

# Reflection

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My graduation project has come to an end, and I would like to take you with me on my endeavors during this journey. By stating the aim of the study, I formulated, first signs of how I approached this graduation project with an explorative mindset, became visible, which to be fair was not always easy and challenged me again and again.

The aim of the study was to close the knowledge gap on how to design and fabricate lightweight, material-efficient (dematerialized) modular, aesthetically valued (bespoke fiber tectonics) load-bearing structures for large spans that can be integrated with building envelopes to form fiber-based building systems using the coreless-filament winding technique and regionally harvested flax. Therefore, the study and design, forming my graduation project topic, had a high interrelationship with one another from an Architectural and Engineering perspective.

*What is the relation between your graduation project topic, your master track (A, U, BT, LA, MBE), and your master program (MSc AUBS)?*

The relation between my graduation topic, the future fibrous flax farm with Architectural Engineering is the interrelationship between Architecture and Engineering itself and showcases architecture from a tectonic perspective. Therefore, the relationship with the Master track of Architecture is relevant on the topics of Architectural Design and Theories. Lastly, the relationship with the master program MSc Architecture, Urbanism and Building sciences is closely related due to covering all the facets learned in my academic endeavors.

The combination of engineering and architecture has always captivated me, and I'm eager to be at the forefront of architectural innovation using cutting-edge methods and materials that may shape the architectural language of tomorrow. This argumentation of choice for Architectural Engineering has also challenged me in ways I could have never imagined before during my graduation journey. From these challenges that arose I have expanded my professional knowledge and skills and therefore I would like to take you with me on how I faced these challenges and how they developed my professional thinking. Firstly, the external influences, such as the interplay between the research and design fascinated me on how they were interrelated with one another. Although, this also created some challenges.

*How did your research influence your design/recommendations and how did the design/recommendations influence your research?*

The research which was predominantly seen through the lens of materiality and technique resulted in conditions for using the material and technique in the built environment. While the design gained its conditions naturally from the context, program and climate. The outcomes of the study generated various opportunities for using, predominantly flax, fibers in combination with coreless-filament winding which would need to be taken into account. The opportunities for example on the aspects of structural form gave conditions to the design to use mostly dome typology structures which were determined to be the most favorable. Therefore, the material- and technologically based research gave essential constraints for using the material and technique in the design phase.

This was also seen vice versa within the design while experiencing potent drawbacks of flax, flammability, water permeability and -repellency for example, while finding solutions to overcome these by treating it for example with linseed oil and bee wax to make it more flameproof or by choosing where to use the material and technique in the fiber-based building system itself. This can also be seen in the design itself whereby the skin of building system is made from wooden shingles to repel the water from the system and the core of the system is made from flax fibrous structures. This interplay was also visible in the design process itself whereby internal influences occurred.

*How did various elements within the design influence one another, and what strategies did you employ to address these interactions?*

In my design process for the Flax Weaving Hub, the interaction between foundational design principles and the choices I made was a critical component, particularly evident in decisions related to roofing material and form. The challenge arose when considering how to reference the undulating landscape surrounding the context, the weaving patterns in the form, and the textures of the roofing material used in local farmhouses. This dilemma—whether to prioritize the material of the roof or its slope illustrates the interplay of design choices in my project.

From the start, I was deeply influenced by the research, which suggested that the structure of a dome was optimal for achieving my objectives. As the project progressed, the necessity of ranking these design principles became clear. I employed a strategy of prioritization and weighting, assigning weights to different design principles to facilitate easier decision-making. This approach was crucial in managing trade-offs between competing elements, such as material durability versus aesthetic considerations.

I maintained an iterative testing and feedback process, where each change in material or structure was tested for its impact on the overall design. This not only ensured that all elements were harmoniously integrated but also that they aligned with the research findings, enabling a more structured approach to integration and adjustments.

The realization of the dynamic interdependencies among the material, structure, and form led to challenging interactions. Each decision I made needed to consider these elements not just individually, but more importantly, how they influenced one another. This interplay became particularly obvious as I mapped out the basic design principles and observed firsthand the interactions among the various components.

Through this reflective practice, I learned the importance of maintaining a balanced view of all design elements and effectively managing their interactions. This experience has significantly enhanced my ability to make informed and impactful design decisions, reflecting a strong connection with both the theoretical and practical aspects of architectural design. The strategies of prioritization, iterative testing, and maintaining flexibility have been integral in navigating the complex challenges of the project, shaping my professional growth and deepening my understanding of architectural dynamics. Reflecting on my project's journey, several unexpected challenges emerged, profoundly impacting my professional growth and deepening my understanding of the field which helped me refine my approach for future professional endeavors.

*Reflecting on my project's journey, what unexpected challenges arose, and how did your responses to these challenges inform your professional growth and understanding of the field?*

Initially, my research was exploratory as I was still defining what I wanted to achieve. Once I had a clear framework and set boundaries for my research, I could focus more on execution, maintaining an explorative approach while ensuring the feasibility of the project within the available time. This innovative approach not only energized me but also gave me a clear direction.

