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	**Daphne de Bruin**
Student number	4618211

Studio		
Name / Theme	Building Technology Graduation Studio	
Main mentor	Serdar Asut	Design Informatics
Second mentor	Martin Tenpierik	Climate Design
Argumentation of choice of the studio	Within this field you are directly working on sustainability, which I think is very important now and even more important in the future.	

Graduation project	
Title of the graduation project	3D Printed Mycelium-Bound Bio-Based Sound Absorbing Panels
Goal	
Location:	The Netherlands
The posed problem,	The built environment contributes in a high percentage to the total CO2 production. Due to climate change and material scarcity the CO2 emissions become a more important topic. Because of material scarcity in the near future, the contribution of bio-based materials become more important. Bio-based materials help by shifting the building industry from a linear economy to a circular economy. Looking at the Layers of Brand, the space plan is the layers with the shortest lifespan. Interior design is also changing with the trends. For this reason, this research focusses on the space plan layer. Whitin this layer one of the problems is acoustic. Because of this, a sound absorbing acoustic panel will be made. The acoustic panel will be made from bio-based materials since

	they have a low CO2 emission and are made from renewable sources. The focus in this research will be put on the biomaterial mycelium since recent developments show that this material might be promising and therefore interesting to include in this project. In most of the projects where they used mycelium, molding is used as the production method. To increase the freedom of form, 3D printing might be an interesting production method. This research will investigate the possibility of 3D printing whit mycelium bound biomaterials and if it has a positive influence on the acoustic properties.
research questions and	Main research question: How can a sound absorbing panel be 3D printed with a mycelium bound biomaterial? Sub questions: - On what substrate, which can also be used for 3D printing, does mycelium grows good? - How can a mycelium bound bioproduct be 3D printed? - How does shape, substrate and 3D printing contribute to the acoustic performances?
design assignment in which these result.	The design assignment for these questions will be a 3D printed sound absorbing panel made from a mycelium bound biomaterial. The panels will be modular panels with a maximum size of 1x1 meter.

Process

Method description

The research can be divided into four main topics: material research, acoustics, 3D printing and design.

Material research
- Literature study
- Experimental study
  Testing the different types of substrates for the mycelium

Acoustics
- Literature study
- Experiments
  1. Material testing with Impedance Tube
  2. Material testing in Resonance Room
  3. Measure the final product in Resonance Room

3D Printing
- Literature study
- Experiments
  1. Extruding the different pastes with extrusion gun
  2. 3D printing of circles for test Tube using cold extrusion
  3. 3D printing final product using cold extrusion

Design
- Reference study for the size and shape
- Experiments
  1. Prototypes

The research and experiments on the different topics will be executed next to each other since information about the different topics is needed to complete the other research/experiments.

To execute these experiments some equipment is required:
- Extrusion gun
- UR5 Robot arm, with WASP LDM extruder
- Impedance tube
- Resonance room at the faculty of Physics

Literature and general practical preference

Literature about mycelium in general
- Papers from Google Scholar
- Papers from TU Delft Repository
- Book: *Entangled Life* from Merlin Sheldrake

Literature about acoustics
- Books with principles
- https://bk.nijsnet.nl/
- Papers about executing the experiments
- Papers in relation to optimizing the panels

Literature about mycelium building products
- Papers about the properties of these products sourced from
  Google Scholar
  TU Delft Repository

Literature about 3D printing with bio and/or living materials
- Papers from Google Scholar
- DIY Forums for 3D printing

Reference research on existing mycelium-based building products.
- Companies
- Research projects
- DIY projects

Reference study about how to grow mycelium
- YouTube video's
- DIY projects from creative forms
- TU Delft Repository

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)?

The master track Building Technology focusses on a variety of topics, including climate design, material science, computational design, and façade & product design. My graduation project touches on most of those topics. Also, since a product is made, design plays a big role. Within the entire master program sustainability is an important factor. This research focusses on creating a bio-based building material, which is directly related to sustainability.

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

Material scarcity is a growing problem, also, the CO2 emission becomes a bigger discussion point. By using traditional building materials those problems will only become bigger. To look at bio-based alternatives for current building products, an example can be giving on how to work with those materials. People will see the possibilities, which might boost the development of new bio-based products. On the scientific framework, this research can contribute to both material research on materials of which not all properties are known/captured, and on the knowledge of how design informatics, in specific 3D printing, can contribute to the process of creating new building materials.