Graduation Plan

A Kop-hals-romp Boerderij Transformation

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Argument of Choice of Studio

The Architectural Engineering Studio gives an opportunity to explore the engineering aspect within the field of architecture design. Usually this part is ignored in other designs in my personal experience. However, it is one of the most important part of architecture, because architecture is not only about drawing and making models, it is also about building and innovating. And I think that is the exciting moment of the studio. I’m interested in structures and materials and I want learn how materials come together and what’s the effect of that. I think the AE studio will help me to explore this fascination.

Fascination

Traditional hybrid structure: Masonry & Timber

Problem Statement

The extraction of gas by the NAM (Nederlandse Aardolie Maatschappij BV) in the area of Groningen induces earthquakes and causes quite some trouble to the residence living there. The general technical problem on architecture level is the lack of stability of the buildings in Groningen, most of which are masonry buildings constructed in old times without consideration of earthquake resistant design. The consequence is obvious and in a way tragic: the buildings start to crack and even fall down due to the continuous tremble from time to time. The treatment to the problem is carried out by the NAM via means of reinforcement, and reconstruction of the houses. Yet it is not the cure. The lack of aesthetics in design and regardless of history don’t prove it a good way to help the local residence. In the meantime, investigations of proper ways to reinforce the buildings is carried out and yet little satisfied results come out. Eventually people start to lose their confidence in the house as well as the area they live in. Thus, the technical problems grows into a social problem.
Among all the different building types in Groningen, the Frisian Farmhouse is one typical and representational farm typology. The farmhouse usually contains of a head and a neck as the living area and a body as the barn for harvest and livestocks, known as “Kop-hals-romp Boerderij” (there are also variations like Kop-romp Boerderij and Bildtse Boerderij). Due to the unique architectural type and their reflection on the history of Dutch agriculture, some farmhouses are claimed as national monument. However, as farmers start to expand their farms to bigger ones due to economic demands and technology development, these old farms no longer suit the requirements of current industrial agriculture production. Consequently, old farmhouses are left vacant or for sale. The shrink of population puts even more emphasis on the situation. Thus, proper means and solid analysis to help transform these heritage into new use and further more help refurbish the surrounding area are in demand.

To transform a Kop-hals-romp Boerderij, one cannot neglect the impact of earthquake. However, the farmhouses have a more complicate hybrid structure than regular residential houses, which makes it more difficult to get hands on the problem. First, on the architectural composition level, the building is not integrated as a single volume as it seems. Consisting of three parts, it is more like a collection of three structure systems
since the dimension of the three parts are all different. Furthermore, on the structural level, two structure types are applied in a single farmhouse. The head and the neck, which are the residential area, are mainly masonry constructed while the barn is mainly a timber structure holding the huge roof. Besides, even for a single architecture volume, the structure is still hybrid: both the head and the neck have a wood roof structure on the brick load bearing walls, whereas the masonry longitudinal walls and gables of the barn only support themselves and a small percent of the roof load. These complexities in structure call for smart seismic solutions in the process of transformation.

In addition to structure concerns, the historic value of the Kop-hals-romp Boerderij is also significant in the transformation design. In Groningen province, there are tens of farms that are declared as national monuments. Built in different ages, they represent the architectural value of different periods in the Netherlands, not only in the field of farmhouse design and construction, but also in a broader view of architectural design history. On top of that, it also represents the unique architecture typology in Groningen, and its tight bond to the vast agriculture landscape in the northern Netherlands. The beautiful timber structure in the barn also manifest its response to the site (the wind, the material, the construction manner, etc.). All these factors require the transformation to take good care of the existing constructions. In the meantime, the technical operation, namely the seismic solution on the structure of the farmhouse, has to be elegant and decent. It should never damage the authenticity lies within the form, the construction and the material of the farmhouse as a heritage, and never break its close link to the terrain as an architecture. These concerns turn out to be the other layer of technique, the exquisite care for human.

