Mobile Parklet Design in Northampton

Northampton Office of Planning and Sustainability

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Design Clinic Final Project Report

Executive Summary

This report details a capstone project for the siting, design, and evaluation of a mobile parklet sponsored by the Northampton Office of Planning and Sustainability (NOPS) as part of a larger program to rehabilitate Northampton, MA. Following the growing parklet movement, cities across the world are using the concept of small public multi-purpose parks to make urban areas more dynamic, attractive, and modern. Whether as sidewalk extensions or in unused alleys, parklets are known to enhance the streetscape and improve the urban design of the given neighborhood.

The student team focused on the modification and transformation of the a recently purchased parklet platform, manufactured by Dero, into a modular mobile parklet to be placed in different locations in Northampton. This transportable parklet will provide a tool for the evaluation of parklet performances in Northampton and will potentially be used as a service paired with local businesses.

Through a collaboration between engineering and architecture students, the project resulted in a proposed final design of the mobile parklet, including reinforcements and wheel engineering designs, accessibility and safety modifications, furniture conceptual designs, as well as implementation logistics, such as cost and siting. The development process began with an evaluation of existing parklet practices and an exploration of the scope of the project, leading into the conceptualization and realization of various key aspects of the mobile parklet. The examination of similar city initiatives and public installation projects allowed the team to define requirements and considerations, with an emphasis on accessibility, mobility, adjustability, safety, and public work constraints. After gathering feedback from the local community through a public exhibit, the team refined and finalized a concrete solution proposal to NOPS for implementing a mobile parklet. This final design proposal includes three main features: the fabrication and testing of custom-made wheels, a thorough compilation of themed layout designs and modular furniture, and a list of three selected locations based on slope analysis and strategic business positions, all documented in a public interactive map. The report also discusses future developments and potential impact of the project.

Acknowledgements

We would like to extend our gratitude to our liaisons Wayne Feiden, the Director of the Northampton Office of Planning and Sustainability and Carolyn Misch, Senior Land Use Planner, for making such a partnership and multi-disciplinary project available to us. You have been supportive contacts for the team throughout the year, helping us work through the project and providing us with information and resources at each step of the process. Thank you to the Northampton DPW, specifically David Veleta and Rich Parasiliti. You were a significant help to us as we struggled to understand the Dero structure and the nuances of its stability and mobility. Thank you to Eric and Dale in the Smith College CDF for helping us complete the fabrication of our Dero model and wheel prototype, both crucial pieces of the project which we would not have been able to do without you. Our shadow team, Youyou Tian, Katie Osterlund, Maureen Leonard, and Samantha Muchongwe, was essential for taking the time to sit with us during the three major stages of our project to understand and help us improve our understanding to lead us in the right direction. Thank you to the LSS 389 Fall 2016 class, it was a pleasure collaborating with you. To Reid Bertone-Johnson, Landscape Studies Associate Professor, thank you for advising our team and navigating the collaboration with LSS, you were a great help to the team. Finally, we would like to thank Design Clinic Professor and team advisor Susannah Howe. You were an inspiration to our team from the beginning to the end and we value the help you gave us throughout. We would not have been able to do it without you, thank you.

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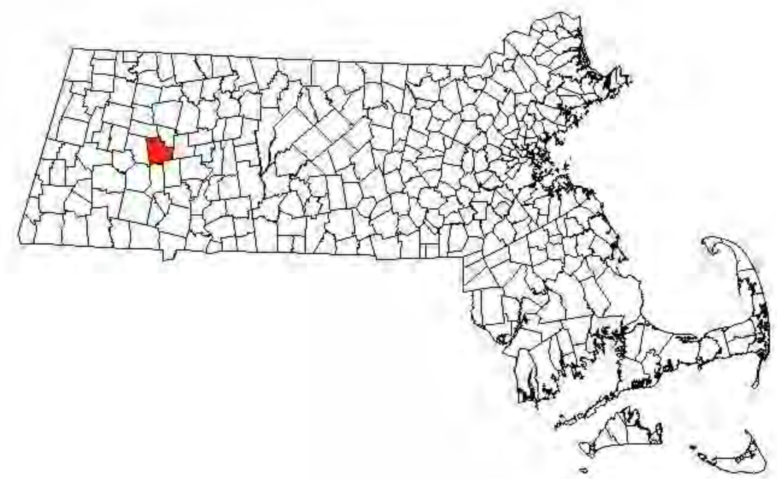
1) Introduction

Parklets, or small public parks, are a recent phenomenon rooted in design of public space and urban planning. They involve the transformation of underused urban spaces and roads into places where community members have the ability to relax and engage in public life. Parklet projects are rapidly spreading across the nation and the desire to facilitate their development is gradually growing [1]. This desire to leverage residual spaces into active urban parks is part of a social movement to reclaim and rehabilitate cities. As part of this effort, the Northampton Office of Planning and Sustainability (NOPS) has involved itself in Pavement to Parks' program identified by the *Open Space, Recreation, and Multiuse Plan* [2] by aiming to create parklets in various locations in Northampton, shown in Fig. 1.



[Fig.1] Map of Massachusetts with Northampton in red

NOPS has recently purchased a platform (see Figure 2) from Dero, a company that sells parklets and bicycle parking structures, to be extended and transformed into a functioning mobile parklet [3]. The outcome of this project involves the evaluation and design of a mobile and modified Dero parklet, first at the entrance of the Cracker Barrell Alley (Figure 3), and then in selected locations across town. The proposed designs and modifications for the temporary parklet will serve as a framework for building other new parklets locally.

[Fig. 2] Picture of Dero Platform from the Dero website

[Fig. 3] Aerial view of Main St, Northampton with Cracker Barrel Alley location starred

The final deliverables of the project are divided into three parts: the mobility of the Dero platform, designs of upper layouts of the parklet, and proposed siting locations of where the Dero should be placed in Northampton, Massachusetts. The project is an interdisciplinary collaboration of engineering Design Clinic students, landscape studies students, and architecture majors in order to explore urban spaces through environmental and socially engaging parklets in the City of Northampton. Through a process of problem scoping, concept generation, feedback collection and research, the project expanded into a detailed mobile parklet development proposal for the Northampton Office of Planning and Sustainability.

2) Background and Motivation

In the past few years, parklets have started appearing in cities around the United States and around the world. What started in San Francisco as a way to reduce pedestrian sidewalk congestion and bring creative spaces to the city has turned into the most recent trend in urban design [4]. From extra outdoor seating to interactive game spaces, these parklets have been on the cusp of innovative urban rethinking, and spreading quickly. They add something new and unique to the area, as well as offer more space for community bonding and relaxation. An example of a parklet design from Boston is shown in Figure 4, and more can be found in Appendix A.

[Fig. 4] Example parklet in Boston, MA

Downtown Northampton is often full of community members walking around, shopping, grabbing a cup of coffee with friends, and exploring the ever-changing area and all it has to offer. The town has many unique stores and shopping centers for community members, as well as events like farmer's markets and holiday strolls to invite people to spend time in the downtown area (see Fig. 5 for an example of one of Northampton's well-known destinations). It is considered "a place of activists, artists, intellectuals and rainbows" [5] and there are constantly elements being added to make it even more of a unique place. NOPS is seeking ways to improve the downtown dynamic further and make it even more welcoming. The recently purchased parklet platform, which NOPS hopes to transform into a mobile parklet, will be deployed to different locations on Main Street. Designs for what will furnish the parklet will also vary based on intended use for specific locations. The project is part of a larger, *Open Space, Recreation and Multiuse Plan* [2] in Northampton, in which there are initiatives to improve many of the elements of downtown structure, such as reworking the parking layout and looking into adding bike lanes. Two mock-up parklets were tested in June 2016 as part of a Complete Streets Demonstration Day, as shown in Figure 6. Later, in October 2016, the Dero platform was temporarily sited at the entrance to Crackerbarrel Alley. The positive feedback from the community led to the decision to move forward with a further implementation of the Dero parklet, which will include having it stay up for longer and having the implementation be more thoroughly planned than the implementation in June 2016. We are hoping to create a new element to the town that people can continually enjoy, while making Northampton even more of a unique place and adding more excitement to the area. This project aims to take the Dero base structure, hereafter referred to as the "Dero," and improve it in various ways to make the process of "platform to parklet" easier and more accessible to many people, as well as designing innovative, interactive elements for the actual parklet layout, and creating maps of ideal locations for the Dero to help the city with its siting.

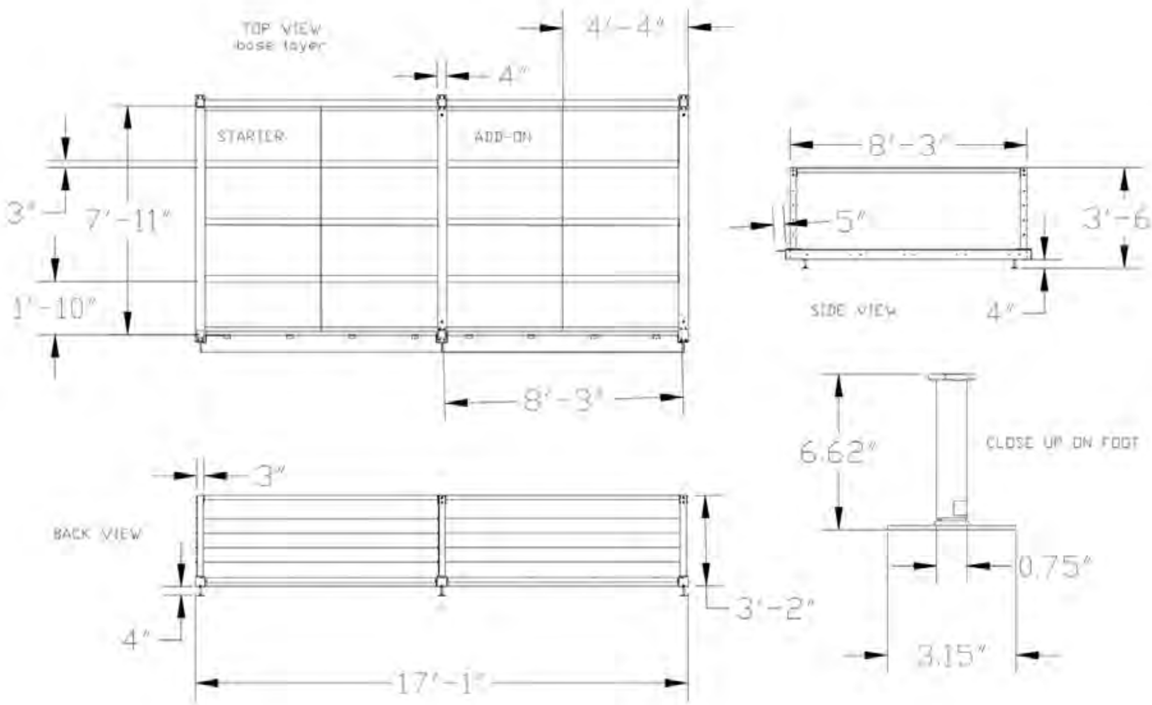
[Fig. 5] Picture of Northampton's most well known indoor marketplace, an example of the unique qualities of the town

[Fig. 6] Example mock-up parklet during Complete Streets Demonstration Day

3) Stakeholder Needs and Design Requirements

In order to address the proper questions for the development of a mobile parklet, the team considered the primary stakeholders for the project: the Northampton Office of Planning and Sustainability, the Northampton Department of Public Works, the community members, downtown businesses, and any engineers or construction workers who may end up working with the parklet in the future. The needs of these stakeholders were identified and documented so as to fully understand the goals and objectives of this project. Research on existing requirements [6] and a meeting with Northampton's Department of Public Works (DPW) helped us summarize these requirements in a Traceability Matrix [see Appendix B] [7]. Several design requirements and criteria were based on existing San Francisco DPW parklet implementation guidelines [8], which were approved by the Northampton DPW as suitable rules to follow.

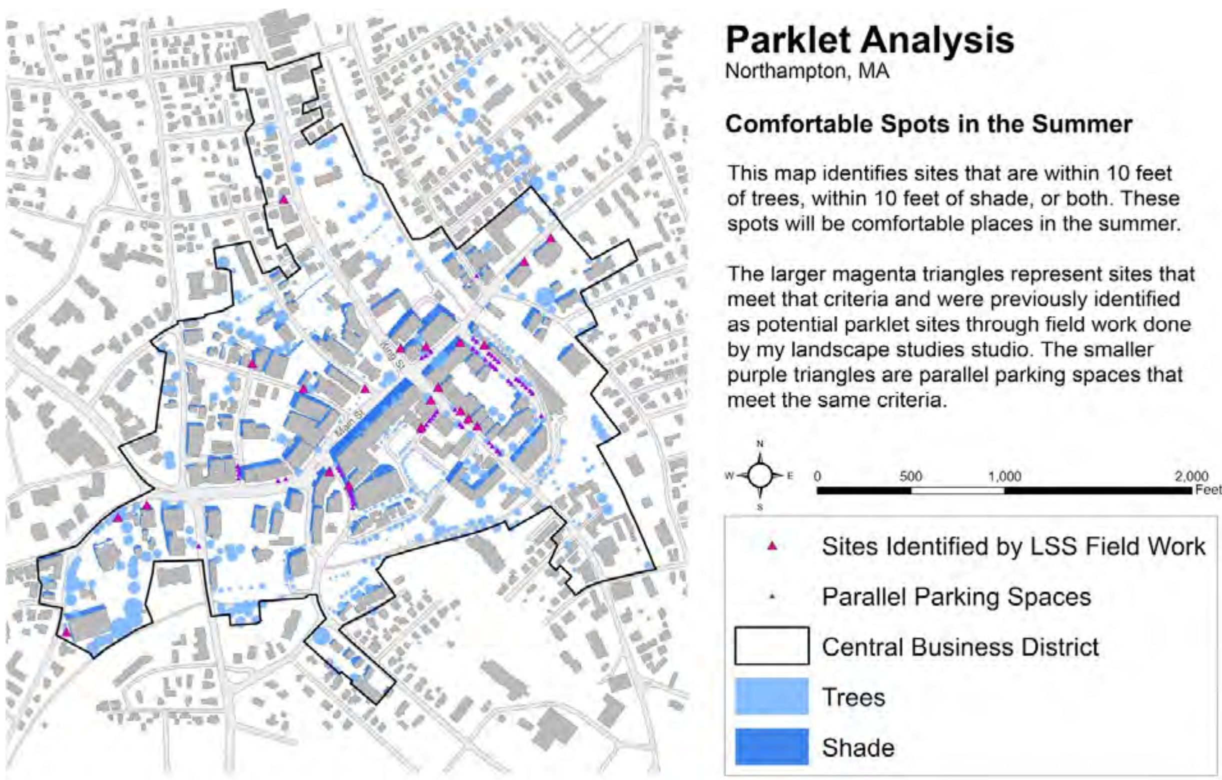
There are two categories of stakeholder needs, those which result in design requirements and those which result in design considerations. The stakeholder needs that have design requirements associated with them are crucial either because they are set by regulations, they are part of the project definition, or they are standards of safety. The first design requirement is *adjustability.* The Dero must be able to raise and lower to meet the height of any curb or to be flush with the ground. In addition, it must have proper *drainage,* to assure the parklet does not get flooded during a rainstorm. *Accessibility* is also a main stakeholder need. This has two aspects to it. The wheelchair accessibility aspect dictates that the parklet must be accessible to any person who wants to use it. This is currently not true for the Dero base, for the ramp on it is currently steeper than the standard angle required by the ADA when no curb is present. The other aspect is accessibility to surroundings. The locations chosen for the Dero should not conflict with surrounding businesses or surrounding utilities (i.e. access to fire hydrants, bus lanes, etc). Another main need is to have a *sturdy, stable base*. The base is the most important part of any parklet design we create. We have engineered the base to be level on any surface, and easily taken apart or moved. Using the dimensions of the base from the CAD files we created (see Figure 7) and the given base materials, we were able to determine a proposed loading scenario and calculate the needed strength to be safe.



[Fig. 7] CAD model of the parklet's structural elements

Mobility is another essential aspect. During the problem scoping phase, we met with our liaisons at NOPS and together decided that one of the main project components would be to design a mobile park, thus making the assessment of many more permanent parklet spots feasible. The Dero should be moved around easily to different locations throughout town. Currently it requires complete disassembly or a crane to change locations, a heavily DPW-involved process. We hope to allow the platform to be moved via the roadways, including wheels that allow it to be towed from place to place. *Safety* is the final need we considered. The platform will most often be placed in one parallel parking space along the side of the main road. As the engineers on the project, we must make sure that if there were to be an accident with a car or other such vehicle running into the structure, the people there would be as safe from harm as possible within reasonable, foreseeable conflicts.

The stakeholder needs that have design considerations associated with them are elements of the parklet that are desirable but not crucial. *Modularity* is the first stakeholder need of this category. The parklets are being designed as temporary and are planned as designs that can be changed around depending on the area and time of year. They should be easily changed and moved so as to keep improving and incorporating new elements. Another consideration we have identified is for the parklet to be *aesthetically pleasing*. The parklet should not be an eyesore to the town, it should have a visual aesthetic that people are drawn to either by its offer of seating and comfort or for its factor of excitement. *Convenient location* is the final stakeholder need of this category. The multiple spots chosen for the Dero's course should all be in locations that are frequently visited by pedestrians and fit the parklet aesthetically. The LSS 389 (Landscape Studies) class conducted a site analysis on possible locations around Main St. Based on preliminary surveying, some location considerations are shown in Figure 8 [full analysis can be found in Section 4c].

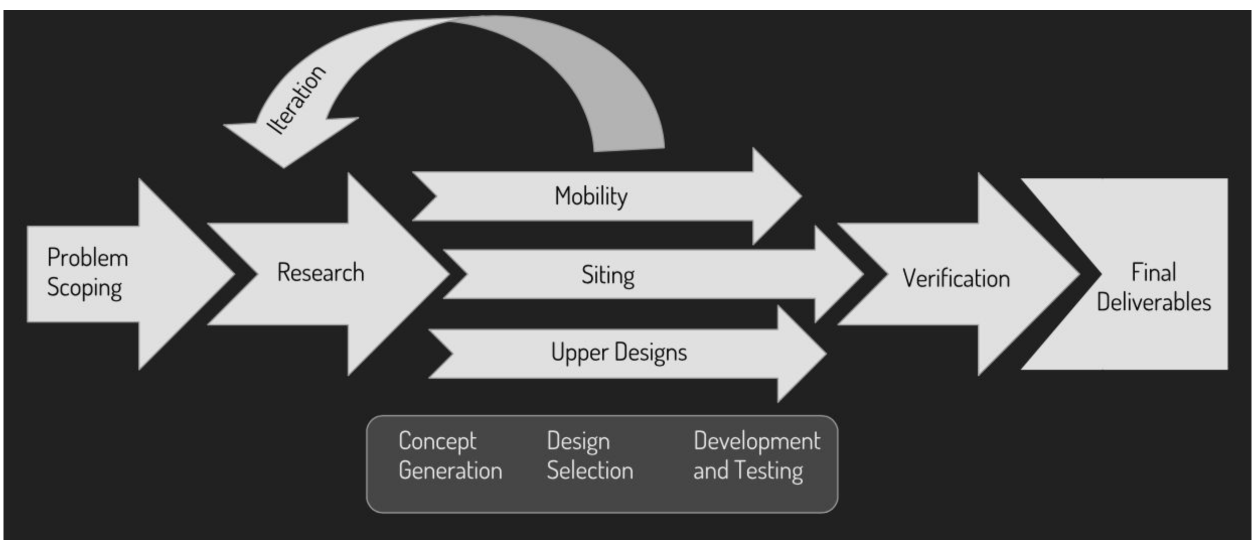


[Fig. 8] Preliminary mapping of possible Dero parklet sites from Fall Semester

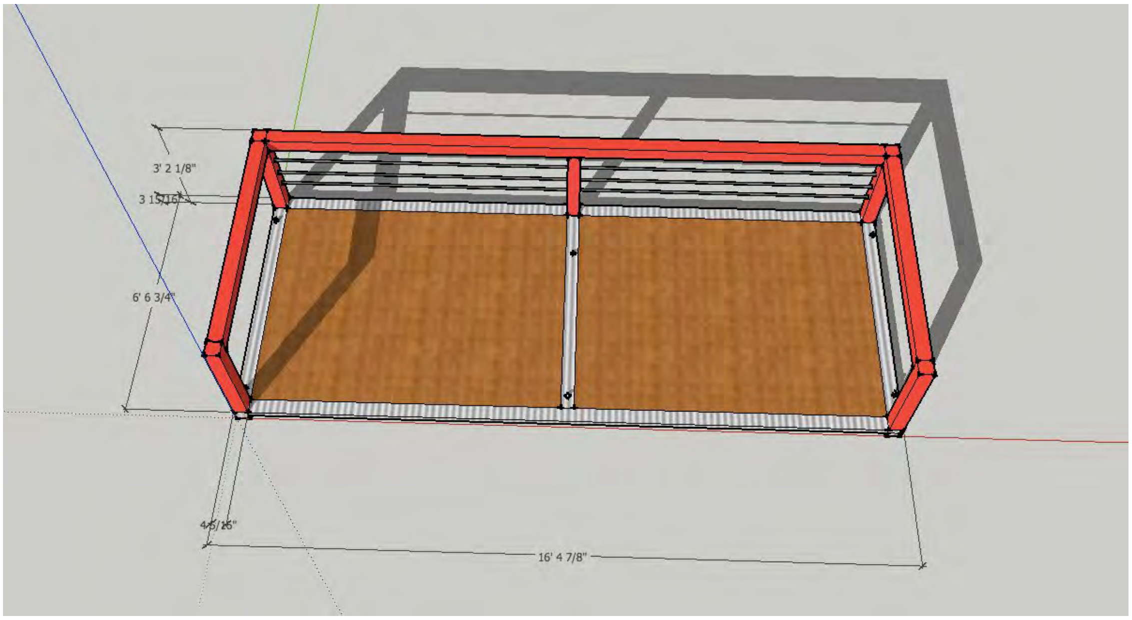
4) Design Development

The overall design process followed in this project included a number of key steps: problem scoping, research, concept generation, concept selection, development and verification (as seen in Fig. 9). The initial problem scoping phase allowed the team to define clear objectives and limits to the project. During this preliminary problem scoping phase, the team learned about dynamizing urban areas, and continuously communicated with NOPS, discussing goals for the project and determining a reasonable budget (see Appendix C, showing our final expenses which fell within this budget). The beginning of the fall semester was spent deciding the scope of the project and on which of the many elements the team was going to focus on. We decided on the Dero as our main objective and from there moved forward with the design process focused solely on the improvements and designs that concerned it. This process was supplemented with a thorough analysis of the base structure itself (initial base structure models shown in Figures 10 and 11) and it also helped the identification of stakeholders and design requirements. The Dero modifications and extensions were all based on the design requirements and selected solutions. With the structure of the base determined, the upper parklet designs and parklet siting could be developed.

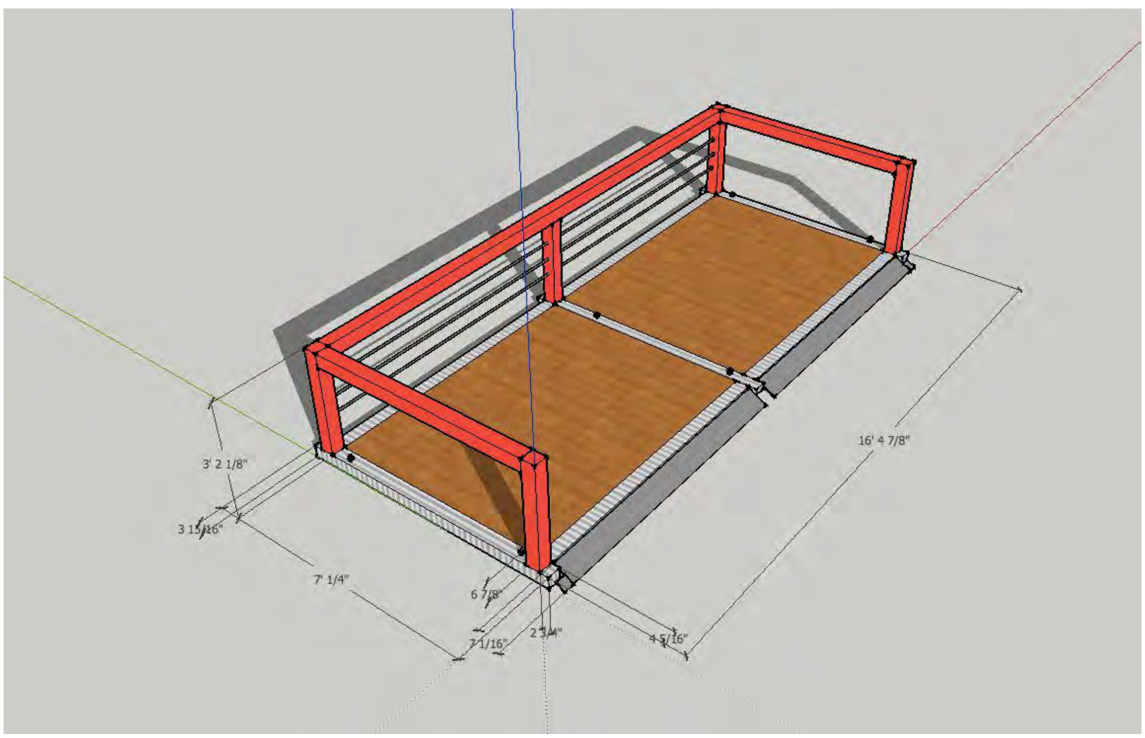
As we moved into the spring semester, the team pursued three concurrent design pathways. These included designing wheel attachments to make the structure mobile, designing themed and modular layouts for the furniture on top of the parklet, and using GIS mapping to site locations for the parklet in downtown Northampton. We integrated each of these processes by using the limits of mobility to determine possible locations the Dero can be pushed, as well as matching themed upper designs to the businesses identified in the siting. While this is the overarching progression, more thorough explanations of the process are described in each design process section below. In addition, Appendix D shows a Gantt chart listing the steps we followed for the entirety of the year as well as the expected time frame of each.



[Fig. 9] Design Process Flow Chart



[Fig. 10] Angled top view of Dero parklet conceptual model



[Fig. 11] Isometric view of Dero parklet conceptual model

4a) Mobility

The mobility process followed a linear progression from conceptualization to fabrication, with any iterations of design along the way. We worked our way from having a stationary parklet, to designing, testing and finalizing a method for mobility, as explained further below.

4.a.1 Mobility Conceptualization

After an initial problem scoping phase, the team affirmed the responsibility of developing and designing a mobile modular parklet, based on the Dero platform, for the evaluation of potential permanent parklets in various locations in downtown Northampton. The decision to make our parklet mobile in the fall dictated the heavily engineering portion of the design process. Throughout the fall we conducted research regarding existing mobile and temporary parklets to better inform the advancement of our project. In particular, we examined both mobility and modularity in precedent parklets, including shipping containers and movable furniture pieces. This research allowed us to understand what technologies have been used to mobilize parklets and how we could relate those techniques to our project. More information on this research can be found in Appendix E.

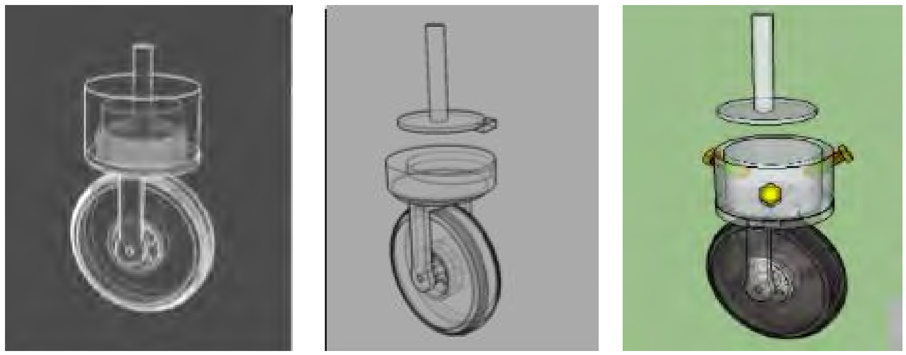
The concept generation phase consisted of producing a wide variety of ideas or concepts addressing particular issues or aspects (see Appendix F). Some of these topics include mobility and use of the parklet during the winter. During concept generation, we employed multiple ideation techniques, ranging from brainstorming to function tables.

We then applied a concept selection phase to the particular aspect of mobility, which is the central component of a mobile parklet. Through the use of concept screening and concept scoring, the suggestion to design a customized wheel mechanism for the Dero platform was chosen as the best solution to implement mobility and we decided to move forward with this design plan. We then performed a sensitivity analysis to evaluate the validity of the selection process. The full concept selection process and potential design solution outcomes for Dero the modifications are shown in Appendix G.

4.a.2 Mobility Design Selection Process

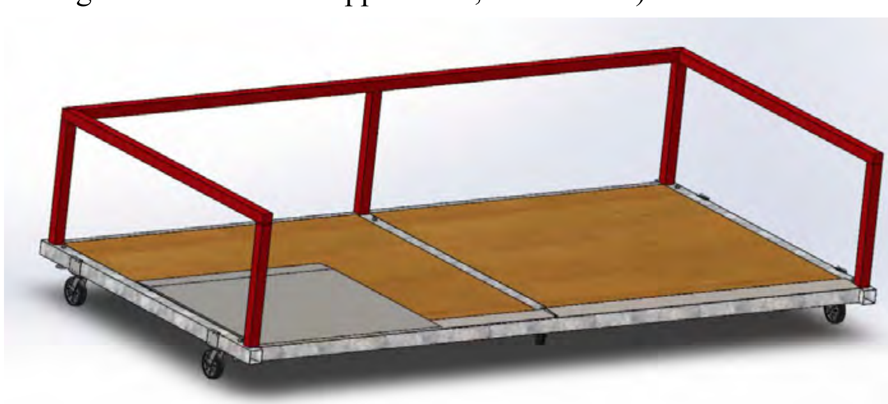
Through the concept selection phase, we came to conclusions for some of our design requirements. To implement accessibility, a ramp conforming to ADA regulations [9] will be added. In addition, we completed loading calculations (detailed in Appendix H) to assure stability. Finally, we established a deck gap as the drainage solution and additional feet will be purchased to provide full adjustability. A thorough explanation of the concept generation and selection process is shown in Appendices F and G.

Another mobility aspect determined through the concept selection was the design of wheels that specifically attach to the Dero. In the fall, we began to generate designs (see Figure 12) for wheels that would attach directly to the feet.

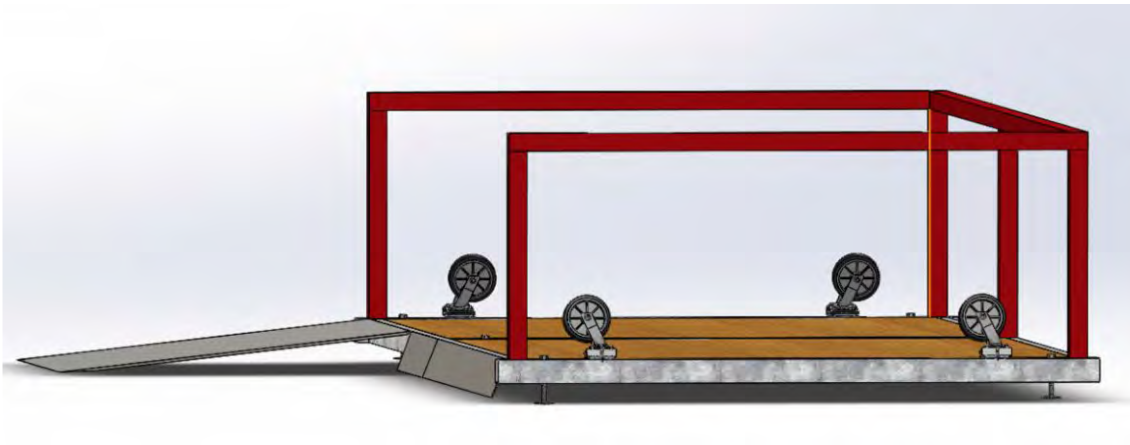


[Fig.12] Concept designs for wheel attachments to feet

After doing more research about regulations for towable structures on roads, we went through an iterative process of improving this design. The wheels we had been designing in the fall would not have been road-worthy when being towed by a car. Thus, we shifted the mode of mobility to a hand-pushable design with specialized wheel designs. Calculations of the weight of the Dero at different road slopes allowed us to determine that with the help of 5 or 6 people, the Dero can be pushed on the road on slopes of no more than 10 and 12 degrees, respectively (calculations shown in the Fabrication Guide, Appendix I). After meeting with our NOPS liaisons and getting this design approved, we moved forward with improving the wheel attachments. For the purposes of strength we decided on more heavy-duty wheels that would attach right onto the steel frame of the parklet. We continued improving our design through doing research on wheel designs of mobile structures and through meetings with the DPW and the CDF. Our final design includes a double-plated wheel attachment that can hinge up and down for easy assembly and disassembly with no storage, as shown in Fig. 13 and 14, below. (Interim versions of the design can be found in Appendix F, Section VI.)



[Fig.13] Wheels under steel beams for transportation of Dero



[Fig.14] Wheels hinged up for stationary Dero

4.a.3 Mobility Modeling, Fabrication and Testing

In order to document our design we modeled the wheel with its plates, hinges, pins, screws, etc. in Solidworks. This allowed us to refine the model until all dimensions fit around the desired 4x4” steel frame. Modeling the design in this way allowed us to find flaws in the initial design, for example the original surface-mount hinge connected to the bottom plate was in the way of the bolts attaching the wheel. Examples of the final model are shown in Figure 15 below and a thorough explanation of the design, its benefits, and installation requirements can be found in Appendix I.

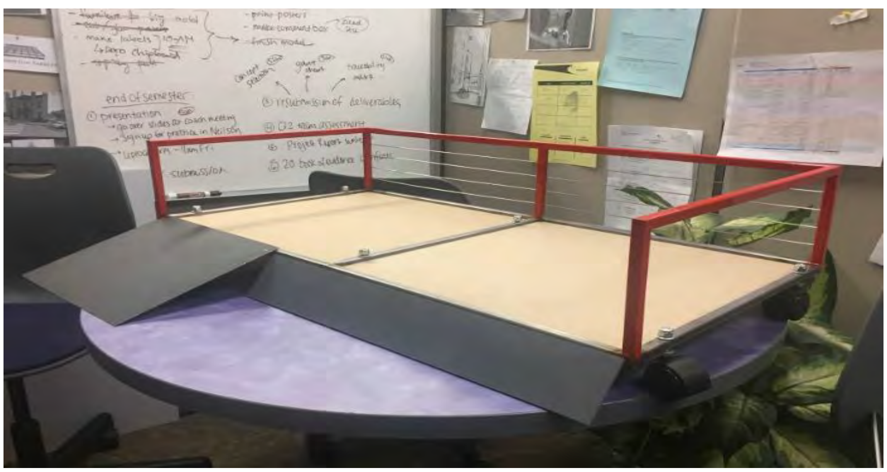
[Fig.15] Solidworks model of wheel, with hinge attachment to Dero on top and pin underneath

With drawings created from this model and parts we ordered from McMaster-Carr [10], we fabricated a prototype of the wheel design. The fabrication process allowed us to understand flaws in the design (such as the wrong selection of bolt) and allowed us to make more design modifications. Through fitting the model on the Dero parklet itself, we were able to see the the side plate needed to be elongated 0.2 in. Calculations of stress by hand and via Finite Element Analysis (FEA) verified that the design was strong enough to hold the maximum loading expected on it. With the revised design and updated Solidworks drawings, we were able to verify the final design for mobility: hand-wheeled transportation with a specialized wheel design made for this specific parklet. A more thorough description of the fabrication and testing process, with pictures of the prototype, calculations, fabrication drawings, and FEA results, can be found in the Fabrication Guide, Appendix I.

4b) Upper Design

Concurrently with the development of custom wheels, we worked through the design process for the upper layout of the parklet. The fall semester consisted of an initial design process for upper layouts (see Appendix J), while in the Spring, more in-depth themes were developed and proposed (see Appendix K). We used conceptual designs in SketchUp to generate, select, refine, and plan designs throughout the project. The main factors that we considered in designing each parklet included visual themes and layouts, technical aspects, materials, products to purchase or fabricate, ease of assembly and disassembly and cost.

In the Fall semester, a key piece of our design process involved a showcase of the parklet layouts at the APE Gallery in downtown Northampton, where we had the chance to talk with community members and receive feedback (see Appendix L), which we incorporated into further design developments. In the week leading up to the APE gallery, we fabricated a 1:6 scale model of the parklet (see Fig. 16).



