

GNG 1103 [F]

Engineering Design

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Deliverable B - Need Identification and Problem Statement

Prepared by Group: #4

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Date: January 31st, 2021

Table of Contents

Table of Contents	1
Introduction	2
1.0 Client Statements from Client Interview	2
2.0 Need statements	3
3.0 Problem Statement	4
4.0 Products to Benchmark	4
Conclusion	5

Introduction

Winter in Ottawa has always been a beautiful landscape, however with its low temperature and frequent heavy snow it can mean inconvenient or dangerous walking conditions. Not only is it very inconvenient for people to travel, but it is also extremely easy to fall and cause physical injury. In order to prevent this from happening, the University of Ottawa came up with a measure to quickly melt snow with salt to increase friction. However, this measure is not perfect, and the use of salt has some adverse effects on the surrounding environment. Therefore, in order to ensure the safety of people's travel and reduce the impact on the surrounding environment, the university would like to implement a heated sidewalk. In this deliverable, we began the first steps of the design process by taking the information from the client interview to create a list of prioritized customer needs and to create a problem statement. Also to get a better understanding of the market, research was done into similar products so that they can be benchmarked in future deliverables.

1.0 Client Statements from Client Interview

- Heating sidewalks embedded in concrete have a high capital cost and are hard to repair
 - Don't have a system to drain water
 - Often require a lot of energy
- Heated sidewalks only need to be warmed to 2 to 3 degrees
 - The product can work in and up to -25 degree weather
 - Can use hydro or electric power to heat
 - Assume that there is always access to these sources
- The product needs to be modular and scalable
 - For this project, we will only need to focus on a small sidewalk for potentially one emergency exit but our device needs to be scalable for the future
 - Stored in extra closets, under stairs, etc
 - Preferably fit through a 3 ¹/₂ foot doorway
- Needs to be able to be removed and stored (ex/ can be rolled up or dismantled and stacked up)
 - Longevity in the material is important (ideally it will last a decade)
 - Weight needs to be kept in mind for making it easy to move around and store
 - Should be in place only during the winter season
- Must be safe for people to walk on while keeping people accessibility issues (ex wheelchairs) in mind
 - Have grip but not so much texture that it would negatively impact wheelchair users
- Have a simple and easy design so it can be repaired in house
 - Needs to be able to be cleaned and maintained

- Good maintenance = longer lifetime
- Preferable be cheap to make and repair
 - Important that the solution cannot be waterlogged
- A solution that can reduce power consumption (by turning it on or off) is preferred
 - \circ 24/7 power option is available if there is no solution to this factor
- Will eliminate the use of salt in the areas which it is used
- Can make minor alterations to the sidewalk as long as it does not affect the Ontario Building Code
- The heated sidewalk will be placed as level as possible
 - Not used on ramps
- Should have low potential danger for wildlife

2.0 Need statements

Main grouping of needs	Number	Needs	Importance
Performance	1	Heat up to about 2°C	5
	2	Can operate in temperatures around -25°C	3
	3	Controls the direction of where the water runoff travels	3
	4	Efficient or more efficient than using salt	5
	5	Quickly heats sidewalks to melt snow and ice as soon as possible	5
Safety and Design	6	Have a grip to walk on while also being accessible to those with wheelchairs or other transportation tools	5
	7	Minimal usage of power	2
	8	Any alterations to the sidewalk abides by the Ontario Building Code	5
	9	The heated sidewalk is low cost	5

Table 1. List of prioritized customer needs

Longevity and Maintenance 10 Preven		Prevents waterlogging	4
	11	Easy access to internal components for repairing and maintaining quality performance	5
	12	Lasts about a decade	3
	13	Cost-effective maintenance	5
Scalability and Modularity	14	Can attach or extend the solution to increase the area of use and to optimize storage	5
	15	Simple and easy to build design	4
Removal and Storage	16	Compact in size for storage	4
	17	Exclusive access for the solution to be removed by an approved individual(s)	2

In table 1 a score of 5 in the importance column means it's the most important need to satisfy, while a score of 1 is the least important.

3.0 Problem Statement

The University of Ottawa needs an environmentally friendly device to remove snow and ice that is cost effective, modular and scalable in order to reduce the use of salt on campus.

4.0 Products to Benchmark

To get an understanding of the market and existing solutions for heated sidewalks, research was done to find three potential solutions that can be benchmarked in future deliverables. The first product found was HeatTrak, which is a roll-up mat that can produce heat by connecting to existing ground fault circuits to melt ice and snow. HeatTrak is marketed towards residential and industrial environments and is modular, since it can connect to other HeatTrak mats using a watertight connector, thus this product would definitely be a competitor in the market for the design we create. One way we can potentially have an advantage over them is by making our solution more cost effective since HeatTrak costs \$139.95 for a 20" x 60" mat.

The second product for benchmarking is the Scotts Elite Spreader which focuses on the traditional method of melting snow and ice with a wheelbarrow design; that needs to be physically pushed and dispenses salt using an electric, timed rotor. Due to its ability to hold 20,000 sq/ft of material, its ergonomic design and low upfront cost, this products' main clients would be families living in suburban areas with large plots of land. This product is a direct opposition to our design that focuses on eliminating the use of salt, but one of the strongest advantages we have is that by not utilizing salt we eliminate the

cost of having to purchase more salt everytime snow or ice needs to be melted. If we manage to drive up the efficiency of our product and in turn lower the electricity costs of operation, our solution could become the much cheaper alternative in comparison to the traditional method.

The final product that was investigated for future benchmarking is the snow-melting mat by Roof Heating Systems. The RHS mat is marketed much more towards residential environments for use as a welcome mat. Similar to the HeatTrak product, the mat is modular and can be secured effectively to the ground, however covers a larger surface area (60" x 120"). The product is also marketed to melt 2" of snow per hour, and when clear to have a no-slip surface for easy tread. The product is able to accomplish these at a low power consumption, and thus will provide a good benchmark for what our prototype should accomplish.

Conclusion

All in all, it is very clear that the important properties that need to be kept in mind when designing this product is the need to be energy-friendly, low cost and usable in the long-term while being modular and scalable for future use. The creation of the product is important because convenient and stable sidewalks can greatly improve safety, thereby reducing risk during use in harsh winter climates. Also, the use of heated sidewalks will also gradually eliminate the use of chlorides such as salt, thereby greatly reducing the damage to the surrounding environment and other facilities, and contributing to environmental friendliness. Researching into potential benchmarking products showed that people still have a long way to go about a heated sidewalk design and use. Thus, after we have done more research and benchmarking in future deliverables we will be able to visualize the gaps in the market better to create a better product than those that currently exist.