's hearts, so this must be handled with care.

Topics to study as a basis for the design:

1. Weaknesses of unreinforced masonry (church)-structures in seismic areas
  - In general
  - Case study
2. Theories to strengthen church-structures
3. Types and examples of complementary support structures
4. (Research paper: What are the possibilities of a complementary wooden structure as a structural reinforcement of the church of Heveskes?)
5. Analysis
  - Building
  - Context
6. Architectural design of the structure
7. Implementation of new function

## Thematic Research Question (research paper)

The thematic research will result in a research paper. Before I can start with this research paper, other subjects need to be explored. Knowledge, about for example the weaknesses of the church of Heveskes and theories to strengthen such a building, will be obtained in preparation for writing the paper. This information won't show up literally in the paper, but works as a starting point on which could be elaborated further.

It's good to know that this research paper won't try to proof the necessity of a wooden structure. It only investigates the possible use of such a structural reinforcement. According to this note the following question will be answered:

*What kind of supplementary **wooden support structure** can be used to reinforce the church of Heveskes in order to withstand seismic activity, in such a way that it anticipates to the **specific weaknesses** of the church, and that it can be applied as an **architectural intervention**?*

Three parts ask for some explanation, with first the choice for a *wooden support structure*. This comes on the one hand from the fascination of existing emergency interventions which are recognizable in the province of Groningen these days. A lot of houses and other buildings have wooden studs to prevent the collapsing of walls because of earthquake damage. On the other hand does wood fit the necessities of a material that is needed for such a support structure: It is relatively easy to manipulate, it has potential for absorbing energy and it is easy to replace broken parts.

Second is about the *specific weaknesses* of the church of Heveskes, related to seismic activity. These weaknesses are already analyzed as a preparation for this paper and can be found in the rapport. It is good to mention that the church isn't damaged yet by earthquakes; this research will focus therefore on a preventive solution in order to prevent damage.

Last remark is on the part about the *architectural intervention*. This addition makes clear that it isn't only a technical solution for which is being sought; it should also work as an architectural statement. A supplementary support structure will change the appearance of the church for a while, so the intervention should add architectural value. This isn't a measurable criterion, but it creates awareness as a signpost during the research.

## **Methodologies**

### **Report**

For the topics of the graduation report, multiple methods can be used next to each other. Aside from literature research and research by design, also interviews and analyses of case studies can be incorporated. The report is a less systematically reporting of the findings during the overall graduation process, when compared to the research paper. It is a more freely shown collection of gathered information and findings.

### **Paper**

First part of the research paper is focused on an exploration on three structures. For every structure a literature study will be done combined with case studies, in order to collect the characteristics of the structure related to force distribution, assembling and customizability. In this part also an analysis will be done for each structure to the possibility of reinforcing for earthquake resistance. The researched structures will be a latticed wood structure, an orthogonal wood structure and a typical shoring structure.

Second part of the research consists of testing the three types of support structure by applying them to the church of Heveskes. Within this part the results of earlier mentioned analysis on weaknesses of this church enters the research, since the support structure should reinforce the church on these specific elements. The weaknesses work as starting points for testing the different structures, so in the end it can be concluded how the selected structures can react to the weaknesses. This part will be developed with the method of research by design.

## Planning

See appendix.

## Relevance

This research can be seen as quite a specific research. The final outcome will be a customized solution for one particular church. Nevertheless is this research relevant in a wider perspective. It is an acclaim to the citizens of the Province of Groningen. The temporary identity of the project will give the people faith in future; it shows that these big problems won't last forever.

Besides this, the research can also be an addition to the contemporary heritage debate. Within this debate nowadays two different camps are recognizable: a more conservative camp which is often responsible for the heritage and the more progressive camp which is often involved in making new plans for obsolete heritage. The idea to give a monument a different appearance for a certain amount of time, to protect the valuable heritage, can be an interesting starting point for further discussion.

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# Appendix I - planning

	Sept.					Oct.				Nov.				Dec.				Jan.				Feb.				Mar.				Apr.				May				June								
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	2.1	2.2	2.3	2.4	2.5	2.6	x	x	2.7	2.8	2.9	2.10	x	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11		
<b>Graduation plan</b>								P1	P1												P2																								P5	P5
Orientation																																														
Problem statement																																														
Research questions																																														
Design questions																																														
Research plan																																														
Graduation Plan first version																																														
Graduation Plan final version																																														
<b>Graduation report</b>																																														
Exploration																																														
Literature search																																														
Study: Masonry and earthquakes																																														
Study: Theories to strengthen																																														
Study: Types and examples of sup.struc.																																														
Writing chap. 1 & 2																																														
Writing introduction																																														
Study: Analysis of church of Heveskes																																														
Implementation of new function																																														
Architectural design																																														
<b>Research paper</b>																																														
Literature search																																														
Part 1: Support structures																																														
Part 2: Application to church																																														
Conclusion																																														
Deadline																																														
<b>Design</b>																																														
Function and program																																														
Concept development																																														
Sketch design																																														
Structural design																																														
Climate design																																														
Facade design																																														
Details																																														
Final design																																														
Model making																																														