[Fig. 16] 1:6 Scale model of Dero Parklet

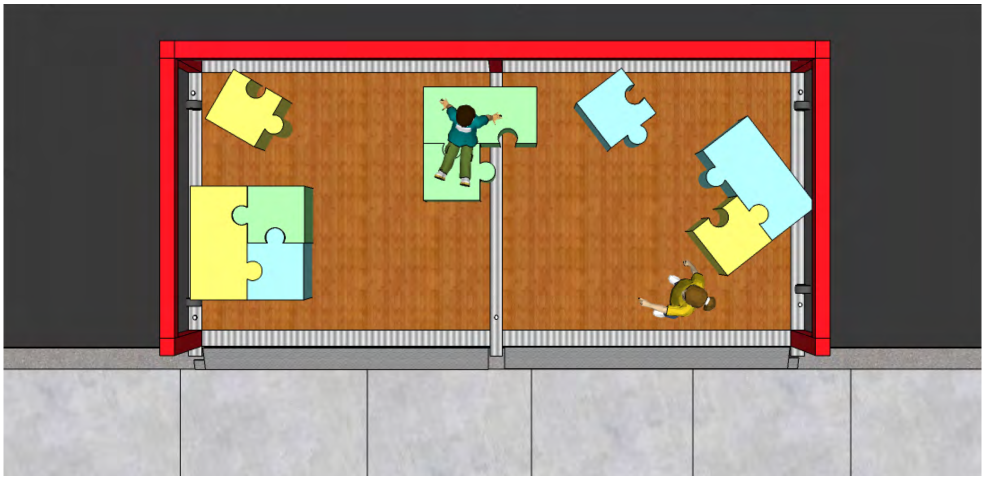
With the feedback from the APE Gallery in mind we chose four themes for the upper parklet designs to model in SketchUp and AutoCAD. The four themes were narrowed down from an extensive brainstorming list that was formed from the LSS Studio the previous semester and the Engineering team in the Spring. The four conceptual designs are ‘Sustainability,’ ‘Library,’ ‘Kid’s Corner,’ and an ‘Restaurant Extension’ (see Fig. 17). Each conceptual design of the Dero included considerations of accessibility, sustainability, urban outreach, and the needs of the City of Northampton.

[Fig. 17] SketchUp models of all four parklets

For the second half of the semester, research and design was completed on modular furniture for the Dero. The research identified other cities that have done similar projects as outreach programs. These innovative projects sparked ideas of what the modular components for the Dero could look like [See Appendix K]. When designing modules for the Dero, we had to keep in mind the placement of the wheels and how the design could help cover them so they would not be a tripping hazard or eyesore. Aspects of modularity we explored included boxes that hold pieces of furniture, pieces that are assembled or folded into various pieces of furniture, or set pieces that are then arranged into various shapes on the base of the Dero. These components are creative suggestions of what the furniture could be, and would require more thought and design when moving forward in the future.

We organized and presented our work at a critique in late March to collect feedback for the summary of the layout designs and mapping locations of this project. We presented hand drawings, images of precedents, and SketchUp interpretations at the critique to members of the NOPS team and a few students at Smith. The feedback we gained from the critique helped guide our continued design development and raised important conversation about the upper modular layouts such as maintenance and chance of theft.

Moving forward post-critique to the last part of the semester, we chose both a modular design to be developed further, as well as furniture similar to the tables and chairs in Pulaski Park that Northampton could purchase for the first iteration of the parklet. Focusing on colorful, identifiable units, the final modular Dero design features set blocks that can be easily moved in various arrangements. The modules are large tetris pieces and puzzle pieces that can easily be stored on a bike trailer, and light enough to be placed and arranged on the Dero by hand (see Fig. 18). Appendix K summarizes the work completed the Spring semester and provides suggestions to what the City of Northampton can do next, including furniture that they can purchase immediately, and designs that they can pursue for future development of the Dero.

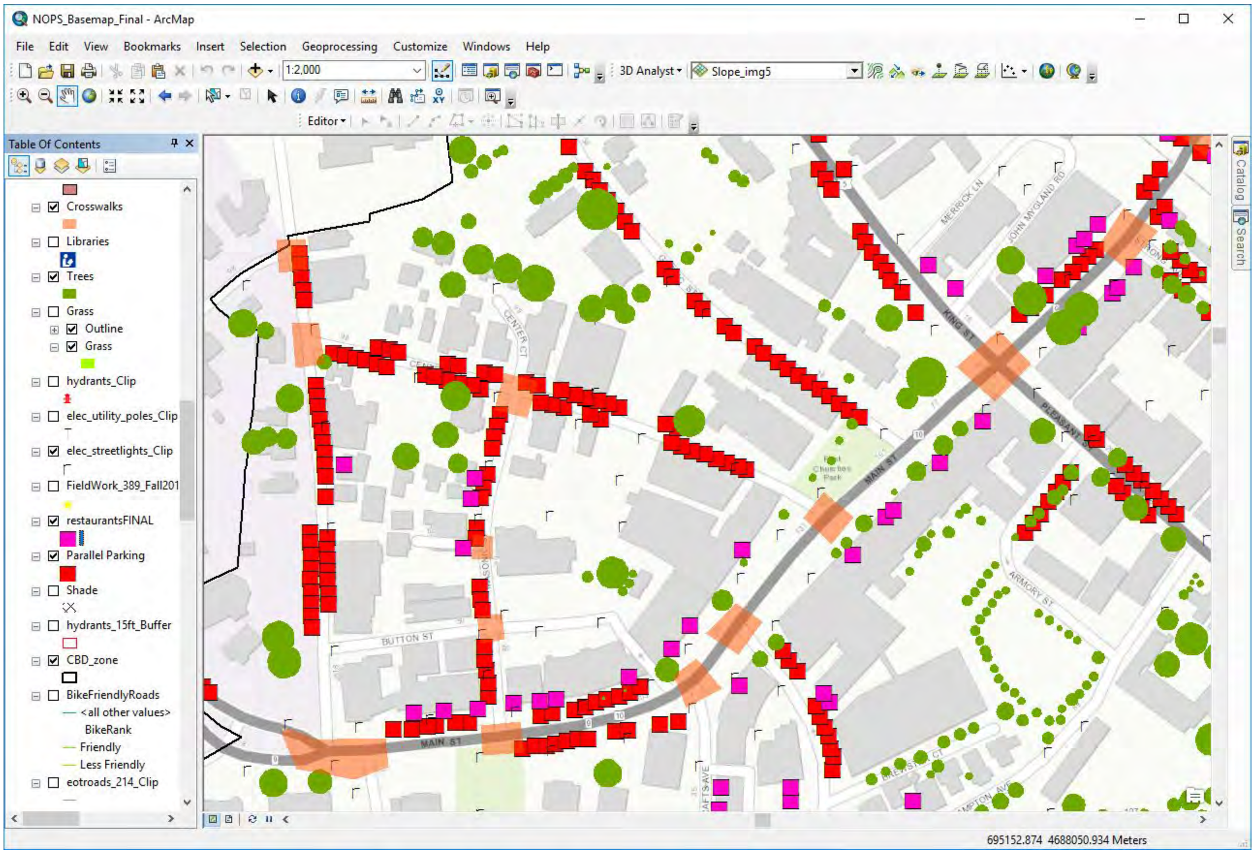


[Fig. 18] SketchUp model of a modular 'puzzle piece' parklet

4c) Siting

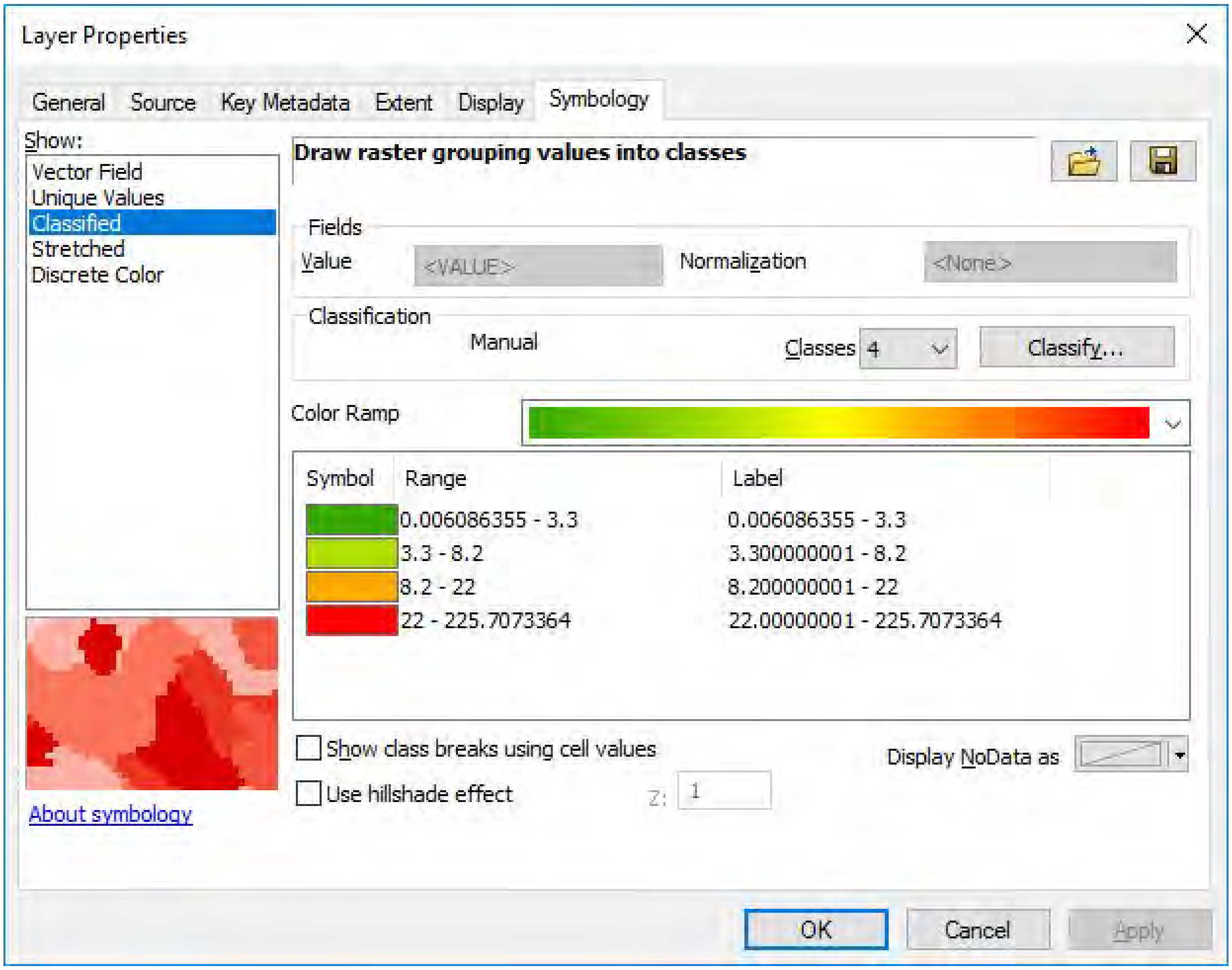
The process of siting the Dero was fairly straightforward. First, we agreed upon essential criteria, then we assigned secondary criteria to the search based on the themes for the upper design, and then finally, we agreed that the most ideal sites would be sites where our primary criteria were present and where some of our secondary sets of criteria overlapped. We then uploaded all of this information to ArcGIS online so it could be available for public viewing.

For our primary site criteria, we specified that the parklet will occupy a parallel parking space in downtown Northampton, and that it must occupy a parallel parking spot on a slope of no more than 3.3%, as it is built currently, due to ADA requirements. We also specified that the parklet must not be immediately adjacent to an intersection or crosswalk, due to the danger of having pedestrians seated too close to turbulent traffic. Having specified these criteria, we made a GIS map of all parallel parking spaces in downtown Northampton, which also includes the locations of streetlights, restaurants, trees, and crosswalk zones (see Figure 19).

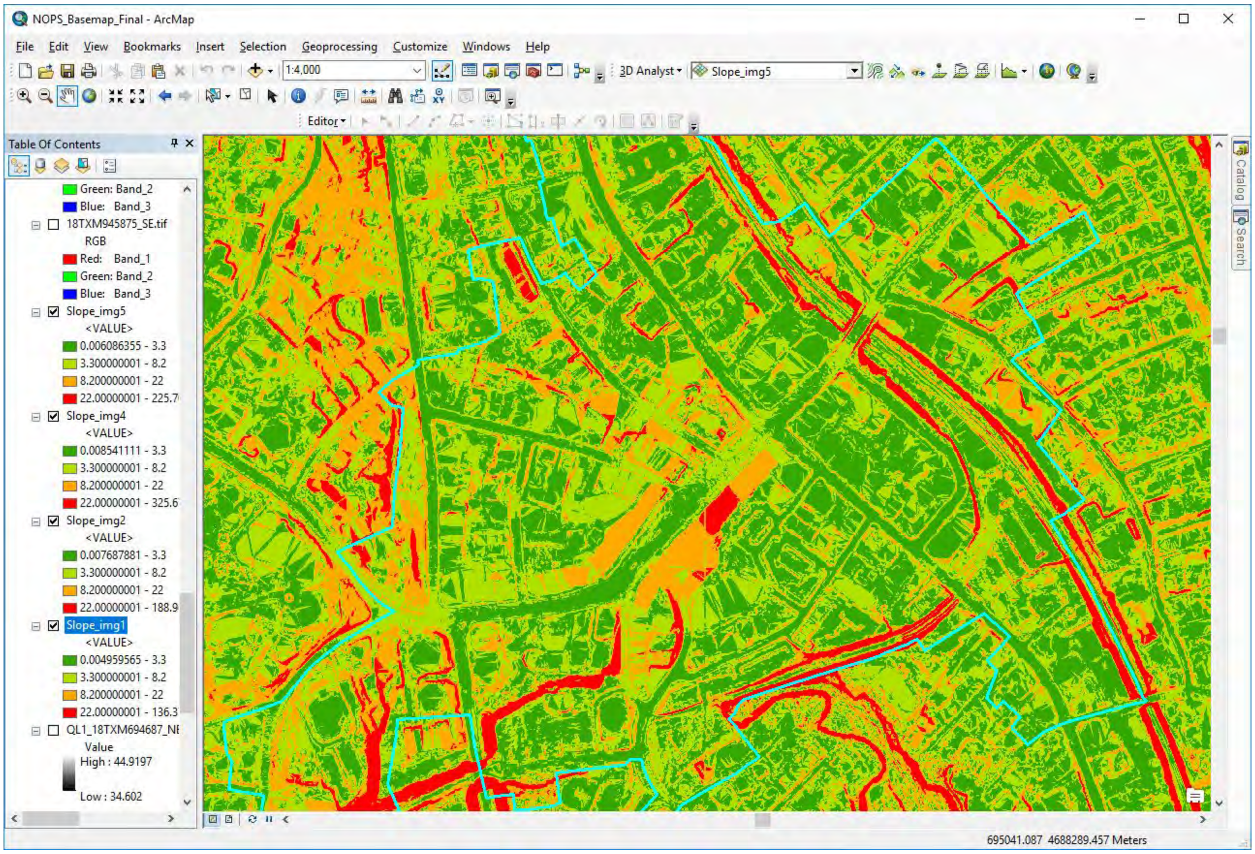


[Fig. 19] Screenshot of ArcGIS map detail, with crosswalk zones in orange, parallel parking spots in red, trees in green, symbols for streetlights, and restaurants in pink (see Fig. M1 for full extent)

This initial map also included a hidden layer with raster data sorted into 4 slope categories: (a) 0-3.3%, which shows where the parklet, as it is now, can be parked for a prolonged period of time, (b) 3.3-8.2%, which shows where the parklet could be parked with our suggested extensions for the feet (up to 17.7 inches added), (c) 8.2-22%, which shows where possible routes could be for the parklet could be pushed by a team of up to five people, and (d) >22%, which are the areas that must be avoided for the siting of both the parklet and its routing throughout downtown Northampton (see Figures 20-21).

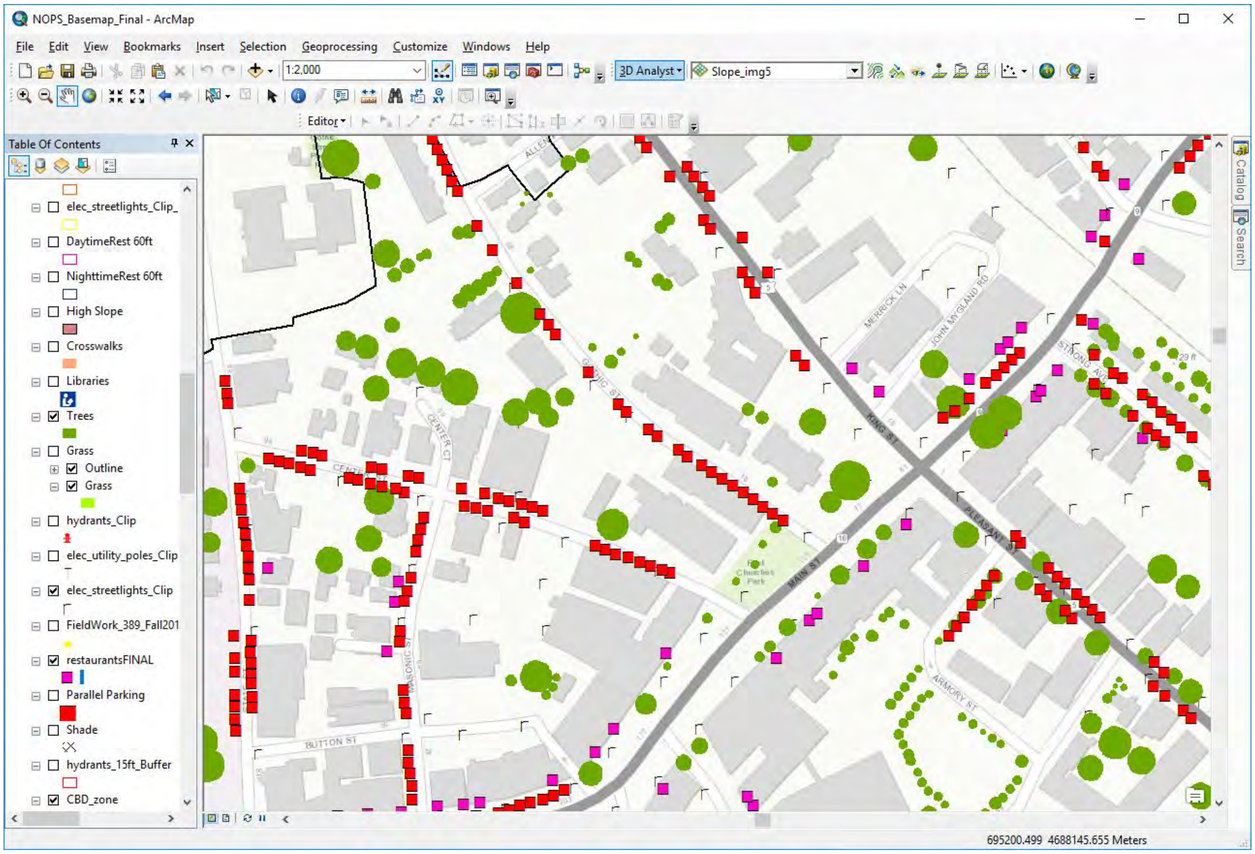


[Fig. 20] Screenshot of raster data sort window



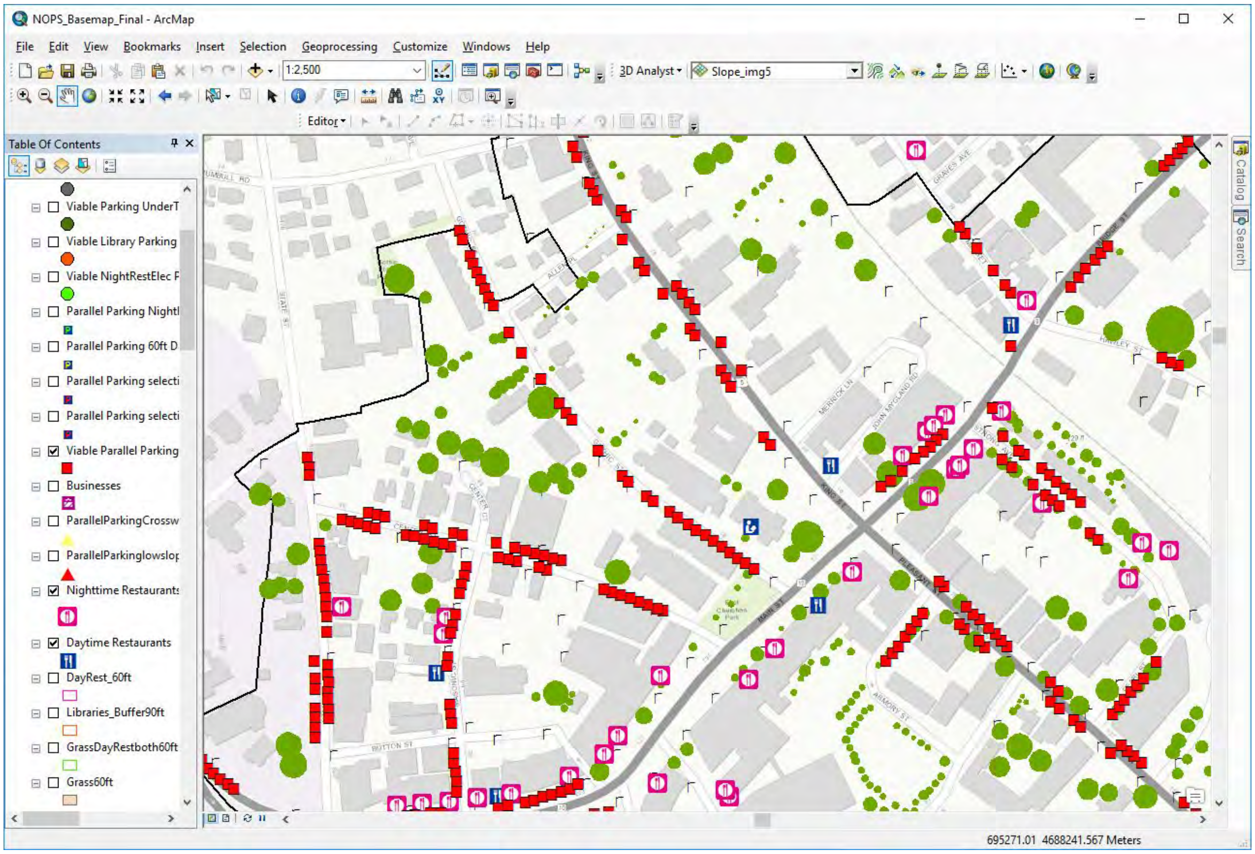
[Fig. 21] Screenshot of ArcGIS slope map detail

Having created this sort, we eliminated all parallel parking spots as potential locations that were on a slope of >8.2% or that were immediately adjacent to a crosswalk or intersection (see Fig. 22).



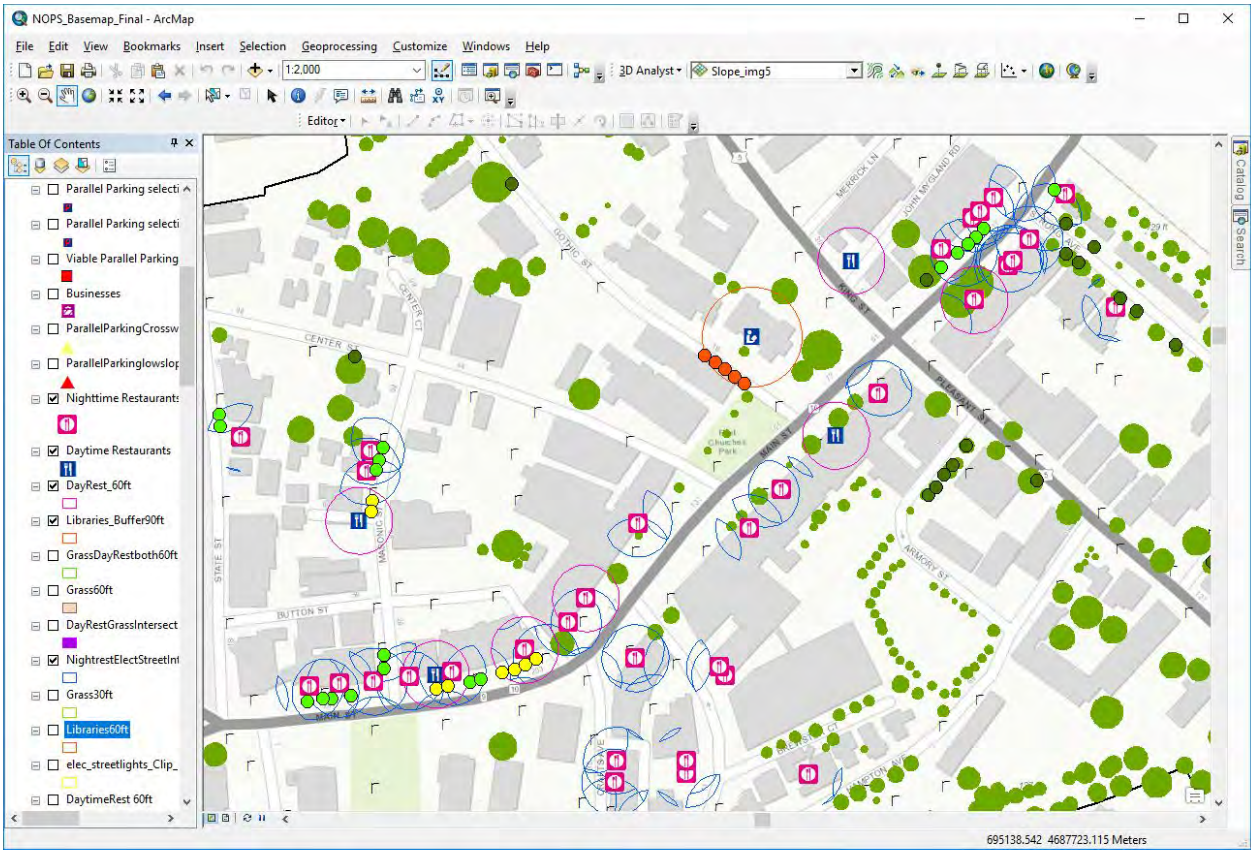
[Fig. 22] Screenshot of ArcGIS map detail, with parallel parking spaces remaining after first round of elimination in red,and restaurants in pink (see Fig. M2 for full extent)

For our secondary criteria, we divided our restaurant sets by daytime and nighttime. For daytime, we decided that proximity by 60 feet or less to trees, libraries, and restaurants that have daytime hours would be the most important. For nighttime, we decided that proximity by 60 feet or less to streetlights and restaurants that have nighttime hours would be the most important. In order to find the parallel parking spots that fit these criteria, we first researched the hours of each restaurant in downtown Northampton, then coded that information using the numbers 1-4; 1 = open all day and night, 2 = open in the middle of the day, 3 = open only in the morning, and 4 = open only at night. From there, we sorted the restaurants into daytime and nighttime restaurants (see Fig. 23).



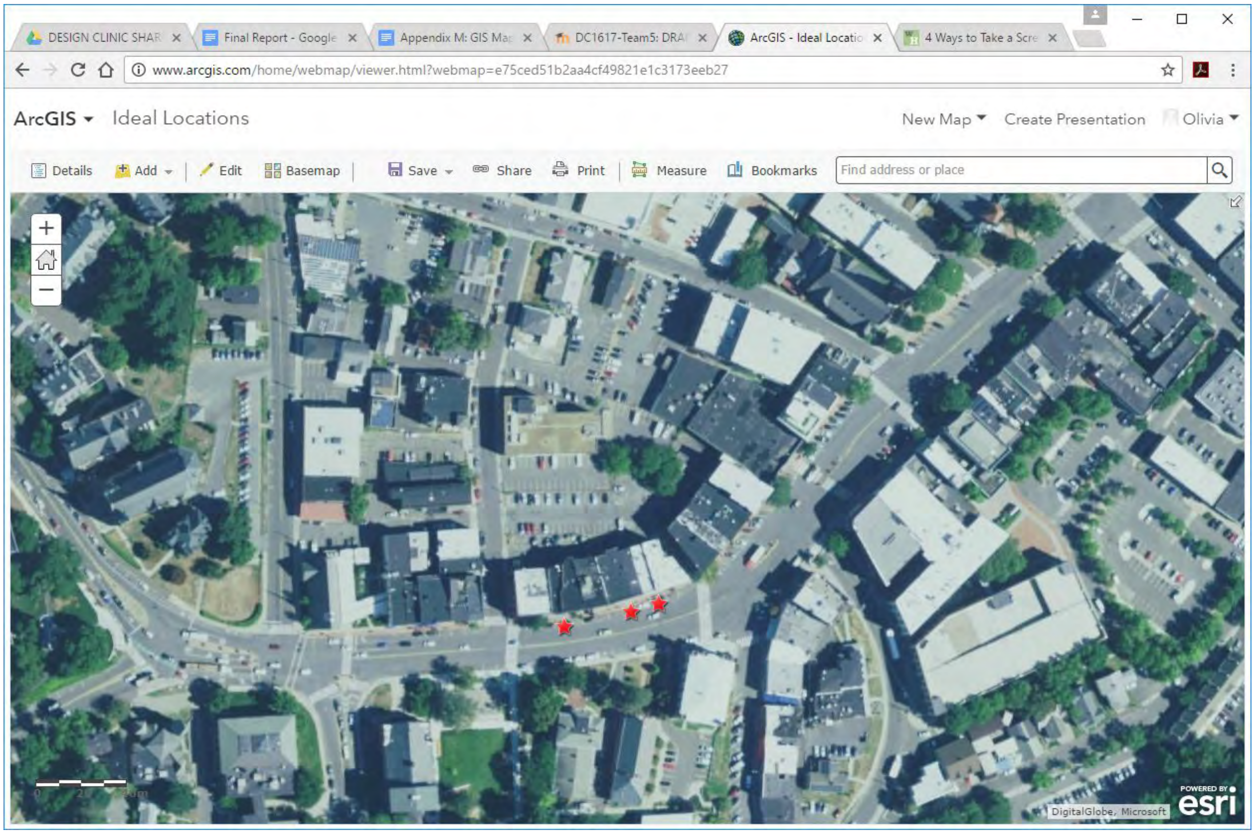
[Fig. 23] Screenshot of ArcGIS map detail, with parallel parking spaces remaining after first round of elimination in red, and restaurants with day hours in blue and restaurants with night hours in pink (see Fig. M3 for full extent)

We then placed a 60 foot buffer around all restaurants, a 90 foot buffer around all libraries, and sorted the parallel parking spaces by whether or not they intersected with or were within those buffers (see Fig. M4). We did a simple selection by location and found that there were several sites at which our sets of secondary criteria overlapped (see Fig. 24).



[Fig. 23] Screenshot of ArcGIS map detail, with viable parallel parking spots within 60 feet of a restaurant with nighttime hours in green, viable parallel parking spots within 60 feet of a restaurant with daytime hours in yellow, viable parallel parking spots under trees in bright green, and viable parallel parking spots within 90 feet of a library in orange (see Fig. M5 for full extent)

From here, we eliminated all spots not on the 3.3% slope gradient needed for the Dero as it currently is built (see Fig. M6), and re-created the essential iterations of our maps on ArcGIS online, from earliest analysis to final product, and made them into Storymaps so that the maps could be compared easily side by side, as well as stand alone static maps that straightforwardly present our finding (see Figs. M7-10). Figure 24 shows a screenshot of the static ArcGIS online map of our final findings.



[Fig. 24] Screenshot of ArcGIS online final map, with ideal locations in red

5) Final Design and Deliverables

The final result of this year-long project has three components: a public storymap siting potential parklet locations, a proposed compilation of upper designs, and a handbook describing a prototype solution to generate an accessible and mobile parklet. These final products and all previously developed deliverables will be submitted to NOPS as guidelines for further advancements in the Northampton mobile parklet project.

The first deliverable completed in the Fall was a Review of Existing Practices Report (see Appendix E), which was used as a supporting source to inform designs and concept generation. A major milestone in the context of this project was one-week show at the APE Gallery, presenting prototypes of initial conceptual designs for the mobile parklet. Those designs and feedback collected from the APE show are documented in Appendix L. This event was an essential deliverable that helped condense the team's ideas and included a collaborative component in the evaluation of our completed work.

During the Spring, one of the main deliverables completed by the team involve a detailed public storymap of possible parklet locations, based on factors such as lighting, slope, and proximity to businesses (see Appendix M). This web map can be found here on the ArcGIS online portal. The mapping analysis resulted in a selection of three main strategic locations on Main St. Another deliverable developed simultaneously is a compilation of upper design layouts, including four themed designs and one more in-depth modular design for the mobile parklet (see Appendix K). The four themed designs include a sustainable parklet, a playground parklet, a restaurant extension, and an outdoor library. Two modular upper layouts were developed as examples of interactive furniture, including a tetris-inspired design and a puzzle block design. Finally, the team also prototyped and tested a working solution for the implementation of mobility (see Appendix I), by designing and fabricating a retractable wheel mechanism, which will allow the parklet to be moved by five to six people over short distances downtown. These deliverables summarize the three aspects on which the team focused its analysis and will allow NOPS to build a fully functioning mobile parklet in the future.

6) Design Verification

For the design verification of our final product, we followed the verification protocols specified in the Traceability Matrix in Appendix B to evaluate the extent to which the requirements are met. Table 1 below lists the result of the verification. All requirements are satisfied by design with adjusted recommendations for future developments, as described in section 7.

[Table. 1] Design Verification Summary Table

DR ID	Design Requirement	Documentation Specification	Verification Result
DR1	Cost of entire project is less than $10,000.	Fabrication Guide, section 4. c.	Satisfied
DR2-A	Existence of an adjustable structure allowing the platform to adapt and incline the height to different curbs and surfaces.	Appendix G: Concept Selection, Figure G7.	Satisfied
DR2-B	Platform design without equipment or people can be moved from one location to another in Northampton.	Appendix I: Fabrication Guide.	Satisfied by design. Recommendation: fabricate three more custom wheels and purchase one more threaded stem caster, as described in the Fabrication Guide.

DR ID	Design Requirement	Documentation Specification	Verification Result
DR2-C	Movement of Dero platform involves 3 or fewer DPW workers, with forklift and trailer only when necessary (movement between locations downtown of 12 degree or more and between downtown and DPW storage) or fewer than 6 NOPS members moving by hand	Appendix L: Fabrication Guide, section 5 and Appendix I1.	Satisfied
DR3-A	The road where parklet is situated must be on slope of no more than 3.3% (ADA regulation of 2% + Dero adjustability of 1.3°)	Appendix M: GIS Mapping.	Satisfied. Recommendation: for more potential locations above the indicated slope limit, purchase feet with longer stem.
DR3-B	The surface of the parklet should have no abrupt changes in level exceeding 1/2".	Appendix K: Upper Design Documentation.	Satisfied
DR3-C	Existence of barriers on edges, wheel stops, soft hit posts, railings, and cables.	Appendix G: Concept Selection, Figure G7.	Partially - Satisfied Recommendation: Purchase of safe hit posts, placed at each end of the parklet [11]
DR3-D	The space has a circular area 60" minimum in diameter for a 360° turn.	Appendix K: Upper Design Documentation.	Satisfied
DR3-E	The adjacent surfaces at transitions at curb ramps to sidewalk gutters, and streets shall all be at the same level. Cross slope of ramp runs shall not be steeper than 1:12.	Appendix H: Loading Calculations, see ramp calculations section.	Satisfied by design
DR4-A	The parklet area will cover less than 22 feet by 10 feet space	Appendix K: Upper Design Documentation, Appendix G: Concept Selection.	Satisfied
DR4-B	Parklet equipment weight is less than 90 lbs/ft2	Appendix K: Upper Design Documentation, Part 3.	Satisfied by design

DR ID	Design Requirement	Documentation Specification	Verification Result
DR4-C	A minimum of 84 inches in height must remain clear of any obstructions along the parklet's path of travel, entry, accessibility areas on the parklet. Obstructions may include but are not limited to tree branches, foliage, sign panels, posts, and/or the applicant's addition of architectural elements to the parklet	Appendix K: Upper Design Documentation, Appendix M: GIS Mapping.	Satisfied
DR5-A	Materials must be usable within a temperature range of 10-90 degrees F	Appendix L: Fabrication Guide, section 4.a., Appendix K: Upper Design Documentation, Part 3.	Satisfied
DR5-B	Materials should be able to last a minimum of 10 years while undergoing 10 freeze-thaw cycles in the winter storage before any deterioration occurs	Appendix L: Fabrication Guide, section 4.a., Appendix K: Upper Design Documentation, Part 3., Dero CAD files.	Satisfied
DR5-C	Surfaces should be deemed "slip resistant" by seller standards.	Appendix K: Upper Design Documentation, Part 3.	Satisfied

7) Future Development and Implementation

In this project, our team has developed a recommendation for implementing parklets in downtown Northampton by selecting strategic sites, conceiving potential layout designs, and designing a mobile parklet. The use of a transportable and modular parklet as a tool to better understand and cater to the urban and communal needs of Northampton locals will facilitate the advancement of more city-wide projects.

On the mobility implementation side, the next step for the City of Northampton is to further develop our mobility plan. This entails the fabrication of three more custom retractable wheels as described in the Fabrication Handbook, in Appendix I. The guide details all the steps they need to take in order to successfully implement our designed wheels on the Dero, from parts to buy, to specific steps of the fabrication process. In addition, they need to purchase two more adjustable feet as well as one threaded stem caster wheel in order for the parklet to be completely mobile. The final steps would include drilling holes into the steel beam structure in order to solidify hinge connections on the parklet and finalize wheel installment. Once all the parts are purchased, assembled, and installed, the NOPS team should perform testing on the mobile parklet by transporting it on different slopes (as detailed in the Fabrication Guide, Appendix I). This would enable NOPS to determine the exact time and number of people needed for the entire process and confirm feasibility and safety of the transportation process.

