GNG1103

Design Project User and Product Manual

Not Salt Heat Mat

Submitted by:

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Table 1. Acronyms

Acronym	Definition
NS	Not Salt

1 Introduction

In this design course, we focused on creating a modular heated sidewalk using the design process learnt in class. During the winter seasons, the University of Ottawa predominantly uses salt to melt ice and snow to make sure walkways are safe for students and faculty to use. Unfortunately over the years, they've noticed a variety of negative side effects that come with using salt such as: it damages surrounding nature such as trees and grass, can be toxic toward the wildlife and destroy habitats and finally, it can damage buildings to such an extent that the service life is reduced by 25% to 50%. Although rock salt might be the cheapest way of melting snow and ice on campus, the high cost that comes with repairing buildings, greenspace and the permanent damage done to wildlife has the University of Ottawa looking for alternatives to salt.

Thus during the semester of Winter 2021 our team alongside our client, the Manager of Sustainable Development at the Office of Campus Sustainability, worked to create 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. Our final product, created within the limitations of having a $100 budget, was called the Not Salt (NS) Heat Mat.

This User Manual includes all the information necessary for future groups to recreate our prototype from the initial stage of gathering client needs, figuring out potential designs, prototyping, and testing while also outlining our final comprehensive design and its key features. This manual will also act as a guide for any users that may want to try out the NS Heat Mat. It'll

contain instructions on how to set up and use the mat, troubleshooting and support information, and finally an overview of the various functions in the mat to keep an eye out for. This manual will be available through our MakerRepo page for anyone that wants a comprehensive guide to know everything about the NS Heat Mat from conception to implementation.

2 Overview

Team Not Salt was proposed the issue by their client, Jonathan Rausseo, that standard rock salt used by the University of Ottawa to melt snow and ice on campus was contributing significantly to long-term damages to its infrastructure. Specifically, the lifespan of infrastructure was said to be reduced by a value ranging from 25-50% of its expected duration, meaning replacements and repairs would be necessary more often than desired. Thus, while rock salt remained the cheapest solution to melt snow and ice on campus, its long term costs would eventually outweigh its short-term benefits. Additionally, Mr. Rausseo has brought to attention the threat that the continuous use of rock salt poses to local plant and animal life, so there are also significant environmental drawbacks to the use of rock salt alongside its infrastructural cons.

From various client meets and discussions with Mr. Rausseo, team Not Salt has ascertained that the client has the following fundamental needs for this product:

- The product can melt snow and ice on campus walkways.
- The product is sufficiently low-cost that it can economically replace salt.
- The product is modular and can be removed during non-snowfall seasons.

In response to these fundamental needs, team Not Salt has developed the NS Heat Mat, a modular heated walkway which will serve as an easy-to-use, easy-to-implement solution for the client's ice-melting needs, and will completely be able to replace salt usage at a low enough cost. Our mat takes the basic principle of a standard heated mat and adds features such as connectivity

to other NS Heat Mat, so long walkways can be covered in mats. The connectivity feature works in both planar directions, so a collection of mats can cover large areas easily. The NS Heat Mat also comes with a convenient Smart Plug, which can be synchronized with a phone application so that users are able to activate the Heat Mat from the comfort of their home or office space or set timers for automated activation or periodic activation settings. Finally, the NS Heat Mat also offers easy-access maintenance through its hinged upper surface, allowing technicians to access the inner workings and de-icing cable. The Heat Mat is functional in as low temperatures as -30 °C, and the de-icing cable contains a sensor that will cause it to activate upon detection of a temperature below 3 °C.

Shown below is a photo of the final prototype, which displays the inner workings of one Heat Mat. Points of interest include the de-icing cable, the studs for support, drainage holes through the studs to prevent the buildup of water on the surface of the mat, and the hinged upper surface for ease-of-access to these parts:

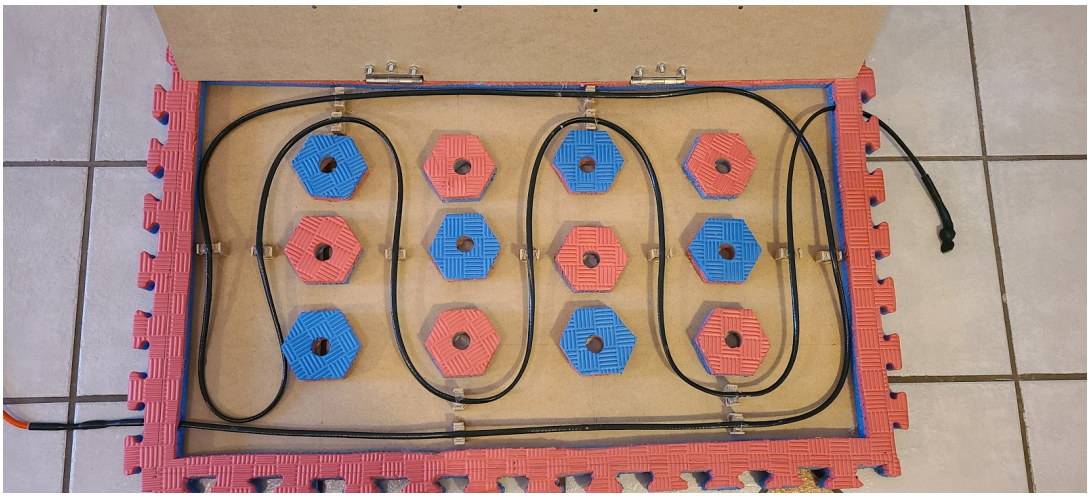

Figure 1: Final Prototype of the NS Heatmat

2.1 Conventions

There are no specific conventions used for the purpose of this manual.