Design Question

How to transform a vacant Kop-hals-romp Boerderij into a public building that meets the safety, climate and heritage requirements, and furthermore can be a seismic proof example of refurbishment and conservation for the Kop-hals-romp Boerderij on construction and architectonic level?
Sub topics of the contains three parts: context study, program analysis and technology application. By diving into these aspects, the final design outcome will be an integrity of the three and try to achieve an aesthetic value. Further concerns of the topics are as follows:

Regarding the general background of frequent earthquakes and my concentration on the hybrid structure of the Kop-hals-romp Boerderij, expectations for the design can be:

1. A proper earthquake proof structure (system) for the architectural typology of Kop-hals-romp Boerderij;

2. An suitable assemble/disassemble system that allows for easy maintenance and repair in case of damage;

3. Appropriate treatment to the existing structure;

4. Added new structure and volume that are compatible with the old ones;

5. Preserve the cultural and historic value while applying the new design;

6. New program for local public that can in a way activate the area;
Thematic Research Topic

A seismic solution for the hybrid structure (masonry & timber) of the Kop-hals-romp Boerderij as heritage.

Key Words: hybrid structure (masonry & timber), seismic solution, Kop-hals-romp Boerderij, heritage

Sub Questions:

Kop-hals-romp boerderij:

1. Earthquake damage on the Kop-hals-romp Boerderij;

2. Farmhouse as heritage: the heritage feature of the boerderij and its transformation requirements.

Hybrid structure:

1. The structure of the Kop-hals-romp Boerderij: the existing structure of the farmhouse, typical form and how the components work as a whole (forces);

2. Properties of timber and masonry in Kop-hals-romp Boerderij;

3. Connections & joints:
   a). timber & timber, timber & masonry, masonry & masonry; load-bearing & non load-bearing;
   b). advantages and weaknesses, proposal for revised structure.

Seismic solution:

1. General overview related to masonry-timber hybrid structure.

2. On different scales:
   a). architectural composition;
   b). structure;
There are three phases for the thematic research: 1). the research phase, gathering information and basic knowledge about the topic; 2). the research result, summarizing the research and get fundamental conclusions that can serve as a guideline for the later design research from the previous phase; 3). the design outcome, with the guidance of research result, certain design operation will be carried out as the final result of the thematic result. The design outcome will be listed as a simple guidebook or manual for the seismic solutions of the Kop-hals-romp Boerderij.

Methodologies
Literature study:

Literature study is an important means to do the research part of the graduation. The literature will cover a wide range from the architectonic and anthropological aspects of the Frisian Farmhouses, to the technique properties of wood structure performing as earthquake proof.

Case study:

Case study is relevant during both research and design. Cases includes the traditional Frisian Farmhouses, earthquake proof wood structures (both traditional and modern), wood structures that bear similar loads (wind load for instance), and wood structure systems that allow for easy assemble/disassemble and can be generally applied.

Research by Design:

Research by Design method is important for this topic. Design for an earthquake proof structure demands experimenting and testing, thus the design process will be carried out in the whole research process in order to achieve the best result of the research. The experiments and tests are expected to be done via computer program.

Fieldwork:

Including interview with the local residence, observation and comparison on different farmhouses.

Relevance

The research and design aim to provide an earthquake proof structure system for the Kop-hals-romp Boerderij. The relevance is twofold: on engineering level, it will give a solution to the earthquake damage of these unique architectural typology; on the social level, the universal application assures that the structure system is able to help the Kop-hals-romp Boerderij residence (and possibly people living in other dutch houses, since the head and neck parts of the boerderij share the similar structure as other Dutch houses: load-bearing masonry walls with wood roof structure) regain their confidence on the house they live in and during the meantime preserve this local architectural landscape and the culture value within it. Furthermore, the transformation of the vacant
Kop-hals-romp Boerderij also shows an opportunity of the new function for this special architecture typology, which will help keep the heritage value and site memory.

**Schedule**

The one year graduation process is a multiline workflow where case study and model making will be carried out through the whole process. Several softwares need to learn for research purpose. And a course series of heritage conservation is parallel to the graduation process in both semesters. The schedule has to be refined on a more detailed level because the design calls for a certain order, e.g. the structure design part includes different aspects from the study of the original Frisian wood structure and typical Dutch masonry to the application of earthquake proof technique to the joints design and assemble process.

**Literature**

According to the research plan, the literature will cover a wide range from research on Frisian Farmhouses to earthquake proof wood structure:

1. Literature on the Frisian Farmhouse, its architectural composition, structure, history and cultural value, and evaluation of earthquake damage on the farmhouse architecture.

2. Literature on earthquake proof design, its principle and cases, helping with the research on the new structure design for the Frisian Farmhouse.

3. Literature on wood structure, including a general overview, the barn roof structure, timber construction manual, wood product and components, and other literature that will give light on the research of Frisian Farmhouse structure system.

4. Other literature, e.g. cases, design code, etc.