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	Meike Mantje
Student number	4676580

Studio		
Name / Theme	Building Technology – Façade & Product Design (+ Climate Design	
Main mentor	Arie Bergsma	Design of Construction or Building products innovation (Façade & Product Design)
Second mentor	Leo Gommans	Environmental & Climate Design
Argumentation of choice of the studio	Façade covers a big part of a building and is very important for different climate aspects. To help the built environment transform from a linear economy to a circular economy new façade products and techniques need to be developed with an optimal climate performance.	

Graduation project	
Title of the graduation project	Reuse of scrap wood for a HSB panel
Goal	
Location:	Netherlands

The posed problem,	The built environment needs to transform from a linear economy to a circular economy to meet the European and Dutch Circularity Goals. Built Environment is responsible for 40% of total waste. Waste should be Reused/recycled to be part of a circular economy. ½ ton of Scrap wood is produced each year in NL and is not fully reused/recycled, but mostly incinerated. **Problem statement:** 1. Huge amounts of scrap wood becomes waste instead of being reused, which is not in line with the sustainability & circularity goals. **Sub problem statements** 2. There is a lack of information of the consistency (+ quality) of scrap wood 3. There is a lack of reuse methods for scrap wood as a building product 4. There is a lack of (general) quality/strength test methods for scrap wood **Objectives** Main objective 1. Explore how scrap wood can be used as a building product Sub object 2. Define/Give an overview of the consistency of scrap wood 3. Define possible reuse methods for scrap wood for building products 4. Define quality/strength test methods for scrap wood
research questions and	**Main question:** 1. How can scrap wood be reused for a HSB panel? **Sub questions** 1. What does scrap wood consist of? 2. What are reuse production methods for scrap wood

	3. How can scrap wood be tested on its quality/strength? 4. What are production techniques for wood (building products) 5. Which scrap wood is already reused and which isn't? Why? 6. What kind of wood is there? 7. What kind of wooden building products are there? 8. What are performance requirements for wooden building products? 9. What is a HSB panel (and what does it consist of + production)?
design assignment in which these result.	A HSB panel with window frame from scrap wood. Besides a HSB panel, an overview of the upcoming problems with reusing scrap wood in the built environment is produced. What are the obstacles? What needs to change to make reusing scrap wood easier.

Process

Method description

Previous methods:

First, in Q2, a literature study has been done. This literature study consists of reading papers, books and (manufacturing) websites about the topic: wood (kind/type of wood, differences), wood and building products & wood production techniques, reusing methods for wood, scrap wood (amount, kind, test methods), and performance requirements of wood for the construction industry. For the context research was done through government & EU goals and articles about sustainability and circularity and contact with Sloopcheck about scrap wood.

Research plan for after P2 until P4:

Here, the planning for after P2 will be discussed. I divided research & design into a few main topics: Literature study, interviews, Research by design, scrap wood research, scrap wood model, case study & reflection. With these topics a planning is made until the P4 (date to be determined), see planning at the end of the document. In general, the plan is to have a research by design approach. The design assignment is designing a HSB panel with window frame made from scrap wood. During the design process I will stumble onto some hurdles with scrap wood. When that happens, further research will be done about the hurdle and possible solutions will be tried to be found.
The topics are further explained:

<u>Literature study</u>

Up until P2, the literature study focused on the topics mentioned above in the previous methods part. During that literature search the design assignment became clear: a HSB panel with a window frame. Right after P2 some literature study will be done about HSB and wooden window frames and the performance requirements will

be finished. The study will be about the components, production methods and performance requirements. If during the design process further research is necessary, then that will be done.

Interviews
It became clear during the literature search and after contact with Sloopcheck, that construction & demolition companies know how scrap wood is (re)used in the built environment. In the first weeks of Q3 contact with different C&D companies will be made and interviewed, so an overview of the problems with reusing scrap wood will become clear and what kind of methods are now available and what methods are missing. If during the design process more contact with the same or other companies seem to be necessary, contact will be made through email or phone.

Research by design
The research by design focusses on designing a HSB panel with a window frame. After some literature study a basic design of a HSB panel and window frame will be made. From that design possibilities with scrap wood will be found how a HSB panel and window frame can be made from scrap wood. When something is not (yet) possible, I will try to find out why it is not possible. Then I will try to come up with solutions and/or discus/talk to companies that might know something about it. During designing the panel and window frame, more and deeper research will be done about scrap wood (see next topic)

Scrap wood research
A start of the research, mostly through literature, was done about scrap wood. With the knowledge of already existing reusing methods and wood production methods, possible new methods can be found for reusing scrap wood. After P2 that research will continue, based on the hurdles during the research by design process. In the first of Q3 assessment methods will be found to see how scrap wood needs to be treated before it can be used. In the weeks after that knowledge is gathered about production methods needed for reusing scrap wood and about other possible hurdles for the design. The knowledge is gathered from the interviews with companies, literature and other mediums. For scrap wood production methods for reusing need to be found. Besides, wooden building products have to meet certain requirements (which was researched in the literature study before P2). Methods to assess scrap wood on its quality and strength to meet those requirements need to be found. If those do not exist, possible assessment methods could be found.