2.2 Cautions & Warnings

As with any electrical heating product, the NS Heatmat should not be left on and unattended for extended periods of time. This is more indicative of multiple days rather than hours, as the mat is expected to function for multiple hours at a time without being a threat to one's health. However, this may cause damage to the mat's materials, so it should be turned off after it has melted its target amount of snow. The final design of the mat will use non-flammable materials to completely eliminate any risk of fire hazard.

If the mat drainage system were to be blocked due to mat placement, water may have trouble draining, and re-freeze on the mat. Be wary of mat placement in order to avoid any potential falls from re-frozen water.

3 Getting started

3.1 Set-up Considerations

The setup for the mat is incredibly straightforward. Simply remove the mat and Smart Plug from their packaging, and use an appropriate, 120 V power outlet to connect the Smart Plug. An extension cable may be required depending on the location of the outlet. Mats can further be connected using the male and female plugs on the de-icing cable.

3.2 User Access Considerations

The two primary customers and users of this product are university maintenance workers, as well as homeowners. The maintenance workgroup of users will have full access to all benefits of the NS Heatmat, since they will require this product for large-scale operations, and will benefit from its modularity and maintenance accessibility systems. Homeowners will find the heating aspect of the mat useful at a relatively low cost, however will not fully benefit from its modularity, since the mats will likely not be necessary on large scale. Pedestrians classify as non-customer users, as they will use the mats in public but are not the purchasers of the mats. Wheelchair users may have slight difficulty mounting the mats due to their thickness, however, the final design of the mat will likely reduce this issue significantly.

3.3 Accessing the System

The only requirement to activate the system is to create a Smart Plug account. As long as the plug is firmly in an outlet, the power to the mat can be activated remotely at the touch of a button on one's phone. To create an account, users will require an email address and password for the Teckin smartphone application.

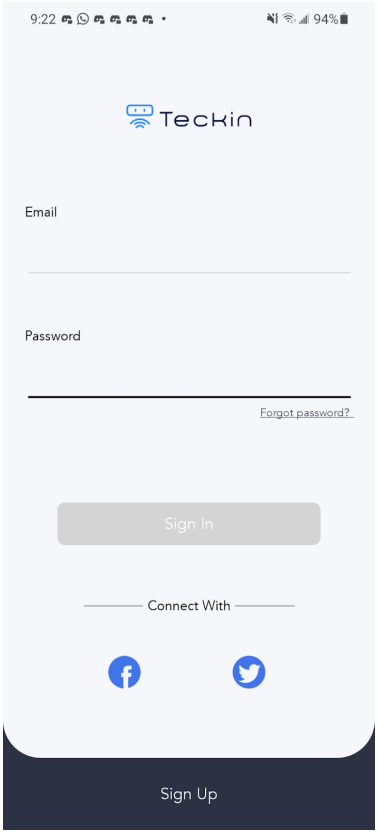

Figure 2: Login display for Teckin smartphone application

3.4 System Organization & Navigation

Once an account has been created in the Teckin application, users can set up the mat's power supply by adding their Smart Plug to the application menu.

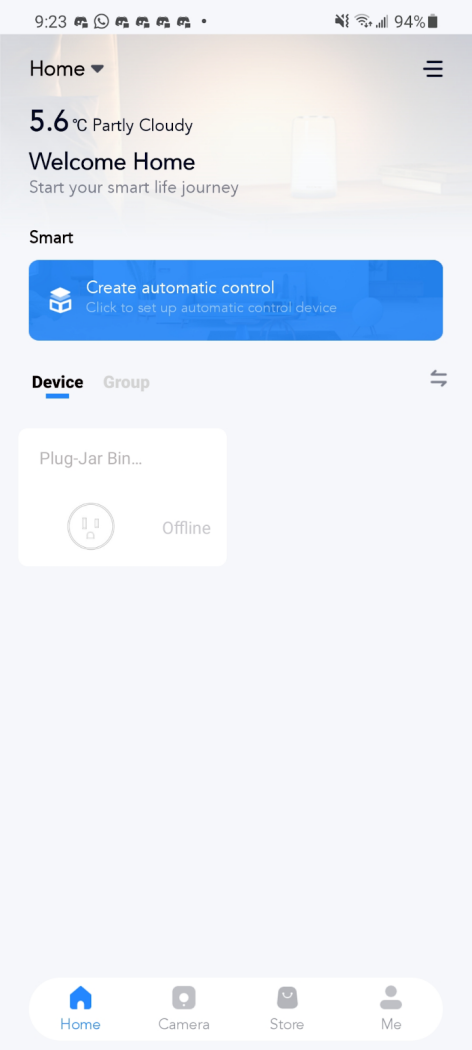

Figure 3: Main menu for Teckin smartphone application.

