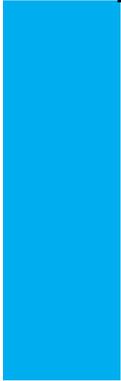


Graduation Plan

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	
Name	Jelle ten Hove
Student number	4854136

Studio		
Name / Theme	BT Graduation Studio	
Main mentor	Arie Bergsma	FDP
Second mentor	Mauro Overend	SD
Argumentation of choice of the studio	FDP (Façade & product design) focuses on the circular aspect of building components, and SD (Structural design) is involved because of the reuse case being structural elements of industrial buildings	

Graduation project	
Title of the graduation project	Structural Steel Reuse Analysis

Goal	
Location:	The Netherlands
The posed problem,	<p>At first, the ongoing nitrogen-oxide crisis in the Netherlands does not seem directly related to the topic of steel reuse. However, as these industrial buildings will end up empty and ready for demolition, ways to reuse the structural components packed inside them should be analysed. The upcoming availability of these halls provides a unique opportunity to research the possibilities of harvesting, refabricating and re-introducing structural components into the circular construction economy. From the background research, the following problems are identified:</p> <ul style="list-style-type: none"> • The construction sector is not a circular industry yet • Reusing structural steel is a niche • The stock of industrial buildings expected to meet their end-of-life phase on a short term will end up being demolished, wasting embodied energy, if no proper plan to reuse elements is provided

<p>research questions and</p>	<p>The following research is attempted to be answered:</p> <p style="text-align: center;"><i>How can structural steel elements of industrial buildings be reused and introduced to a circular urban context?</i></p> <p>The following sub questions were developed to support the answer to the research question:</p> <ul style="list-style-type: none"> • <i>What are current barriers for steel reuse to become common practice?</i> • <i>What is the economic and environmental benefits of steel reuse?</i> • <i>How can the quality of retrieved elements be evaluated?</i> • <i>How can industrial buildings be analysed to provide the necessary data for potential reuse?</i> • <i>How can retrieved elements be used in a structurally optimized way?</i>
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<p>design assignment in which these result.</p>	<p>Objectives</p> <ul style="list-style-type: none"> • Find a way to analyse the industrial building stock on structural reuse potential • Introduce a framework that will help to make the reuse of structural elements from large industrial buildings common practice. • Evaluate the proposed framework from multiple perspectives
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Process

Method description

Literature review

For this research paper, various information sources are intended to be used. The goal is to create a mix of both theoretical knowledge - especially on the material, component and structure level – and practical experience from stakeholders active in the steel (de)construction sector.

The literature research focused on 5 main topics

- Circular construction economy
- Material
- Steel Reuse
- Industrial Halls
- Standards & Formulas