For the upper layouts of the Dero, the City of Northampton will need to purchase furniture for the first iteration of the parklet. As suggested in Appendix K, using the same tables and chairs in Pulaski Park, as well as tall planters will help to gain public interest in the parklet and visual consistency to downtown. The puzzle piece and tetris modules will need more design development and fabrication. We believe that the modular components pair well with the mobility of the parklet and the ideals of Northampton.

For the siting of the Dero, the City of Northampton may want to consider an interactive online platform with a map of potential Dero locations so that businesses and institutions can request to have the Dero placed near them (see Appendix M, Figs. M7-M10 for images of initial online maps, and Fig. 24 above). This extension of accessibility and ownership of the Dero to the public would likely improve the success of the Dero, as it would allow members of the community to guide the city in where to place the Dero for optimal use.

8) Summary

This project involved the design, siting, and mobility implementation of temporary parklets, as part of a larger program to rehabilitate urban spaces proposed by the Northampton

Office of Sustainability and Planning. The objectives of the year-long project included the research, feedback collection, engineering analysis, siting, conceptual design, and finally solution proposal to develop and evaluate parklets in downtown Northampton. The project leveraged a Dero platform recently purchased by the City of Northampton. Throughout this process, the team closely considered requirements concerning accessibility, safety, durability, modularity, and social impact. The project included three main deliverables, exploring the three key aspects of mobile parklet development in Northampton. A retractable wheel design with instructions for fabrication and installation, as documented in a mobile parklet handbook, was produced to facilitate the implementation of a more easily transportable parklet platform. A collection of suggested modular and themed upper layout designs were compiled to help inspire future furniture purchases and installations. An interactive web map of three selected locations on Main Street, was created to help visualize the placement and public potential of the mobile parklet. These solutions will help the city of Northampton better understand and approach the evaluation of parklets in the downtown area. The recommendations in this report may be used and extended in the future to strategically implement a mobile parklets throughout Northampton and beyond. Ultimately, our team leveraged three major aspects of existing parklet practices (mobility, layout, and siting) to extend a new method of transforming cities though temporary, interactive, and modular parklets.

9) References

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Appendix A: Parklet Examples

Parklet designs from London and San Francisco

[Fig. A1] Example parklet in London

[Fig. A2] Example parklet in San Francisco

Appendix B: Traceability Matrix

Appendix C: Expenses

The year-long project expenses including all processes from fabrication to team coordination, are summarized in Table C1.

Table C1 - Design Clinic Project Expenses

Expense Description	Account Code	Specifications	Amount
Wheel Components	85101	All components ordered for the fabrication of one wheel and the purchase of one threaded stem caster (assuming we will be sending the extra wheels back)	$243
Liaison Gifts	71780	Model Dero materials and other end of project gifts	$100
Team Bonding	74299	Meals and snacks used by the team	$50
Transportation	74110	Transportation costs for visiting the Dero at the Leach 8 Landfill and the DPW	$40
Printing/copying	72001	Posters, report, and agenda printing	$100
Supplies	71610	Supplies purchased for APE gallery and other prototyping tools.	$50
Total			$583

The future developments of the project imply additional expenses for furniture purchase and wheel fabrication. The estimation of potential costs are shown in Table C2.

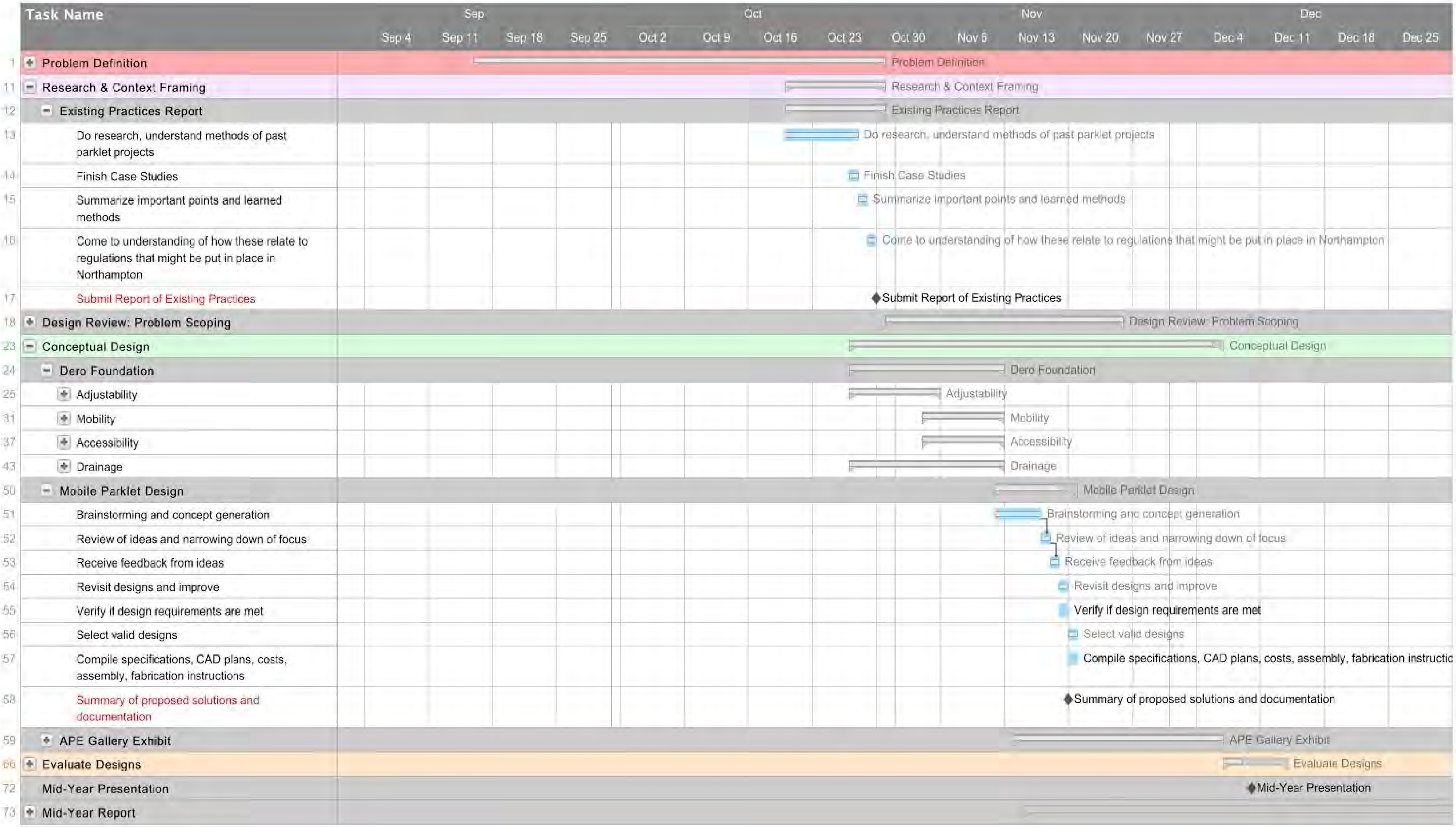
Table C2 - Estimated Future Development Expenses

Expense Description	Specifications	Amount
Wheel Components	Minimum cost required for additional fabrication and purchase of threaded stem wheels	$638
Chairs	Nine Fermob Bistro Chairs, as specified in Appendix K	$342
Tables	Three Fermob Bistro Tables, as specified in Appendix K	$537

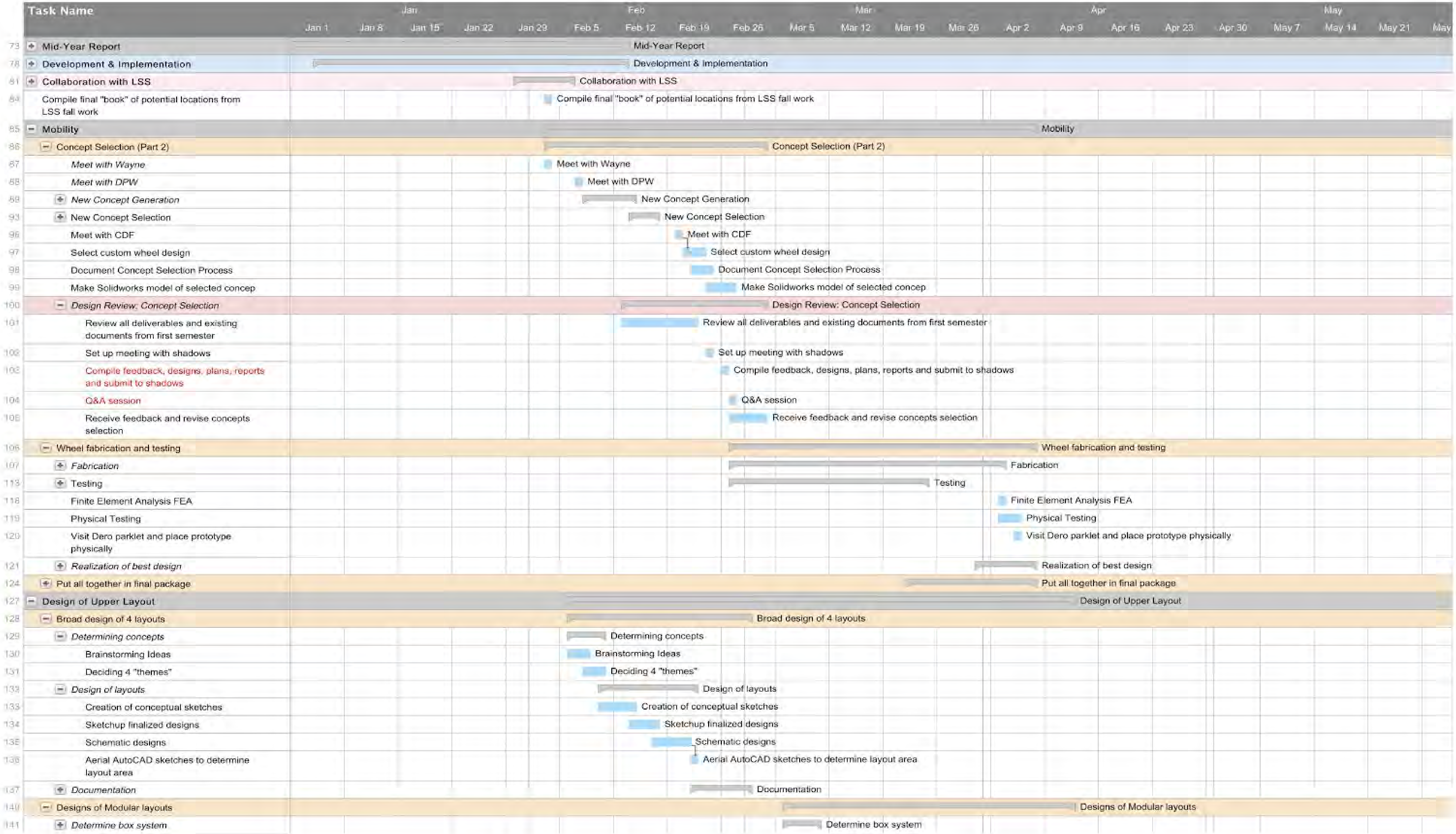
Total	$1,517

Appendix D: Gantt Chart

Fall Semester:



Spring Semester:



	Task Name
73	**Mid-Year Report**
78	**Development & Implementation**
81	**Collaboration with LSS**
84	Compile final "book" of potential locations from LSS fall work
85	**Mobility**
86	Concept Selection (Part 2)
87	*Meet with Wayne*
88	*Meet with DPW*
89	*New Concept Generation*
93	New Concept Selection
96	Meet with CDF
97	Select custom wheel design
98	Document Concept Selection Process
99	Make Solidworks model of selected concep
100	*Design Review: Concept Selection*
101	Review all deliverables and existing documents from first semester
102	Set up meeting with shadows
103	Compile feedback, designs, plans, reports and submit to shadows
104	Q&A session
105	Receive feedback and revise concepts selection
106	Wheel fabrication and testing
107	*Fabrication*
113	Testing
118	Finite Element Analysis FEA
119	Physical Testing
120	Visit Dero parklet and place prototype physically
121	*Realization of best design*
124	Put all together in final package
127	**Design of Upper Layout**
128	Broad design of 4 layouts
129	*Determining concepts*
130	Brainstorming Ideas
131	Deciding 4 "themes"
132	*Design of layouts*
133	Creation of conceptual sketches
134	Sketchup finalized designs
135	Schematic designs
136	Aerial AutoCAD sketches to determine layout area
137	*Documentation*
140	Designs of Modular layouts
141	*Determine box system*

Appendix E: Existing Methods and Practices Report

Introduction

Mobile parklets or small mobile public parks offer the opportunity to create a more dynamic, interactive, and cooperative structure for cities. The concept of a mobile parklet involves an easily storable, moveable, and modular mechanism that can convert unused city spaces into public open space. Mobile parklets intend on helping citizens use streets differently, encouraging sustainable practices and creating community driven activities. The purpose of this report is to assemble the best current methods and practices to support the creation of mobile parklets in urban environments. Through the study of two relevant cases, the design, building, and impact of mobile temporary parklets is reviewed and summarized. The analysis of these existing practices will help inform the research and design of the Northampton Mobile Parklet project proposed by the *Northampton Office of Planning and Sustainability*.

Scope

The objective of this study is to provide a formal definition of a “mobile parklet”, to analyze existing projects through case studies, and to give an overview of the technical and creative tools employed to repurpose cities through parklets. The existing practices reviewed will be taken from two specific case studies: *Beyond the Curb* [1] and *Curb’d* [2] projects. This report provides an overview of research to construct the initial context of our project. The team acknowledges that the information included in the report addresses only a limited aspects.

Methodology

The method used in this report is to gather information through a number of literature reviews and two case studies, while paying particular attention to the following areas:

Design considerations
Safety Features
Choice of Location
Description of impact of projects

Each case study is divided into the following sections:

Goals and Background
Planning Process and Development
Implementation and Maintenance
Successes and Challenges

The first case study focuses on the mobility aspect of temporary parklets, while the second case study analyzes the modular aspect of those parklets. These two major aspects will serve to inform the conceptual design phase of the Northampton Mobile Parklet project.

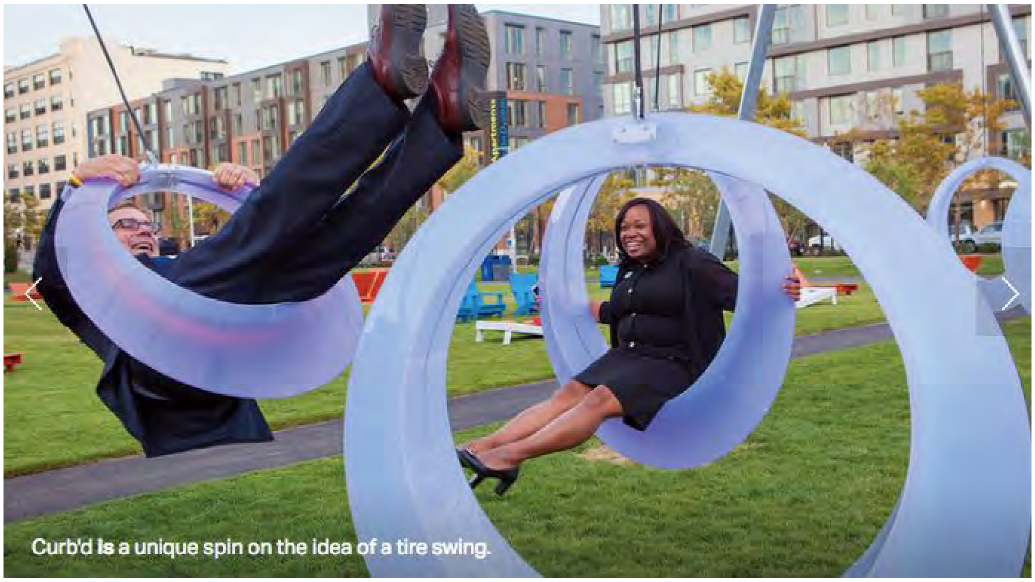
CASE STUDIES

CASE STUDY 1: Curb'd

Goals and Background

Curb'd aims to create immersive public experiences in the area of a parking space. The organization pairs design teams with businesses in the district of urban Covington. Walkability, connectivity, and placemaking are values and used to showcase the region's design talent through quasi-temporary public installations. Repurposing parking spaces for interactive, non-passive objectives and activities are central to the organization's goals. Some examples include a movie theater (Fig. E1) and public swings (Fig. E2).

(Fig. E1) Movie Theatre Parklet



(Fig. E2) Parklet with Interactive Swings

Planning Process and Development

The design development of Curb'd projects includes a number of steps aiming to bring together greater Cincinnati based creatives, fabricating and installing parklets in Covington's urban core, and verifying that immersive public experiences are created.

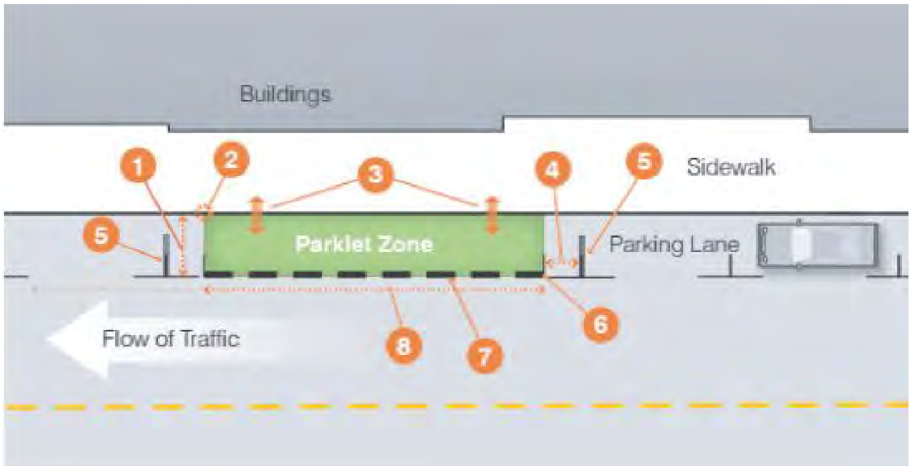
- Design teams express their interest to Curb'd.
- The interested team must attend an informational workshop where they receive the information needed to develop and submit a completed parklet design proposal.
- The design proposal is submitted.
- The businesses interested will choose their top proposals.
- The 12 businesses attend a fabrication workshop where they will work together with design and build experts to refine their parklet proposal.
- Upon completion of final proposals, a panel of experts will choose the top 5 parklet designs, based on originality, community interaction, safety, and feasibility to move forward with fabrication.
- The majority of costs associated with producing, permitting, and installing are funded by Curb'd.
- Design constraints of the chosen site must be specified in the final proposal (including fire hydrants, overhead utilities, lights, trees, signage, etc.). The final proposal checklist is shown in (Fig. E3)
- The final design checklist must respect the following regulations, as illustrated in (Fig. E4):

- Max of 6’ width unless otherwise noted on the business’s fact sheet.
- Maintain curbline drainage.
- Parklet decking flush curb, ½” gap max.
- 4’ distance from parklet to wheel stop.
- 3’ wheel stop installed 1’ from curb.
- Reflective soft hit posts.
- Visually permeable outside edge. Railing must be required.
- The parklet should must support 100 lbs./sq. Ft.
- Design should have vertical elements so that it is visible from vehicles.

Design Checklist:

1. Name and contact information of each team member. Identify one team member as the primary contact.
2. One or two sentences describing each members' background and role in the project.
3. A short statement describing previous community project experience produced by the team as a whole and/or the lead of the team.
4. A short bio or design statement. Design statement should include the intended use, if applicable (250 word max).
5. Are you submitting for a particular business or as a general submission? If you are submitting for a business, include the name(s) and address(es) of the business the parklet is being designed for. If you are opting for a general submission, how do you plan on dealing with the limits of context? (signs, utilities, etc.)
6. Designs should indicate existing constraints of the site. Some examples include changes in pavement, trees, signage, drains, fire hydrants, overhead utilities, lights, etc.
7. Image specs: a **minimum** of three renderings – (1) plan view with dimensions, (2) elevation view with dimensions, (3) one section view with dimensions – more renderings may be required to illustrate the concept fully.
8. **Bonus**: 3D illustrations/renderings.
9. Include dimensions and scale of parklet design.
10. Include a list of anticipated construction materials.
11. Include an itemized budget for materials, construction, logistics, installation, and deconstruction.
12. A proposed project plan: Where will you be building your proposed parklet design? How will you be moving your parklet to its corresponding location?
13. Identify maintenance expectations and how they will be managed.
14. Include any insight into your process and why you think the concept is appropriate (500 word max).

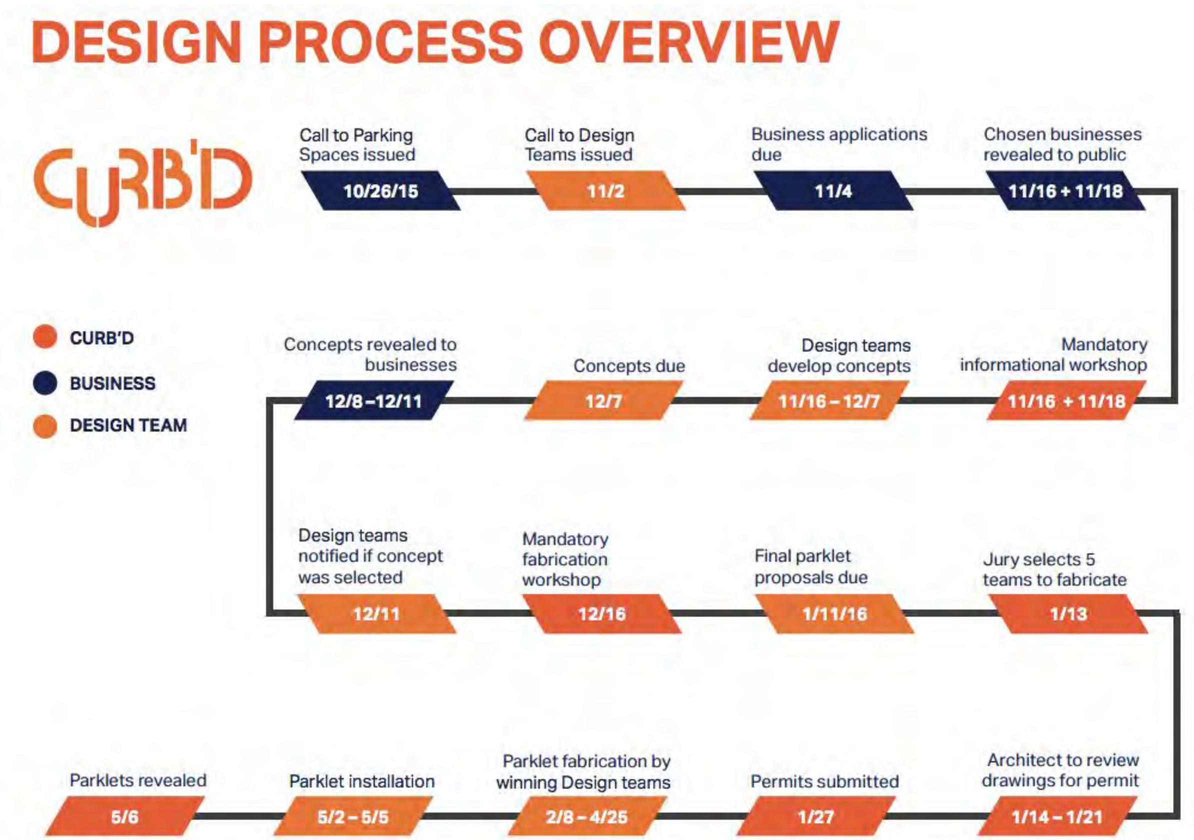
(Fig. E3) Design Checklist for Parklets



(Fig. E4) Visual of Design Checklist

Implementation and Maintenance

After the following design process (Fig. E5) is carried out, the parklet in question is installed and meant to be maintained for a certain period of time, which varies case by case.



(Fig. E5) Design Process Overview for Implementation

One example of the implementation can be taken from the finalist of the parklet competition: “Work A+D”. As described in (Fig. E6), the swing parklet designed by Work A+D, a shipping container is used to implement mobility and a modular mode of deployment and positioning is used for customizability. This recess container will be able to be able to be easily packed onto the back of a truck and hauled to its next location. The design of the parklet is intended to require little to no maintenance for a one year active placement. Locking casters enable it to be situated and leveled. The plant used will be a low maintenance ivy with a long life expectancy.

(Fig. E6) Design of Swing Parklet

The use of shipment containers modified to become parklets has become a new method of moving the installations to new locations and storing them[1]. Made from recycled shipping containers, the parklets are easily transported enabling them to be trialled in various locations. These shipping containers are often adapted with large open sides or windows, filled with benches and boxes, giving residents as well as passers-by a place to stop and take in the activities of the street. The use of shipping containers also fits the repurposing of empty parking spaces, which are most often the locations of interest for parklets.

Other interesting designs from other projects include an outdoor restaurant seating area extension in Montréal (Fig. E7), an outdoor art gallery (Fig. E8), and an engaging space for children (Fig. E9).

(Fig. E7) Seating Area Parklet for Restaurant

(Fig. E8) Art Gallery Parklet

[1] See recent SamA designs of small public spaces for community socialising and greening the street [3] or upcycled shipping container project in Montréal [4].

(Fig. E9) Children's Parklet

Successes and Challenges

Many of the Curb'd projects present ways of achieving the expected goals of the Northampton Mobile Parklets project. The various designs entered in the competition are able to implement:

- Interactivity/public engagement: swings, stage, playground, movie theater, bike exercise
- Mobility : use of shipment containers
- Space: takes up the same area as the Dero parklet and is meant to be installed in unused parking spaces
- Budget: the amount of resources allocated to the project seem sufficient and manageable about $150, 000 for the total costs allocated towards 4 parklets.
- Pairing with local businesses: the projects are each correlated to a local business, which integrates the parklet and allows a good symbiosis with its environment and community.

Nonetheless, on many levels the Curb'd projects present a few challenges that can also be applied to the Northampton parklet project:

- Modularity: all the parklets presented seem to be made for unique purposes and fail to implement the total modularity that the Northampton mobile parklet aims for.
- Maintenance: the maintenance of the parklets lack description and seem to disregard weather hazards.

CASE STUDY 2: Beyond the Curb

Goals and Background

The Beyond The Curb project is a subset of the North Jersey Local Demonstration Project Program, focusing on improving its downtown Morristown area, shown in Fig. E10.

(Fig. E10) Map of Downtown Morristown

The project proposed to add parklet sidewalk extensions adding new places to the city for people to "gather, eat and drink, celebrate and create, work, play, and build community." Their project specifically proposed four elements to build upon this plan:

- Facilitate use of parklets to foster a more pedestrian and bicycle-friendly areas of the city, making the downtown more desirable to community members and guests.
- Incorporate public art and recreational aspects into the area
- Promote these small temporary parks as a tool for economic development
- Finish project with a handbook to easily transfer progress and information to other areas around New Jersey.

These parklets have been identified as a tool to reactivate the street life and allow for a more walkable and bikeable. The parklet themselves focused on installations of public seating, art, plants and other passive recreational elements.

Our team is interested in this case study because one of the pieces of their design process includes finding the volume of storage space needed for each design. An extension of our project is combining our Dero parklet with the LSS class idea of a "park-it" trailer, similar to the one shown in Figure E11. This trailer will be driven around with the Dero to fit all the pieces to be put on it. One of our design requirements will be to find the volume of storage space needed for the pieces of our designs and make sure they can be fit into the space in this trailer.

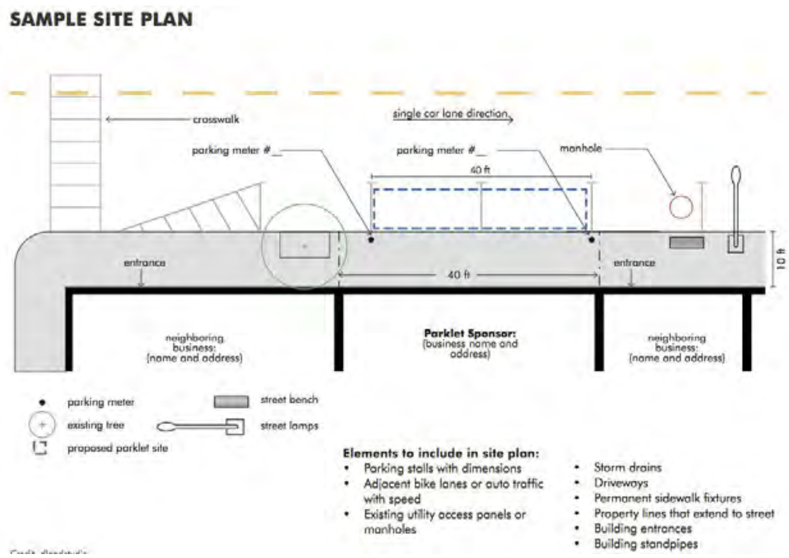
(Fig. E11) Visual of “Park-it” Trailer

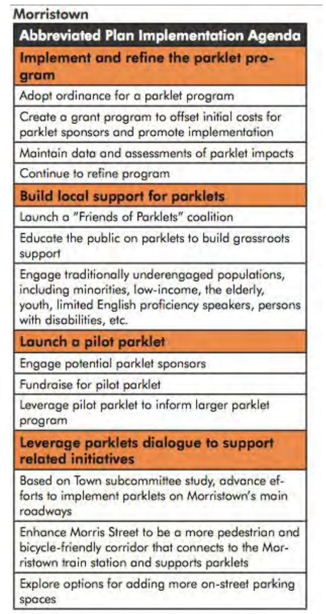
Planning Process and Development

The planning process of the Beyond the Curb program involves a series of community-driven tests and workshops to get a better understanding of what the residents want before the implementation of anything. This is similar to the steps we are taking in our project with the APE gallery, community feedback and associated redesign are a large portion of our design development phase.

- Implement and refine the program: Communicate with committee members and officials to set up a program for the parklet .
- Build local support: Make a “Friends of Parklets” group to engage members of the Community and business owners to promote the benefits of parklets in urban settings.
- Launch a pilot parklet: Find interested businesses to sponsor the parklet and host the pilot design, demonstrating the possibilities to the community.
- Use interest in parklets to improve other projects: Add more parking spaces as to lose no net parking with the parklet in a space, and enhance Morris Street to be more bicycle and pedestrian-friendly.

A more thorough description of this process can be found in Figure E12.





Morristown

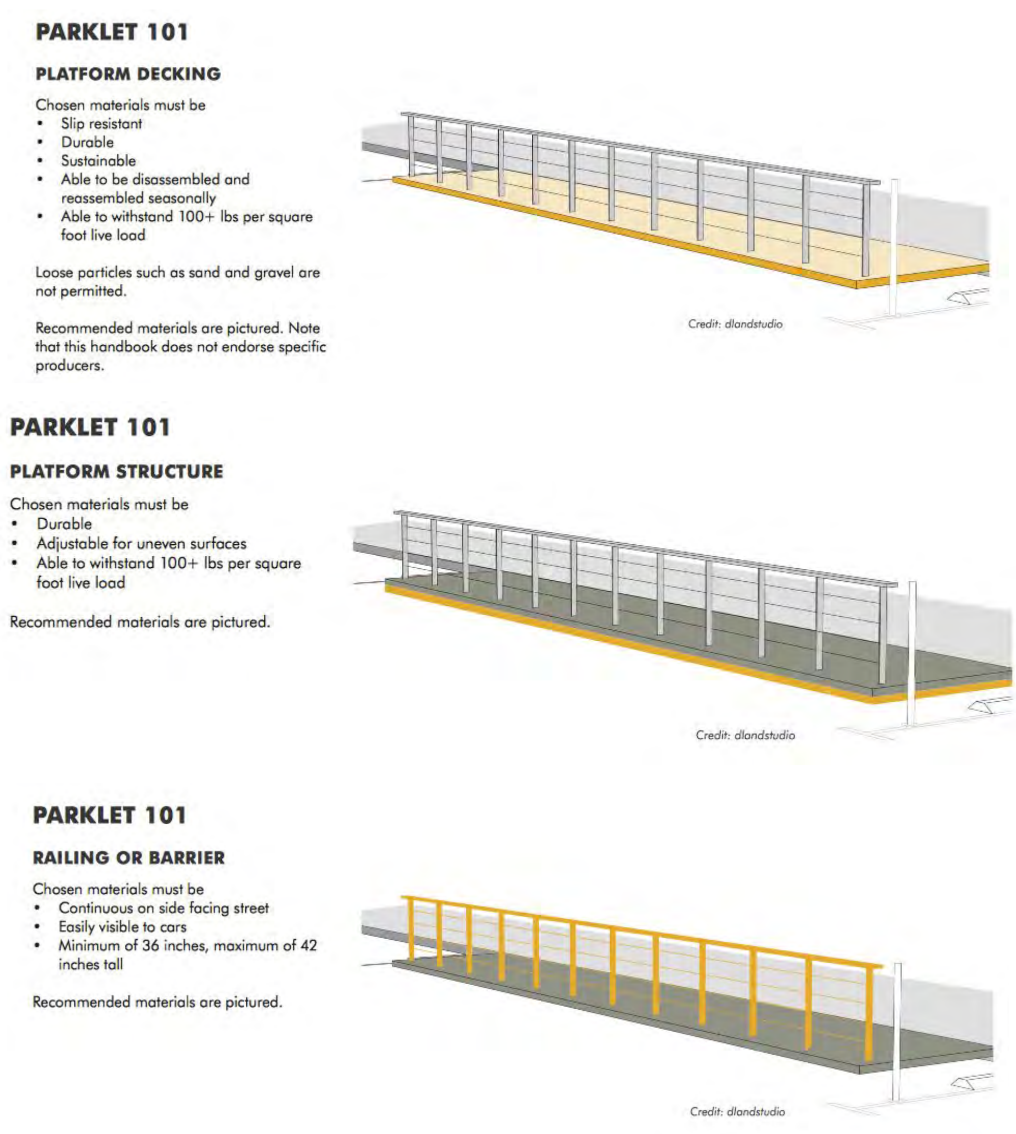
Abbreviated Plan Implementation Agenda
Implement and refine the parklet program
Adopt ordinance for a parklet program
Create a grant program to offset initial costs for parklet sponsors and promote implementation
Maintain data and assessments of parklet impacts
Continue to refine program
Build local support for parklets
Launch a "Friends of Parklets" coalition
Educate the public on parklets to build grassroots support
Engage traditionally underengaged populations, including minorities, low-income, the elderly, youth, limited English proficiency speakers, persons with disabilities, etc.
Launch a pilot parklet
Engage potential parklet sponsors
Fundraise for pilot parklet
Leverage pilot parklet to inform larger parklet program
Leverage parklets dialogue to support related initiatives
Based on Town subcommittee study, advance efforts to implement parklets on Morristown's main roadways
Enhance Morris Street to be a more pedestrian and bicycle-friendly corridor that connects to the Morristown train station and supports parklets
Explore options for adding more on-street parking spaces

(Fig. E12) Visual of Sample Site Plan and Morristown Implementation Plan

The plan for implementation is in regards to the space of two parking spaces, as shown above. Ours is very similar, but only taking up one parking space, and the area around the site (including manholes, parking meters, parklet sponsor) would change according to the sites chosen. Overall, the plan to opening process has three phases: application and selection, design and agreement, and installation. The installation process is as follows:

1. Applicant must contact the Municipal Engineer to schedule a site inspection within 72 hours before the installation is to begin.
2. Parklet is put up.
3. Municipal Building Department & Engineer inspect the implementation process to make sure all construction plans and design requirements are met.
4. Applicant notifies Municipal Engineer the parklet installation is complete.
5. Municipal Building Department & Engineer do final inspection of parklet.
6. Parklet opens

There are multiple design requirements that must be met along the way, as shown in Figure E13. These are also requirements we must take into account throughout the process of our design and implementation.