Users can then click on their device after it has been set up, and activate the power supply to the mat from the following menu:

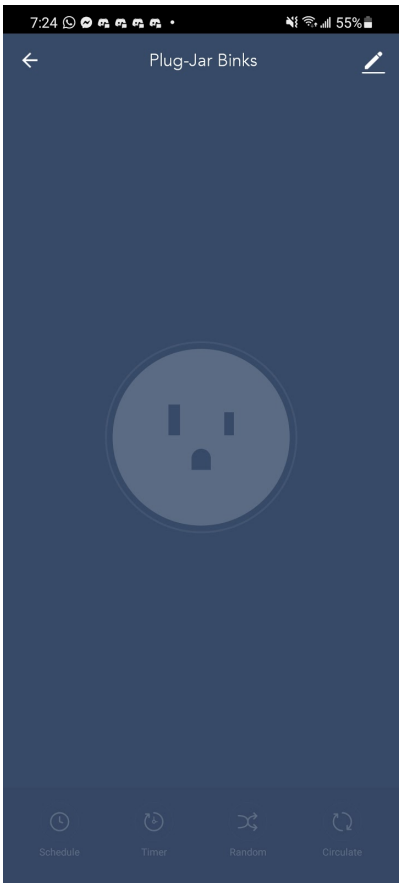

Figure 4: Device display for Teckin Smart Plug in Teckin smartphone application.

Note the taskbar at the bottom, which allows users to set schedules and/or timers so that the mat can be automatically activated during certain hours, or set to run for specific durations.

3.5 Exiting the System

To deactivate the mat, users can use the same button to cut power to the Smart Plug. Alternatively, if a timer was set, the plug will power off the mat automatically. Finally, if the de-icing cable continuously detects temperatures above 3 °C, it will automatically remain in the “off” condition.

4 Using the System

The following subsections will provide step-by-step instructions on how to use the various functions or features of the NS Heat Mat. This section will be helpful to both people planning on using the mat and also those who may want to understand the details of NS Heat Mat design better.

4.1 Dovetail Connections

One of the main requirements asked for by the client was the ability for the mat to be modular, so that in the future when more mats could be produced they would be able to connect and create large cohesive units. To be able to do this we used dovetail connections, which are inverted triangles, around the edge of the mat, so that mats can easily be connected. The design of the tails would also make sure that when users are walking over the mat the force caused horizontally on the mat will not cause the mats to disconnect. Since we were only able to produce one mat due to our budget, a theoretical example was created using paper of how four mats can be configured using this design, as seen in Figure 5.

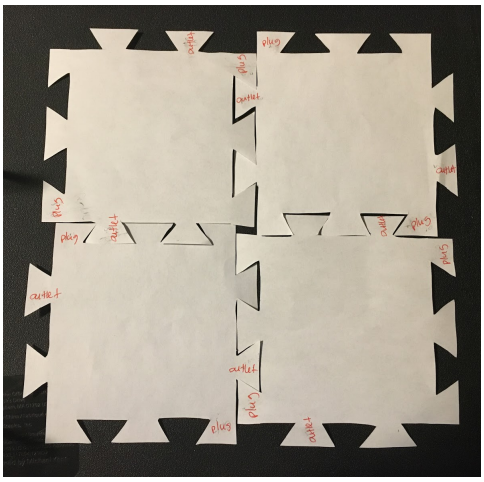

Figure 5: A theoretical example of how four mats can be connected

On two corners of these dovetail connections, there are some openings that allow the de-icing cable to be thread through, so the dovetail connections will also act as a layer of protection for the cable and give the mats the ability to connect the heat source of one mat to the next.

4.2 Drainage System

Since the NS Heat Mat is meant to melt an abundance of ice and snow constantly, there will inevitably be a lot of water created. This is why it was important for the design to have a method of directing the water away from the mat after melting so that there wouldn't be pools of water on the surface of the mat. To accomplish this, the NS Heat Mat has drainage holes on the surface and bottom of the mat as seen in Figure 6 and Figure 7. These holes were created by drilling through the surface of the mat, then through the support column right underneath it and

finally through the bottom layer of the mat. Thus, after the NS Heat Mat melts snow/ice the water produced will simplify fall through the holes on the surface, through the internal support columns and finally be diverted to the ground below the mat.

