Designing and optimizing a heating system for a storage container

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Public Summary

During the colder months of the year, the temperatures in storage containers often drop below the freezing point. This causes the items that are stored inside, to be exposed to cold temperatures which result in the deterioration of these items. Universal Storage Containers, a company specialized in storage containers, desires a solution to this problem. Therefore, this assignment aims to design and evaluate a heating system for the storage containers.

This heating system has multiple requirements: It should not compromise the available space in the container as little as possible. Also, as customers come and go, it should be flexible. This means that the design should be able to be installed and uninstalled easily. Finally, the design should be energy efficient, which means that the heat loss of the container should be minimized and the system itself should be as efficient as possible.

Realizing such a system is done through various phases in the design process. First off, literature studies are conducted to gain the knowledge required to design. This research is about the current situation, different types of heating, insulation, and so on. The research phase is followed up by experiments, calculations, and simulations. These will give a better understanding of the heat transfer inside the container and also to verify the findings of the research phase. The experiments consisted of a storage container analysis by means of a thermal camera, and also a humidity analysis. The calculation and simulations were about the required heat output and the behaviour of heat inside the container. The findings from both these experiments and the research were then combined and used in the design phase. Here the best solution was chosen for the heating system. This consisted of a radiant panel, which can be mounted against the ceiling with the use of magnets. This solution is not only very space-efficient but also easy to install and uninstall. Next to that, the heat loss inside the container is reduced by better insulating the division wall that divides the storage units from each other and reducing the effect of the thermal bridges in the container. Which was achieved by covering the division with reflective insulation and reducing its gaps so less heat escapes to adjacent units. To the thermal bridges, additional insulation is applied and covered with a rubber seal.

From the designed heating system, also working prototype has been constructed. There are some aspects that still need to be implemented to actually realize this system, which mainly consist of usability tests and additional tools that are beneficial to present this solution to the customers. In the end, the final design satisfied the requirements and would likely sufficiently heat the container effectively.