During the design phase, my exploratory attitude allowed me to discover various aspects of the project. However, my fascination with the project's details, such as workforce considerations and the technical specifics of materials like how wooden shingles would be mounted on willow branches, sometimes overshadowed the core objectives. My project began to expand unnecessarily as I delved into numerous details, such as referencing the flax bundle as an organizational form, which complicated the narrative and blurred the distinction between main and peripheral issues.

I implemented several strategies to overcome the challenges that arose. Firstly, I prioritized the core aspects of the project over peripheral details. This focus helped manage the project's scope and prevented it from becoming overly complex. Secondly, looking back I used an iterative design process to continuously refine my project. Whereby I critically analyzed my design choices which helped me maintain its integrity and feasibility. Thirdly, I established clear boundaries and guidelines for the research and tried to do so for the design phases as well to keep the project aligned with its original goals.

These strategies were crucial as I learned the value of focusing on the core aspects of my work. My tutors encouraged me to maximize exploratory potential, pushing me to explore beyond standard construction materials and methods. However, I sometimes misinterpreted feedback during the phases between P2 and P3, leading to either overly detailed or overly superficial treatments of my design elements.

After P3, I refocused on the main aspects of my design, using my research findings as a guide to reassess and realign my design with the initial research outcomes. This process taught me for instance to make decisive choices and differentiate primary concerns from secondary ones. Although, while maintaining an explorative approach, I placed controls to ensure the exploration did not deviate from the project's essential goals. I learned bit by bit to interpret and apply feedback constructively, which was as previously noted sometimes a challenge for me. To look back on my architectural position I gained confidence in making decisive choices which helped me cut through the noise of multiple possibilities to see what was truly beneficial for the project. Lastly, engaging in frequent discussions with my tutors and fellow students provided new insights and perspectives essential for dynamically adapting the project which sometimes included downscaling the project or even eliminating some design aspects, such as the more philosophical aspects I wanted to include.

Through these experiences, I have grown significantly in my ability to manage complex projects, demonstrating a capability to harness creativity within structured boundaries. This journey has not only shaped my professional practices but also enriched my approach to architectural design, making me more adapt at navigating the nuanced interplay between innovation and feasibility.

*How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?*

This graduation project is relevant due to the high level of innovation it can bring to the building industry. From a scientific point of view the in-depth analysis of the fibrous material, flax, and its structural purposes to create lightweight structures and thereby reduce material waste, increase building efficiency and speed play a big role in the innovation it can bring. The translation of the techniques of coreless-filament winding into architectural practices which can be used in various building programs with large spans can benefit the field of architecture as well. The combination of the biobased material and the robotic technique result in more material and production efficiency whereby less material is wasted. This by connecting the necessary characteristics of a material that are needed for lightweight structures to its source, the soils, a true sustainable building cycle can be achieved. From a societal perspective the synergy between farmers (harvest), builders (production) and residents (living) can strengthen the cohesion in society. The design research can also have great effects on the image that has been portrayed on the farm industry the last couple of decades. A new image can be resulted whereby a circular economy can be created, but also in the built environment itself with new farm typologies of the future which co-exist with nature and truly protect the natural environment. Additionally, a connection with the Groninger landscape has been made in the design and can therefore give farm architecture a new place in Groningen and The Netherlands. Lastly, from an economical and environmental perspective the combination of the biobased material and the robotic techniques can create prosperity, reduces the environmental impact of the industries and creates a consciousness in society that we truly can work with the environment instead of depleting it for our own purposes. From an architectural point of view, a new architectural language may arise due to the bespoke fibrous tectonic structures created.

*How do you assess the value of the transferability of your project results?*

The project results possess significant potential for transferability to fellow students and scholars on key points, however they also have their limitations. The research provides a comprehensive and integrated study of utilizing flax fibers with coreless filament winding from an Architectural Engineering Perspective. It points out the shortcomings of the material and technique, encouraging others to explore new solutions. Nonetheless, there are some gaps in the research. For example, the case studies were somewhat restricted as it focused only on pavilions with temporary functions, which means that it's unclear how these findings might apply on a larger scale. Additionally, the prototypes were wound by hand instead of by a robotically which might have affected the results. Lastly, more research still needs to be done to find a fully fibrous building system.

In terms of design, the project aimed to use flax fibers in combination coreless filament winding, trying to use as much biobased materials as possible. While some aspects worked well, others, like water and fireproofing, were challenging. There's still a lack of knowledge on how to handle these issues effectively. The project explored various ways of connecting materials and building structures, but it hasn't found the perfect solution yet. Therefore, there are still quite a few practical challenges to overcome. The insights gained during this graduation project have been integrated into the architectural design which provide a fruitful foundation for others to further develop.