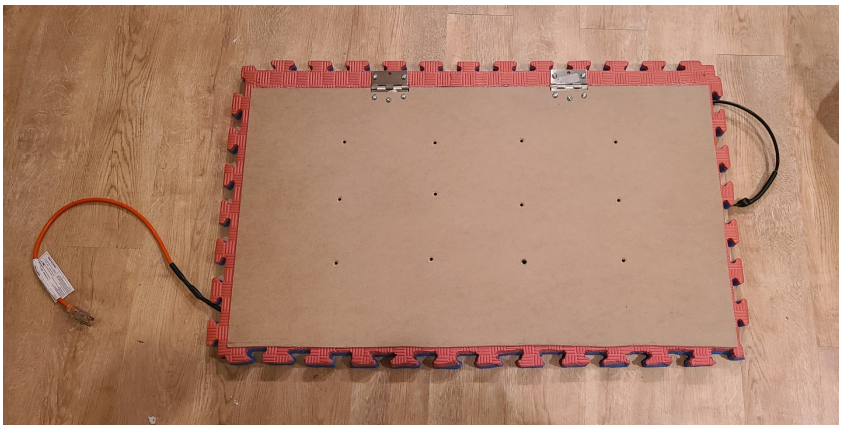

Figure 6: Top of the prototype

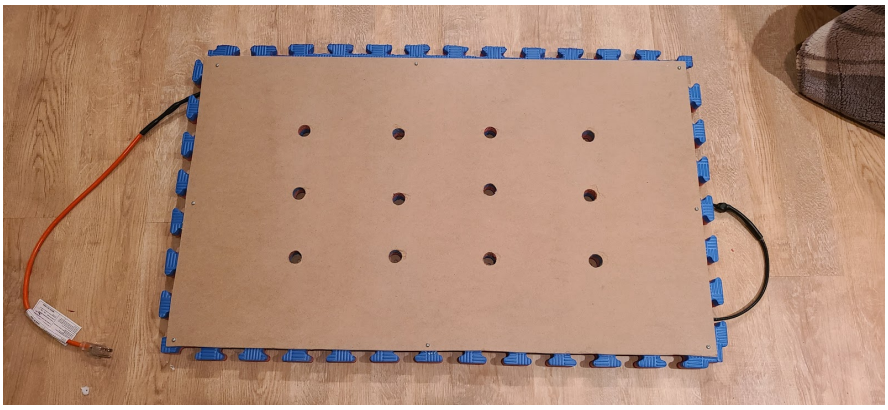

Figure 7: Bottom of the prototype

4.3 Electrical Components

4.3.1 De-icing Cable

The key feature of the NS Heat Mat is the ability to heat the surface of the mat to melt ice and snow. To create this function, we decided to use a premade de-icing cable due to time constraints and the limitation of the team's knowledge. This cable was threaded through the opening of the dovetail connection and wrapped around the support columns with the mat as seen in Figure X. To power this cable, one end of it was connected to a smart plug that was plugged into an outlet. This way the user can control the power to de-icing the cable using an app as mentioned in *Section 4.3.2 Automation.*

4.3.2 Automation

In the future, there is the possibility that a user may purchase multiple mats and use them to cover a wide region of space. Due to that, it was important that the design of the mat needed to include an automation feature that would allow the user to remotely control each mat, so they wouldn't have to walk to each mat and individually turn them on. This feature was implemented using a smart plug as seen in Figure 8 and Figure 9. It would simply allow the user to use a mobile app to turn on/off the mat remotely or even set up a timer or schedule for when the de-icing cable within the mat should function. Please refer to *Section 3.3 and 3.4* for more details on how to set up and use this feature.

Figure 8: Smart Socket SP10 by TECKIN

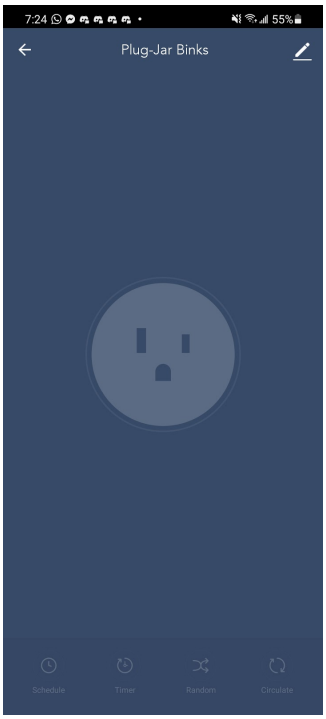

Figure 9: Mobile Application used to control the SP10

4.4 Maintenance

4.4.1 Access to internal components

An important need to cover in the design of the mat was the ability to easily repair the mat if needed. Unlike heated sidewalks in the current market, where if it breaks you need to replace the entire unit, the NS Heat Mat allows maintenance crews easy access for repair which will save the user money in the long run. To access the internal components for repair, simply lift the top layer made out of wood to be able to replace, fix, move, etc the internal components. The opening function was created using two hinges on the surface of the mat as seen in Figure 6. The hinges allow the top layer of the mat to be swung open if needed as seen in Figure 10.

