# Reflection  - Bio-based Air Ducts

**P5**
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**1. What is the relation between your graduation project topic, your master track BT, and your master programme (MSc AUBS)?**

The graduation topic is related to Building Technology in the following ways:

- Understanding the manufacturing and construction process of air ducts and related design requirements.
- Understanding and applying circular strategies at different scales from material to  product to building and regional when producing bio-based materials locally.
- Understanding the potential and differences between bio-based material in terms of functional and mechanical properties aswell manufacturing methods.
- Potential design and prototyping of an integrated innovative building product in the field of building services: bio-based air duct. By combining knowledge about climate design, product design, circularity and bio-based materials.
- Performance evaluation to validate design concept and final design.

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

The literature review focussed on three main aspects: air ducts, circularity and bio-based materials with their corresponding manufacturing methods. This helped to understand the important aspects of air ducts components, in terms of requirements related to functionality, circularity, manufacturing and costs aswell gave insight in the feasability of certain materials. In addition, by creating models from available bio-based materials it helped to physically experiment the possibilities of the material in terms of material workability; the strength, the amount of pressure it can handle and an idea how the material will be handled during installation. In this way, certain design decisions could been taken resulting in new insight. The development of the concept followed from the suitable materials which were selected after a combination of design and research, respectively model making and investigated the pros and cons of the materials followed by a carbon footprint assessment. In terms of design and research, more data could have been generated by experimenting to use less assumptions for decision making as mentioned in the next section.

**3. How do you assess the value of your way of working (your approach, your used methods, used methodology?**

The literature review on the mentioned topics helped to get an understand of the topics to set up design requirements and make design decisions. The analysis of the manufacturing methods and corresponding bio-based materials give insight in the division into different type of components: linear (linear, joint) and complex (bend, t-component). The assessment for the selection of suitable materials and concept was more subjective due to many assumptions. Therefore, for a topic with limited information available it would been beneficial to focus more on experimenting rather than trying to find information in literature which is not available or hard to find.

In order to have more insight in the potential of moisture resistance a solution could have been to do experiments related to water absorption earlier in the process. By applying different type of coatings such as beeswax, bio-resin, bio oil on the selected bio-based materials. This might not have solved the problem but could have eliminated certain options, which could have broaden the final results.

The same applies for the chemical emission, by experimenting with materials and coatings which are potentially a danger for human health, as example recycled plastics. For now an assumption is made that the chemical emission for smaller components would be neglegtable.

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

The circular economy is important to tackle crises related to climate, environment, and pollution. Exploring the possibilities of renewable bio-based materials in the building services sector would potentially keep resources in a longer cycle, which reduces $CO_2$ emissions caused by the energy needed for the fabrication of steel metal for air ducts. Furthermore, raw materials can be saved for industries where they are more urgent and where bio-based materials have no potential to be applied, so these sectors can last for future generations. There are a large number of researches performed related to bio-based materials and their applicability in many industries such as furniture, cars as well buildings. Nevertheless, the research related to the relation between bio-based materials and air ducts is yet to be explored. This project could fill the scientific gap in the possible applicability of bio-based materials in air ducts. Furthermore, the research and design should show research and design methods for the use of suitable bio-based materials and how to validate these concepts in a final prototype according to the setup requirements.

In terms of ethical aspects, however there are no requirements for air duct materials in terms of fire safety. The use of bio-based materials and/or plastics brings along a higher risk in terms of flammability in comparison to sheet metal. Neverthless, there is also a positive aspect which is the lightweight of bio-based materials, which would be beneficial for installers to work with.

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

The project describes a first result related to the applicability of bio-based materials for air ducts. Being one of the first doing research in this specific topic, the methodology should be a starting point for future development and research of bio-based air ducts. The projects gives an understanding of crucial methods which should be followed to assess the applicability of bio-based materials for the construction of air ducts. This includes the elaboration on potential suitable manufacturing methods and corresponding bio-based materials assessed by important critical design requirements aswell a life cycle assessment for the selection of a suitable material per duct component. Important to note is that the LCA is only calculated for the linear product, so the LCA for other components will vary. However it gives an indication of the difference between different materials to make design decisions. This results in the development of a concept and design. Unfortunately the final assessment of validating the concept on the main issue of preventing moisture and chemical emission was not conducted and should be further explored, the results of these aspects are now based on assumptions. Ideally, this could be conducted earlier in the process.

Overall, the projects results are transferabile in a broader sense as a methodology, specific decisions were made based on assumptions and logical thinking making the final results a starting point for further development in this field. This relates to decisions related to the scalability of the material, mechanical properties, moisture resistance and chemical emission. However, experimental research could be conducted for developing and exploring these aspects earlier in the design process.