(Fig. E13) Platform Decking, Structure, and Barrier

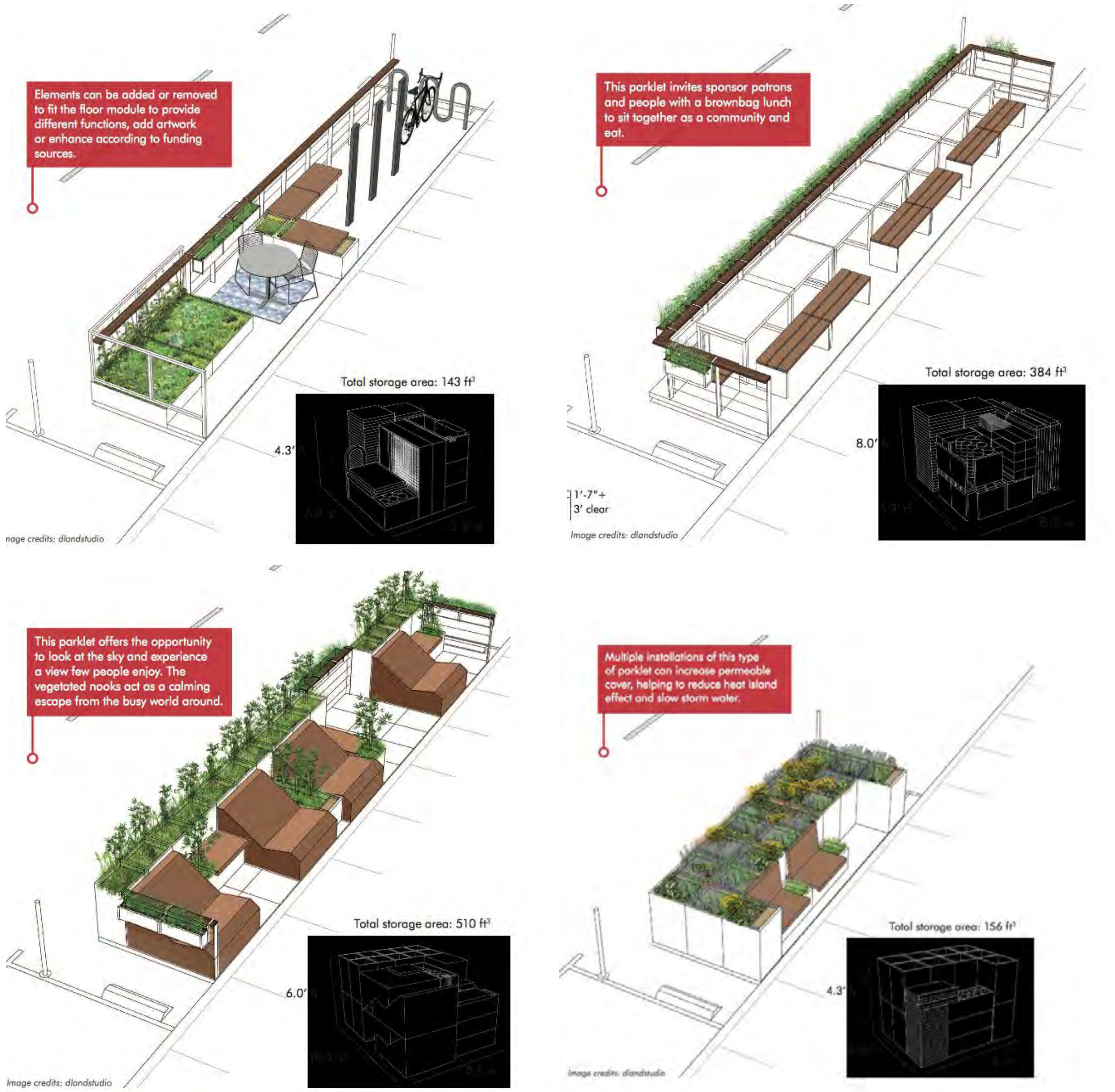
Design Concepts

In this report, four of the possible designs are explained. The propositions include a purpose of the design, a visual model, and storage capability. The storage aspect combines all modular pieces into the most compact space possible, giving a final volume of storage. This relates to our project in that we must take this concept and adapt it to the Dero and the pieces fitting into the park-it trailer.

The designs include the following items:

1) A basic example parklet - Design components include: 3 farm modules, 3 low planters, 1 bike rack, 3 rail planters, interactive art element, moveable table, and moveable chairs. Total storage volume = 143 ft^3
2) A Community Table Parklet - Demonstrates the opportunity to offer eating as an act of community gathering. Design components include: 2 collapsible tables, 1 small collapsible table, 6 fixed benches, 1 small fixed bench, and 18 rail planters. Total storage volume = 384 ft^3
3) A relax station parklet - Invites users to “take a moment to catch a breath and take a break.” Design components include: 4 low planters, 14 high planters, 4 fixed lounges and 7 rail planters. Total storage volume = 510 ft^3
4) A bio bench parklet - Offers a compact, small bench-sized design to increase plants and greenery in downtown areas. Design components include: 18 high planters and 2 low planters with bench tops. Considerations: Offseason alternate locations for planters. Total storage volume = 156 ft^3

These designs are shown below in order. We will take similar steps with our process to model the proposed designs, give a reason and description for each, and find a setup that works with a storage volume suitable for the trailer.



(Fig. E14) Sample Outdoor Parklets

Conclusion

The two case studies included in this review represent a large range of recent mobile parklet practices. The methods employed to implement modularity, mobility, accessibility, and creativity can be reused in the context of our team's project. In terms of mobility, the practice examined in this report focuses on the use of shipping containers as a parklet structure and mechanism of transportation. The main successes of the shipping container method include effective use of space, upcycling, and relative ease of mobility. The main challenges pertaining to the Northampton Mobile Parklet project involve funding, maintenance, and the existence of a Dero platform, which needs to be adapted to the shipping container concept. Altogether, the first case study provided a good reference for the development of a portable small public space in Northampton. The second case study provides a good source of inspiration and a solid context for the modular requirement of our project's design. It focuses on the temporary parklets in parking spaces, as our project does, and catering the designs to the needs of the community. Another large piece of their process included taking each design and determining the most compact volume in which it can be stored. This is equivalent to the steps we must take in order to assess our own design in terms of them fitting in the "park-it" trailer. This will allow our project to be self-sustained and mobile within the travel of just the trailer and the Dero itself. Overall, the cases studied will help to build a framework for the design guidelines of mobile parklet development in this project, as well as beyond Northampton.

References

[1] Connecting, Places People, And, and Potential. *BEYOND THE CURB: PARKLETS IN NORTH JERSEY* (n.d.). 12 Nov. 2016. <http://library.rpa.org/pdf/TNJ-Beyond-the-Curb.pdf>.

[2] "'PARKLET' COMPETITION FINALIST:." *WorK Architecture + Design*. 12 Nov. 2016. <http://workaplusd.squarespace.com/blog/2015/12/22/parklet-competition-finalist>.

[3]"SAMA Design." *SAMA Design*. 12 Nov. 2017. <http://www.samadesign.com.au/>.

[4] "Turning Grey Boxes Into Green Spaces." *Pop-Up City*. 29 Aug. 2014. 8 Nov. 2017. <http://popupcity.net/turning-grey-boxes-into-green-spaces/>.

Appendix F: Mobility Concept Selection Process

Table of Contents

Overview

One of the main objectives of our project is the transformation of an existing static platform into a mobile parklet, which can be moved to different locations in downtown Northampton. Our team therefore focused the engineering part of the project on the aspect of mobility.

The concept selection process of this project was composed of two main phases. The first phase consisted in generating and selecting various ideas based on prior research, the tools provided in class, and the team's internal knowledge. The concepts selected after this first phase were then proposed and reviewed by liaisons and stakeholders. Thus the second phase of our concept selection process involved meeting with the project sponsors, with the city engineers, and with the fabrication center manager to examine our initially selected concepts and revise them. Many of the decisions made by the team were progressively modified, undergoing constant change and improvement as we projected our concepts into reality. Although the process was complex, we were able to find a compromise solution and learned much about coordination, communication, and realization.

The final chosen concept for implementing mobility are five 6-inch custom made caster wheel attachments. The wheels will be permanently installed, and will be placed down thanks to two plates connected to two hinges (see Selected Concept section). When the parklet is static, the wheels can be placed above the metal parklet structure and incorporated in the upper design. The development plan of the concept will begin with verification of models and design, fabrication, and finally three testing stages.

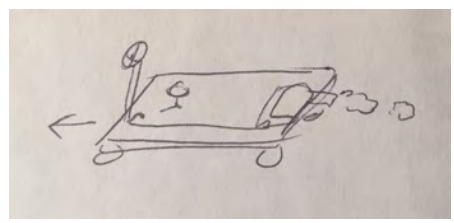
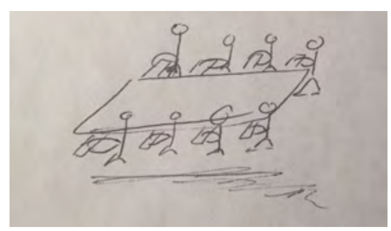
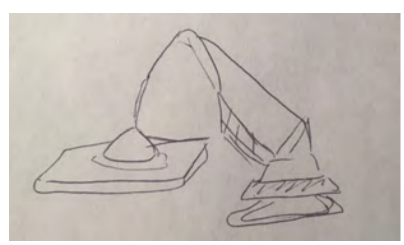
Concept Selection Phase 1: Internal Decisions

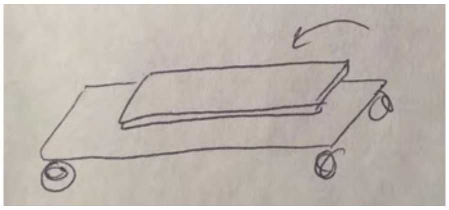
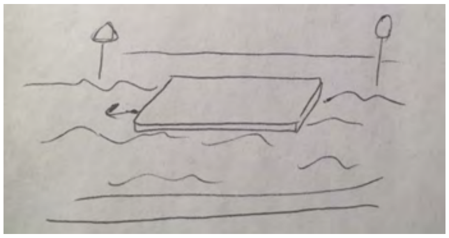
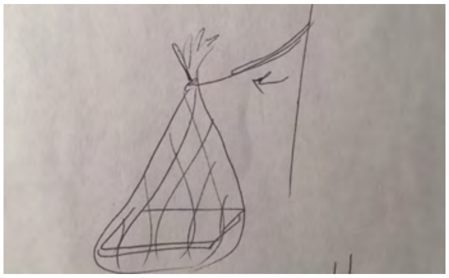
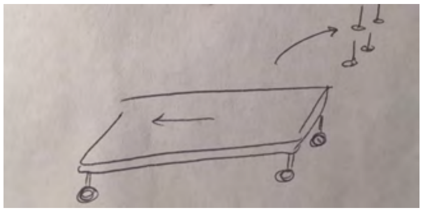
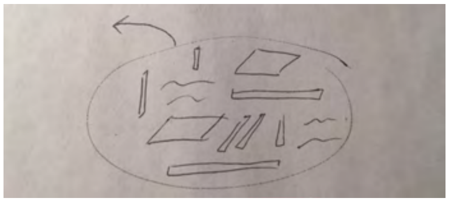
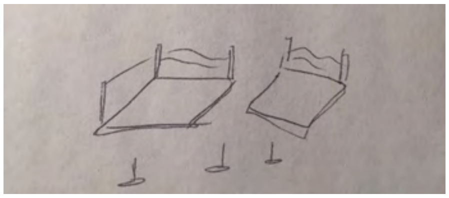
I. General Mobility

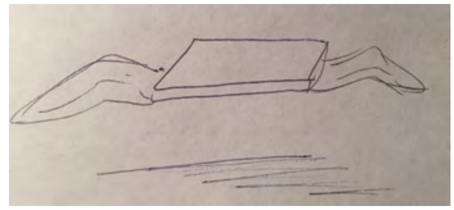
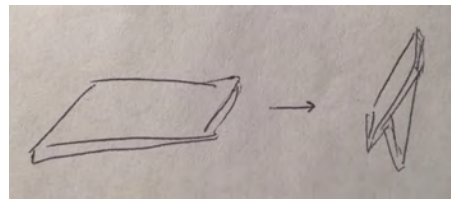
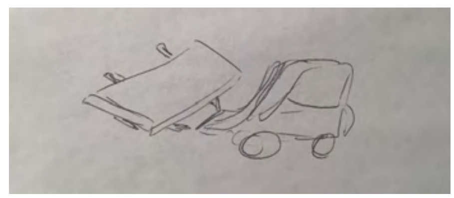
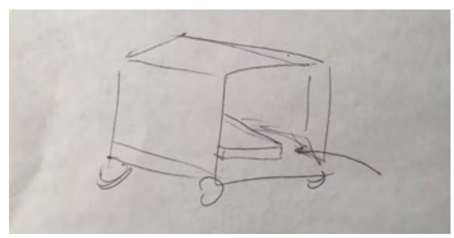
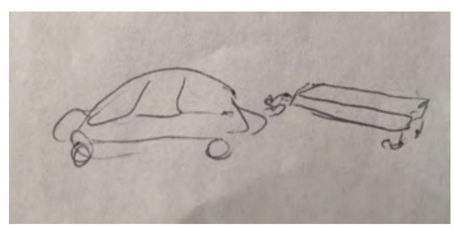
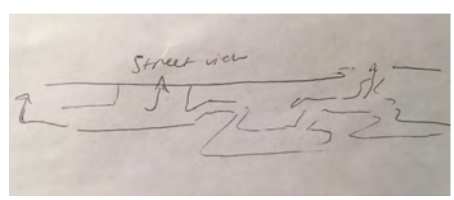
A. Ideas and Concepts

In order to generate concepts, two techniques were used: brute think and analogies. For brute think, we used two words to produce nine ideas of different levels of feasibility. The first word is octopus, which generated six ideas. The next word used was watermelon, which generated three concepts. As to analogies, we thought about mobile objects to which we could compare the Dero platform.

Table F1 - Summary table of concepts generated for mobility

Technique Used	Association / Analogy	Description of Solution	Visual Representation
1. Brute think	*Octopus* - propel bodies forward through water	Put an engine on Dero to propel it forward to next location like car	
2. Brute think	*Octopus* - have 8 tentacles	Add 8 or so connective pieces to be picked up by workers and carried	
3. Brute think	*Octopus* - have suction cups	Giant crane-like suction cup to stick to Dero and lift to move	

Technique Used	**Association / Analogy**	**Description of Solution**	**Visual Representation**
4. Brute think	*Octopus* - associate them with a cartoon I saw once of one wearing skates	Lift Dero up and put on already rolling platform (like giant skateboard) and roll around on that	
5. Brute think	*Octopus* - swim in water	Flood Northampton streets and float it to next location	
6. Brute think	*Octopus* - can get caught in fisherman's net	Scoop up Dero in giant net from up above and lift it to next location	
7. Brute think	*Watermelon* - they roll around	Change out feet of platform and add wheels to roll it around	
8. Brute think	*Watermelon* - can be smashed into a lot of small pieces	Completely disassemble Dero to easily move smaller pieces, then reassemble	
9. Brute think	*Watermelon* - spit out the black seeds while eating	Take out a few key bolts to make smaller pieces, full disassembly not required	

Technique Used	Association / Analogy	Description of Solution	Visual Representation
10. Analogies	Dero is like a bird, migrating around town	Put wings on the Dero and fly it around like a plane or drone from place to place	
11. & 12. Analogies	Dero is like a note getting passed around from person to person during class	Make Dero foldable to be more compact when moving	
12. & 13. Analogies	Dero is like a package being “shipped” from place to place	- Move it with a large fork lift - Put in a truck to transport	 
14. Analogies	Dero is like a mobile home trailer	Add hitch and have car drive it around to new locations	
15. Analogies	Dero is like the subway, stopping at different places along its course	Underground tunnels for it to travel through	

As the team moved into the concept selection process, we decided to focus on three of the most feasible concepts, which were:

- Partial disassembly to platform and transport via truck (1)
  Specifics: A few key bolts would be taken out so Dero can separate into railings, and two sections of the platform to take up a smaller area while moving. They would be moved in a truck which Wayne has confirmed the DPW has.
- Wheels secured onto platform and rolled to next location (2)
  Specifics: Wheels would be added directly to the Dero platform, along with a trailer hitch connection component to be attached to car and driven to chosen sites.
- Lift stationary Dero onto a rolling platform (3)
  Specifics: Two wheeled-dollies would be slid under the Dero platform, then the feet raised to lower the platform onto the dolly to be rolled around. Manufacturing of a connecting element between a car and the platform will need to be made.

B. Selection Process

The selected criteria for our concept screening refer mainly to the larger categories of our traceability matrix. Cost refers to design requirement DR-01 with the intention to build a low-cost parklet. DPW involvement is a concern communicated to our team by the Northampton Office of Planning and Sustainability. The safety criterion refers to design requirement DR-07 and the need to implement a public space that respects all regulations and avoids harm. Ease of implementation and manufacturing/purchasing complexity criteria were chosen as necessary requirements to allow an easy transition between stationary park and transportation and to allow mobility to be feasible.

We first used a concept screening as a selection tool and found that option 3 (with dollies) would be the least desirable solution. Then moving into a concept scoring process, we defined rating scales based on our chosen criteria and quantified the different levels of satisfaction. This resulted in differentiating concepts 1 (partial assembly) and 2 (wheels), with concept 2 as the final most desirable concept.

II. Purchased Wheel Options

A. Ideas and Concepts

The team made a second concept selection to examine and compare three specific wheels. We wanted to make the concept selection as precise and thorough as possible to determine the specific design we would finally choose.

The three selected concepts for adding wheels to the base are:

- (1) *Threaded Stem Caster* (see Fig. F1). With compatible ¾’’-10 thread diameter, these wheels will screw into the the same spots as the feet. Thus, for mobility the feet will be taken ot and replaced by wheels to roll. They will change back to feet for stability purposes while the parklet is stationary.

Heavy Duty Threaded-Stem Casters

Stem Caster with Total Lock | Long-Stem Caster

Our strongest threaded-stem casters have a thick metal frame for heavy loads and long service life. Wheels are nonmarking.

Swivel casters with total lock brake the wheel and lock the swivel in one operation.

Long-stem steel casters have a 4" long stem.

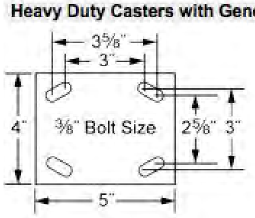
CAD For technical drawings and 3-D models, click on a part number.

Wheel Dia.	Wheel Wd.	Mount Ht.	Cap. Ea., lbs.	Stem Thread Size	Swivel	Swivel Each	Swivel with Locking Device: Locking Device	Swivel with Locking Device	Swivel with Locking Device: Each
Long-Stem Steel Casters									
Abrasion-Resistant Black Polyurethane Wheels—Extra-Hard (55D Durometer)									
6"	2"	7 1/2"	900	3/4"-10	9813T97	$35.79	Total Lock	9813T67	$56.15

Fig. F1 - Threaded Stem Caster Example from *McMaster-Carr*.

- (2) *Plate Caster Wheels + socket on top* (see Fig.2). In this design, the wheels will be more permanent, screwing in underneath the base and dangling down as the feet support it. Here, they do not need to come on and off each time, simply the feet will be screwed in more and the dero will be lowered onto the wheels.

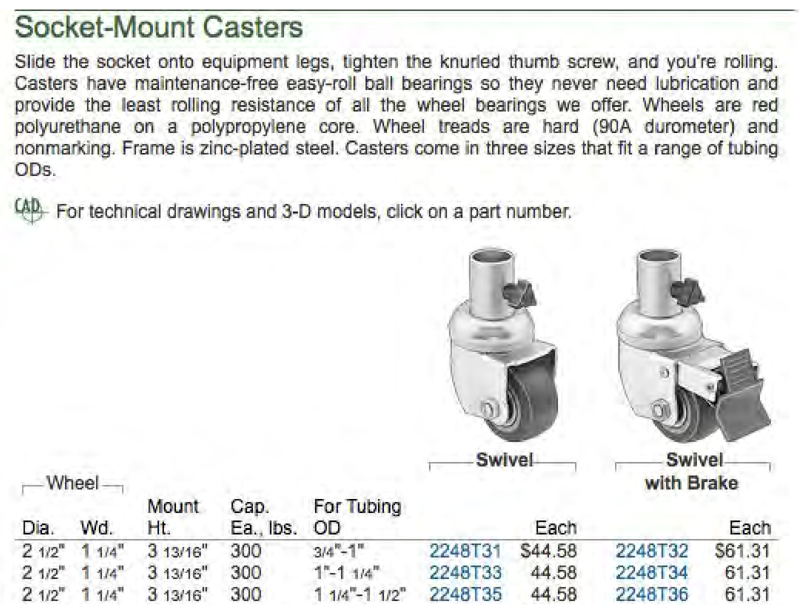
Heavy Duty Casters with General Purpose Wheel Bearings



Wheel Dia.	Wheel Wd.	Mount Ht.	Cap. Ea., lbs.	Swivel	Swivel Each	Swivel with Brake	Swivel with Brake Each	Swivel with Brake and Swivel Lock	Swivel with Brake and Swivel Lock Each	Rigid	Rigid Each	Rigid with Brake	Rigid with Brake Each
Abrasion-Resistant Green Polyurethane on Aluminum Wheels													
6"	2"	7 1/2"	1,230	2856T38	$81.44	2856T67	$131.11	2856T17	$162.70	2856T78	$46.03	2856T113	$93.08

Fig. F2 - Plaste Caster Example from *McMaster-Carr*.

- (3) *Socket Mount Caster* (see Fig.3). These wheels attach by allowing the feet to be placed inside of them, thus giving a very temporary wheel modification which does not require taking the feet out.



Socket-Mount Casters

Slide the socket onto equipment legs, tighten the knurled thumb screw, and you're rolling. Casters have maintenance-free easy-roll ball bearings so they never need lubrication and provide the least rolling resistance of all the wheel bearings we offer. Wheels are red polyurethane on a polypropylene core. Wheel treads are hard (90A durometer) and nonmarking. Frame is zinc-plated steel. Casters come in three sizes that fit a range of tubing ODs.

CAD For technical drawings and 3-D models, click on a part number.

Wheel					Swivel		Swivel with Brake	
Dia.	Wd.	Mount Ht.	Cap. Ea., lbs.	For Tubing OD		Each		Each
2 1/2"	1 1/4"	3 13/16"	300	3/4"-1"	2248T31	$44.58	2248T32	$61.31
2 1/2"	1 1/4"	3 13/16"	300	1"-1 1/4"	2248T33	44.58	2248T34	61.31
2 1/2"	1 1/4"	3 13/16"	300	1 1/4"-1 1/2"	2248T35	44.58	2248T36	61.31

Fig. F3 - Socket Mount Caster Example from *McMaster-Carr*.

The criteria used for this selection were determined by our traceability matrix and the primary characteristics that define mobility. Cost, interference with stability and withstandable load are related to DR-01 and DR-07, in order to respect budget and regulations. Mounting complexity allows the implementation of the mobile parklet to be more or less feasible.

B. Selection Process

Just as for our previous general mobility concept selection, we performed a concept screening, which did not significantly eliminate any of the three wheel options. Therefore, we proceeded with a concept scoring stage. The criteria used for this selection were determined by our traceability matrix and the primary characteristics that define mobility. Cost, interference with stability and withstandable load are related to DR-01 and DR-07, in order to respect budget and regulations. Mounting complexity allows the implementation of the mobile parklet to be more or less feasible. The rating established the socket mount casters (option 3) as the type of wheel to move forward with.

III. Custom Wheel Options

A. Objectives

Once we had completed initial concept selections, our team realized that it would be particularly interesting to design and fabricate custom wheels for the Dero platform. The intention was to create custom-built wheels that could potentially be sent to Dero as add-ons for their platforms. The company would then be able to promote mobile parklets as a commercial product. Our objective in exploring the idea of custom-made wheels was also to simplify the transportation of the Dero platform and find a mobility solution that was practical and immediate for the Dero platform.

Since the team intended to take Solidworks and prototyping training over J-term, we decided to move forward with the custom-made wheel designs, which would be based off of the socket mount casters, chosen in the previous concept selections. The main challenge in designing self-made wheels was the attachment and connection mechanism, which we brainstormed ideas for. We documented some of our initial custom concepts in section III. B.

B. Ideas and Concepts

1. Bolt Lock

One of the fastening concepts we explored was a locking mechanism, using a pin, bolt, or screw. The wheel would be attached to a socket mount which could be easily installed by simply locking the mount with a bolt (see Fig.4).

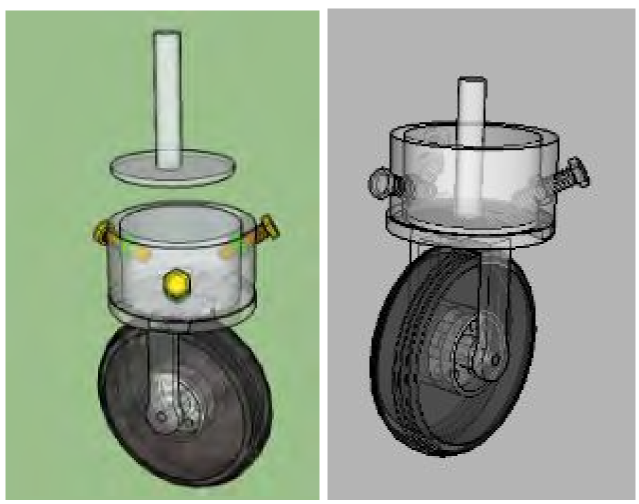


Fig. F4 - Sketchup model of bolt lock mechanism

2. Sliding Lock

Another concept we generated was a sliding link that would mount and lock into the wheel socket (see Fig.5). The interesting aspect of this idea was that it did not involve any additional tools or materials for installation.

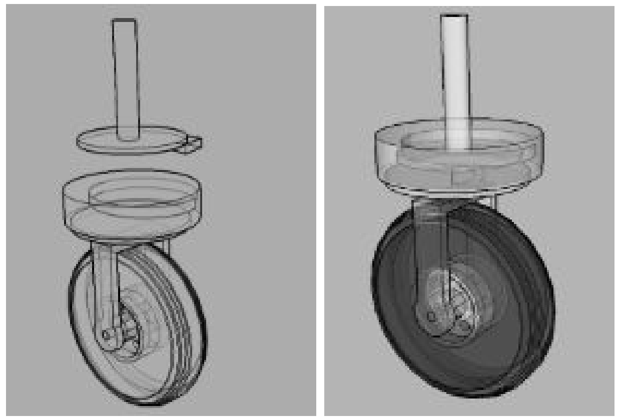


Fig. F5 - Sketchup model of sliding lock mechanism

3. Threaded Lock

Our third concept consisted of a threaded mount. The wheel would then lock into place by screwing in the two parts of the socket (see Fig.6). Just as the previous design, this concept would be practical in terms of installation, but more difficult in terms of fabrication.

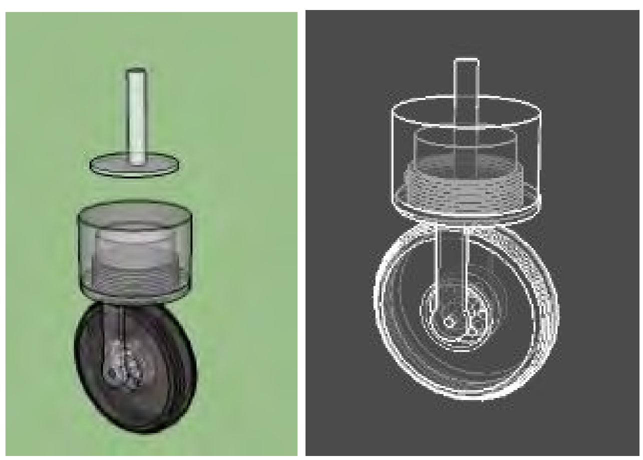


Fig. F6 - Sketchup model of threaded lock mechanism

Concept Selection Phase 2: External Advice

IV. Northampton Office of Planning and Sustainability

A. Meeting Summary (Feb 03, 2017)

After the J-term break, our team was ready to move forward with the custom wheel designs. We met with the Northampton Office of Planning and Sustainability (NOPS) lead to explain our intentions and clarify the logistics involved around our designs. Beyond our questions about general pavement or sidewalk occupancy rules, we asked about how plausible it would be to hitch the Dero platform to a car, without having it registered as a trailer.

Some of the issues mentioned by our liaisons addressed public property concerns, noise complaints, and weather conditions. Concerning the aspect of mobility, it was suggested to the team that the towing the platform on the road would require support from the Department of Public Works (DPW) and perhaps even the Northampton Police Department. The NOPS leadership agreed with most of our decisions and suggested that we meet with the DPW engineers to verify the road regulations. NOPS was curious about how we would be able to install wheels and secure a static platform when the wheels are not present. We explained that by making custom wheels, we were trying to address these exact questions and find a solution that would both facilitate mobility implementation and still preserve the safety of the public platform.

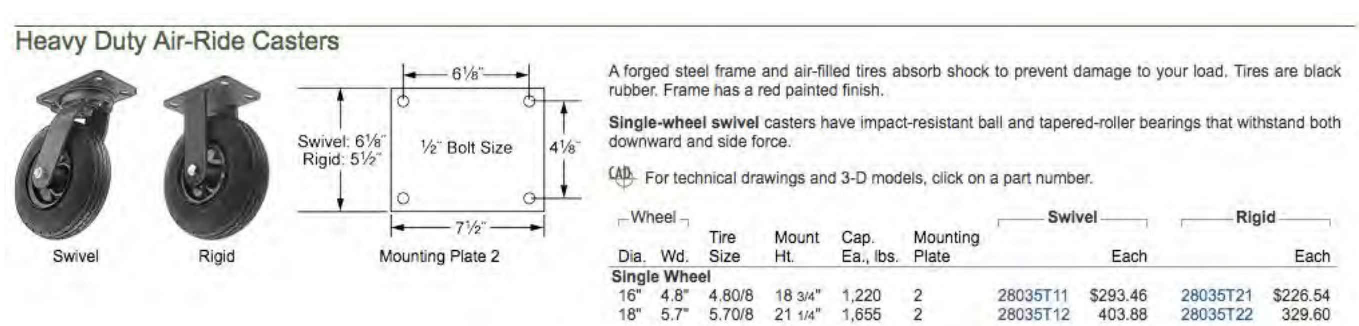
B. Conclusion of Meeting

Following this meeting, our team decided to research regulations regarding towable vehicles. We included these regulations into the Traceability Matrix. The modifications were mainly concerned with the maximum speed [1] of the vehicle connected to the Dero platform, trailer regulations [2], and the load each wheel would need to withstand. Our research and our conversation with NOPS led us to realize that the wheels we had initially selected from our concept selection might not be strong or large enough to be road-worthy. Therefore, our design ideas now included various more road secure possibilities.

One of our ideas was to use an inclining trailer (see Fig.7), onto which the Dero platform with wheels could roll. The major inconvenience with this proposed idea was the cost of the project, which would increase by about $10,000. Nonetheless, this solution would allow the Dero parklet to be fully mobile and transportable through the city. The addition of wheels under the platform would allow it to be adjusted locally and trailed onto the tilted deckover. The wheels attached to the Dero platform would be the custom wheels mentioned in section III. B.

Fig. F7 - Specifications of a 26ft deckover tilt from *PJTrailers*

Our other road-worthy concept was to use larger caster wheels (as shown in Fig. F8). Using larger heavy duty casters would allow the Dero platform to be freely moved downtown, but posed the additional problem of mounting and unmounting a component of a significant height. The other problem rising from this concept was the attachment mechanism that would secure the casters in a way that is also removable. Another concern was the idea that the platform would have to be registered as a trailer, and thus require many more components.



Wheel Dia.	Wheel Wd.	Tire Size	Mount Ht.	Cap. Ea., lbs.	Mounting Plate	Swivel	Swivel Each	Rigid	Rigid Each
Single Wheel									
16"	4.8"	4.80/8	18 3/4"	1,220	2	28035T11	$293.46	28035T21	$226.54
18"	5.7"	5.70/8	21 1/4"	1,655	2	28035T12	403.88	28035T22	329.60

Fig. F8 - Specifications of heavy duty air-ride casters from *McMaster-Carr*.

The two concepts discussed above became our main focus at this point of the project. We hoped that the DPW engineers could give us more insight on the various questions that arose, since they were the individuals most concerned with public transportation regulations and logistics. We were interested in learning about the engineers' experience with transporting the Dero platform so far, as well as their opinions on our proposed solutions, since our main goal was to make their work easier.

V. Department of Public Works

A. Meeting Summary (Feb 07, 2017)

David Veleta, the acting city engineer of the Northampton DPW met with us to answer our questions. He informed us that the current method of transporting the Dero platform involved hoisting the platform with a fork lift (through the middle of the structure, with the help of wooden reinforcement along the width of the base) onto a truck. This system was necessary because he noticed that the length of the Dero parklet presented significant bending. One of his main concerns with our tilted trailer concept was how we would hoist the platform on it despite the wheels. He suggested methods such as winches, pulleys, or cables, but emphasized his skepticism towards this solution for its impracticability.

As to the larger custom wheel option, Mr. Veleta advised us to take into account the lateral load that the wheels would add to the whole system. He also stated that the only way to allow this kind of non-registered trailer to be wheeled around downtown would require individuals to push it. The only towable vehicles are trailers, which have specific dimensions and regulations. Having people push the parklet around would necessitate police detail, and would probably have to happen at early or late hours, since roads would need to be closed. All of these additional issues that we had not yet considered made this option less desirable.

On a positive note, Mr. Veleta confirmed that our load calculations were correct and that our solution to add two additional middle feet was enough to reinforce the Dero base. One of his suggestions was for us to evaluate the possibility of registering the Dero platform as a trailer. This would however require a considerable amount of work, seeing as we would need to find a way to store the trailer wheels and equipment when the parklet is static. Having a "parklet trailer" would also require a considerable effort towards designing custom parts and accessories for the platform.

B. Conclusion of Meeting

Given the mentioned concerns about the force needed to move the entire parklet, we calculated the average amount of individuals needed to push the Dero (see Fig. F9). We concluded that having the parklet be wheeled around by individuals would not be a viable option, as this would require at least seven people and a significant amount of public obstruction, and that theta=15 degrees.

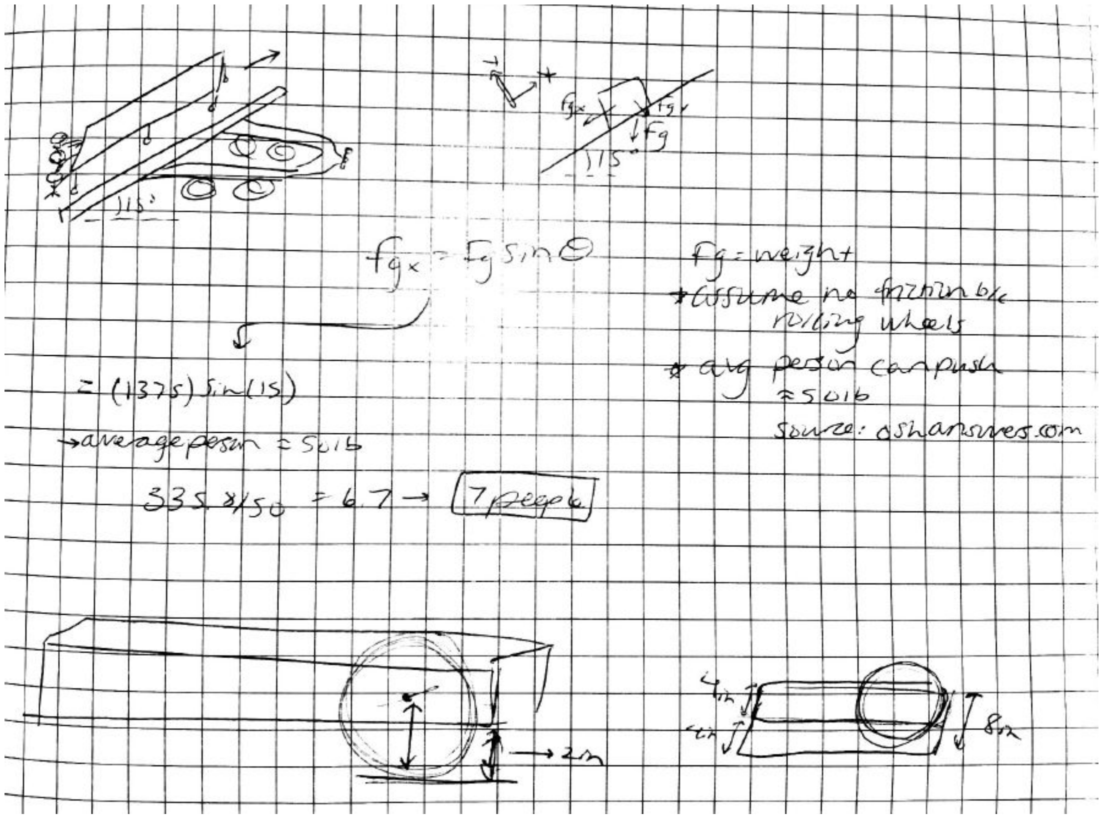
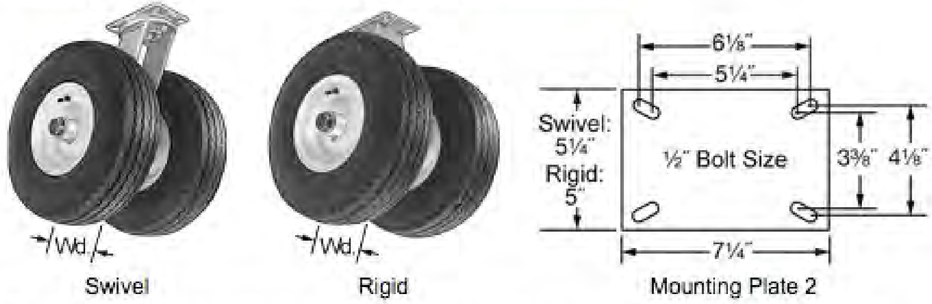


Fig. F9 - Force calculations according to Dero platform weight.