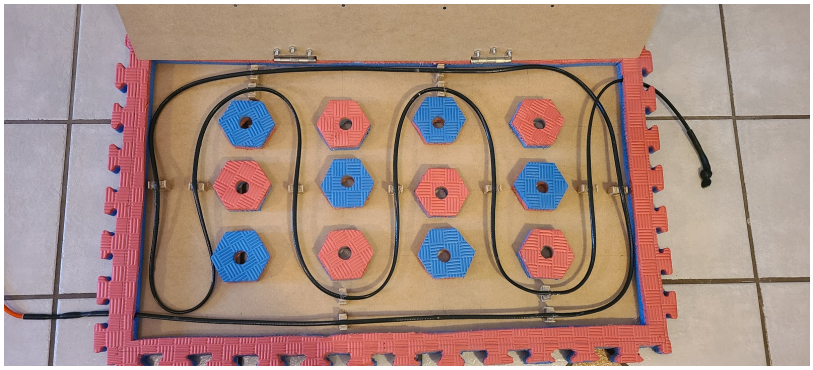

Figure 10: Internal view of NS Heat Mat

4.4.2 Support Columns

Similar to the hinge design, the creation of the support columns was to provide maintenance crews with the ability to replace the heating cable if needed. The common industry practice when it comes to modular heated sidewalks was to permanently fix the heating cable using either industrial staples, cement or other permanent binding methods. Our design focused on being a low-cost alternative, which meant having the ability to replace specific components if they were to break instead of replacing the entire unit. Since the heating cable was the main component of our design, we needed to ensure that regardless of the rest of the components if the cable were to ever get damaged that the maintenance crew would be able to remove the wire and either repair or replace it. Thus we came up with the support column method to bind the wire in place.

The columns were made using the same rubber mat material as the dovetail connections around the edge of the mat and were cut down into hexagonal shapes seen in Figure 6. These columns were placed in three rows inside the mat, where each row contained four hexagonal supports.

The support columns not only aided with evenly distributing the weight of users walking over the mat but also helped hold the wire in place. Since the wire is loosely bound by these support columns if ever needed the maintenance crew can just unwind the wire from the columns and remove it from the mat.

5 Troubleshooting & Support

5.1 Error Messages or Behaviors

Some error behaviours that the mat might exhibit could be things such as leaking water into the mats internal machinery, sparking from the outlet on the side of the mat, snow or ice not melting, the mat sinking in on itself or the mats not joining together. Some troubleshooting that can be carried out for these issues are checking the mat for openings caused by wear and tear for any physical/mechanical issues; issues such as the leaking water can lead into the sparking outlet. Troubleshooting for the issue of mats not melting ice and snow can be done by checking whether there is electricity running through the cables or by connecting a control variable device to the outlet used by the mats to narrow down the possible cause of the issue. The issues of the mats joining or the mat sinking into itself can be caused by denting or by the weight of the people of items crossing over the mat.

5.2 Special Considerations

When handling the mats make sure that the mats are not hot so as not to get a burn since the mats could be too hot for bare skin.

5.3 Maintenance

Some regular maintenance that could be done is checking to make sure that the cables are still all conducting electricity thereby heating the mats. Making sure that the mat lock is working and secured so that nobody can open them without the proper key. Finally, the mats internals should be checked to make sure that there isn't any serious water leaking.

5.4 Support

For any issues with the heat mat that can not be solved by an on-scene electrician, contact our team for help.

6 Product Documentation

6.1 Physical Prototype

6.1.1 BOM

Table 2. Bill of materials for the NS Heat Mat

Material	Quantity	Unit Cost ($CAD)	Cost ($CAD)	Link
Gym Mat	2	Previously owned	$0	
Hardboard	2	$5.44	$10.88	https://www.homedepot.ca/product/alexandria-moulding-standard-hardboard-panel-1-8-inches-x-24-inches-x-48-inches/1000132234
Hinges	2	$2.77	$5.54	https://www.homedepot.ca/product/everbilt-3-inch-satin-nickel-door-hinge/1000769448
Deicing Wire (6 ft)	1	$28.99	$28.99	https://www.amazon.ca/6-feet-Heating-Cable-Built-Thermostat/dp/B01GZJJ7MG/ref=sr_1_8?dchild=1&keywords=heating%2Bwire&qid=1615163986&sr=8-8&th=1
Smart Plug	1	$19.99	$19.99	https://www.amazon.ca/Wireless-Compatible-TECKIN-Function-Required/dp/B07FQMVW45/ref=sr_1_5?dchild=1&keywords=smart+plug&qid=1615852920&sr=8-5

⅛-7”x¾” Flat Head Wood Screw	8	Previously owned	$0	
¼-20x¾ Round Head Bolt and Nut	10	Previously owned	$0	
Total Cost After Taxes:				$73.90

6.1.2 Equipment list

To be able to build the prototype, the following list of equipment will be needed:

- Drill
- ¼” and 7⁄64” Drill Bits
- 1” Spade Bit
- Exacto Knife
- Reciprocating Saw
- Hot Glue Gun
- Marker, Pen, or Pencil
- Robertson Screwdriver or Drill Bit
- Locking Pliers

- Low-grit Sandpaper

6.1.3 Instructions

To start making the prototype, all the necessary preparations must be completed. Firstly, one of the gym mats needs to be trimmed down to the correct dimensions. By using the second mat, a row of dovetails was traced onto the mat that will be cut so that the dimensions at the base of the connections are 100 cm by 60 cm. Then, a rectangle was traced out 2.5 cm from the base of the dovetails, and the interior was cut out. Both of the mentioned cuts were made using an exacto knife. With the excess material from the mat, trace 12 hexagons, each with a side length of 2 cm. These will be the supports for the heating mat. As for the top and bottom covers, sketch a rectangle defined with a length of 95 cm and a width of 55cm on both pieces of hardboard; cut them out with the reciprocating saw. The final piece that needs to be cut out is the studs used to raise the deicing wire; to prep, cut out 90 2 cm by 1 cm rectangles out of the extra hardboard. Use the sandpaper to smooth out any crooked cuts as all of the materials were cut free-handed.

To start the assembly, the case was constructed first. To do so, 8 ⁷⁄₆₄” clearance holes were made; 4 in each of the corners and 4 at the midpoints of each of the sides, all of which are made about 1 cm away from the edge. This clearance hole will allow the wood screw to go through the board and catch onto it with its threads without cracking the wood as it pushes aside the fibres in the material. Align the bottom cover to the hollowed-out gym mat with the dovetails, and use the

screws to secure it in place. Note that because the mat is made out of flexible rubber, a clearance hole is not needed as the screws will not cause any cracks in it.

Next, a grid was made dividing the interior of the prototype into a 3x4 grid (evenly spaced). At each of these vertices, use some hot glue to secure each column to each of the vertices. Add some hot glue to and gaps in the edges of the mat that may appear. Next, use the 1” spade bit to create a hole in two opposite corners of the mat walls; this is where the cable will be fed through. The most effective way to create a clean hole without ripping off too much rubber is to use high speed on the drill while applying low pressure. To finish the external casing subsystem, place both hinges 30 cm away from each side of the edge; trace them out and remove a 5 mm layer of material from the mat where the hinge will rest. If the hinge will obstruct or interfere with the dovetails when doing so, make adjustments as necessary. Once completed, mark out where the holes of the hinge will be on the mat and top cover, and use the ¼” drill bit to make holes for the nuts and bolt. For each hinge, three bolts will hold the hardboard and 2 others will hold the hinge to the mat.

Moving onto the internal subsystem, mark holes on the top cover where they align roughly with the centre of each column and drill a ¼” hole through the columns, top and bottom plates. Use the sandpaper to clean out any rough surfaces made from the drill. Afterwards, use the spade bit to make a 1” through only the columns and bottom cover. Doing this will allow for a minimum amount of melted ice and snow to seep through any potential cracks between the top cover and the columns, as well as avoid the creation of a tripping hazard.

To build a single standoff, 5-6 of the 2 by 1 cm pieces of hardboards will be used. Using sandpaper to adjust the size by minuscule amounts, use hot glue to create the formation shown in figure 10 below. Depending on if there is a kink in the wire, an extra piece of wood used to make the standoff can be added under the support if needed. Once completed, feed the de-icing cable through one of the holes in the walls of the mat that was previously created. Following the layout, as seen in figure 9, use hot glue to hold the standoffs and the wire in place. The standoffs should align with the grid that was made to mark where the centres of the columns will be. Once the wire is secured and the end is fed out through the second hole, the prototype is completed and ready for use.

Figure 11: Standoff holding up the de-icing wire

6.2 CAD Drawing

6.2.1 Equipment List

For the CAD drawing Onshape's AutoCAD was first used for the 3D model but then migrated to AutoDesk AutoCAD 2021 version for the 2D CAD drawing

6.2.2 Instructions

For the 3D drawing on Onshape's AutoCAD software the 2D drawing of the base of the mat is made including the dovetails and all, after which the extrude tool is used to stretch the 2D drawing in the z axis. then hollowing out the 3D model for the internal subsystems using the shell tool; then inside of the hollowed out space draw the hexagon supports, and then extruding those 2D drawings of hexagons to reach a little less than the height of the top of the mat. After which you hollow out a drainage hole on the supports by drawing a circle on the top of each of the supports and hollowing it out with the extrude tool.