Case Analysis

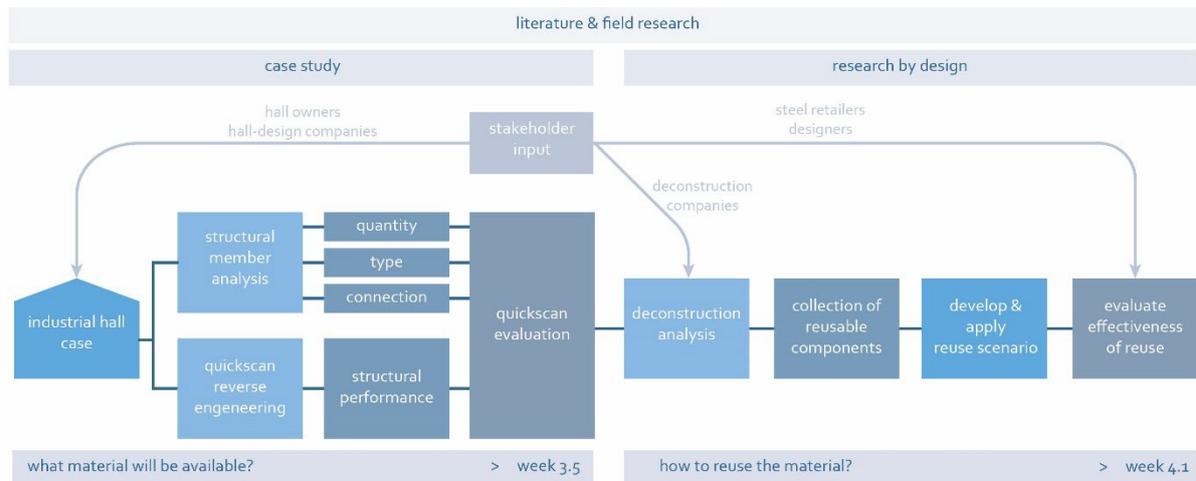


Fig. 1.1 Case Analysis

A case analysis will be at the center of this thesis project, both as an industrial hall to analyse and as a test case to apply evaluation methods and reuse opportunities to. As for now, a case has not been selected yet. The case requires an industrial hall that A) is still standing, B) has proper documentation available to validate results, and C) can be visited. Drawings and structural data of a hall structure in Wapenveld were found, but it is yet to be decided if the hall is suited as a case due to its design.

Research by Design

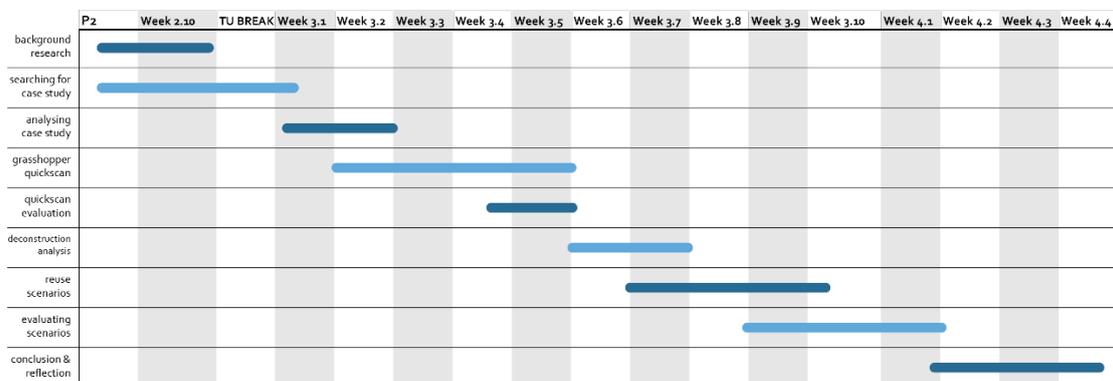
The case that will be analysed will be reused in a theoretical design scenario to evaluate the efficiency on a structural, economical and environmental basis. The research in this part of the process can be considered research by design.

- Designing a structure with retrieved elements to evaluate the efficiency
- Designing reusable connections

Field research

Stakeholders in the practical world will be approached to get a better insight into the barriers that occur in the process of steel reuse. Above that, it is desirable if the selected case study can be visited in order to expand the case analysis with qualitative information

- Visiting industrial buildings
- Interviewing stakeholders

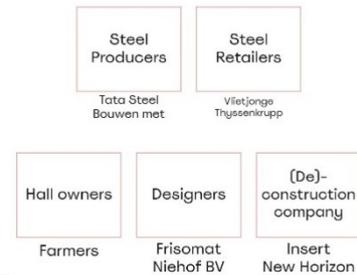


Literature and general practical preference

Added to this document is a reference list of sources that have been used for the background information.

As said, practice experience is considered to be relevant in order to have reuse strategies being implemented. Fig. 1.2 shows the stakeholders that are intended to be involved in the process of this thesis.

Fig. 1.2 Stakeholders



Reflection

1. This graduation topic is related to the BT master track on multiple levels. The topic involves research into the properties of a material (steel) and finding ways of using these properties to the fullest extent in a construction context in order to add to the transition of the construction sector becoming more circular. This is also where the disciplines of SD and FPD come together in this graduation; the focus is on structural components, but these components are seen as a circular products that do not only function in one particular building, but are used for their technical lifespan, many times over.
2. Various sources that were consulted for the background research suggest that steel reuse is no doubt possible, but more of a niche rather than common practice. There is a demand for more applied research into, and case studies and practical examples of steel reuse – to gain more knowledge on the topic itself, but also to promote and normalize the idea of steel reuse. Linking steel reuse to the ongoing nitrogen-oxide crisis shows that potential opportunities for steel reuse can arise in the ongoing transition to a climate-friendly world. Providing research data will help to better seize these opportunities and turn them in to steel reuse practices.

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