Seeing as using a tilted trailer would be considerably expensive and would need some kind of hoisting mechanism, our team decided to reject the tilted deck concept. Instead, we considered Mr. Veleta's suggestion to transform the parklet into a trailer. For this, we needed to use road worthy heavy duty casters (see Fig. F10) and design a connecting mechanism that would be easy to mount and unmount, as well as store. We generated multiple concepts, which prioritized simplicity and ease of fabrication. Some of these concepts involved a clamp system or a rotating wheel shaft (see Fig. F11). Other concepts extended our previous ideas with new types of locking systems, solid enough for 12in-16in diameter wheels (see Fig. F12 - Fig. F13). The process of concept generation used was brainstorming and precedent research. The team generated concepts inspired by suitcase wheels, concert platforms, and theater rolling risers.

Heavy Duty Easy-Turn Air-Ride Casters



Dual wheels provide better load distribution and easier turning than single-wheel casters. Casters have a zinc-plated steel frame for durability.

CAD For technical drawings and 3-D models, click on a part number.

Wheel Dia.	Wheel Wd.	Tire Size	Mount Ht.	Cap. Ea., lbs.	Mounting Plate	Swivel	Swivel Each	Rigid	Rigid Each
Black Rubber Pneumatic Wheels									
16.3"	4.8"	4.80/4.00-8	19 1/8"	2,000	2	23585T31	$474.11	23585T41	$399.09
18.4"	5.7"	5.70/8	21 1/4"	2,340	2	23585T11	481.60	23585T21	412.46

Fig. F10 - Specifications of Heavy Duty Easy-Turn Air Casters from *McMaster-Carr*.

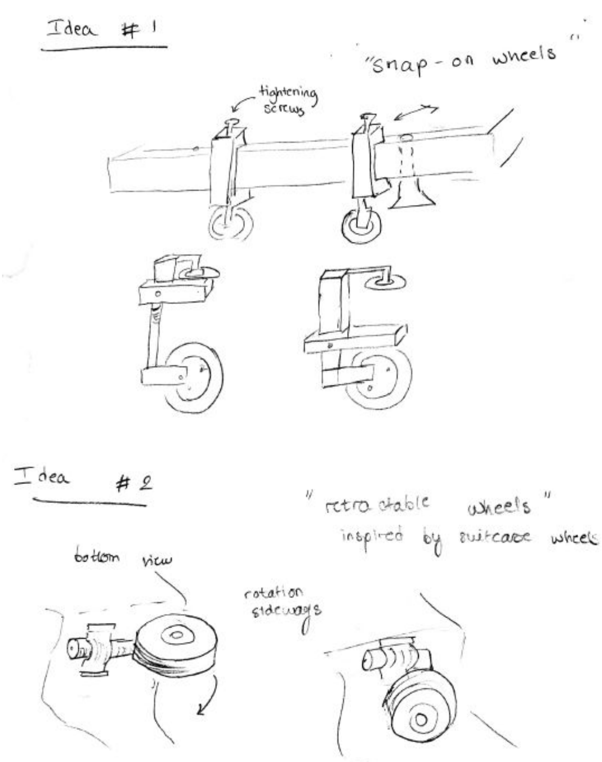


Fig. F11 - Concept generation ideas for clamp and rotating shaft mechanisms.

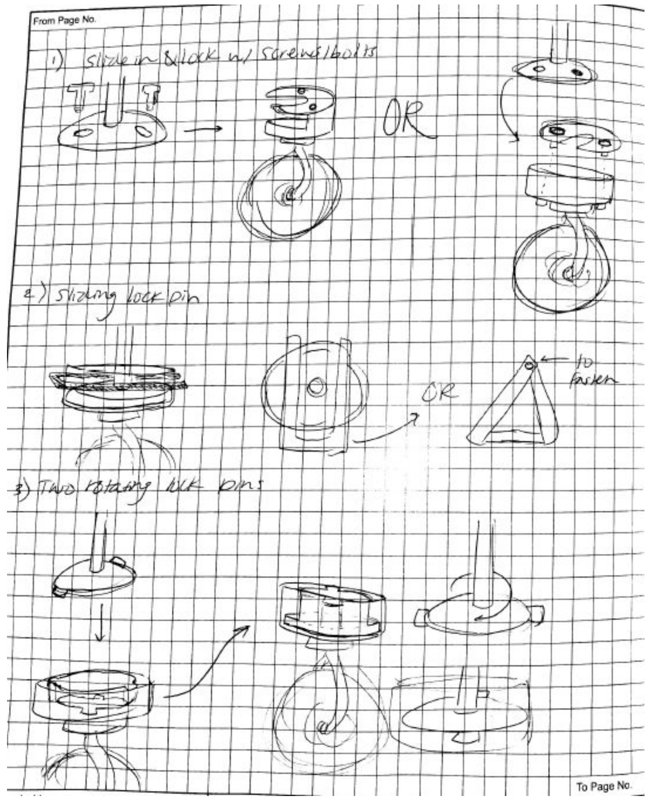


Fig. F12 - Concept generation ideas for locking system extension (part 1).

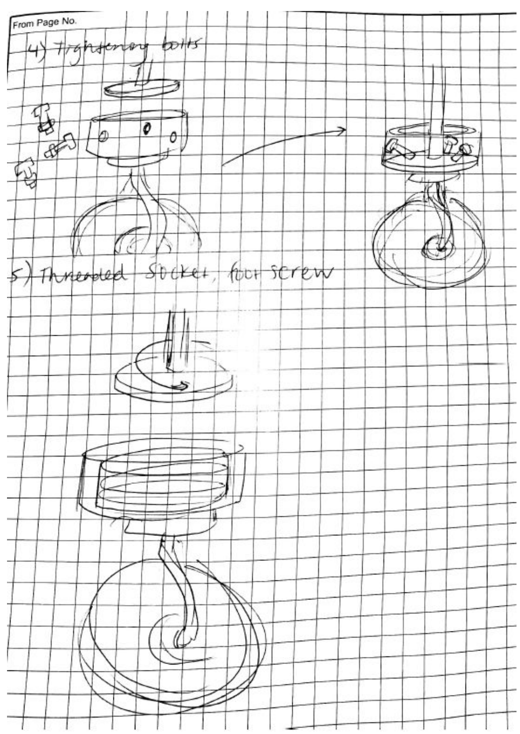


Fig. F13 - Concept generation ideas for locking system extension (part 2).

The team also researched the accessories needed to have a fully functioning trailer. As seen in Fig. F14 below, the parklet would require a lighting system that would plug into the towing vehicle's 4-way plug. Additionally, mirrors and hitching cables needed to be purchased and included as additional materials. Many of these accessories can be bought in trailer kits (see Fig F14 -Fig F15) and would be stored in the DPW or with the other parklet furniture, currently kept in a building next to the Northampton Sanitary Landfill .

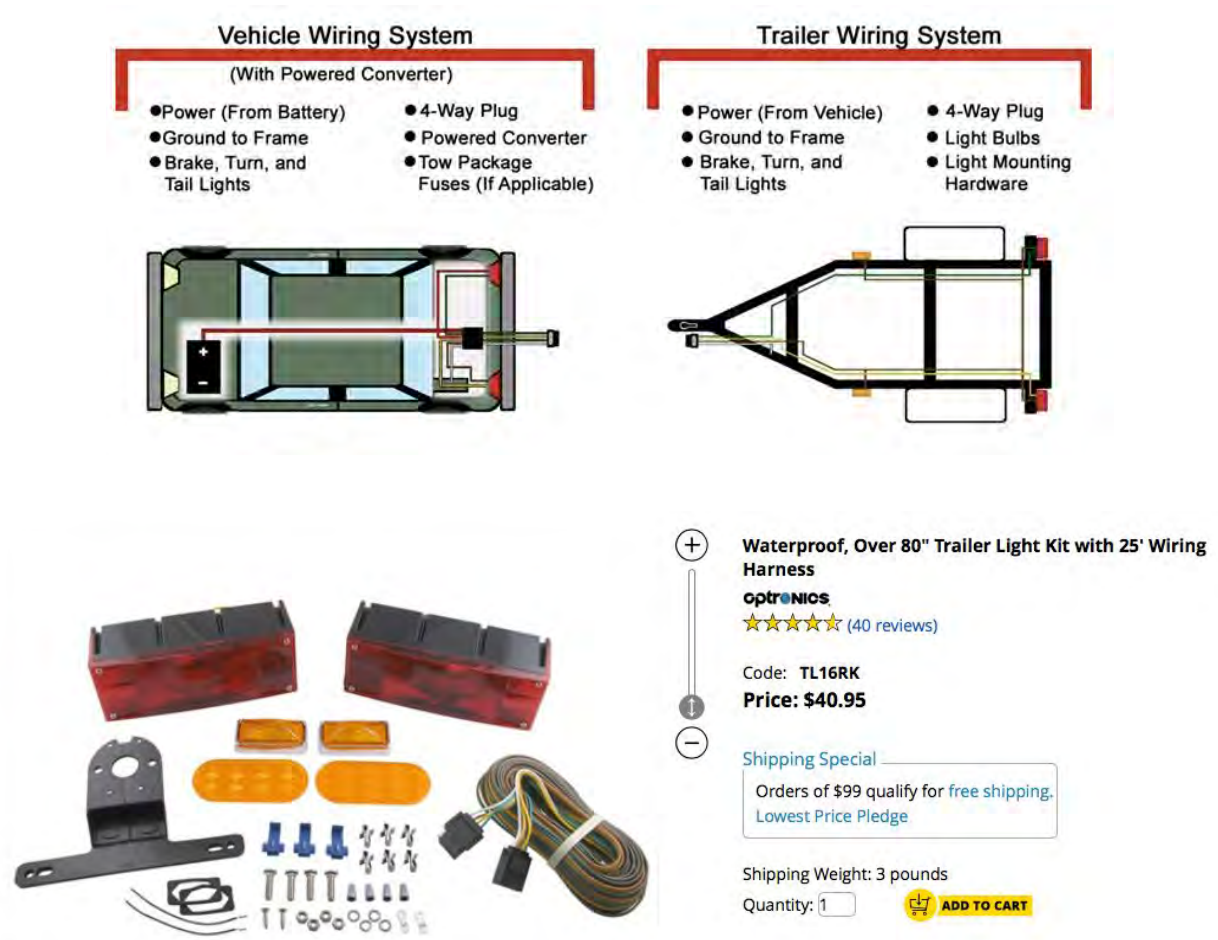


Fig. F14 - Trailer lighting system schematic.

Fig. F15 - Trailer accessories for sale from etrailer.com.

VI. Center for Design and Fabrication

A. Initial Ideas

From the generated concepts presented in section V. B., we selected three main mechanisms based on feasibility and simplicity to present to the Center of Design and Fabrication (CDF) for additional feedback. These design concepts included a swivel wheel, which would allow the parklet wheels to always be attached to the platform. This means that there would be no installation and no storage issues involved. However, this system would not be able to be implemented in the front of the platform, given the obstructing curb ramp (see Fig. F16). The second selected concept was a removable wheel, which would only involve screwing in the casters on a clamp. This mechanism would be easy to fabricate and install, but still did not solve the problem of the front curb ramp. The last selected concept is a wheel mount which would clamp the edges of the base structure from the bottom. This concept would allow an even distribution of loads, since the wheel layout would be a symmetrical (with two feet on each long side of the parklet and one wheel on each short side of the parklet). Nonetheless, this option would be slightly more difficult to implement, since it would involve working from the bottom of the platform. Given that we were not certain of the available space between the steel beams and the wooden platform, choosing this concept would also mean taking a significant design risk.

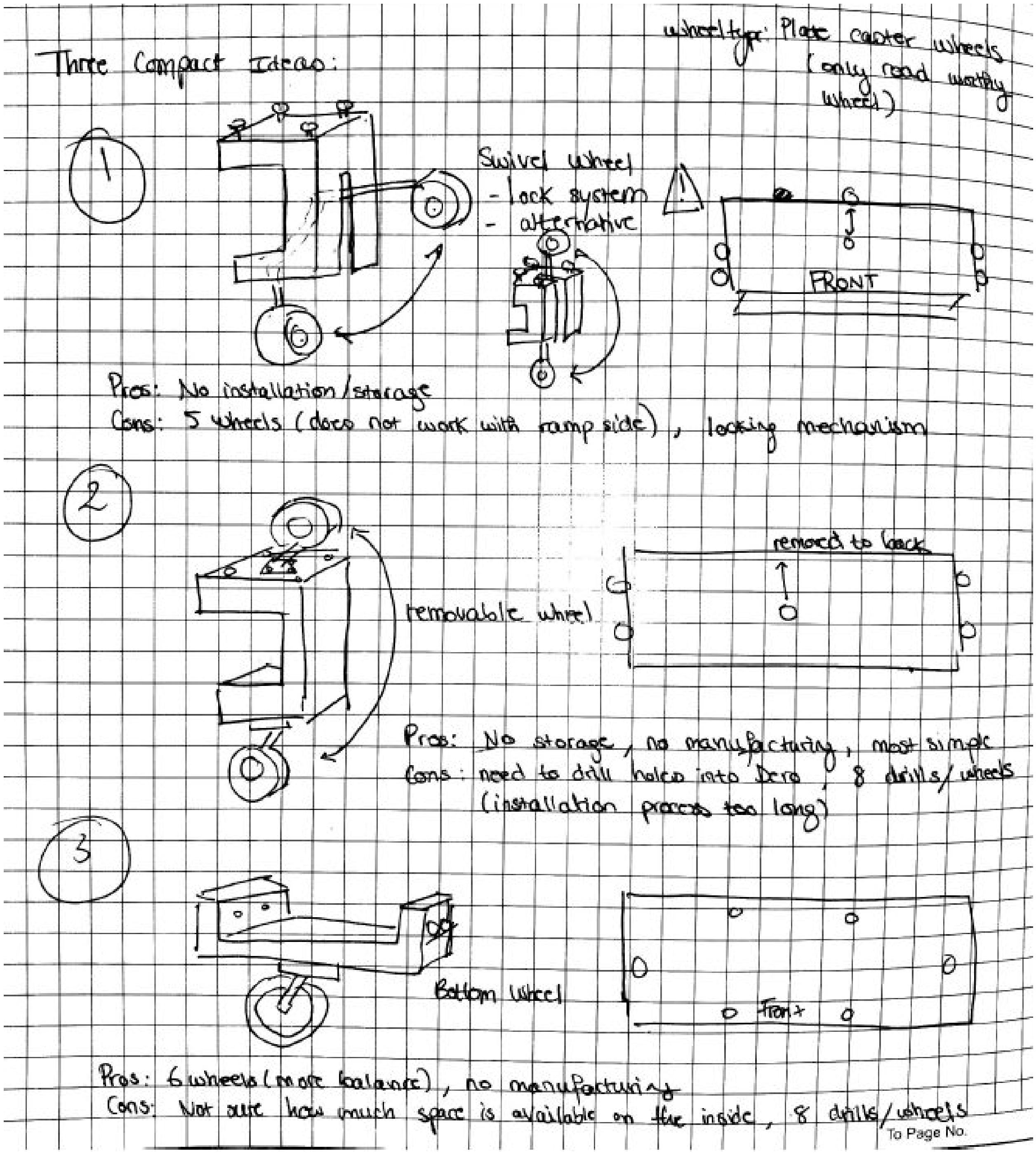


Fig. F16 - Three main selected wheel mount concepts presented to the CDF.

B. Meeting Summary (Feb 20, 2017)

The meeting with Eric Jensen at the CDF was the last concept selection review meeting we would need before moving into the development of our final selected concept. After reviewing our three concepts (see Fig. F16), Mr. Jensen brought to light a central design aspect that we had still not fully considered, despite our extensive research, modifications, and meetings. He was concerned with the way we intended to attach the parklet to a car, which so far involved simple hitching cables. Since neither of our designs included wheels that were linked by a central axle, the parklet would float relatively freely behind the car. This posed several road safety hazards. First, without a hydraulic system or a metal frame, the parklet trailer would have no means of stopping on the road except by bumping into the towing vehicle. Furthermore, our design did not take into account the many curb changes in downtown Northampton, which would affect the platform's independent wheels in uncontrollable ways.

To address these safety problems, our team brainstormed ideas with Mr. Jensen. One of the solutions was to use an axle connected pair of wheels in the middle and two independent swivel wheels in the front and in the back. This would allow rotational motion, as well as a way to direct the parklet safely. However, this solution would be complex to implement, given that one would have to slide the axle beneath the Dero platform and secure it on the wheels, which requires extensive tools and space. Moreover, having only four total wheels might not be enough to preserve the stability of the entire structure. Another proposed solution was to use two dollies that could slide beneath the Dero platform and support it from the middle. However, this was also an imperfect solution, since the dollies could not be more than a few feet apart. If the dollies were only holding the weight of the Dero platform from the center, the parklet might bend and fall from either side.

C. Conclusion from Meeting

Although it was a difficult decision, our team decided to reject the idea of transforming the Dero parklet into a trailer because there were too many complications involved with making it road- worthy. We concluded from our meeting at the CDF that it would be wiser to prototype custom wheels for the Dero platform that would simply allow it to adjust locally and be more easily rolled onto a trailer, if need be. Although we explored the possibility of implementing road-worthy wheels, of registering the parklet as a trailer, and of buying a tilted deck for it to roll onto, we finally reverted to a mobility solution that was closer to our initial concept generation idea from section III. The design that Mr. Jensen and our liaisons seemed to prefer was the swivel wheel design that would not involve any kind of additional installation effort. The wheel would simply be "flipped up" when the parklet needs to be static.

Selected Concept

The final concept (see Fig.17) addressing the mobility of the Dero parklet is a swivel wheel that would use two rotating hinges and a pivot boss pin to lock into place. The mechanism would allow the wheel to be placed vertically and support the load, while the parklet needs to be adjusted into a parking space. The hinges would then allow the wheels to fold up and lay above the parklet steel beams when the parklet is at rest.

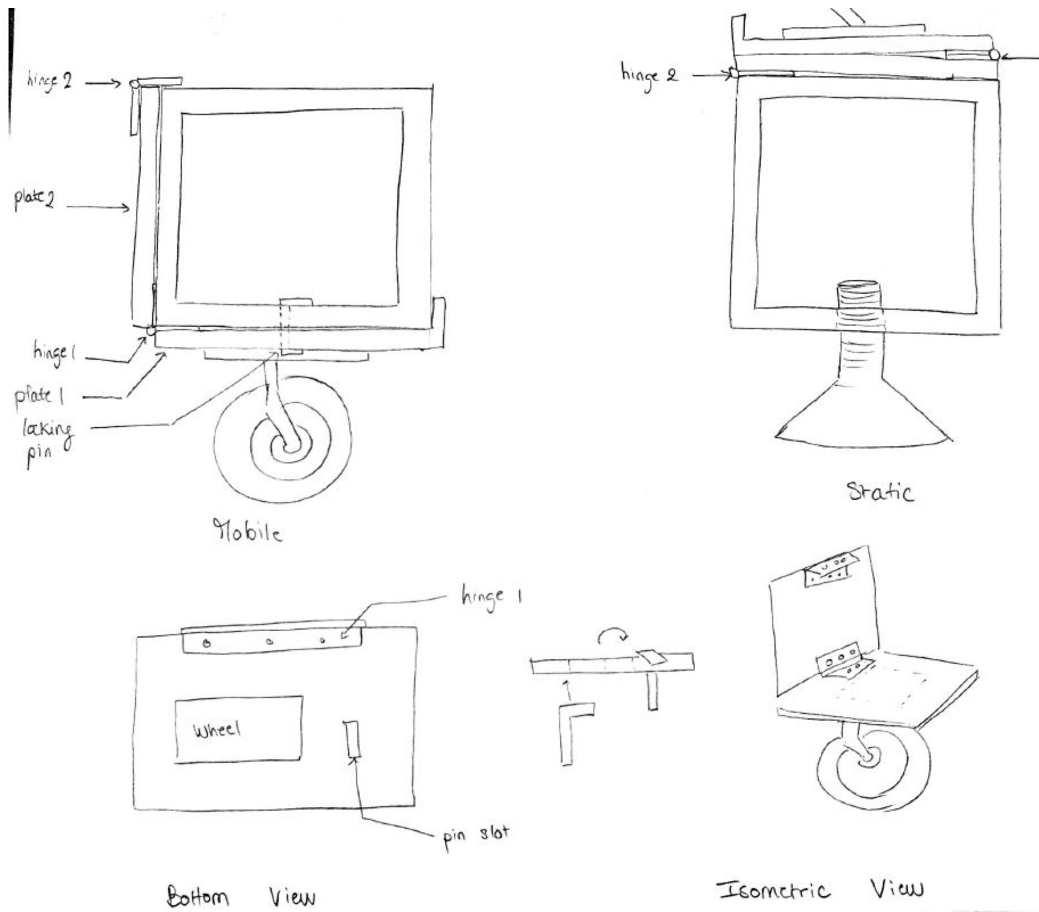


Fig. F17 - Drawing of final selected concept.

The design will require purchasing the following items per fabricated wheel attachment:

- 2 hinges
- 1 6-inch caster (see Fig. F18)
- 12 screws
- 2 metal sheets
- 4 screws for securing the wheel plate

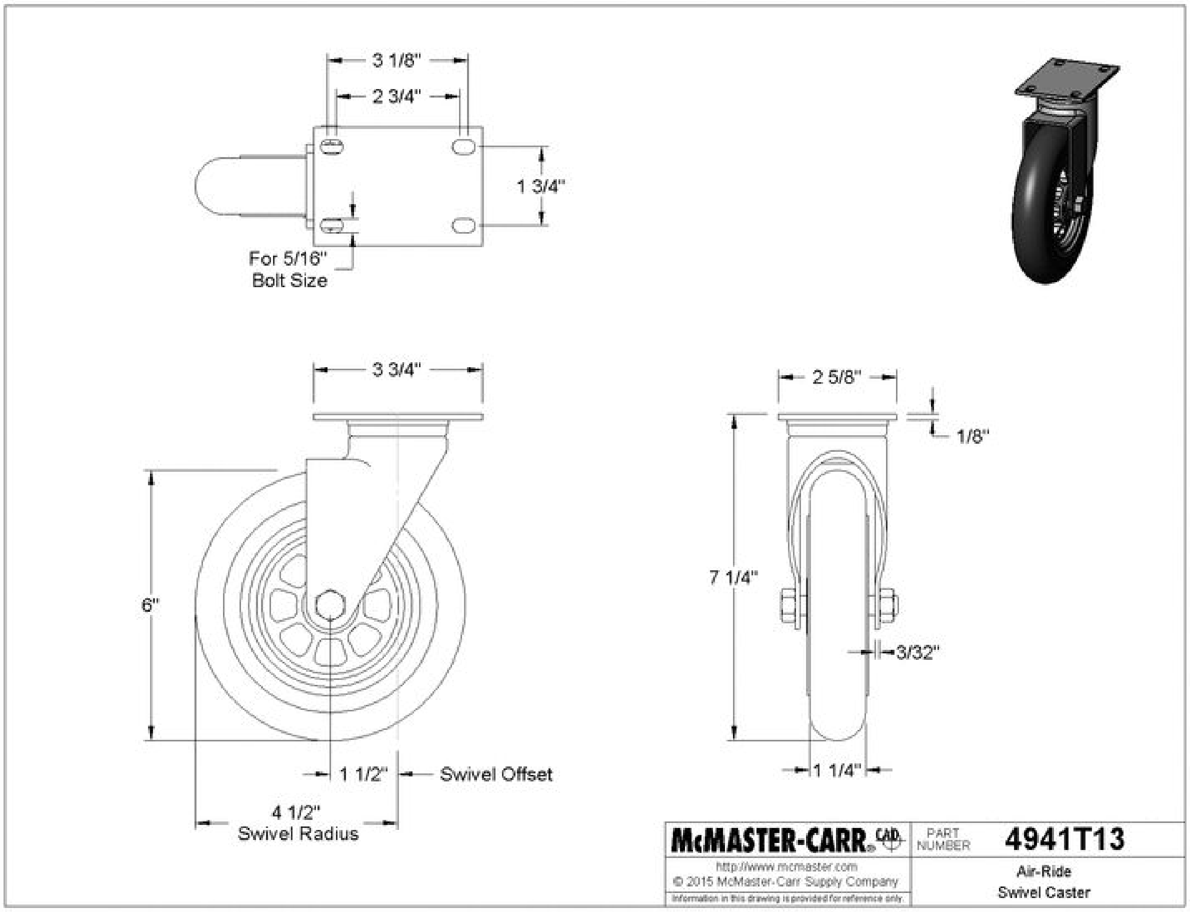


Fig. F18- Example caster wheel from *McMaster-Carr*.

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[2] "Massachusetts Trailer Laws & Regulations." Trailers.com. N.p., n.d. Web. 24 Feb. 2017. <http://trailers.com/state-laws/massachusetts.php>.

[3] "Professional Grade Trailers in the USA." PJ Trailers Dump, Gooseneck, Tilt, Equipment, ATV, & Utility Trailers. N.p., n.d. Web. 24 Feb. 2017. <http://www.pjtrailers.com/>.

[4] "McMaster-Carr." McMaster-Carr. N.p., n.d. Web. 24 Feb. 2017. <https://www.mcmaster.com/>.

[5] Liszewski, Andrew. "The First Suitcase With Wheels That Retract So They Don't Get Destroyed." Gizmodo. Gizmodo.com, 07 Apr. 2015. Web. 24 Feb. 2017. <http://gizmodo.com/the-first-suitcase-with-wheels-that-retract-so-they-don-1696268182>.

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Appendix G: Concept Selection of Dero Modifications

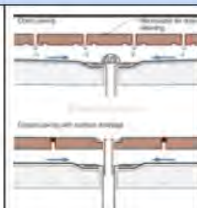
This appendix explores the selection process of Dero Modifications that the NOPS team compiled in order to meet the main stakeholder needs. The first phase was concept generation (Table. G1) in which we brainstormed ways of making the Dero mobile. We selected concepts by going through a two-tiered process of weighting the various factors involved to come out with the best solutions. The main concept selection criteria include drainage, adjustability, accessibility, mobility, and stability. The process and the outcomes of the selection process are shown in this Appendix.

[Table. G1] Summary Comparison Table for Dero Base Modifications

	Specifications	Cost	Source	Pros/Cons	Figure	Design Requirements / Considerations
Accessibility						
Modular Ramp (bolted)	Every 50cm (spacing between bolts) provide either curb ramp or road ramp (2 lengths)			Pros: - Effective - Modular - Customized for each location Cons: - Cost - Complexity		• <2.0% slope • <1/2" surface • Barriers on edges, wheel stops, soft hit posts, railings, and cables • Space has a 30" by 48" deep clear floor area • The space has a circular area 60" minimum in diameter for a 360° turn
Single Ramp	Use one plate for entire ramp			Pros: - simplicity Cons: - Long when curb is there - Difficulty for transportation?		
Modular Ramp (retractable)	Have alternating retractable ramps (2 lengths)			Pros: - Modular - effective Cons: - Complicated - Implementation difficult		

	Specifications	Cost	Source	Pros/Cons	Figure	Design Requirements / Considerations
Adjustability						
Adding and removing square pieces	Dero comes as square components that can be added together to make a parklet of any length desired. Can buy more to allow more possibilities in length	Cost - determined by contacting Dero for a quote	http://www.dero.com/product/dero-parklet/	Pros: - Can choose length and how many parking spaces to take up - Can have more room on Dero if desired/need be, or can make it small a fit it into smaller spaces Cons: - Harder to store and move more pieces - With more square modules, more space will be take up on street, i.e. more parking spaces		• Must not negatively affect safety of Dero • No hindrance to mobility
Adjustable feet	Raise and lower feet as necessary to match curb height or road level. Can make it up to x ft high and can make it level (0°) on virtually any road surface		http://www.dero.com/dero/dero-designs-its-first-parklet-to-help-cities-and-businesses-add-space-and-vibrancy-to-streets/	Pros: - Adjustable to most road surfaces - Can raise and lower - Can put the parklet at a small-angled tilt for drainage Cons: - Currently missing two, will need to buy more - Hard to adjust with weight of the platform on the feet		

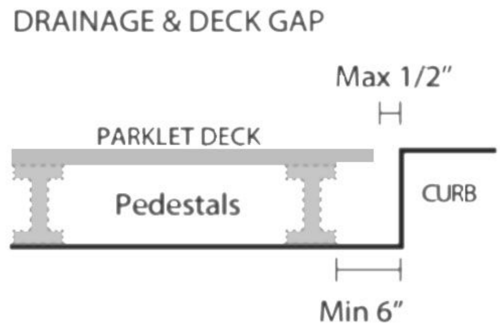
	Specifications	Cost	Source	Pros/Cons	Figure	Design Requirements / Considerations
Mobility						
Dero on wheels	Wheel replacements where feet are now. Compatible screwing into Dero technique (same diameter threading) on wheel replacements		http://carbusters.org/2011/10/08/parking-day/	Pros: - Can be on feet and stable when its a park and wheels when we want to move it - Won't require team of DPW workers to move it - Easy - Reasonable inexpensive and safe compared to adding permanent wheels Cons: - Would have to find these exact wheels or manufacture them which would make them potentially unsafe		• Shafts must be able to withstand loading • Swivel so it can be moved sideways out of parking space, then forward • Won't be unsafe to other cars or pedestrians • Quick process, won't clog up a lane of the road for too long (~5 minutes)
Trailer attachment	Add a piece that could be attached to a trailer hitch on a car so it can be essentially driven from location to location		http://www.hondapartsdeals.com/product_reviews_info.php?products_id=216&reviews_id=171	Pros: - Easier to pull around Cons: - Adds a piece that might jut out on side or into park and take up space - Will have to buy piece and securely attach		
Partial disassembly and truck	Assess structure of Dero with all it's pieces and how they connect. Determine easiest way to take apart 3-5 key connections to undo. Once		http://hubpages.com/sports/Homemade-Camping-Truck-Bed-Storage-And-Sleeping-Platform	Pros: - Won't require any modifications directly to Dero - Safer Cons: - Either need to rent a truck each time it's moved or need a truck that can be used for this whenever necessary - Will take DPW workers to do the disassembling/reassembling - more work required for the process	Similar to: 	

	Specifications	Cost	Source	Pros/Cons	Figure	DR/DC's
Drainage						
Permeable Deck	Pervious wooden deck: Usually made out of wooden plastic composite (e.g. for swimming pools), installed with layers underneath which water is filtered and directed into drainage or a catching system or directly the road.	Permeable wooden deck prices: $130 - $1,000	Concrete pervious pavements: http://www.pavementinteractive.org/article/permeable-pavements/ Rooftop permeable decks: http://www.oahi.org/waterproofdecks.pdf	Pros: - Very effective - Interesting design Cons: - Most costly		-Allow rainwater to flow along the curb without obstructions. -Ability to access drainage channel if it is blocked -Street drains must not be blocked -Drainage provisions need to accommodate the long-term viability of any proposed planting.
Drilling Holes	Drill a specified number of holes in wooden area (specify diameter)	$0	http://ths.gardenweb.com/discussions/2612233/drill-holes-in-slab-to-drain-garage-flr-low-spots	Pros: - Cheap - Effective Cons: - Less aesthetic		
Deck Gap	Rainwater passes underneath the structure thanks to a gap: minimum 6-inch horizontal gap between the curb and the base of the frame and a minimum 2-inch vertical gap between the street surface and the bottom of the parklet decking	Elevation feet /pedestals: Bison pedestals $10-$30 / pedestal	http://www.seattle.gov/transportation/docs/parklets/Parklet_Handbook_DIN.pdf	Pros: - Easy to implement - Cheap Cons: - Drainage not uniform - Need to slightly incline the parklet - Depends on the existing curb and location		
Drainage Channel	Built-in drainage chanr retain the existing flow of curbside drainage, designed in such a way that regular clearing of debris is possible so that a clear route to the nearby catch basins can be maintained.	Public Space drainage: $20 - $200	http://vancouver.ca/images/web/pdf/parklet-design-construction-manual.pdf	Pros: - Independent from location - Relatively cheap Cons: - Makes structure heavier - Requires more maintenance (in case objects get stuck in the channel)		

Concept Selection Outcomes

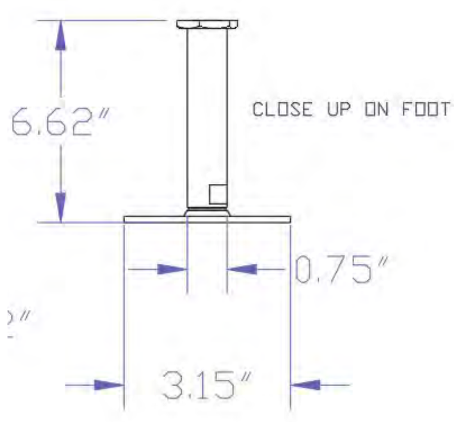
For the modifications to the base, there were five main categories of design requirements we selected solutions for. The categories, the selections, and appropriate figures and pictures are shown below.

Drainage - Deck gap was chosen to allow water to run underneath the parklet (see Fig. G1)



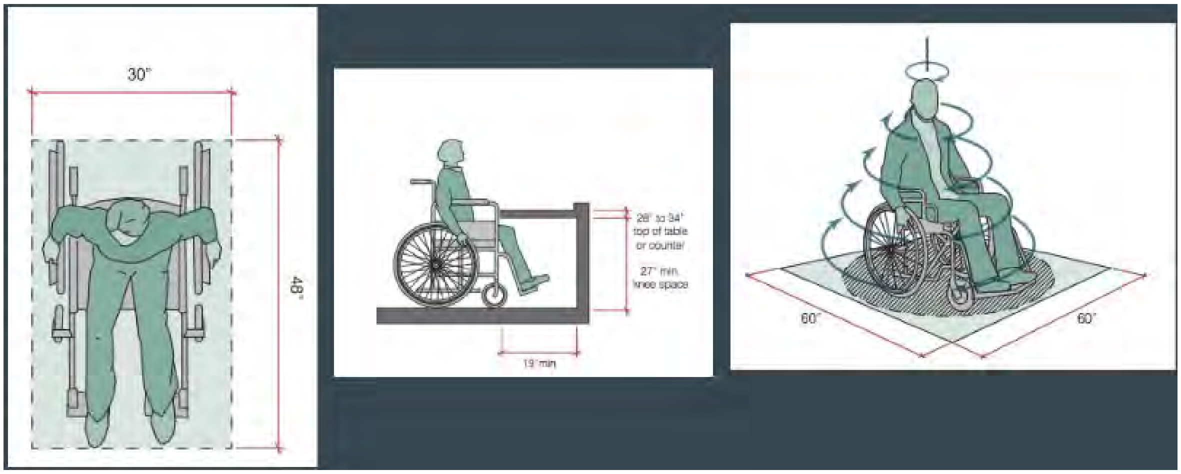
[Fig. G1] Deck gap showing drainage solution

Adjustability - Leveling feet (see Fig. G2) screw in and out of the base to allow the parklet to raise or lower to any height curb. Based on maximum safe leveling adjustability, the feet can be screwed up to hold the parklet 2.5" above the road, allowing the road a maximum slope of 3.3% in order to keep the parklet level.

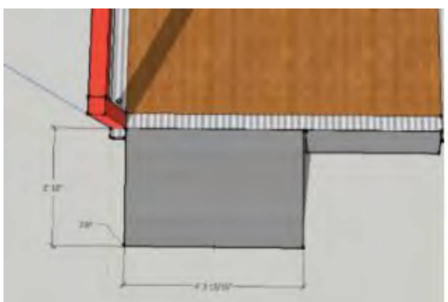


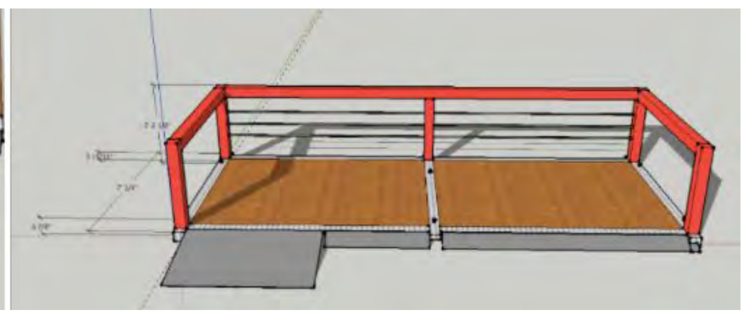
[Fig. G2] Leveling feet

Accessibility - Wheelchair accessible ramp on any height curb, length of 5 ft, width of 4 ⅓ ft (see loading calculations under stability) with storage space for wheels underneath. At least a 5 ft diameter of rotation on any design layout for upper portion (see Figs. G3-G6 for visuals).