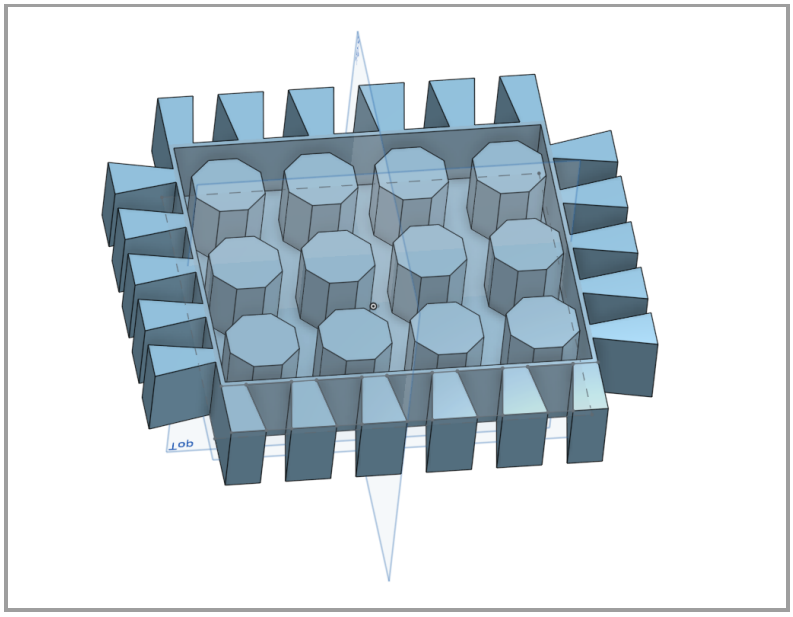

Figure 12: 3D AutoCAD finalized rendering

For the 2D drawing of the model on the AutoDesk AutoCAD the drawing was created using the basic shape and line tools in the software, with the dimension tool helping readjust the drawing in accordance with the dimensions acquired from the physical model. While also changing the color of specific parts of the drawing in order to distinguish the wiring, non-visible aspects of the design (on the bottom of the mat) and the mat and dovetails itselves.

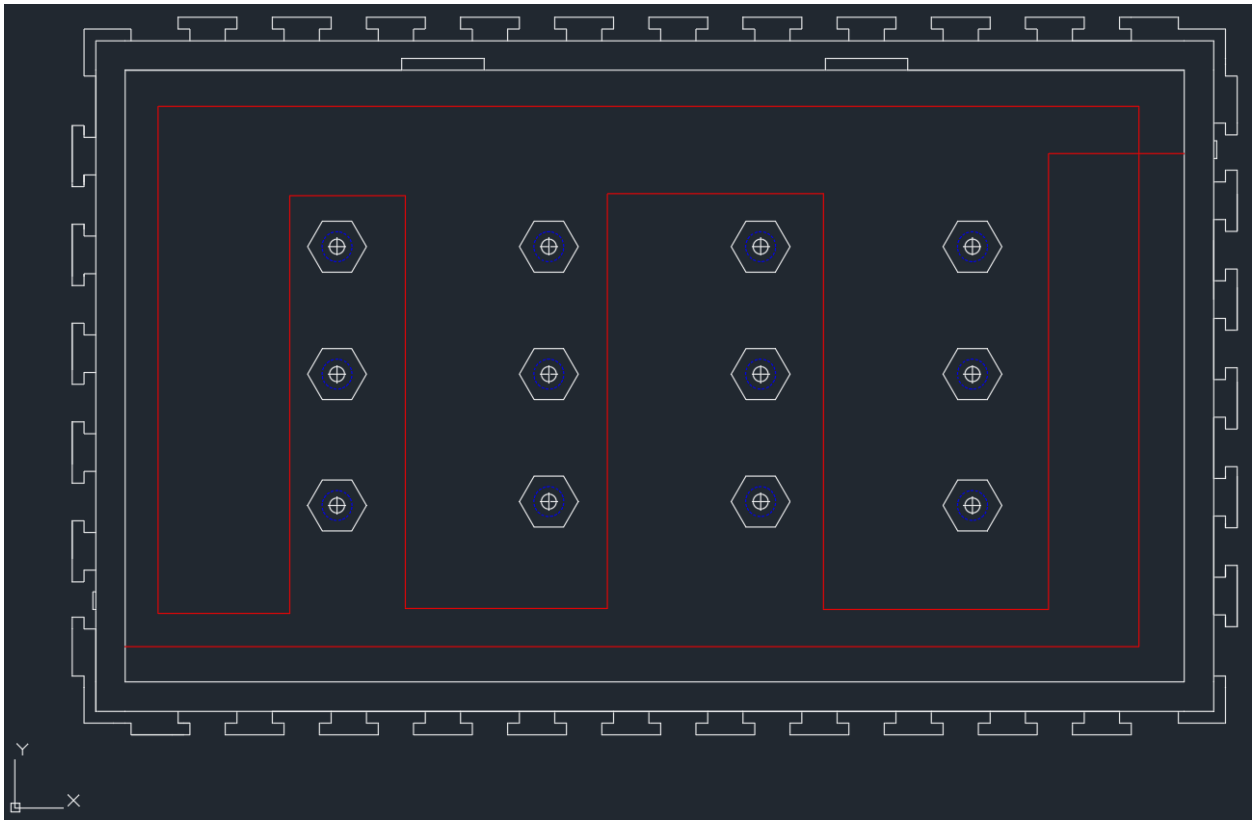

Figure 13: 2D AutoDesk CAD drawing finalized version

6.3 Testing & Validation

- weight testing
    - i just stood on it with my brother in law, so talk about that and just say i used other objects and how it can hold over 400 pounds
- ice melting
    - for control group

