This reflection gives a description of my graduation process. My graduation started in April 2015. I was quite indecisive on what topic I wanted to graduate, until a slide about the bio composite bridge project came along. I did not have any background knowledge about bio composites, but the idea of creating materials out of natural or recycled elements and contributing in finding new environmentally friendly materials which are suitable for structural design, made me enthusiastic. Together with Joris Smits, it was decided that I would do a self-standing graduation project which was linked to the 3TU bio bridge project. In the beginning of my graduation, I got into contact with Mark Lepelaar, from NPSP, a bio composite company which also contributes to the bio bridge project. This lead to a graduation internship at NPSP.

THE RELATION BETWEEN RESEARCH AND DESIGN
The starting point of my graduation was a design question, are bio based composite suitable to use in building engineering and structural design, and if so, would it be possible to replace petrol based glass fibre composites by bio composites? This question originates from a 3TU research project, the bio based bridge. Through this bridge project it is possible to test the structural application of bio based composites in real life. However, since this is the first actual structurally designed project with bio composite, information on the material is limited. Therefore, the goal of my graduation is to add to the knowledge about the use of bio composites in structural and architectural design, and hopefully contribute to the actual use of bio composites in architectural engineering.

When I started my graduation my knowledge of bio composites was very limited and the field of bio composites is very large. The first thing done was a small literature study into the type of bio composite used in the bio based bridge project. I learned that the durability of bio composites is a main concern when using it in the outside environment and for structural applications. I combined that knowledge and the bio bridge project into a research, testing the effects of weathering on the mechanical properties of the bio based composite used in the bio bridge.

Throughout my graduation, the research has become the main focus, which lead to more than just a literature study. Focussing on my own research and designing my own experience challenged me to go out of the comfort zone of my own faculty. This lead to a graduation involving lots of traveling and planning. To make my own test specimens I could use the facilities of NPSP, a bio composite company, where I was a graduation intern. The testing of the specimens was possible at the 3ME faculty at the TU Delft, under supervision of Fred Veer. However, finding an accelerated weathering testing machine proved to be very difficult. In the end, I was able to use the QUV accelerated weathering machine at Avans Hogeschool in Breda.

In the end, this graduation did not lead to an actual design, but it has lead to a design manual for architecture and engineering students and professionals which contributes to the use of bio based composites in building engineering and architecture.

THE RELATION BETWEEN THE THEME OF THE GRADUATION LAB AND THE SUBJECT/CASE STUDY CHOSEN BY THE STUDENT WITHIN THIS FRAMEWORK
My graduation, the implementation of bio composites for structural use, relates to the 3TU bio bridge project. My research into weathering and the mechanical properties of bio composites involves both the
knowledge of structural design combined with material science. While the use of bio composites, as a more environmentally friendly material than for example glass fibre composites, relates to sustainable design.

In the end, working within such a broad context, it was a challenge to not make my research too broad. With the connection to the bio based bridge project, I was able to choose specific bio composites suitable for structural design and from there my research was designed.

The practical knowledge, gained by joining the building of the bridge and making own test specimens, helped to understand the material. Bringing the theoretical knowledge from the literature study to the practical side, proved a valuable learning experience. Not only about the material, but also on how to translate a design into a building plan.

THE RELATION BETWEEN THE METHODICAL LINE OF APPROACH OF THE GRADUATION LAB AND THE METHOD BY THE STUDENT IN THIS FRAMEWORK

Within the building technology master track, a lot of research is done through design. However, in my graduation the bio based bridge was already designed by the 3TU team. My graduation is based on research for design, which has the goal to supply enough knowledge which can be used to make a design.

My graduation process started with a literature review about bio composites, focussing on bio composites suitable for structural design and the specific bio composite used in the bio based bridge. This literature review helped me to design a good experiment into weathering, finding the right tests to be done and defining the limitations and assumptions within the experiment. The experiment into weathering was set up with advice from Fred Veer, but has been adapted to the access to facilities and testing equipment. The challenge in this graduation was the time planning, which was very tight for the experiment. Especially when the accelerated weathering testing machine experienced technical problems and test needed to be postponed. This has forced me to be flexible, planning all my other graduation tasks around the testing equipment. However, this has taught me that doing a good experiment need patience, flexible planning and to document everything around the test very carefully.

In the end, the time planning made at the P2 presentation was not followed because of technical problems with testing equipment. However, the methodical approach of the experiment is followed throughout my graduation, acting like a guideline and helping to connect the theoretical knowledge with the research.

4. THE RELATION BETWEEN THE PROJECT AND THE WIDER SOCIAL CONTEXT

The aim of this graduation is to provide knowledge about the application of bio composites in building engineering and architecture, boosting the development toward the use of sustainable materials.

My ambition with this graduation project is to prove that new sustainable materials are suitable for structural use in building engineering and architecture. With research projects like the bio bridge, the building industry is alerted to the possibilities with this material. And, while there are still a lot of challenges to overcome, bio composites can be the solution in replacing the petrol based glass fibre composites for a more environmental friendly option.