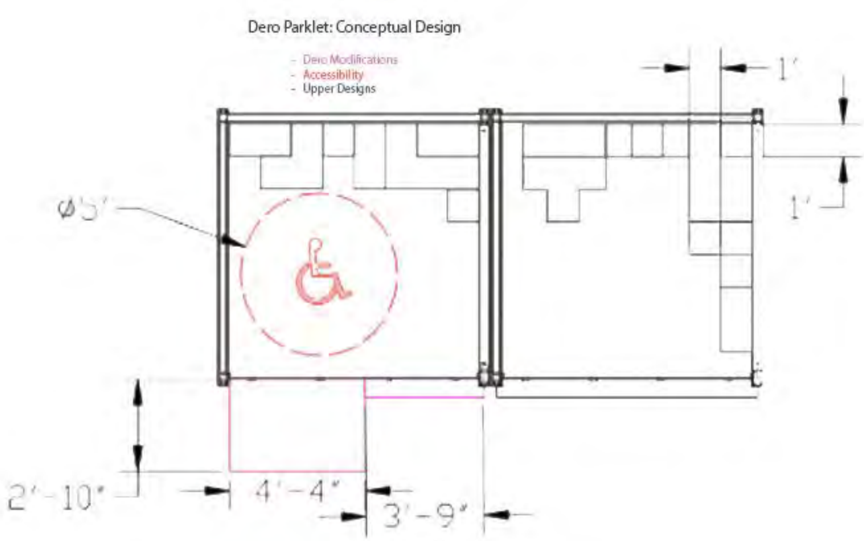


[Fig. G3] Wheelchair accessibility





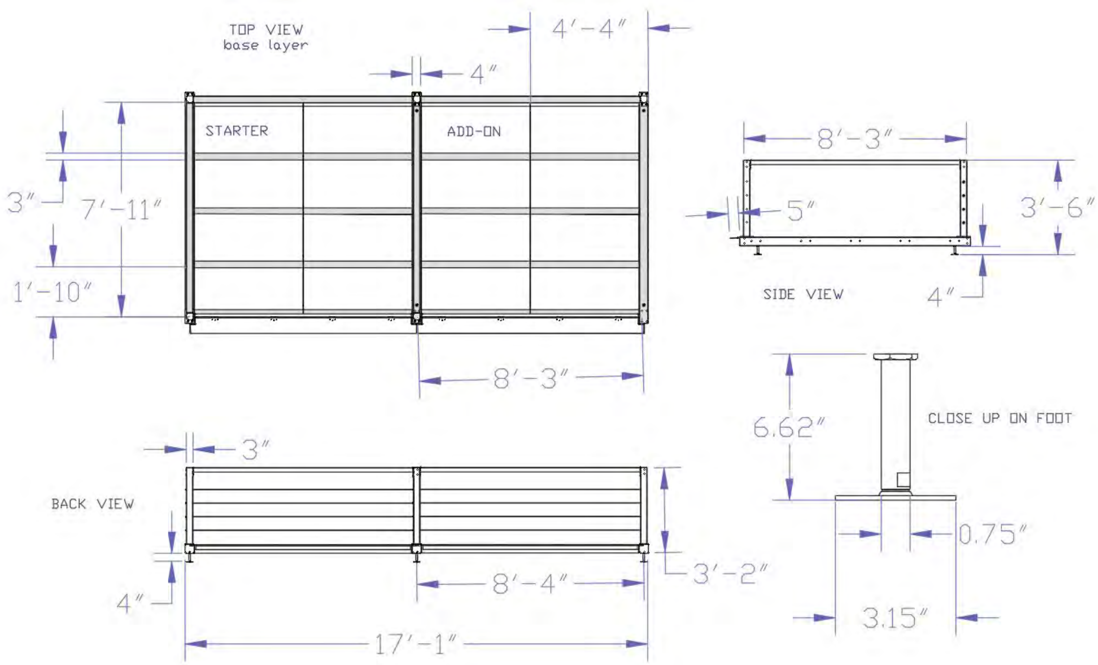
[Fig. G4] Wheelchair accessible ramp (left). [Fig. G5] Whole parklet with ramp (right)



[Fig. G6] CAD drawing of top view wheelchair accessible parklet layout

Mobility - Design of attachable, swiveling wheels with storage on Dero, see Appendix F for Mobility Concept Selection Process.

Stability - Loading calculations determined the need for more structural support. We decided upon extra reinforcement of two feet to be added to center beam of parklet to add the needed stability, as shown in the AutoCad drawings below in Fig G7 and the loading calculations in Appendix J.

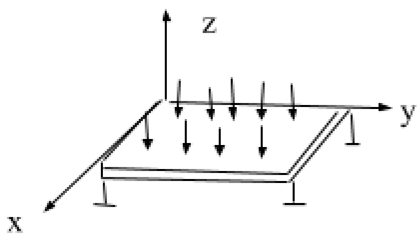


[Fig. G7] CAD Model of all Dero dimensions

Appendix H: Loading Calculations

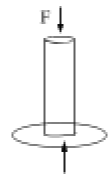
Dero Platform Structural Calculations

Stress on shafts of feet:



Pedestrian live loading: load = 90 lb/ft^2

W = weight f Dero = 600 lbs (starter) + 225 lbs (railings) + 550 lbs (add-on) = 1375 lb



d = 0.75in

$A_{cs} = \pi(0.75in/2)^2 = 0.442\ in^2$

$A = 8 \times 17$ ft $= 136 ft^2$

-Assume uniform loading: load from ¼ platform per foot

$F = (50\frac{lb}{ft^2})(¼)(136 ft^2) + 1375 = 3075$ lb

σ on foot cross-section = F/A_{cs} = 3075 lb/0.442in^2 = 6957.01 psi

Foot material: stainless steel - grade 30, 1.4305 bar

-allowable compressive: ultimate strength [worst case scenario] = 500 MPa = 72518.9 psi

FOS = $(\sigma_{allow} / \sigma_{actual})$ = 72518.9psi / 6957.01psi = 10.4 ✓

Max loading before reaching max allowable deflection on platform

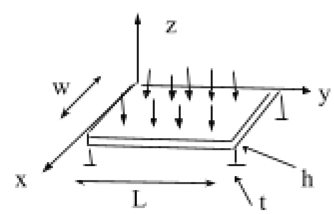
Assumptions:

-evenly distributed load

-standard L/240 deflection used

-load duration of 10 years

-constant material, no cross-loading



Pedestrian live loading = 90 lb/ft^2

F_c = 72518.9 psi = 10442721.6 lb/ft^2 A = 136 ft^2 L = 17 ft w = 8 ft

D = Dero = <L,w,h> h = 4in = 0.33ft t = 3in = 0.25ft d = 0.0625ft

P(D) = max allowable loading on Dero

<u>Derivation of equations</u>:

-failure due to deflection: $\Delta = \frac{5PL^4}{384EI}$ p= weight per linear ft P = weight per ft^2 = $\frac{2p}{w}$

$L/240 \geq \frac{5PL^4}{384EI} \rightarrow p \leq \frac{768EI}{1200L^3w} = 0.64\frac{E_xI_x}{L^3w}$ - in x direction

In y direction : $p \leq 0.64\frac{E_yI_y}{w^3L}$

-failure due to bending: $M_{max} \leq F_bS \rightarrow \frac{pL^2}{8} \leq F_bS \rightarrow \frac{PwL^2}{8} \leq F_bS$

In x direction: $P \leq \frac{8F_{bx}S_x}{wL^2}$ In y direction: $P \leq \frac{8F_{by}S_y}{Lw^2}$

-buckling of supporting feet:

$$F_cE = 0.3\,\frac{Ed^2}{t^2} \qquad \text{Column stability factor} = C_p = \left(\frac{1+\frac{F_cE}{F_c}}{1.6}\right) - \sqrt{\left(\frac{1+\frac{F_cE}{F_c}}{1.6}\right)^2 - \left(\frac{\frac{F_cE}{F_c}}{0.8}\right)}$$

$$= \left|0.625 - 0.625\frac{F_cE}{F_c} - \sqrt{0.3906\frac{E^2d^4}{t^4F_c^{\,2}} - 0.1406\frac{E\,d^2}{t^2F_c} + 0.3906}\right|$$

$$= \left|0.625 - 0.187\frac{Ed^2}{t^2F_c} - \sqrt{0.03516\frac{E^2d^4}{t^4F_c^{\,2}} - 0.1406\frac{E\,d^2}{t^2F_c} + 0.3906}\right|$$

$$P \leq \left|\frac{4}{Lw}AF_c\left(0.625 - 0.1875\frac{Ed^2}{t^2F_c} - \sqrt{0.03516\frac{E^2d^4}{t^4F_c^{\,2}} - 0.1406\frac{E\,d^2}{t^2F_c} + 0.3906}\right)\right|$$

$\rightarrow$ Take minimum of maximum load:

$$P(D) - \min \left\{(1)\ 0.64\frac{E_xI_x}{L^3w} \quad (2)\ 0.64\frac{E_yI_y}{w^3L} \quad (3)\ \frac{8F_{bx}S_x}{wL^2} \quad (4)\ \frac{8F_{by}S_y}{Lw^2}\right\}$$

$$\left\{(5)\ \frac{4}{Lw}AF_c\left(0.625 - 0.187\frac{Ed^2}{t^2F_c} - \sqrt{0.03516\frac{E^2d^4}{t^4F_c^{\,2}} - 0.1406\frac{E\,d^2}{t^2F_c} + 0.3906}\right)\right\}$$

Worst case scenario: with wooden platform material = Richlite R50

-modulus of elasticity: $E = 1 \times 10^6$ psi $= 1.44 \times 10^8$ lb/ft^2

-moment of inertia: $I_x = 1/12\,(Lh^3) = 0.052$ ft^4

$I_y = 1/12(wh^3) = 0.025$ ft^4

-allowable bending stress: $F_{bx} = 22000$ psi $= 3168000$ lb/ft^2

$F_{by} = 17300$ psi $= 2491200$ lb/ft^2

-section modulus: $S_x = \frac{Lh^2}{3} = 0.63$ ft^3 $\qquad S_y = \frac{wh^2}{3} = 0.3$ ft^3

Self weight of Dero
= 1375lb/(17x8ft)
= 10.11 lb/ft^2

not acceptable

(1) $P = 0.64\frac{(1.44\times10^8 lb/ft^2)(0.052ft^4)}{(17ft)^3(8ft)}$ = 121.93 lb/ft^2 - 10.11 = 111.8/(90lb/ft^2) $\rightarrow FOS = 1.2$ X

(2) $P = 0.64\frac{(1.44\times10^8 lb/ft^2)(0.025ft^4)}{(8ft)^3(17ft)}$ = 264.7 lb/ft^2 - 10.11 lb/ft^2 = 255.6/(90lb/ft^2) $\rightarrow FOS = 2.8$ ✓

(3) $P = \frac{8(316800lb/ft^2)(0.63ft^3)}{(17ft)^2(8ft)}$ = 6906.0 lb/ft^2 - 10.11 lb/ft^2 = 6895.9/(90lb/ft^2) $\rightarrow FOS = 76.6$ ✓

(4) $P = \frac{8(2491200lb/ft^2)(0.3ft^3)}{(8ft)^2(17ft)}$ = 5495 lb/ft^2 - 10.11 lb/ft^2 = 5484.9/(90lb/ft^2) $\rightarrow FOS = 60.9$ ✓

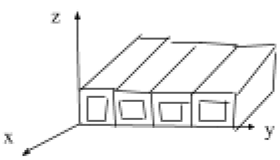
$$(5)\ \left|\frac{4}{(17ft)(8ft)}(136ft^2)(10442721.6lb/ft^2)\right| \times$$
$$\left|\left(0.625 - 0.187\frac{(4.03\times10^9)(0.0625ft)^2}{(0.25)^2(104\times10^5)} - \sqrt{0.03516\frac{(4.03\times10^9)^2(0.0625)^4}{(.25)^4(104\times10^5)^2} - 0.1406\frac{(4.03\times10^9)(.0625)^2}{(.25)^2(104\times10^5)} + 0.3906}\right)\right|$$
$$= \left|(4.17x10^7)(0.625 - 4.54 - \sqrt{20.62 - 3.405 + 0.3906})\right| = ✓$$

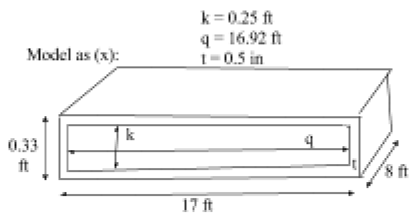
$$units \equiv \left(\frac{lb}{ft^2}\right)\left[\frac{lb}{lb}\left(\sqrt{\frac{1}{1}}\right)\right] \equiv lb/ft^2$$

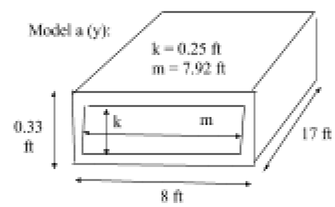
should definitely not fail in buckling because length of foot "beams" is very small

$E_{foot} = 193$ GPa $= 4.03\text{x}10^9$ lb/ft^2

Best case scenario: material = steel ASTM A500 square tube







$$E = 29000 \text{ ksi} = 4.18\times10^7 lb/ft^2$$
$$I_x = \frac{1}{12}\left[(17ft)(0.3)^3 - (16.92)(0.25ft)^3\right] = 0.0162\,ft^4$$
$$I_y = \frac{1}{12}\left[(8ft)(0.3)^3 - (7.92)(0.25ft)^3\right] = 0.0077\,ft^4$$
$$F_{bx,y} = 225500 \text{ psi} = 3.67\times10^6 lb/ft^2$$
$$S_x = \frac{Lh^3 - qk^3}{6h} = \frac{(17ft)(0.3)^3 - (16.92)(0.25ft)^3}{6(0.3ft)} = 0.108 \text{ ft}^3$$
$$S_y = \frac{wh^3 - mk^3}{6h} = \frac{(8ft)(0.3)^3 - (7.92)(0.25ft)^3}{6(0.3ft)} = 0.0513 \text{ ft}^3$$

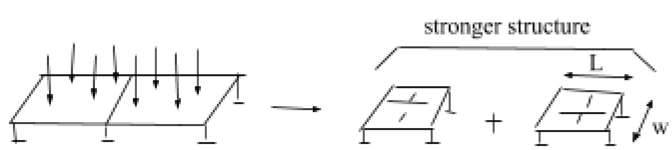
(1) $0.64\frac{(4.18\times10^9 lb/ft^2)(0.0162ft^4)}{(17ft)^3(8ft)}$ = 1102.6 lb/ft^2 - 10.11 = 1092.5/(90lb/ft^2) $\rightarrow FOS = 12.14$ ✓

(2) $0.64\frac{(4.18\times10^9 lb/ft^2)(0.0077ft^4)}{(8ft)^3(17ft)}$ = 2366.6 lb/ft^2 - 10.11 lb/ft^2 = 2356.6/(90lb/ft^2) $\rightarrow FOS = 26.2$ ✓

(3) $\frac{8(3.67\times10^6 lb/ft^2)(0.108ft^3)}{(17ft)^2(8ft)}$ = 1371.5 lb/ft^2 - 10.11 lb/ft^2 = 1361.4/(90lb/ft^2) $\rightarrow FOS = 15.13$ ✓

(4) $\frac{8(3.67\times10^6 lb/ft^2)(0.0513ft^3)}{(8ft)^2(17ft)}$ =1384.3 lb/ft^2 - 10.11 lb/ft^2 = 1374/(90lb/ft^2) $\rightarrow FOS = 15.27$ ✓

*fix worst case scenario by adding extra supports:
L = 8.5 ft



w = 8 ft   h = 0.33ft

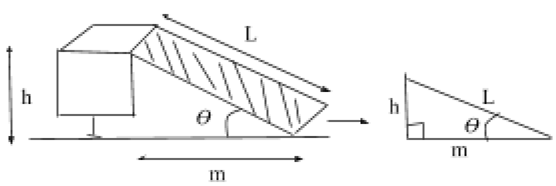
→ only concerned with min value found for worst case scenario, if this works all the rest will

Min value (1) --originally $0.64\frac{(1.44\times10^{8}lb/ft^{2})(0.052ft^{4})}{(17ft)^{3}(8ft)}$ = 121.93 lb/ft^2 → FOS = 1.2

With supports: $P = 0.64\frac{(1.44\times10^{8}lb/ft^{2})(0.052ft^{4})}{(8.5ft)^{3}(8ft)}$ = 1524.12 lb/ft^2 - 10.11 = 1514 lb/ft^2

→ *new FOS for worst case scenario* = $1514/(90lb/ft2) = 16.8$ ✓

Ramp Calculations: length & angle



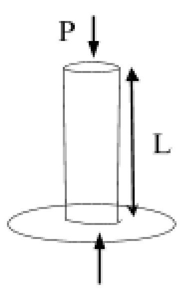
Worst case scenario → h = 5in (4 in height of Dero + 1 in gap) = 0.4167 ft
(longest ramp length needed)

L = $\sqrt{h^2 + m^2}$ ADA requirement: h/L = 1/12

Length: L = 12(h) = 12(0.4167ft) = <u>5 ft</u>

Angle: sinΘ = h/L → $\theta = sin^{-1}(h/L) = sin^{-1}(\frac{0.4167ft}{5ft}) = \underline{4.78°}$

Buckling calculation for feet:



$P \leq \frac{\pi^2 EI}{L^2}$ P = max load = $W_{dero} + W_{max\ allowed\ loading}$

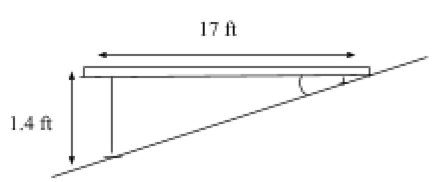
= 1375 + 90lb/ft^2 (136ft^2) = 13615 lb

Threaded stud material: Stainless steel 303

→ E = 28.0×10^{6} psi   → d = ¾ in   → I = $\frac{\pi}{4}r^4 = 0.0155$ in^4

$L \leq \sqrt{\frac{\pi^2 EI}{P}} \leq \sqrt{\frac{\pi^2(28.0\times106\ psi)(0.0155\ in^4)}{13615\ lb}}$ →   L ≤ <u>17.7 in = 1.48 ft</u>

Max allowable percent road slope with longer feet:



Percent slope = rise/run × 100

= 1.48/17(× 100) = <u>8.7%</u>

Appendix I: Fabrication Guide

NOPS Design Clinic Team, Smith College 2016-17

Wheel Design and Fabrication Guide

Northampton Dero Mobile Parklet

Introduction

A guide to the mobility of the Northampton Dero parklet. This guide explains the justifications behind the mobility decision, the specifications and features of the wheel design, parts and steps to the fabrication process, and evaluation and use of the wheel prototype. This document serves to record the process as to make a repeatable procedure for future use of mobile parklets.

Table of Contents

1) Mobility and Wheel Purpose

The Dero platform, which was purchased by the Northampton Office of Planning and Sustainability (NOPS) to be used at a parklet space downtown, was designed to be a stationary structure. Its designated use is to be situated in a single parallel parking space and remain there for a short amount of time as a "temporary park." For the Dero in Northampton we are instead suggest converting this temporary parklet into a mobile parklet to move around the city. This idea sparked our interest and that of our liaisons at NOPS for a few reasons.

1) The Dero was originally purchased to be used as an evaluation tool for spaces downtown in which more permanent parklets could be built. Added mobility, more evaluation would be possible.
2) The desire for this parklet is to have it be used and rented out by many businesses.
3) As the parklet moves around, it can change designs, adding a unique dynamic to the city as people follow its progression throughout the city.

Currently, the only way to move the platform is through the Northampton DPW, involving a fairly complicated process of fork-lifting the platform onto a trailer. Although this process is effective in transport to and from storage, it is not a reliable method of mobility for the purposes listed above. Thus, to minimize complexity of transportation, our team has designed wheel attachments to be placed in four locations around the steel perimeter of the structure, designed to carry the load of the parklet from location to location via the road.

2) Process

In order to implement the mobility of the Dero platform, our team carried out a two-tier design process before engaging in fabrication and testing. The first phase of the design process involved internal decision making based on prior research, concept generation tools, and theoretical engineering knowledge. The second phase included modifications based on advice from liaisons and stakeholders. These include the project sponsors, city engineers, and the fabrication center technicians who reviewed the concepts generated from the first phase of our design process. We were then fabricated and tested our design to provide future development suggestions.

In the first part of our design process, two techniques were employed to generate initial mobility ideas: brute think and analogies. Once enough ideas were generated, the team moved into two concept selection iterations that focused on three of the most feasible ideas. Various rating scales and scoring methods were used, prioritizing criteria such as ease of implementation, cost, withstandable load, and maintenance of stability (see Appendix G for a more thorough explanation of the concept selection process). Although the socket mount caster was chosen as the most preferable wheel option, our team generated three additional custom wheel options. The intention was to create custom-built wheels that could potentially be sent to Dero as add-ons for their platforms. The three attachment mechanisms that our team conceived were a bolt lock system (Fig. I1), a sliding lock system (Fig. I2), and a threaded lock system (Fig. I3).

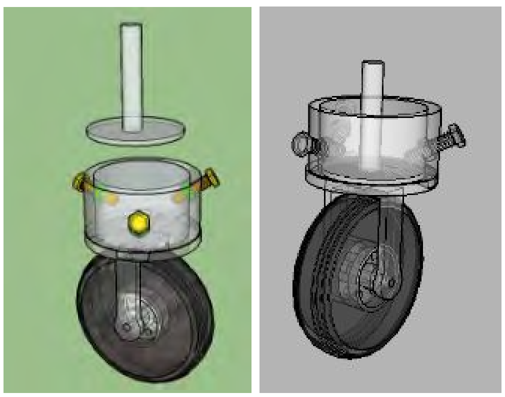


Fig .I1 - Sketchup model of bolt lock mechanism

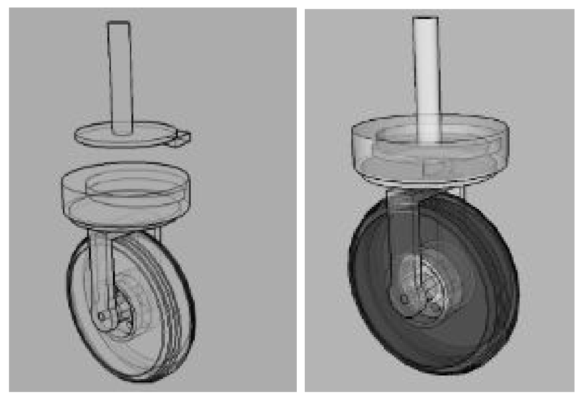


Fig. I2 - Sketchup model of sliding lock mechanism

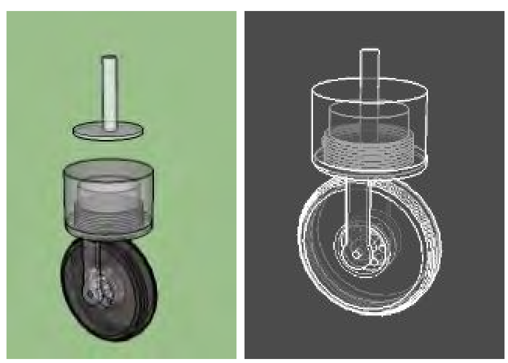


Fig. I3 - Sketchup model of threaded lock mechanism

In the second phase of our design process, our team made many revisions based on comments and insight given by the Northampton Office of Planning and Sustainability, the Northampton Department of Public Works, and the Center for Design and Fabrication. As our team progressively developed our wheel design, numerous changes were made to coincide with our safety, installation, and fabrication requirements per our Traceability Matrix (Appendix B). These modifications are documented in the timeline shown in Fig.I4 and exemplify the continuous improvements that our team aimed to make. Although the process was complex, our team was able to find a compromise solution and learned much about the coordination, communication, and realization of such a project.

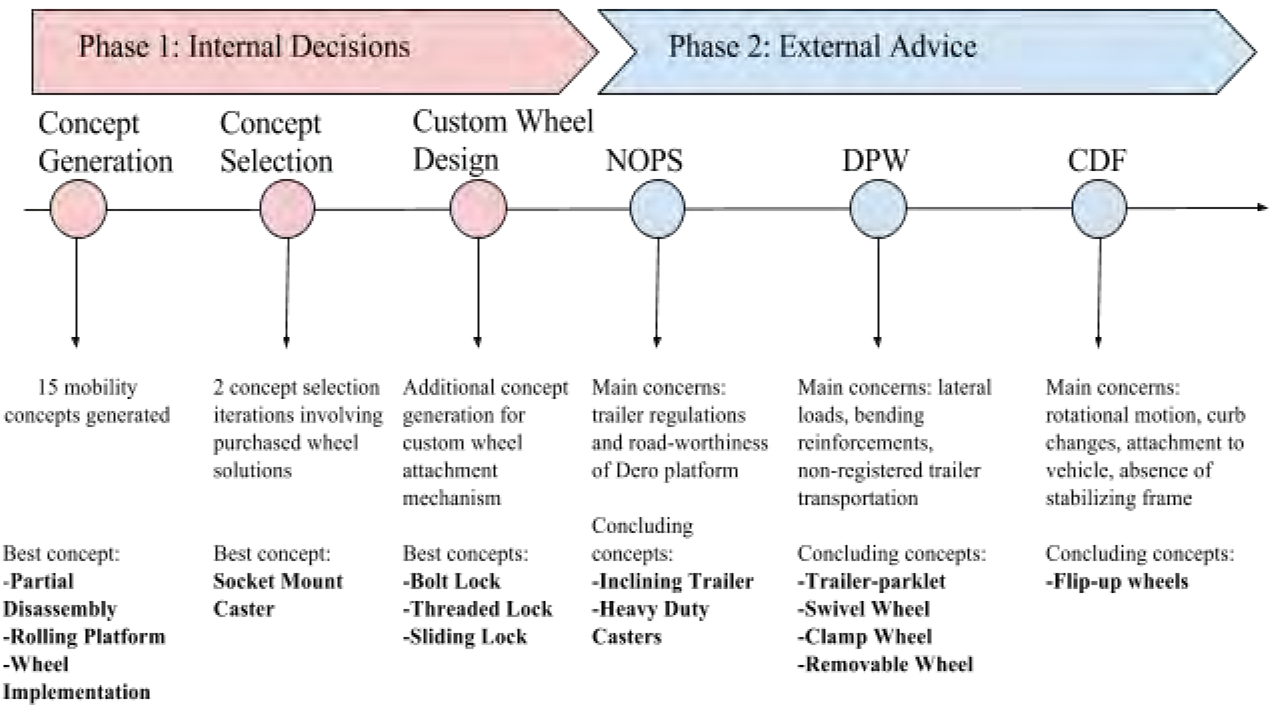


Fig. I4 - Summary of design process

The final selected concept (Fig. I5) for implementing the mobility of the parklet is a custom wheel attachment that allows the wheels to be easily transformed from a static parklet to a mobile platform. Five additional 8-inch custom made caster wheels will be permanently installed on the steel structure of the Dero platform. The original size we selected was 6-inch but we had to size up due to the load each wheel could take, and the 8-inch casters can each support ¼ the weight of the Dero, with a factor of safety of 1.5. These wheels can be placed on top or under the platform thanks to two plates connected to hinges. When the parklet is static, the wheels can be placed above the metal parklet structure and incorporated in the upper design.

Fig. I5 - Final selected wheel design

Once the wheel design was approved by various stakeholders and initial safety calculations, we fabricated one wheel prototype. This involved the ordering of parts, matching of components, and the assembly of the wheel attachment structure.

3) Description of Design

The wheel attachments were designed to maximize strength and road-safety while minimizing difficulty of use. In order to do this, the design consists of four wheels, each designed to hinge down and rest under the platform during transport, then hinge up to allow the feet to hold the parklet stationary when in location. Figures I6 & I7 below are Solidworks models of the Dero parklet, depicting what it will look like while stationary, then while in motion.

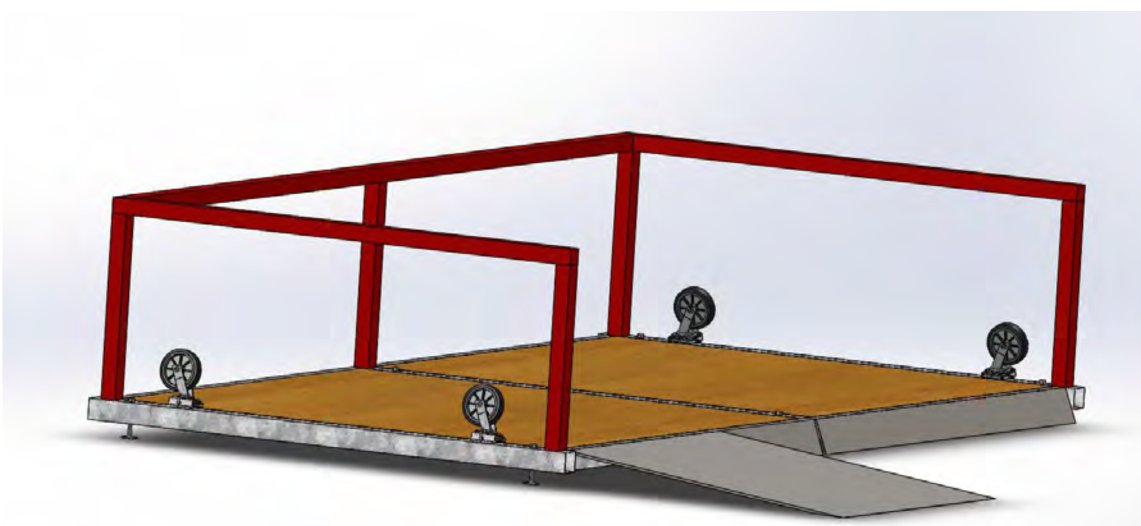


Fig. I6 - Dero parklet while stationary

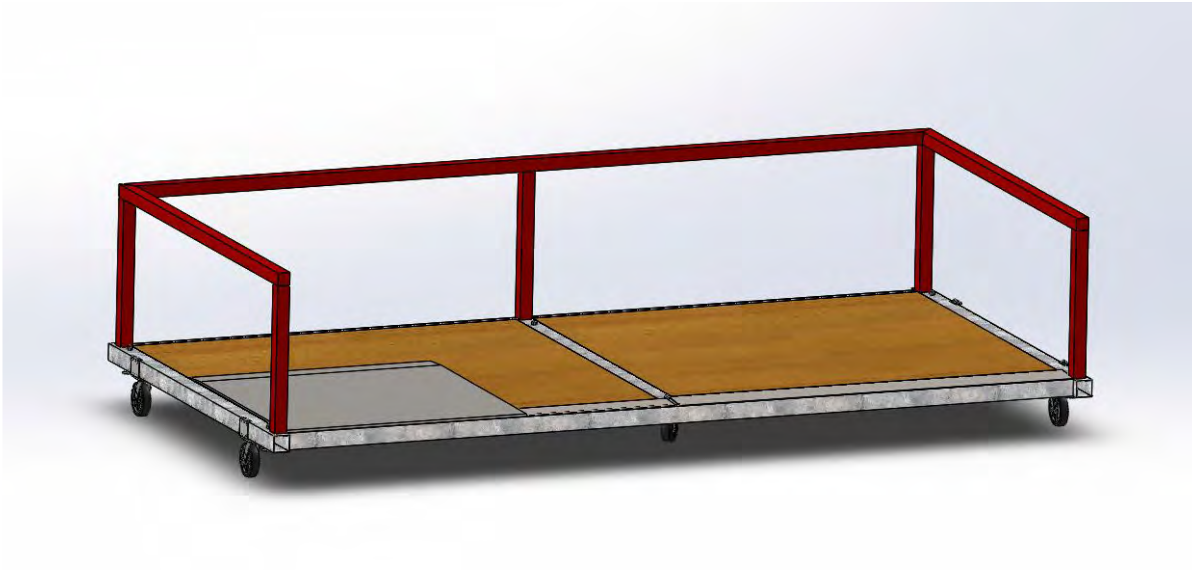


Fig. I7 - Dero parklet while being moved

Features of transportation and wheel design

Based on communications with the Director of NOPS about people available and calculations of load vs. road slope (Appendix I1), the design requirement for the transportation is that it must be able to be wheeled around by five or fewer people by hand. This design allows the parklet to be moved from location to location as we deem safe, based on mapping road slopes desirable on ArcGIS.

The wheels themselves are designed to help with this process. They are each to be connected in the top of the steel frame structure with screws, as shown in Fig. I8, left. They each have two hinges connected two metal plates (one a 90 degree angled plate), as shown in Fig. I8, right. These hinges allow flexibility in the movement of the wheels. They can be hinged down under the platform for transportation and hinged back up onto the platform to remain out of the way while it is to be lowered onto the feet for stability (as shown in Fig. I6). This design allows the wheels to remain attached to the platform, meaning no need for storage of the wheels.

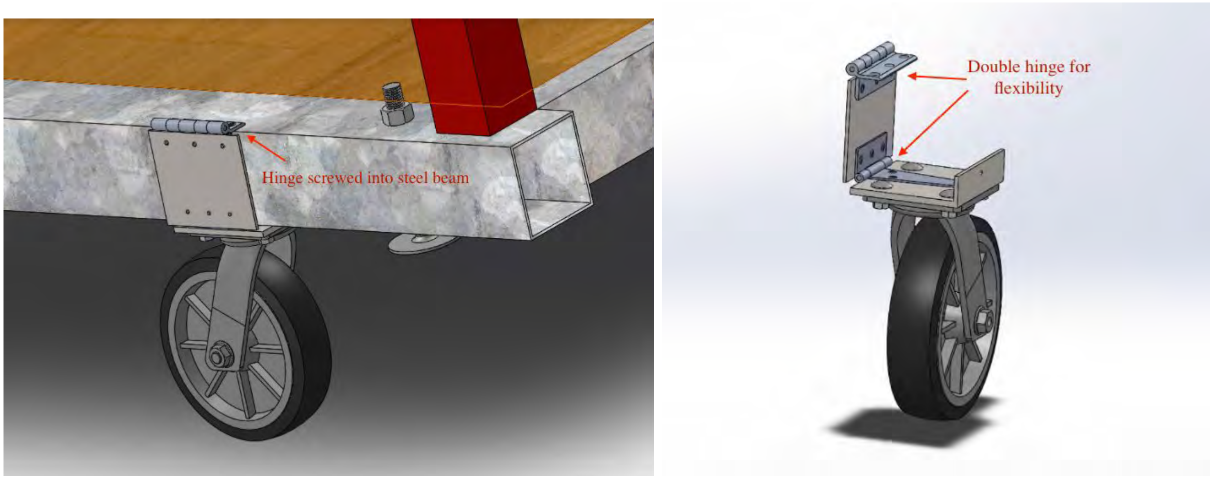


Fig. I8 - Wheel connection to Dero and two-hinge design

To add more strength to the design as it is being wheeled around, there is a pin connection from the angled plate to the inside face of the steel beams, as shown in Fig I9. These pins are designed to be easily released, with the push of a button when the wheels are being hinged up. They are strong to take much of the transverse load that may occur during transport.

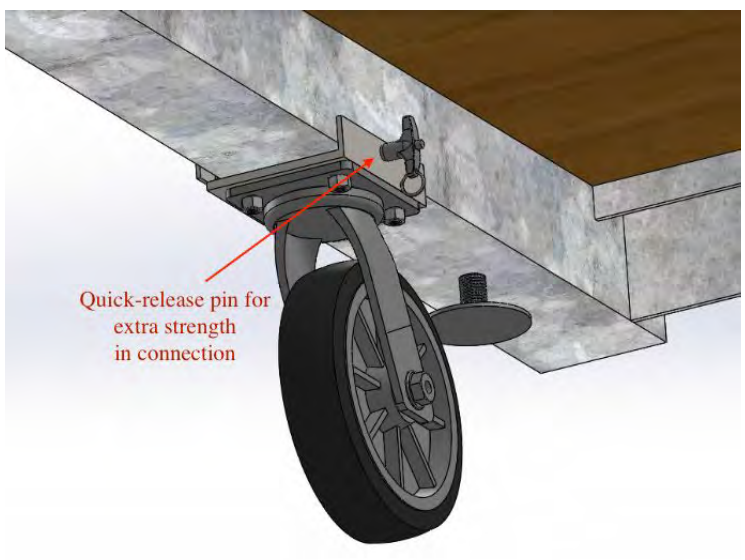


Fig. I9 - Pin attaching the wheel to the structure underneath the Dero

Another feature of the design is that each wheel has the ability to swivel. This adds ease to the process of pushing the platform and moving it into the right position next to the curb. Along these same lines, to help with transportation, there will be two threaded-stem caster wheels added to the middle of the platform. To install these wheels, the feet in the middle of the platform will be screwed out and the wheels screwed in from underneath. This will allow for extra support in the bending area of the platform and will help if being push on uneven roads. Fig I10. shows a schematic of these wheels in the Dero, while Fig I11. shows the information about the specific wheel to purchase from McMaster Carr.

