DESIGNING AN ATTACHMENT MECHANSIM FOR A MODULAR GREEN ROOF

Public Summary

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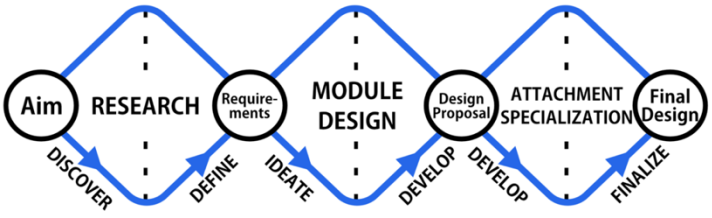
Green Panels | University of Twente

This paper talks about designing a mechanism for attaching modular green roofs. Green Panels, a start-up working out of the University of Twente accelerator Incubase, gave the assignment.

The product offered by the company is modular green roofs for pitched roofs. The advantages of having a modular green roof include the flexibility and customizability of coverage on the top and ease of installation. This is necessary since buildings often need help to accommodate the weight of a complete green roof. Furthermore, the current attachment method could be more efficient and ergonomic. The client's product is still in the early development stages and requires a redesign to compete in the market. The assignment proposal was formulated around these issues, aiming to deliver a design that would make the panel meet the demands of the users. The project's scope included redesigning the panel, focusing on the attachment mechanism to create a more competitive product. Efficiency was not the only criterion for the mechanism; it also needed to be ergonomic since installers work on pitched roofs, which is considered a hazardous environment. The approach used for this project can be visualized using a triple-diamond diagram. The first phase included the research phase used to discover and define the assignment aim, concluding with a list of requirements. During the second phase, a panel design was developed using a morphological chart to generate ideas. The panel design was used to create three concepts for the attachment mechanism. Finally, in the third phase, the project scope was narrowed to focus solely on the attachment. Developing a functioning mechanism that promotes efficiency and safety was more important for the assignment's aim.



Once the assignment aim had been formulated and a research plan was developed, the design process started with literature research. Comprehensive research was conducted

into green roofs, including analyzing benefits (Hui & Chan, 2011; Mahdiyar et al., 2020), composition (*Green Roof System Structure - Sempergreen*, n.d.; *Steep Pitched Green Roof with HYDROPACK® - Vegetal i.D*, n.d.; netconstructions.de, n.d.), norms, and modularity (Korol & Shushunova, 2016; Sonego et al., 2018). Furthermore, the installation method, like that of solar panels (DirectSolar1, 2012; Ho et al., 2020), and the application context were investigated. This research formulated the first list of requirements, which was used as a guide throughout the ideation phase.

The tool used during the ideation phase was a morphological chart. It created the possibility of developing multiple ideas by combining different solutions for numerous features. For this assignment it meant combining other ideas of features of the green roof to come up with solutions for panels that included all of them. Certain combinations that showed high potential were eventually chosen to further elaborate on and turned into concepts. At this project stage, the broad scope of the assignment caused development to move on slowly due to unanswered questions. The module's design was fixed by finding a solution that would fit all concepts to reduce the number of variables. The focus now shifted to the design of the mechanism. The proposed module design was presented to the clients but still required further development and needed to be more feasible. The importance of developing a functioning mechanism meant that the redesign of the module was eventually dropped.

To deliver a feasible design for a mechanism, the limitations were now given by the production method of the modules. The production method chosen by the Green Panels was injection molding. A new list of requirements was formulated, guiding the further development of the mechanism. Once three possible concepts were developed, they were evaluated based on their viability and adaptability. From this evaluation, an attachment mechanism was chosen, which seemed feasible and showed the most potential. To finalize the development of the design, a storyboard was created to visualize the application context of the mechanism and the modules. It was used to understand the constraints implied by the interactions and environment with which the design must be compatible. From this analysis, and final list of requirements was composed, and used to develop and evaluate the final design. The final design was a redesign of the second concept, making it suitable for the application. It offered to improve the installers' safety and reduced each module's attachment time.

Nevertheless, the evaluation of the design showed that there were still issues regarding the strength and stability of the design as well as the aesthetics. This assignment posits the necessity for additional advancement in creating a secure and robust mechanism while considering the various interactions and contextual factors. The utility of this assignment lies in its capacity for comprehending the fundamental understanding of the lateral aspect.

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