Case Studies
This will not be the first project from scrap wood, so I will look into some building projects with scrap wood. Those projects will be analysed on used methods, assessment methods and possibly hurdles that those designers came across.

Scrap wood Model
Retrieve some scrap wood from companies/shops to see for myself what scrap wood consists of and what can be done with it. Also try to retrieve a piece of a wooden window frame. I want to work with real scrap wood to see what the conditions are

and how some production methods are done. In the end, some models from scrap wood would be nice to show what scrap wood can transform into.

Reflection
Reflect on the graduation process and approach. Start with the draft 1 week before the P3 deadline. This will give me more time to use the chosen approach and see if it works. Before P4 a full reflection on the research by design approach with products will be made.

Literature and general practical preference

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Façade products are an important part of the building and define a big part of the architecture. Facades need to protect people indoor from the outside (weather, etc) and keep the people comfortable. Besides, the built environment needs to transform to be more sustainable. Something what is also taught within the master programme, also in building technology. A few topics of building technology is designing building and façade products, with a focus on sustainability, climate design and material knowledge. So designing a HSB panel and window frame (façade design) from reused scrap wood (sustainability & material knowledge) fits within the BT track and MSc AUBS.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

Social relevance

This thesis will contribute to changing the built environment from a linear to a circular economy. In order to meet the sustainability goals and fight climate change a circular economy is necessary. Within a circular economy materials and products will be reused or recycled, and renewable materials will be used. The material and product stream is circular, so there will be no waste. This thesis will contribute to that by reusing a waste material, scrap wood, for a new building product. Wood is also a renewable material. To fight climate change, less carbon emissions need to be released in the air. Wood stores CO2, so it has a positive effect on lowering carbon emissions, especially by reusing wood. Developing a circular strategy for scrap wood, contributes to changing the mindset of using waste materials for building products.

Scientific relevance

Sustainability is an important concept in the world. Every industry needs to transform into a more sustainable industry. The EU and the NL want to transform their economy from a linear to a circular one. Within the circular economy products and materials should be reused/recycled (or other R-strategy) instead of becoming waste. Waste is a big issue in the built environment (40% of total waste). So, to come up with a design made out of scrap wood (from waste within and outside the built environment), more (wooden) materials and products are being reused or recycled instead of becoming waste. It contributes to minimising the total amount of waste and to transforming from a linear economy to a circular economy, within and outside the built environment. There is a lot of research on why the built environment needs to transform to a circular economy, but research on how is lacking. Especially the 'how' in more detail, which happens in this thesis. Scrap wood is not yet fully reused and there is not a lot of information about scrap wood. This thesis contributes to chart scrap wood and its possibilities.

Date	30/1 - 3/2	6/2 - 10/2	13/2 - 17/2	20/2 - 24/2	27/2 - 3/3	5/3 - 10/3	13/3 - 17/3	20/3 - 24/3	27/3 - 31/3	3/4 - 7/4	10/4 - 14/4	17/4 - 21/4	24/4 - 28/4	1/5 - 5/5	8/5 - 12/5	15/5 - 19/5	22/5 - 26/5	29/5 - 2/6	5/6 - 9/6	12/6 - 16/6	19/6 - 23/6	26/6 - 30/6
P-dates									**P3**							**P4 date tbd**					**P5**	
																					hand in Report to repository 3 days before P5	Right after P5:Hand in all documents to repository, Unsubscribe TU Delft
Literature study	Literature study HSB + window frame + finish wood performance requirements															**Finish literature study about wood, wooden building products, scrap wood, performance requirements, HSB and wooden windowframes mostly (final detail can be added/change depending of feedback)**			Implement feedback from P4		**Finish literature study**	
Scrap wood research			Research assessment methods	When necessary, due to design process, do more research on scrap wood method. Research through the interviews and literature studies												**Final scrap wood research**			Implement feedback from P4		**Final scrap wood research**	
			Come up with assessment methods	Come up/find methods to transform scrap wood into usable wood for building products, such as: cleaning and testing methods, beams slats & plates, possible curing methods					Test on assessment methods, see what information is missing						Test on assessment methods, see what information is missing						
Interviews	Come up with questions for C&D companies	Waiting for reactions + doing the interviews.							Summary of interviews until now							**Final report interviews + lessons learned**			Implement feedback from P4		**Final report interviews + lessons learned**	
	Find C&D companies, send email/call with questions regarding scrapwood	Depending on results more interviews or more conversations with the companies									More interviews if necessary											
Research by design			Start set up of base design HSB panel and windowframe	Start designing with scrap wood, in case of hurdles go to scrap wood research					First design of HSB panel and windowframe		Work further on design			Finish final design		**Final design of a HSB panel with window frame from scrap wood**			Implement feedback from P4		**Final design of a HSB panel with window frame from scrap wood**	
Case studies	Find case study/studies															**Summary of case study/case study**			Implement feedback from P4		**Final report cas studies**	
	research case studies																					
Scrap wood Model							Gather some scrap wood				Working with scrap wood								Start making final model		**Finished model**	
Reflection								Start draft Reflection	Finish draft reflection						Start final Reflection	**Finished Reflection**						