Fig. I10 - Threaded-stem caster wheels shown from bottom of Dero (left) and close up, in threaded hole (right)

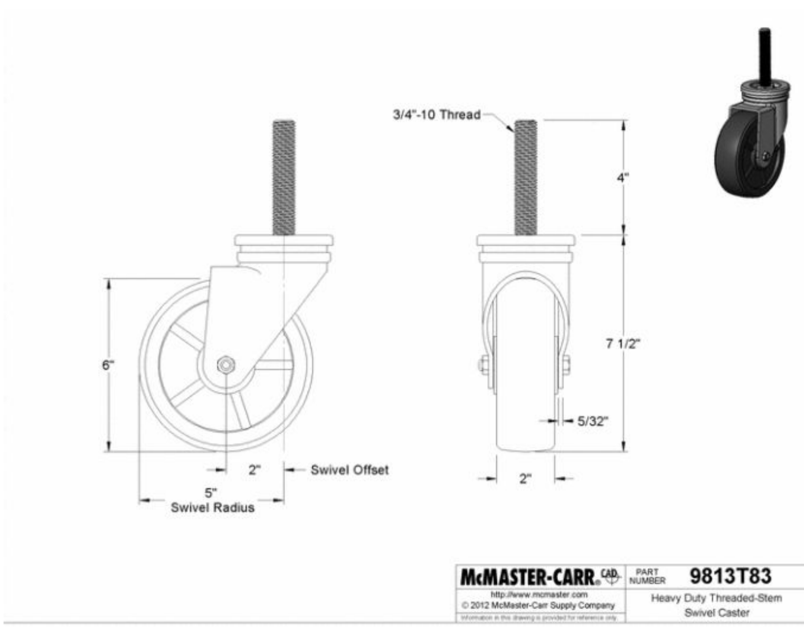


Fig. I11 - McMaster Carr Solidworks Drawing for Heavy Duty Threaded Extended Stem Caster (https://www.mcmaster.com/#9813t93/=16xcfll)

Finally, the materials were chosen to hold up the design requirement of holding up in adverse weather condition. All the screws, bolts, nuts, hinges and metal stock included in the design are stainless steel. This material is weather resistant and won't rust or corrode. For the wheels themselves, the design includes Cushioned Black Rubber on Polypropylene Wheels. Instead of tires, this material will provide friction on the roads without the risk of getting flat.

The assembly drawings for the wheel design Solidworks models can be found in Appendix I2.

Potential issues and flaws

Although this is the recommended design, there are a few issues with it which may be worked out in the future. 1) Two jacks are needed to lift the Dero to hinge the wheels down and put in the threaded-stem wheels. There is no foreseeable way around this due to the height of the Dero while stationary. 2) The only way to transport it from location to location would be to wheel it around by hand. This would cause some possible road congestion. To this, our suggestion is to transport early in the morning when the road are clear, with either a DPW or police escort for safety. 3) When the wheels are hinged onto the Dero they have the potential to be in the way of the furniture on the parklet or to be a slight eyesore. One solution to this is that the wheels don't need to be hinged all the way up onto the platform. They can be hinged out to rest on the road on either side of the parklet if there is space there. The other solution to this which is somewhat feasible is to find ways to incorporate the wheels into the design. 4) There is potential for the wheel designs to break or wear over time, although this is not something we see as a probable cause for concern.

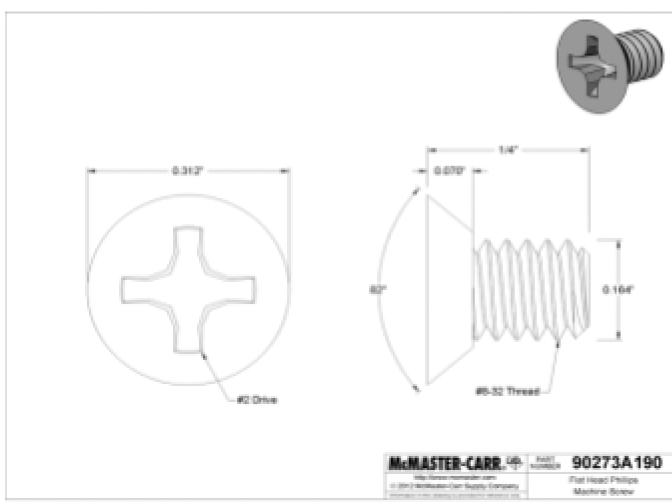
4) Fabrication of wheels

a) Parts List

All parts used in the fabrication of wheels were ordered from McMaster- Carr.

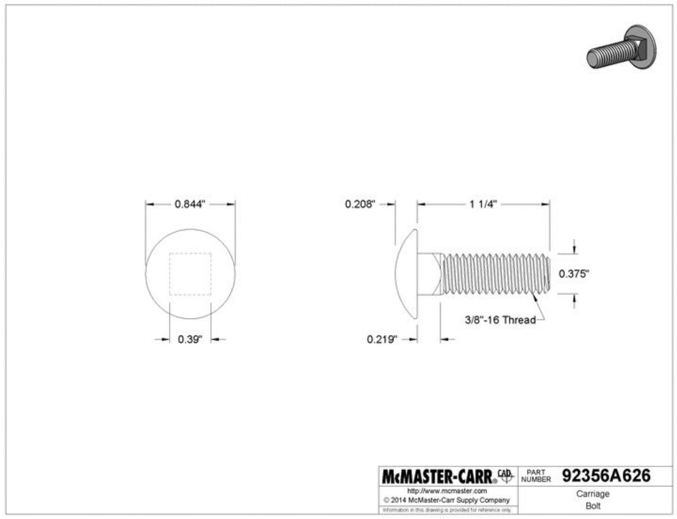
Steel Phillips Flat Head Screws

Use: Attachment for the hinges
Part Number: 90273A190
Thread Size: 8 - 32
Material: Zinc - Plated Steel
Tensile Strength: 60,000psi



Link:
https://www.mcmaster.com/#90273a190/=16l6ktv

Stainless Steel Square-Neck Carriage Bolt

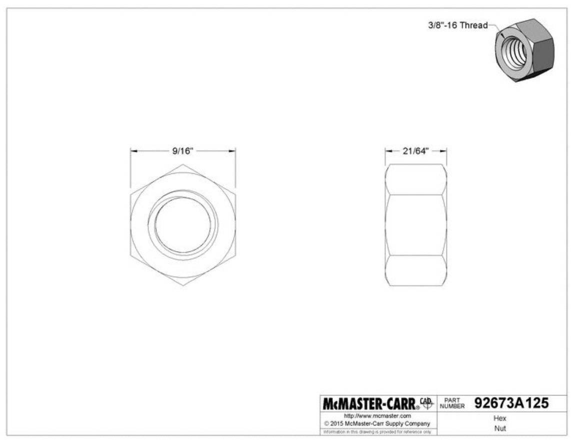


Use: Connecting the Casters to Steel Plates
Part Number: 9235A626
Thread Size: ⅜” - 16
Tensile Strength: 70,000psi
Material: 18 - 8 Stainless Steel
Specifications Met: ANSI B18.5

Link:

https://www.mcmaster.com/#92356a626/=16va2qf

Stainless Steel Hex Nut



Use: Bolt Nuts
Part Number: 92673A125
Thread Size: ⅜” - 16
Material: 18-8 Stainless Steel
Specifications Met: ASTM F594

Link:
https://www.mcmaster.com/#92673a125/=16ko5od

Multipurpose Type 304 Stainless Steel 90 Degree Angle

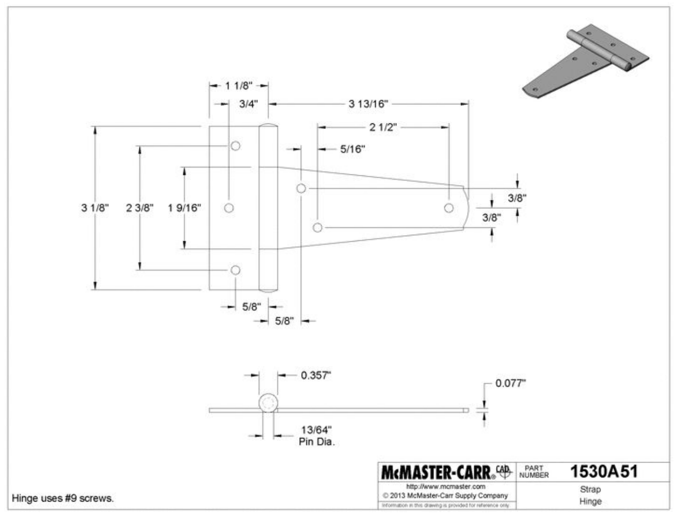
Use: Bottom support for wheel
Part Number: 1260T43
Fabrication: Heat treated, hot rolled
Material: 304 Stainless Steel
Thickness: ¼”
Height (outside): 4”
Width (outside): 6”
Yield Strength: 25,000psi
Link: https://www.mcmaster.com/#1260t43/=16l1ip9

Stainless Steel Bar with Certification

Use: Upper support for wheel attachment
Part Number: 1260T596
Fabrication: Hot rolled
Material: 304 Stainless Steel
Thickness: ⅛ ”
Width: 6”
Yield Strength: 30, 000 psi

Link: https://www.mcmaster.com/#1250t596/=16jhjuh

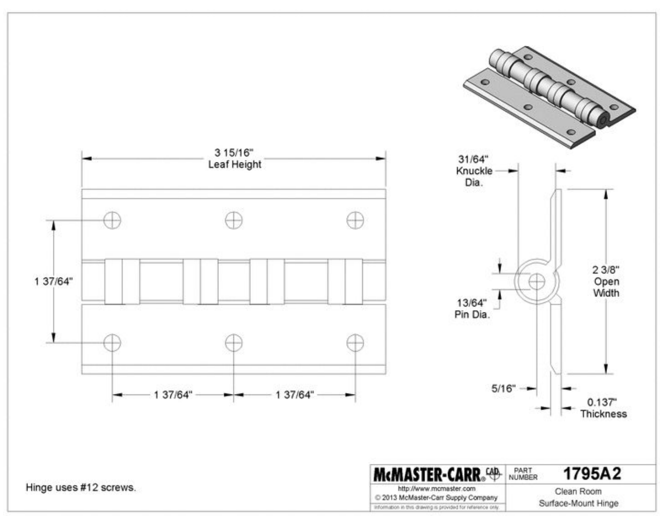
Strap Hinge



Use: Allow rotation for plate supporting the wheel
Part Number: 1530A51
Range of Motion: 270°
Material: Zinc-Plated Steel
Mounting Screw Size: No. 8

Link: https://www.mcmaster.com/#1530a51/=16koh6b

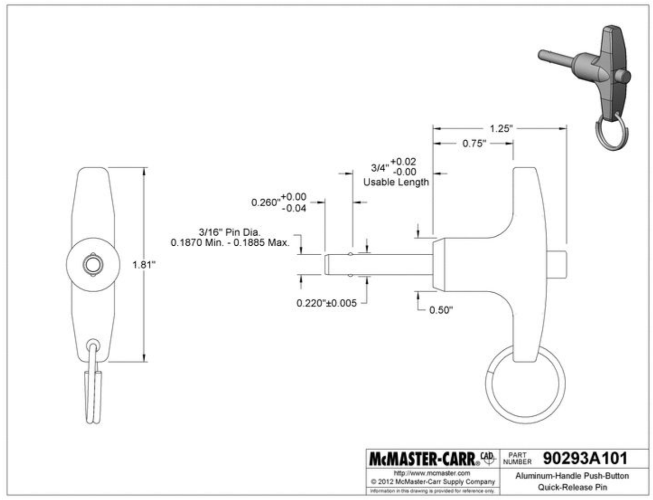
Clean Room Surface-Mount Hinge



Use: Allow rotation for upper plate connected to the Dero platform
Part Number: 1795A2
Range of Motion: 270°
Material: Unfinished 6063 Aluminum
Mounting Screw Size: No. 12
Link:

https://www.mcmaster.com/#1795a2/=16gx1uy

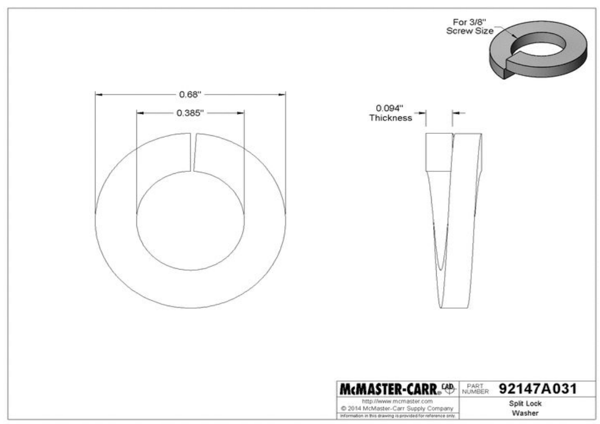
T-Handle Push-Button Quick-Release Pin



Use: Maintain wheel plate in place and reduce transverse load of platform in motion
Part Number: 90293A101
Breaking Strength: 5, 100 lbs
Material: 17-4 PH Stainless Steel
Pin Type: Quick Release
Locking Feature: Button

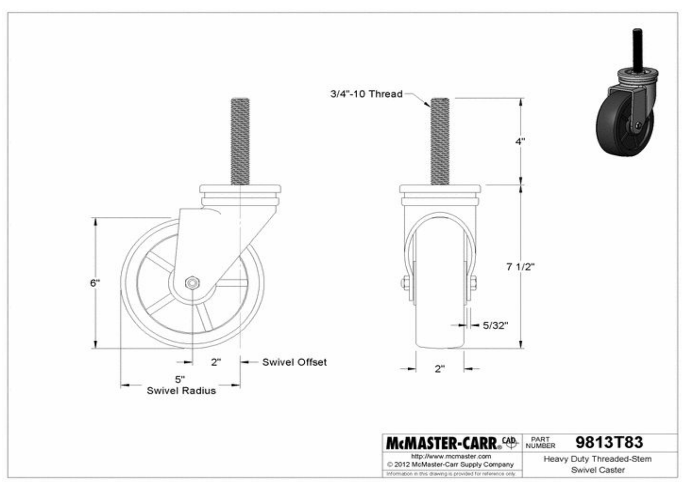
Link:
https://www.mcmaster.com/#90293a101/=16va7es

Stainless Steel Split Lock Washer



Use: Distribute the pressure of the nut over the surface
Part Number: 92147A031
Screw Size: ⅜”
Material: 316 Stainless Steel
Washer Type: Split Lock
Specifications met: ASME B18.21.1

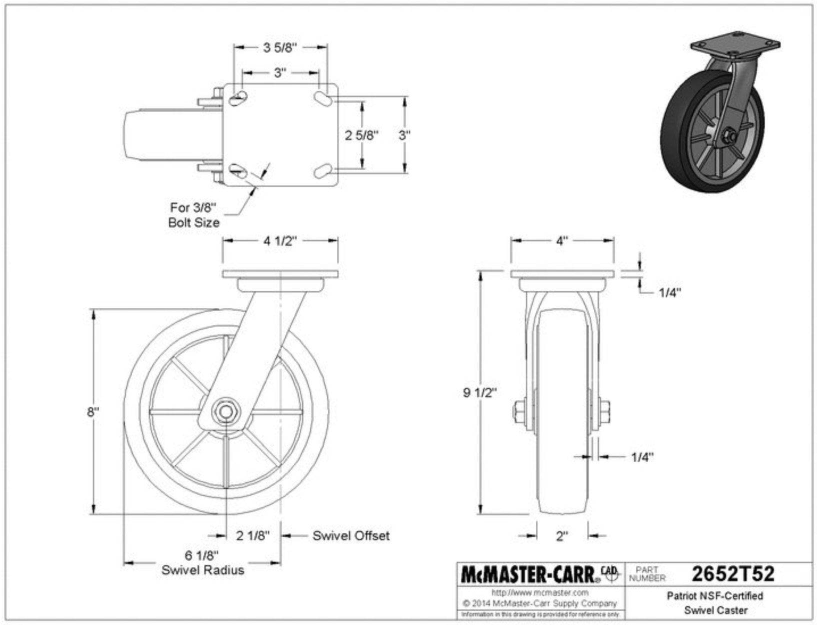
Link: https://www.mcmaster.com/#92147a031/=16va39o



Heavy Duty Threaded Extended Stem Caster

Use: Distribute the weight of the platform and add support and balance during transport
Part Number: 9813T93
Stem Thread Size: 3/4”
Material: Polypropylene Wheel
Capacity: 900lb
Link: https://www.mcmaster.com/#9813t93/=16jf6b6

Patriot Food-Service Caster



Use: Allow mobility to the Dero platform
Part Number: 2652T52
Mount Height: 9 ½"
Material: Cushioned Black Rubber on Polypropylene Wheels
Capacity: 500lb

Link:
https://www.mcmaster.com/#2652t52/=16jfdoq

b) Steps to modifying and fabricating

Once all the parts from section (4a) are received and verified, the fabrication process can take place. This process requires access to fabrication equipment and machinery used for metal work. The following fabrication steps were completed at the Smith College Center for Design and Fabrication.

1. Since the steel plates received had rough edges, the preliminary step was to cut the material to size and bur edges. This was done with a horizontal band saw.

Fig. I12 - Steel plate being squared in mechanical band saw

2. The milling machine (Proto Trak K3) was then used to square the parts to have an even more accurate cut.

Fig. I13 - Steel plate being squared in milling machine

3. The milling machine was also used to cut square hole pockets with a four-lip ¼” drill. The edges of the holes were then refined with a ⅛” drill. The method used for drilling the holes consisted of first marking one hole at 1.656in and 1.406in from the center. To drill

the 3 other holes, we ran 3 sub-programs, each placed at either 3.313in vertically or 2.812in horizontally from the first hole.

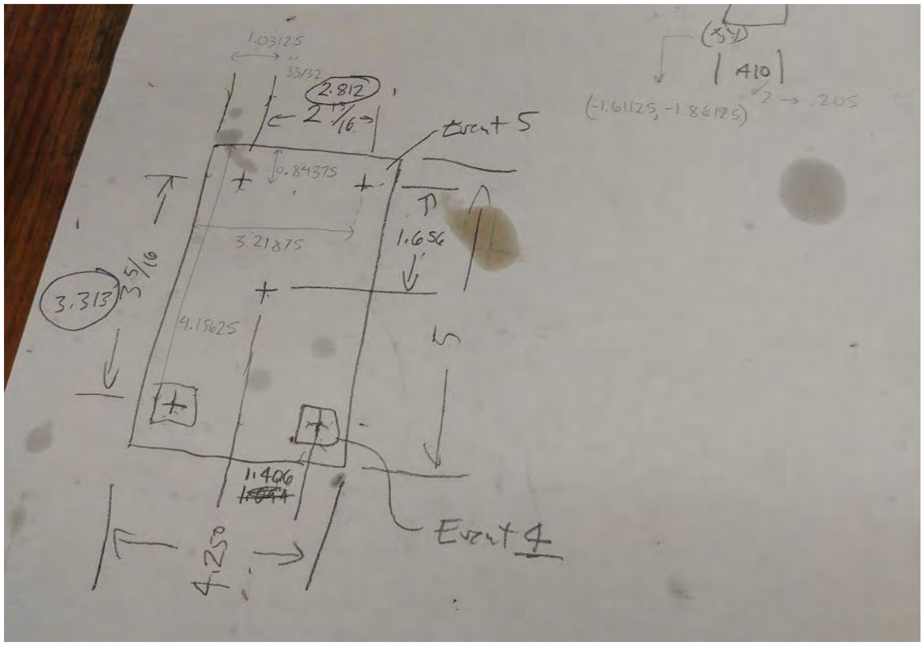


Fig. I14 - Hand written notes of bolt hole placements on steel plate

4. Three circular holes for the strap hinge were drilled on the 90° steel plate.

5. The carriage bolts were flattened by removing 0.051” from the top. Machines used include a TRL 13x40 manual lathe and the Proto Trak milling machine.

Fig. I15 - Bolts being flattened on the manual lathe

Fig. I16 - Bolts being flattened on the milling machine

6. The milling machine was finally used to drill a 0.19” hole at the center of the 90 degree angled steel plate for the quick release pin.

Fig. I17 - Pin hole being drilled

c) Total cost and time

To make one wheel, including the attachment and all modifications, the team visited the Center for Design and Fabrication five times, each for a duration of about one hour. The total time spent fabricating and assembling the wheels therefore equals about five hours. The time spent ordering and receiving all parts from MacMaster-Carr should take no more than two days, given the company’s one-day shipping policy. Fabricating three more retractable wheels for the Dero parklet would therefore require an additional 15 hours. The two additional threaded wheels to place along the width of the Dero can immediately be used as soon as they are ordered and received from MacMaster-Carr.

The total cost of all ordered parts to fabricate one retractable wheel is $212.91. An additional $29.77 was spent on purchasing one threaded stem caster. The bill of materials to fabricate 3 more custom wheels and order one additional threaded stem caster is described in Table I1. These additional costs total $638.29.

Table I1. Bill of materials

Part	Amount	Part N°	Cost	Total
Flat Head Screw	36 needed (pack of 100)	90273A190		$4.26
Square-Neck Carriage Bolt	12 needed (pack of 10)	9235A626	$5.39 (x2)	$10.78
Hex Nut	12 needed (pack of 25)	92673A125		$2.27
90° Angled Plate	3 (½ ft-long)	1260T43	$82.82 (x3)	$248.46
Flat Steel Bar	3 (½ ft-long)	1260T596	$28.17 (x3)	$84.51
Strap Hinge	3	1530A51	$3.54 (x3)	$10.62
Surface-Mount Hinge	3	1795A2	$27.87 (x3)	$83.61
Push-Button Quick-Release Pin	3	90293A101	$18.15 (x3)	$54.45
Split Lock Washer	12 needed (pack of 50)	92147A031		$5.88
Threaded Stem Caster	1	9813T93		$29.77
Food-Service Caster	3	2652T52	$34.56 (x3)	$103.68
Total for 3 more wheels				$638.29
Total cost of one Fabricated Wheel				$195.11
Cost of purchased Threaded-Stem Caster				$103.63
Total cost for 6 wheels				$937.03

d) Final Product

Our final prototype took about 1.5 weeks to fabricate in the Smith College Center for Design and Fabrication. Below are pictures showing the fabricated model.

Fig. I18 - Custom wheel attachment mechanism before drilling the pin hole and flattening the bolts and hinge screw

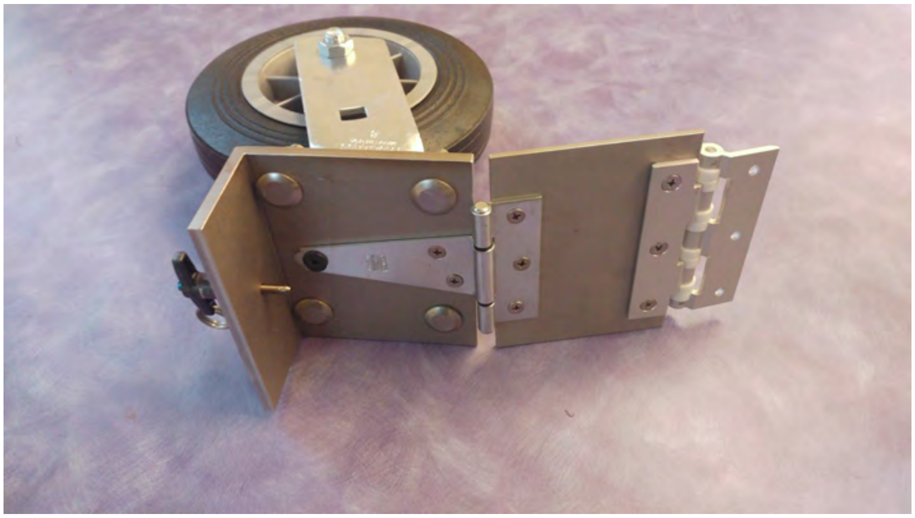


Fig. I19 - Custom wheel attachment mechanism after drilling the pin hole and flattening the bolts

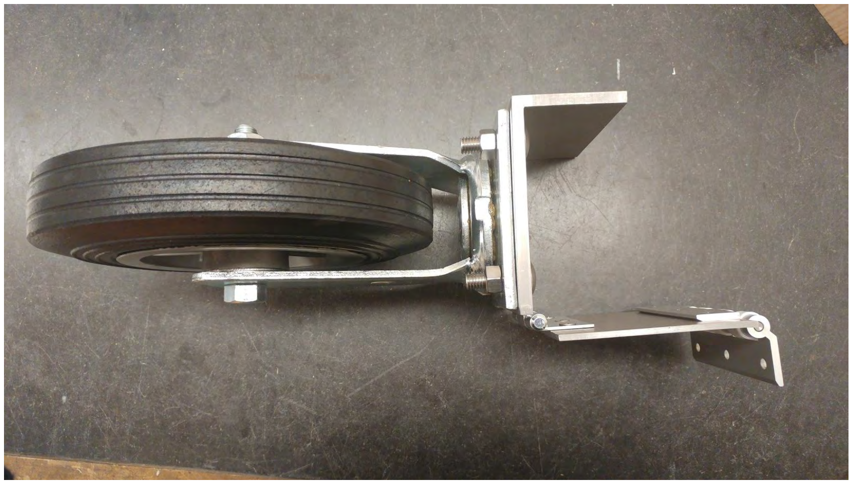


Fig. I20 - Front view of the entire wheel and custom attachment mechanism

Fig. I21 - Side view of final custom wheel mechanism

5) Evaluation of design

The evaluation of the final wheel design was a three-phase process, which involved both theoretical and physical testing of strength and sizing.

The first phase included calculations of various parts of the design to test its factor of safety under assumed loading condition during transport, assessing the shear stress on the pin and verifying its factor of safety. The second phase involved simulating the loading scenario in

Solidworks, and running a Finite Element Analysis (FEA) to compare the greatest stress to the yield strength. Based on assessment of the model, the pin and the angled plate are the two places of most concern. Using the properties of the materials as listed on each part's respective McMaster Carr listing, the pin has a factor of safety of about 1,000. The FEA showed a maximum bending stress on the angled plate of 5370 psi, compared to the material's yield strength of 25000, giving a factor of safety of 4.7. From this, we conclude that the design is strong enough to hold up in the loading scenario while being wheeled around from location to location. These calculations and the FEA can be found in Appendix I3.

The final phase of evaluation included fitting the model to the actual Dero parklet. The wheel connection has been designed to fit around a 4x4" steel beam, as this matches the steel frame around the actual Dero. Due to the complication of the design, with hinges and bolts in various locations, as well as possible variations from the website's specs sheet to the physical structure, it is important to recognize if our design, with the dimensions we modeled, fits on the Dero at its conclusion. After the fabrication process was complete, the NOPS team brought the prototype to the parklet to test. Specific things we were looking for were as follows: 1) If the part fits around the beam with little to no looseness, 2) If the pin and screw holes line up in desired locations according to the design, and 3) The wheel easily hinges up and down to resting locations with no friction or scraping.

After completing this part of the process, we changed one part of the design, to make the side plate 0.11 in longer. To fit the side of the steel beam, the side plate was originally made to be smaller than 4in, as the plate is raised slightly above the bottom plate, as can be seen in Fig I20. Due to the top of the bolts sticking up into the pocket, the plate needs to be adjusted slightly because it is now not quite long enough. If this modification were made, the top hinge would lay flat on the top of the beam as desired. We have updated the design and Solidworks drawing to account for this change and they now represent a final model. The other two design requirements were met and therefore need no modifications. Pictures of the fitting of the wheel to the Dero can be found in Appendix I4.

With the evaluation complete, we hope to have a finished product which the Northampton Office of Planning and Sustainability can use on their Dero parklet, as well as have a repeatable process by which other cities can follow to make their Dero parklets also mobile.