        - It is just some hardboard on the floor so that the ice cube is on a surface as the mat so that both cubes undergo heat transfer with the same material
    - for experimental
        - needed to submerge the temperature sensor in the wire so that it reads below 3 degrees and will turn on
        - time lapse was for an hour and 10 minutes
        - ice on the mat melted about twice as fast as the control group

After a series of tests on the final design, we got a series of satisfactory and reliable results. First of all, for the weight capacity problem that the customer is worried about, several experiments were conducted to test how much weight the mat can support. To do so, 2 people had stood on the mat while holding a variety of objects to see if standing on the mat can fully guarantee their safety. Through these tests, it was found that the module was able to hold over 400 pounds with very minimal flexing. Finally, regarding the most critical aspect of the entire design, the ability to melt ice was tested. To prepare the test, a control group was set aside; this group consisted of an ice cube melting on a regular piece of hardboard. As for the experimental group, an ice cube of the same volume was placed on the heated mat. This was done so that there can be a comparison between how well the heat transfers into the ice while maintaining a constant heat transfer factor (same material and same thickness). By the end of the test, the design showed that it is able to heat up the ice cube significantly faster than the control group when the ice cubes are placed at the same time. After about an hour, the experimental ice cube melted completely in

about an hour, and the melting rate was much faster than that of the control group as it had only melted about half of the ice cube.

7 Conclusions and Recommendations for Future Work

In order to reduce mistakes and clarify what is desired, plans were made from the very beginning of the project: not only were problems considered from the perspective of the designers, but also from the customer's perspective, such as the acceptable cost range or the size of sidewalks. It is also enforced that members of team Not Salt constantly urge each other to free up time to correct mistakes in the design process. Tasks were begun early and were actively discussed on a regular basis to ensure that all team members were successful in their work, contributing to a positive and functional working environment. It was always possible to deliver our results on time and get constructive feedback on the work produced.

Accounting for the scope of the entire design, there are still some areas where actions could have been clearer and more reasonable in nature, and should be adjusted in the future. Regarding the junction box, there is an important question. It can be seen from the physical drawing that the wires of the prototype are not fixed and have a risk of becoming tangled. The connectors are scattered about haphazardly on the inside of the prototype, which can easily cause damage to the wires or even leakage into the inner workings of the mat. A dedicated junction box is necessary to store the wiring as best as possible, so that this threat is more safely averted. For example, a box of proper size and appropriate amounts of insulation would be useful to prevent the wires from experiencing external friction, and avoid potentially damaging scenarios. In addition, to prevent rain and other liquids from corroding the mat, extend the service life of the

mat,and maintain the quality of the design, waterproofing would be essential for the outer shell of the mat, since the mat will almost always experience erosive forces from water drainage.

APPENDICES

8 APPENDIX I: Design Files

This document is an overview of the previous deliverables during the duration of this course. For more information about our design steps and why certain decisions were made please visit our MakerRepo: https://makerepo.com/PaulMacIver/823.not-salt and look through the project files as listed in Table 3.

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Deliverable A	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc1V3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--39287a6b6a9a4715f9aa36353dff80ce78d1042b/Deliverable%20A.pdf	2021-04-14
Deliverable B	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc1l3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--a64f43de9ef05	2021-04-14

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Deliverable C	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc2N3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--335a530b3eab1c940da38c4f044a68b4417cf97a/Deliverable%20C.pdf	2021-04-14
Deliverable D	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc2d3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--1c4f51cdfab8b8f63a7686d343d9489636eb868c/Deliverable%20D.pdf	2021-04-14
Deliverable E	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc2t3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--53791aa8fe5edadcfbe00c23c66d1bd2343a7570/Deliverable%20E.pdf	2021-04-14

Deliverable F	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc293IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--0400d5bf5ee86a7f3b5872318684c68cba2f76b0/Deliverable%20F.pdf	2021-04-14
Deliverable G	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc3N3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--82607b5cf5360284caf072f94b55df65e3c9395b/Deliverable%20G.pdf	2021-04-14
Deliverable H	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBc3d3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--92a5d1410d0887238104a1f543f21fdf9e5f1304/Deliverable%20H.pdf	2021-04-14
Deliverable I	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBczB3IiwiZXhwIjpudWxsLC	2021-04-14

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Deliverable J	https://makerepo.com/rails/active_storage/blobs/eyJfcmFpbHMiOnsibWVzc2FnZSI6IkJBaHBBczR3IiwiZXhwIjpudWxsLCJwdXIiOiJibG9iX2lkIn19--2168c7df31b7c529b4b60bc0b43aedf7953402e7/Deliverable%20J.pdf	2021-04-14