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

<table>
<thead>
<tr>
<th>Name</th>
<th>Kees Uytenhout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student number</td>
<td>1516159</td>
</tr>
<tr>
<td>Telephone number</td>
<td>0614421866</td>
</tr>
<tr>
<td>Private e-mail address</td>
<td><a href="mailto:keesuytenhout@gmail.com">keesuytenhout@gmail.com</a></td>
</tr>
</tbody>
</table>

### Studio

<table>
<thead>
<tr>
<th>Name / Theme</th>
<th>Sustainable Design Graduation Studio</th>
</tr>
</thead>
</table>
| Teachers / tutors             | First mentor: Dr. ir. Martin Tenpierik  
                                | Second mentor: Dr. Michela Turrin          |
| Argumentation of choice of the studio | -                                   |

### Graduation project

<table>
<thead>
<tr>
<th>Title of the graduation project</th>
<th>Small Home Music Studio Design</th>
</tr>
</thead>
</table>

### Goal

<table>
<thead>
<tr>
<th>Location:</th>
<th>Small standard sized bedrooms or office rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>The posed problem, research questions and design assignment in which these result.</td>
<td>see below</td>
</tr>
</tbody>
</table>

Problem statement

Starting music producers encounter several problems with creating a studio. Not enough knowledge and a low budget may lead to bad decision making and bad sound proofing and acoustic treatment solutions. There are lots of different products you can buy to improve the acoustics in a home studio, but the exact type, amount and placement of the products is mostly a subject for the experts. An improved workflow can ensure the non-professional studio builder to tackle these problems.

To be able to create an improved workflow, there are two main problems to address.
On the one hand the sound leaks through the faces of the room either from the studio to the neighbours, or from outside to inside the studio. This is a sound proofing problem. Sound proofing a room is necessary to keep out unwanted noise and to stop the sound from travelling out of the room.

On the other hand the sound will cause problems within the room by reflecting off the walls. This is an acoustic treatment problem. Without acoustic treatment the reflecting sound can cause various problems as flutter echo's or comb filtering, all affecting the monitoring accuracy. Sound reflections can even cause your brain to think a sound from the left speaker will come from the right speaker.

Home studio’s in small rooms especially have to deal with problems in the low frequency range. Low frequencies are more affected by acoustic interference than high frequencies. The low frequency energy from the speakers will excite the room’s natural resonances and causes peaks and nulls of sound pressure in the frequency spectrum. These peaks and nulls can differ a lot in level when moving through a room, which makes it hard to judge the sound apart from the room. Low frequencies, in comparison to high frequencies, are much harder to simulate and not yet fully integrated in computational design.

Next to the technical issues there is the issue of cost. Building a studio can be quite an expensive job. For the professional audio companies this is much less of a problem than for the starting music producer.

Working with acoustic materials as fibreglass or even insulation made of organic fibres can be hazardous to health. The different materials used for studio building each have their own (sometimes unexpected) safety/health risks. Next to the risks, environmental impact is not always considered in studio building, especially in case of DIY studio building. It is either the cost or the sound that plays a much bigger role.

**Research objective**

The main research objective is to improve the work flow in designing a small non-professional home sound studio.

Improving the work flow will result in a method used to design a small non-professional music studio by utilizing both basic hand rules as well as acoustic simulation, measurement and generating tools to define the placement of acoustic materials in a parametric environment.
Research Questions

Main research question:

“How can a computational design method help in designing a small non-professional soundproof music studio?”

Subquestions:

• What is the current way of designing home studio’s?
• How can parametric design be implemented in studio design?
• How can a home studio be parametrically optimized concerning sound proofing, room acoustics and cost?
• Will the solution be beneficial for the end user?

Design assignment

The design assignment is to create a workflow in designing the sound proofing and acoustic treatment needed in different small home music studio’s. The final design of the workflow should be in a parametric design environment to ensure the applicability in any standard size room of a house and should provide the user with a sustainable studio design.

Target group

The target group of the thesis is anyone who wants to build a small sound proof music studio and/or acoustically treat a small room. This group consists mostly of music producers and sound designers who are looking for ways to better assess their sounds.

<table>
<thead>
<tr>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method description</td>
</tr>
</tbody>
</table>
The research consists of three phases: Literature study, Research analysis and Design.

First, the literature study will focus on the state of the art in studio building (both professional and DIY studio’s) and the scientific context of small room acoustics. The subjects include: Basic acoustic theory, Low frequency problem, Acoustic simulation, Current studio design, Sound proofing rules, Acoustic treatment rules.

The second part of the literature study will focus on Acoustic Parametric Design, to gain insight in the available tools for analyzing, simulating or generating design solutions.

During the research analysis the information from the literature study will be used to define the design methodology. The aim of the research analysis is to find suitable solutions for the problem statement to be used in the design methodology.

A case study room is selected to give input to the design method. Acoustic measurements will be performed to obtain information on the acoustics of the room. Acoustic simulations will be performed to test the prototype method.

In the design phase a computational design method will be developed for a non-professional home studio. Research by design is used to develop the design method where the context varies and the object follows; The design method can be used in different places, while the output is adjusted to that specific location.

After finalizing, the design method will be put into practice by building a prototype of (a part of) the studio. The prototype is measured and the results will be used to evaluate the output of the design method, generate conclusions and further recommendations.

General research framework:

Literature study
- State of the art studio building
- Scientific context of small room acoustics

Research analysis
- Information analysis
- Potential utilization research of acoustic tools
Case study
- Case study definition
- Measurements
- Simulations

Design
- Research by design
- Optimization of the design method
- Design for construction

Prototype
- Prototype definition and manufacturing

Results
- Validation of the design method by measurements and simulations
- General recommendations and final report

Literature and general practical preference

[The literature (theories or research data) and general practical experience/precedent you intend to consult.]


Rienstra, S. W., Hirschberg, A. (2015) *An Introduction to Acoustics:* Eindhoven University of Technology


---

**Reflection**

**Relevance**

This research investigates the potential of computational design to optimize the workflow in designing small home studio's. It should provide the user a tool to quickly generate and validate acoustic solutions for studio design.

Should the design methodology developed during this graduation thesis be proven valid, it can be further developed and applied in any situation where sound proofing and acoustic treatment can improve the working or living environment.

---

**Time planning**
## TIME PLANNING

<table>
<thead>
<tr>
<th>Months</th>
<th>June</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursework</td>
<td>4.8</td>
<td>1.0</td>
<td>1.6</td>
<td>1.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Literature study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>17 June 2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td>17 June 2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P4</td>
<td>17 June 2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P5</td>
<td>17 June 2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validation of the design method</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2 presentation preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3 presentation preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P4 presentation preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P5 presentation preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>