Appendix I1 - *Slope Calculations*

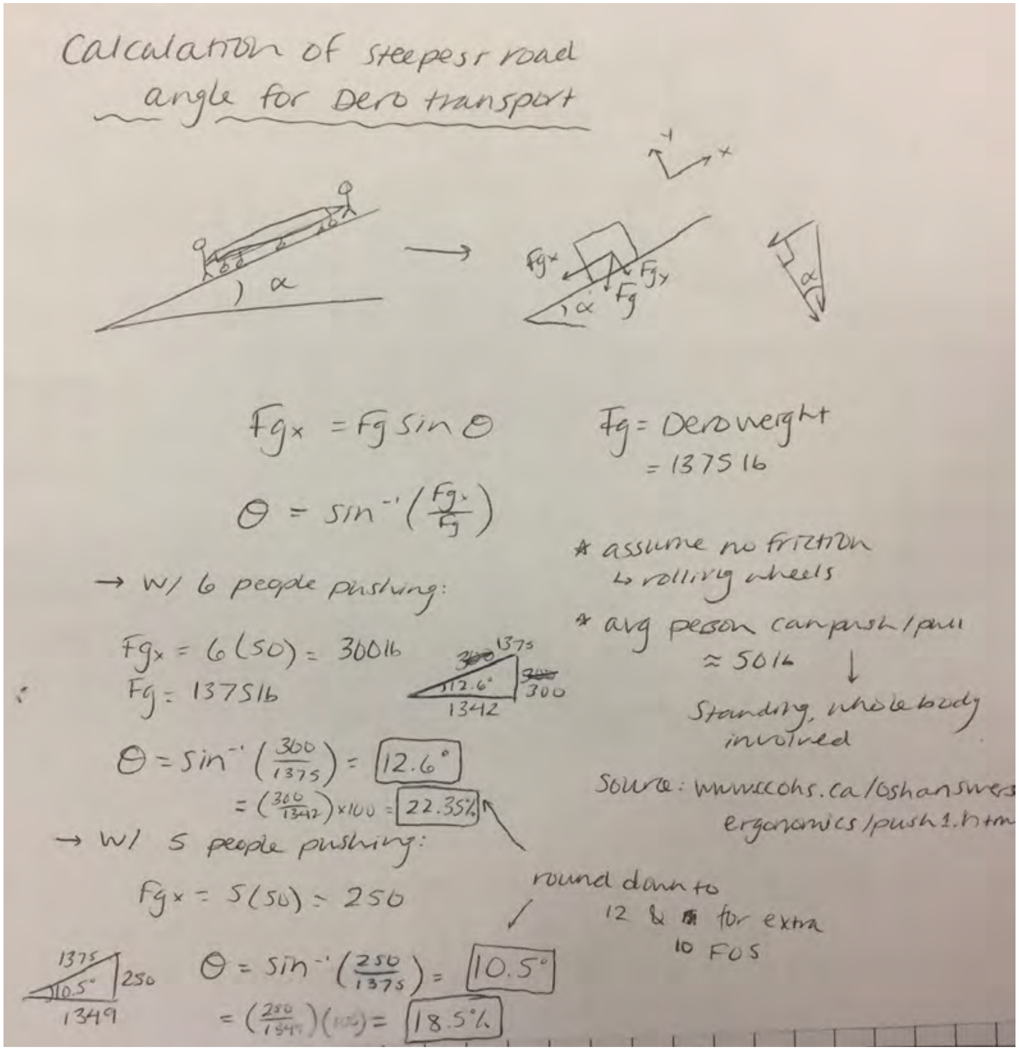


Fig. I22 - Calculation of road slopes for 5 and 6 people pushing

Appendix I2 - *Solidworks wheel design drawings*

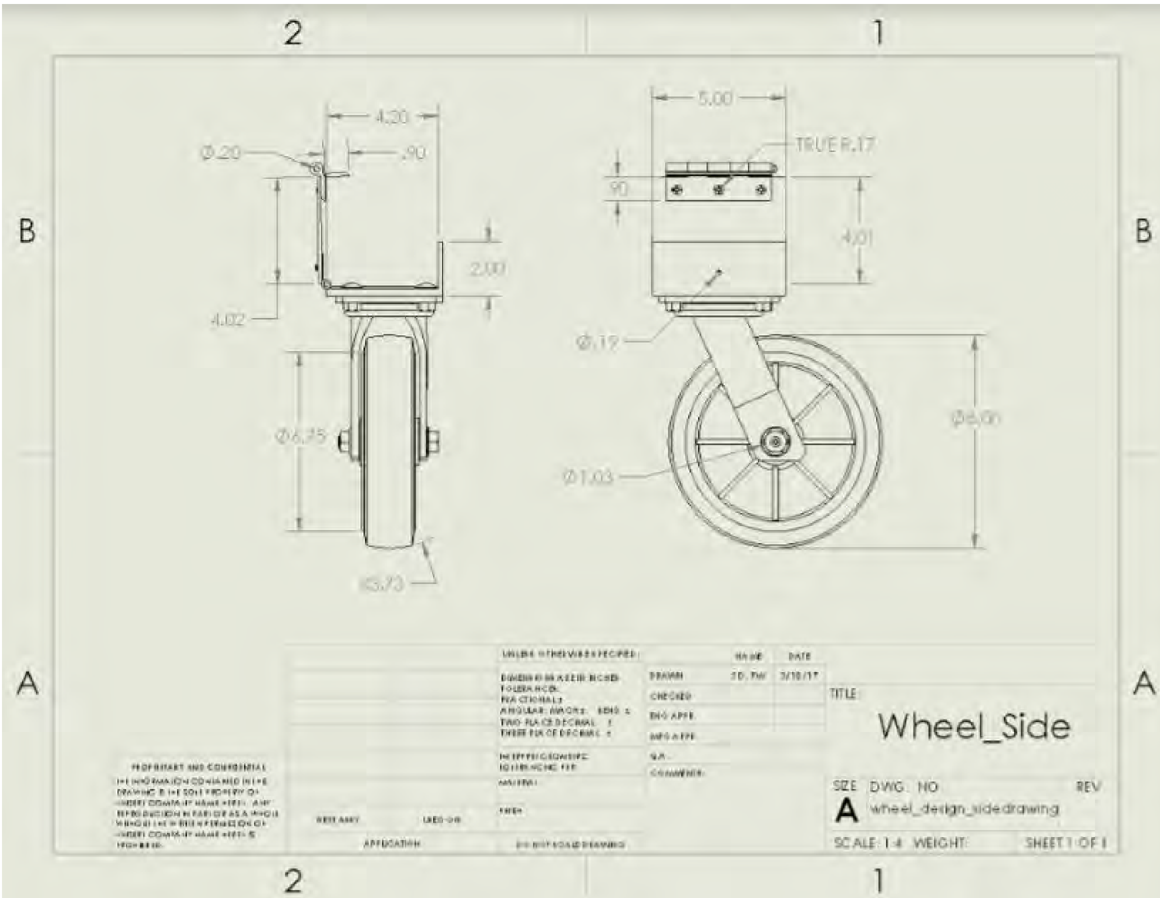


Fig. I23 - Side view drawing of wheel design

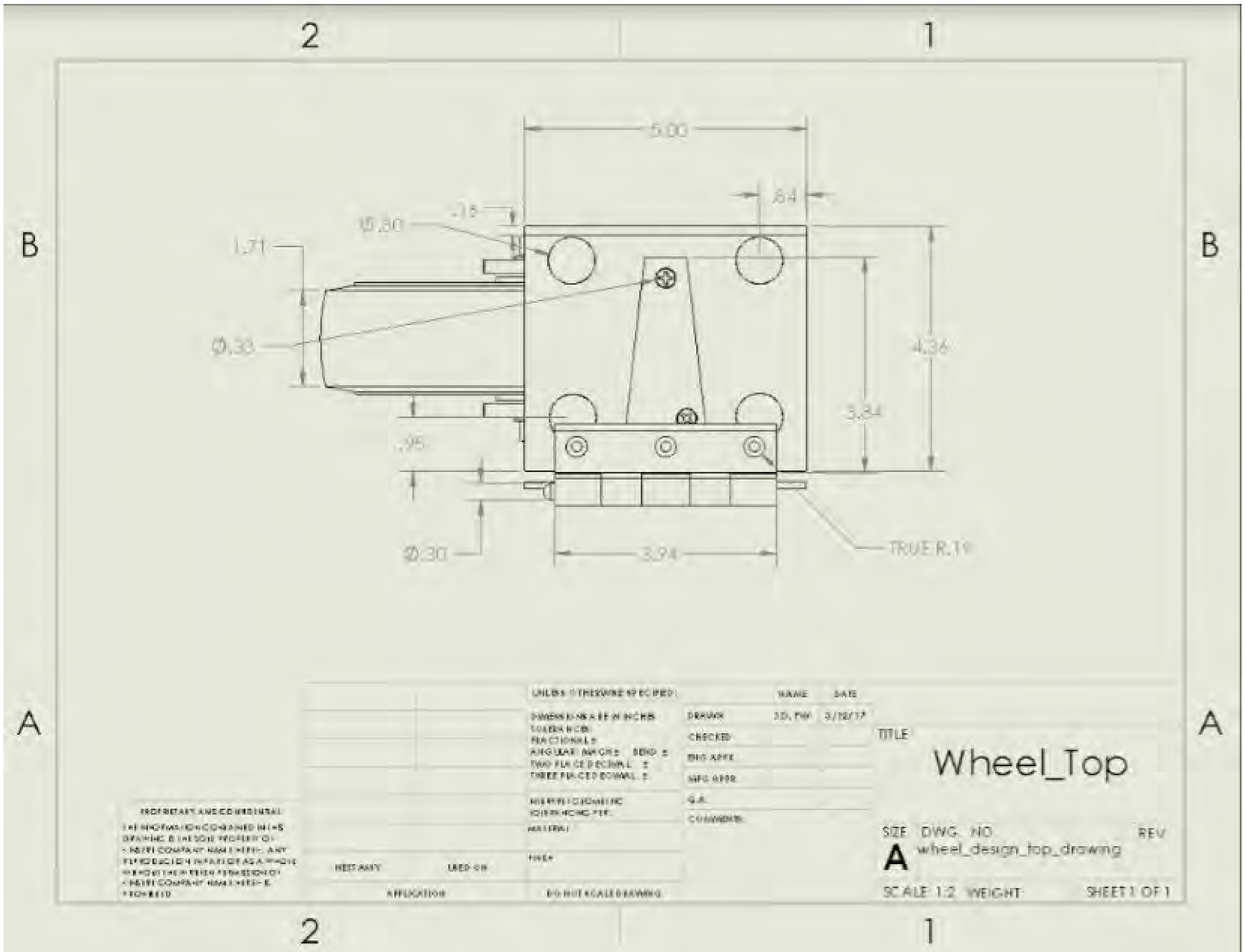


Fig. I24 - Top view drawing of wheel design

Appendix I3 - *Strength Calculations and Finite Element Analysis*

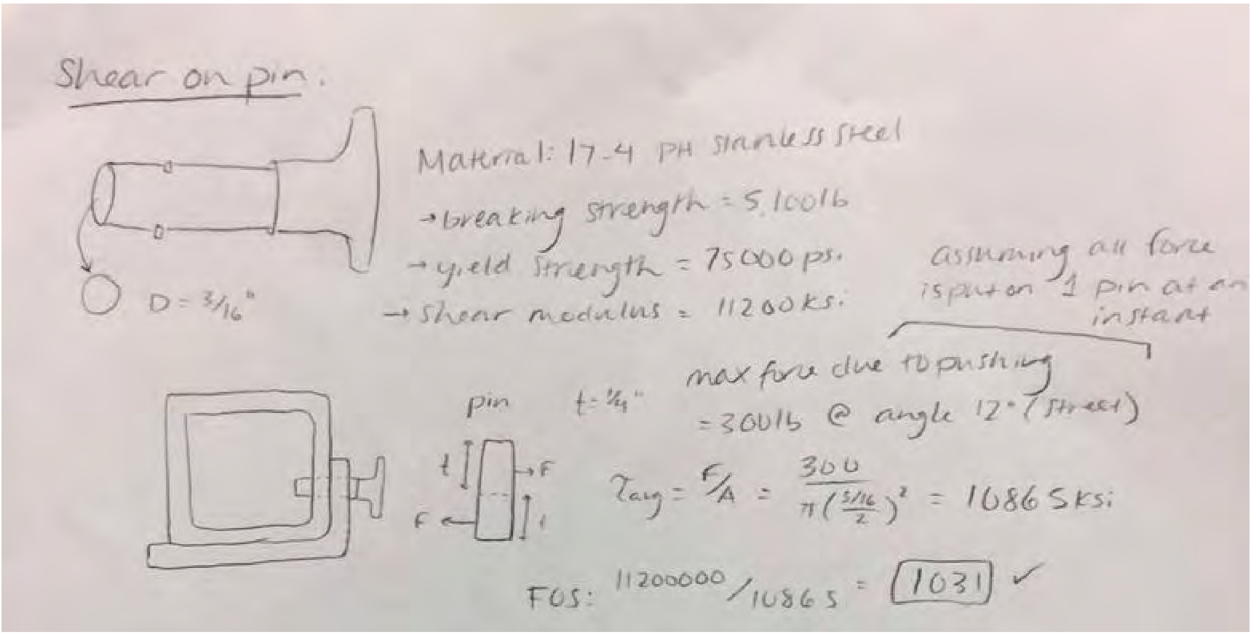


Fig. I25 - Calculation of shear on pin

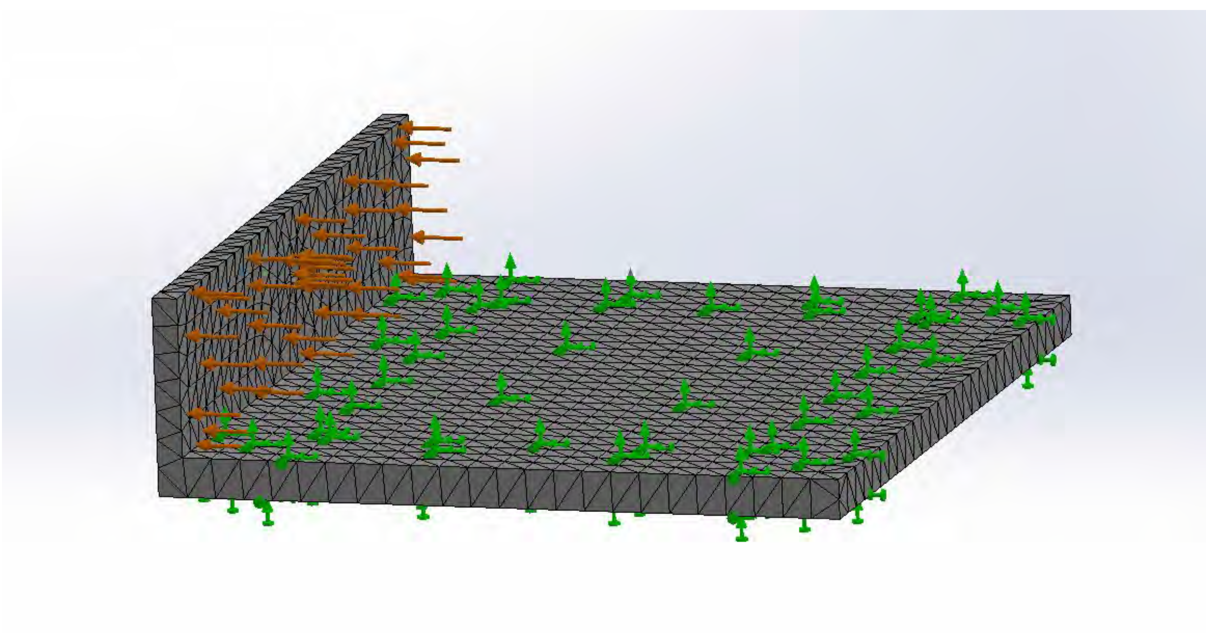


Fig. I26 - Meshing of Solidworks Piece

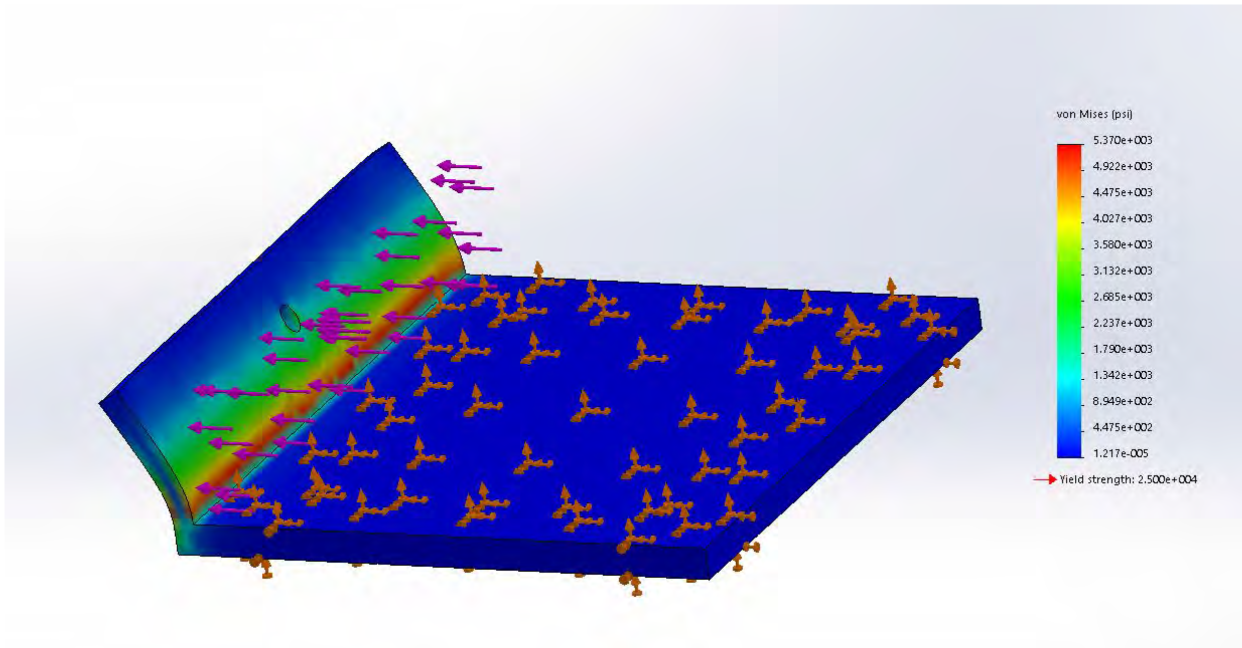


Fig. I27 - Finite Element Analysis of maximum stress on angled plate

Appendix I4 - *Fitting Wheel Prototype on Dero*

Due to the location of the Dero low to the ground, the wheel was fitted to the side of the 4x4 steel beam, with the “top hinge” being fit against the inside face of the beam, under the parklet. Due to the symmetry in the beam, this process still verified that the wheel fits the beam in the specified ways we were looking for.

Fig. I28 - Underside of beam, showing the hinge almost fitting

Fig. I29 - Custom wheel fitting on 4x4 parklet beam

Fig. I30 - Fitting the custom wheel to the back side of the 4x4 parklet beam

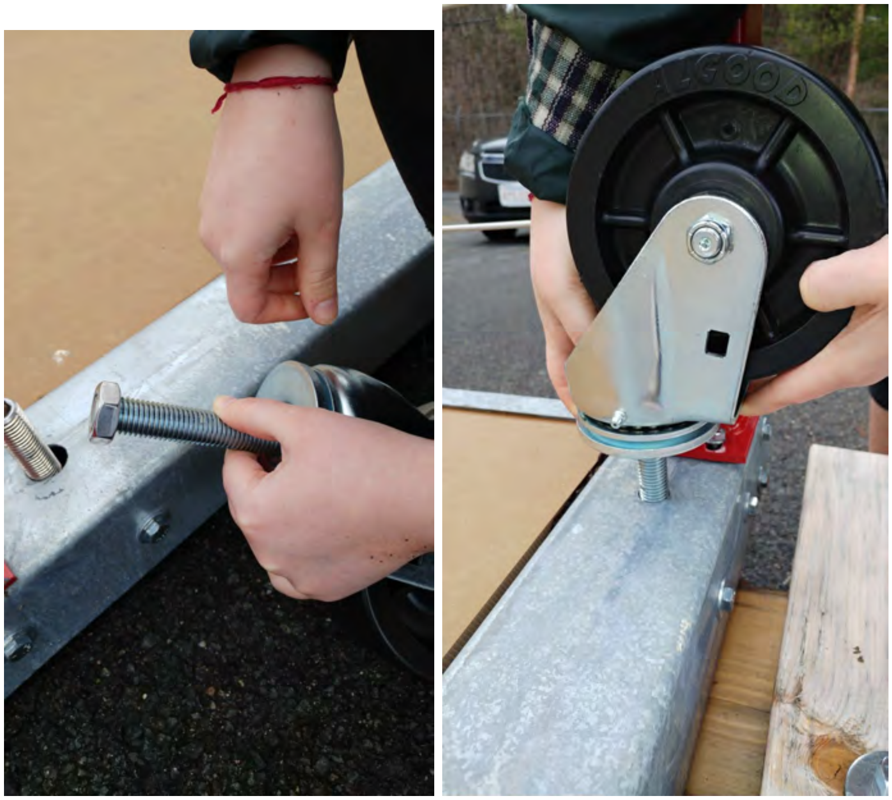
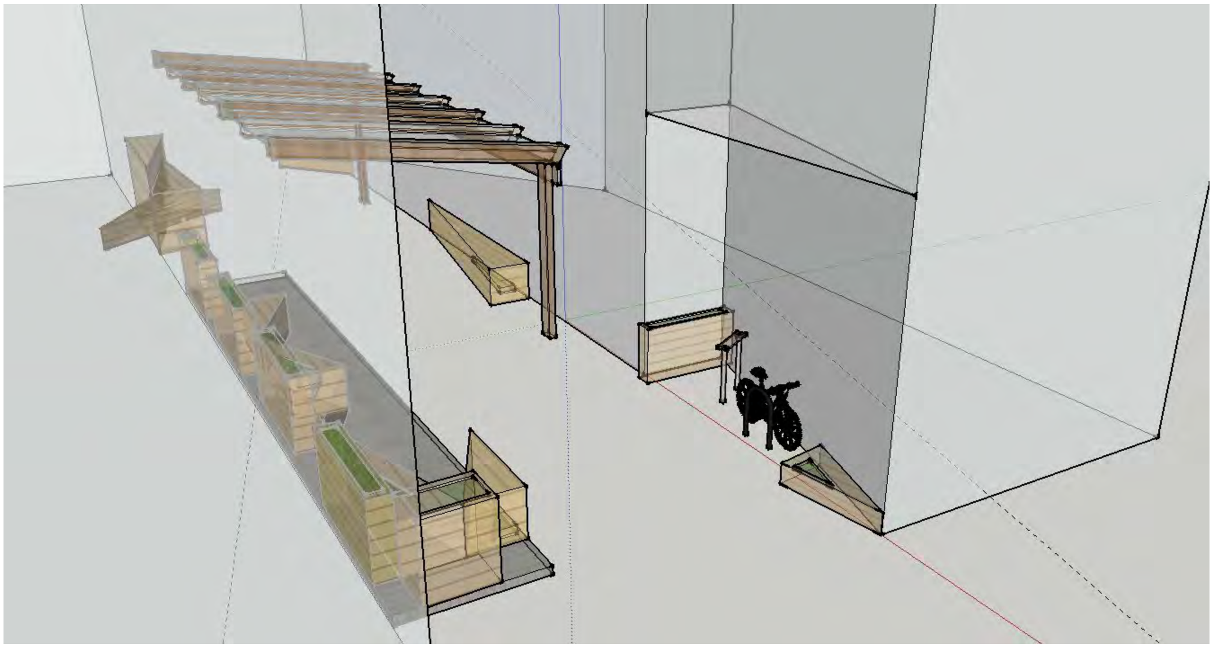


Fig. I31 - Fitting the threaded stem caster to the hole and the nut

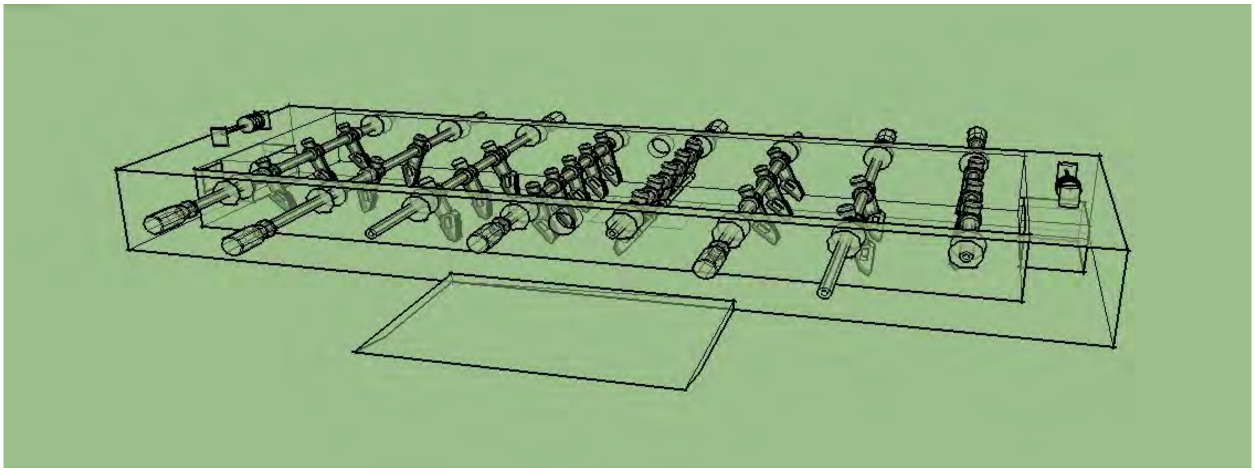
Appendix J: Conceptual Designs

This appendix (Figs J1-J14) show initial conceptual designs for parklets both in Cracker Barrel Alley and on the Dero parklet made by the NOPS team. These designs were used as inspiration for the final design layouts of the parklet.

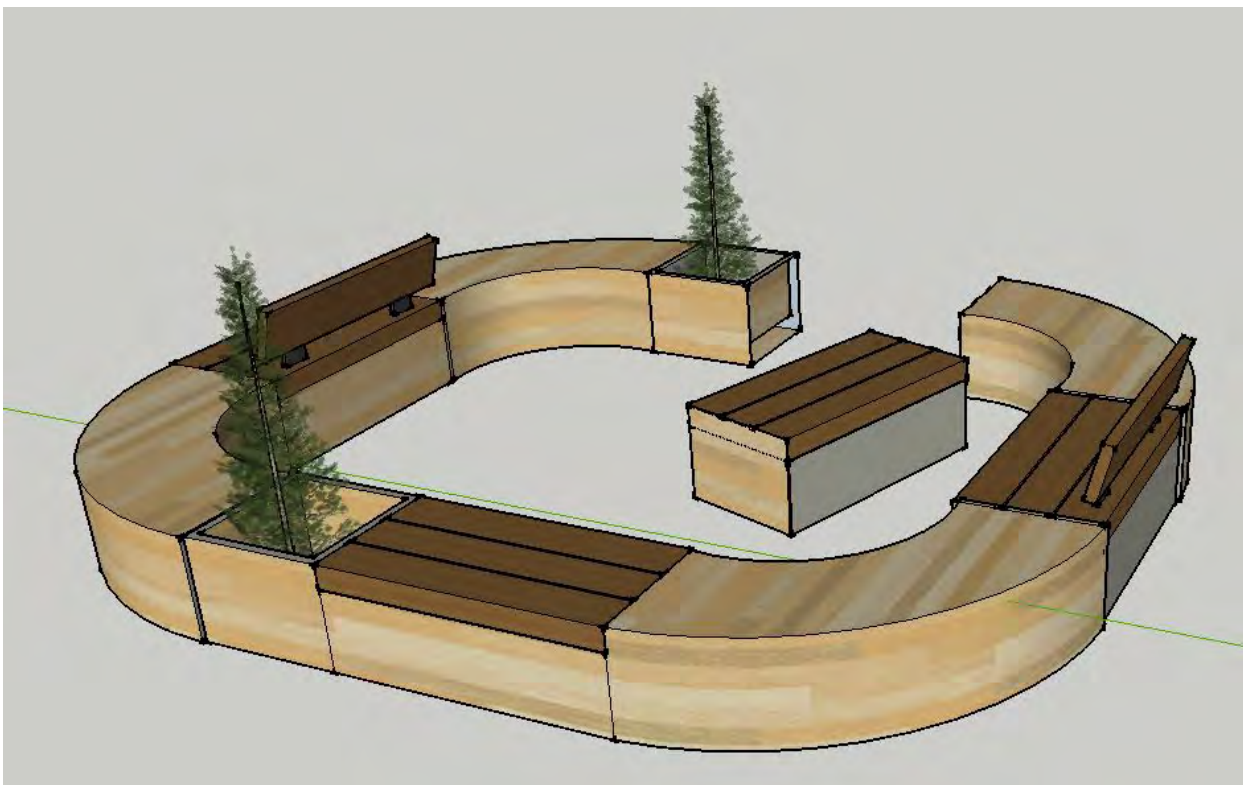


[Fig. J1] Cracker Barrel Alley Simple Design

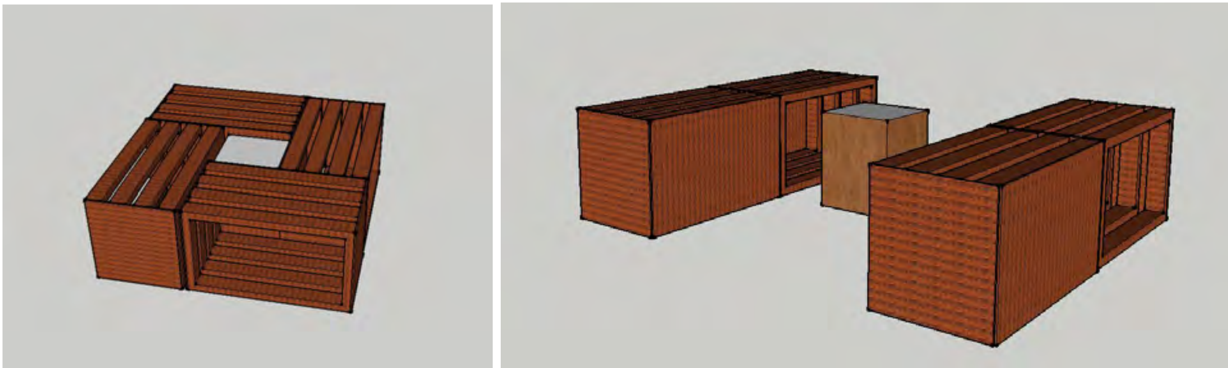
[Fig. J2] Cracker Barrel Alley Simple Design - Side View



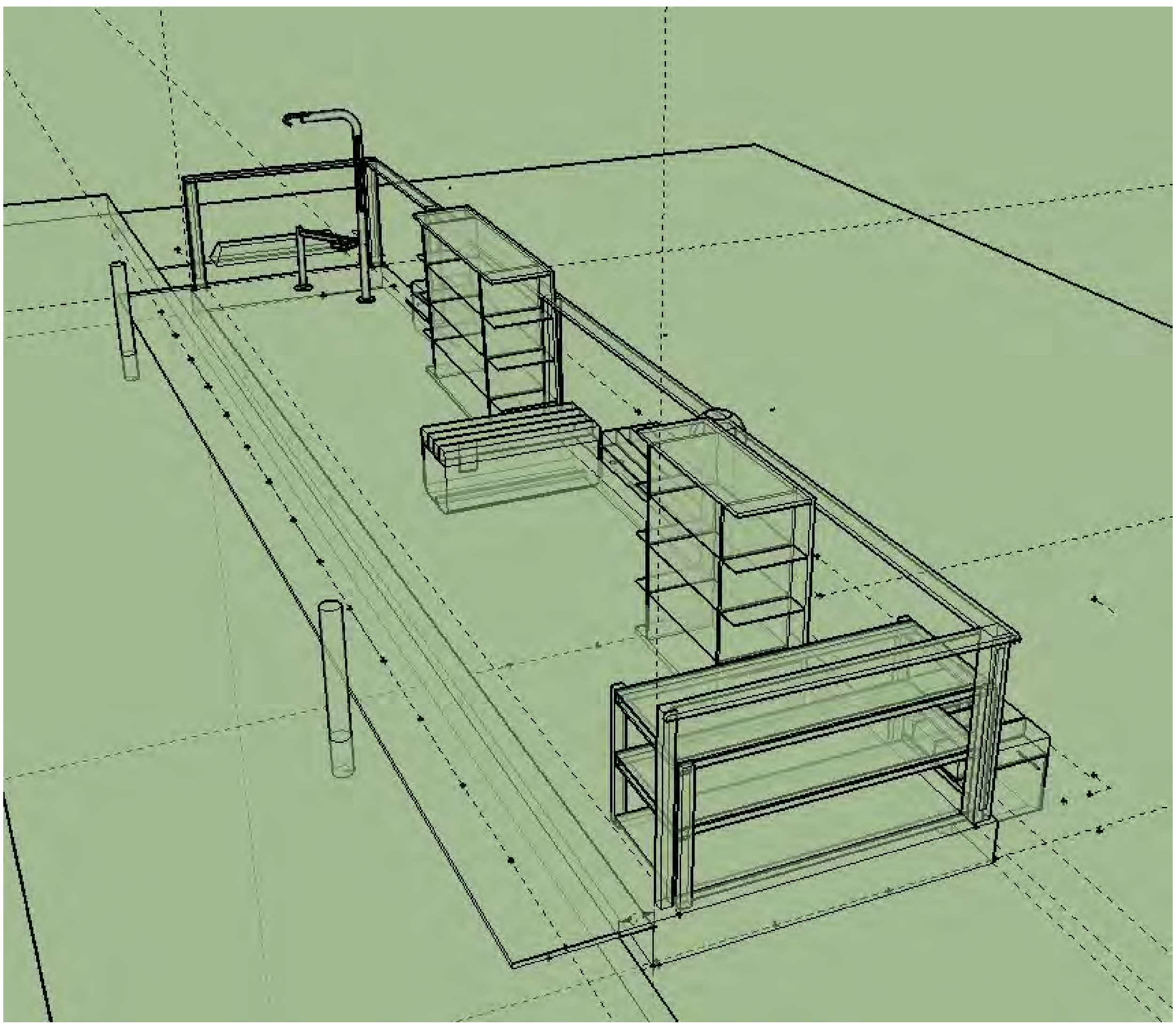
[Fig. J3] Dero Parklet Foosball Table



[Fig. J4] Round Bench Parklet

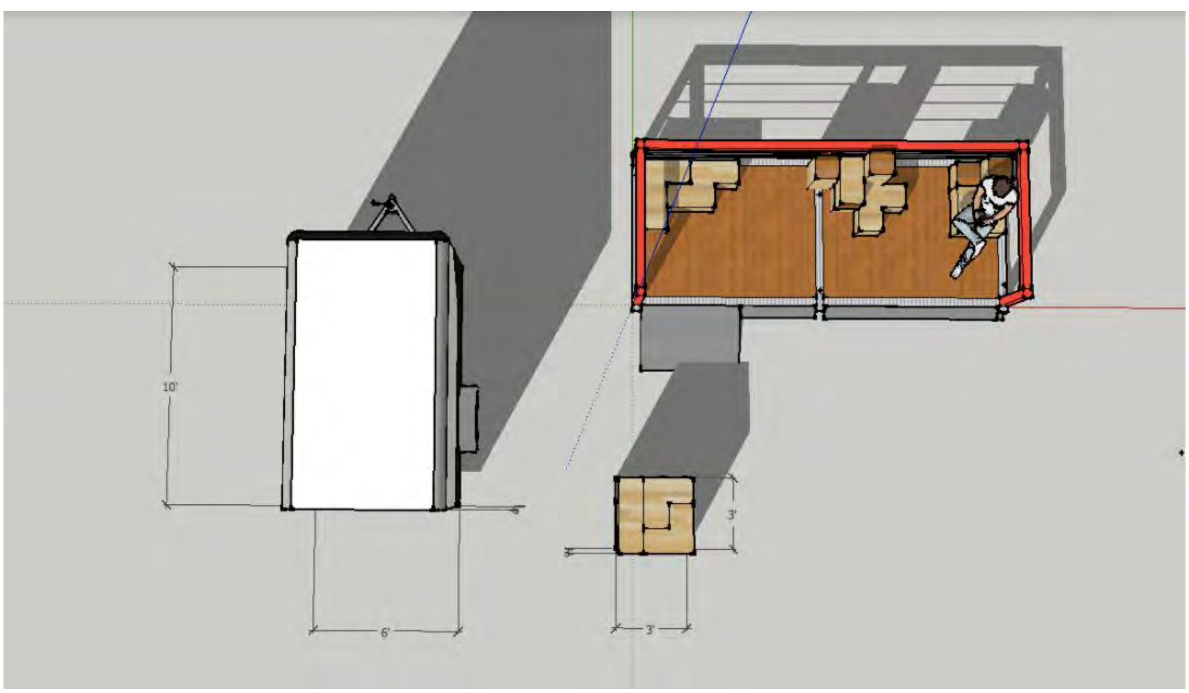


[Fig. J5] Modular Bench Crate Design

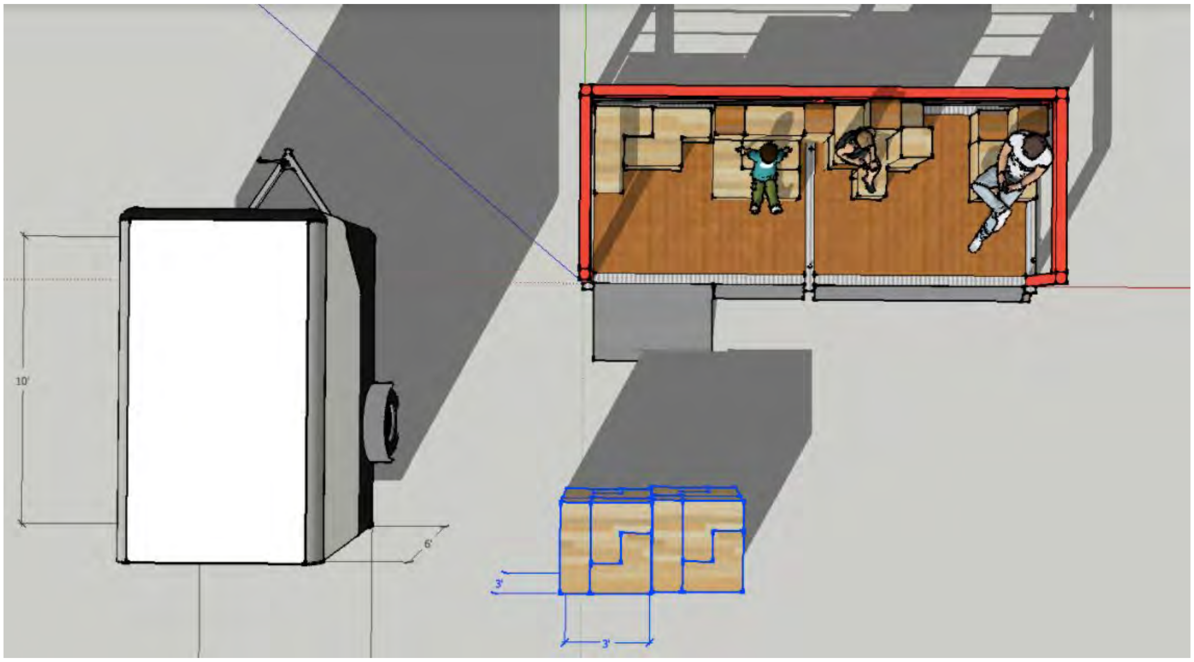


[Fig. J6] Line Design of Library Parklet

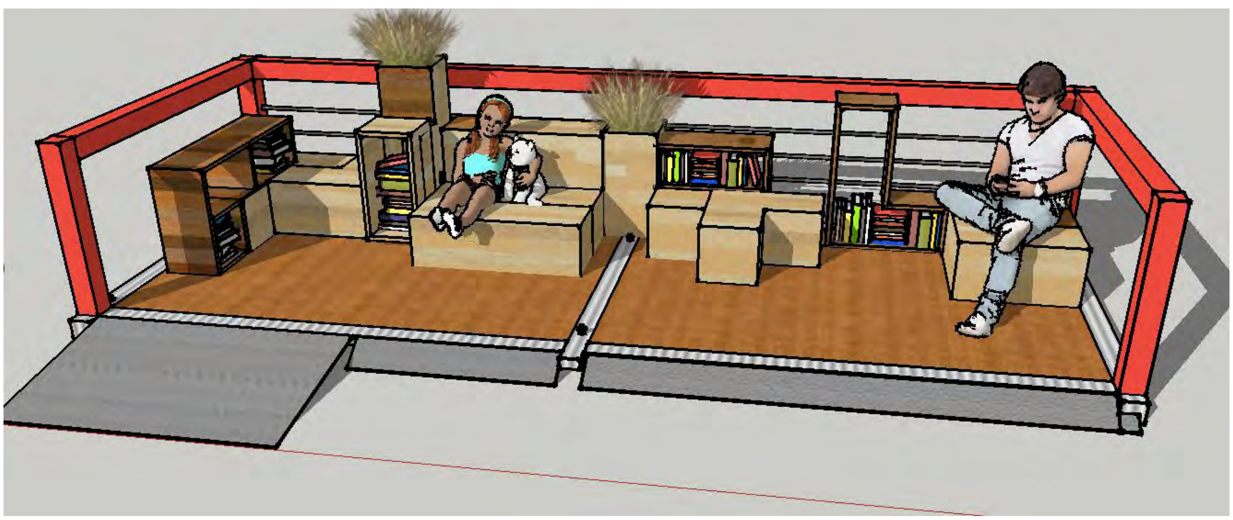
[Fig. J7] Eco-Parklet Initial Layout



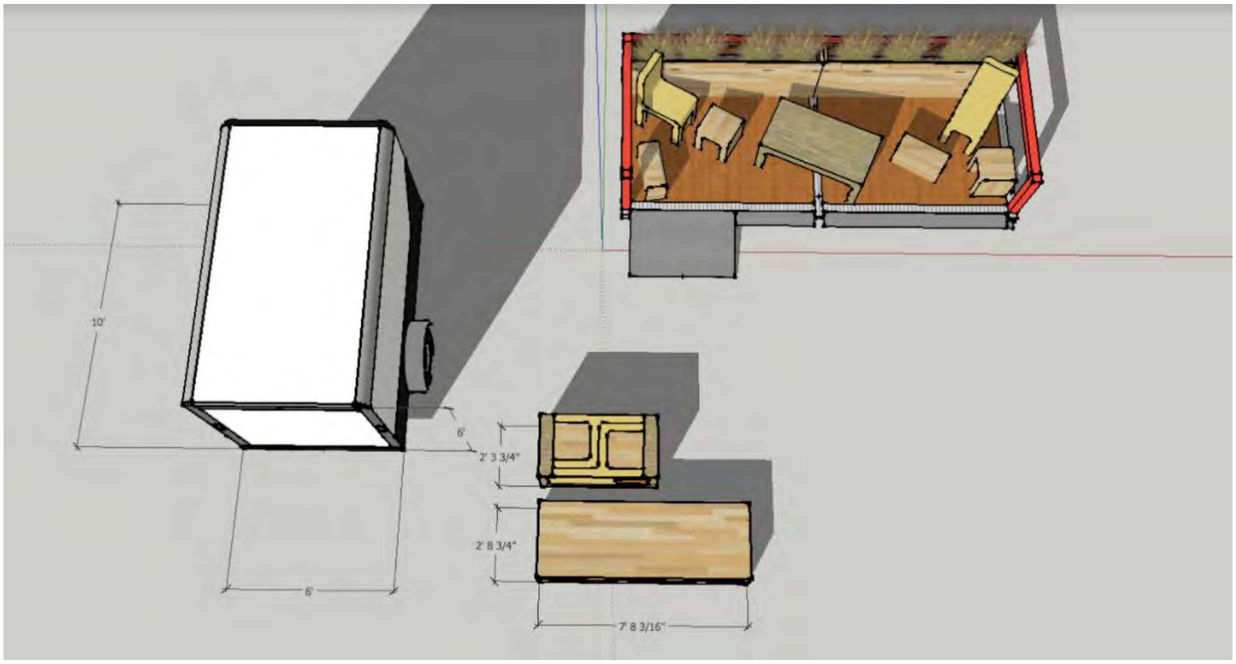
[Fig. J8] Top View Modular Furniture and Trailer



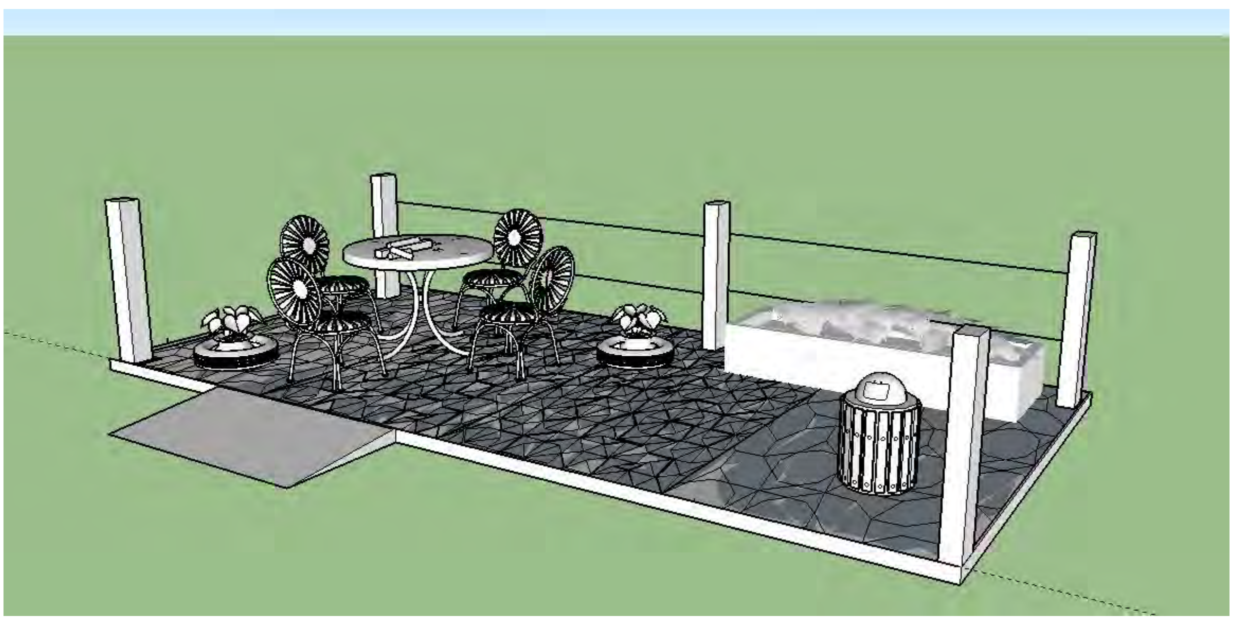
[Fig. J9] Modular Furniture with Trailer Volume



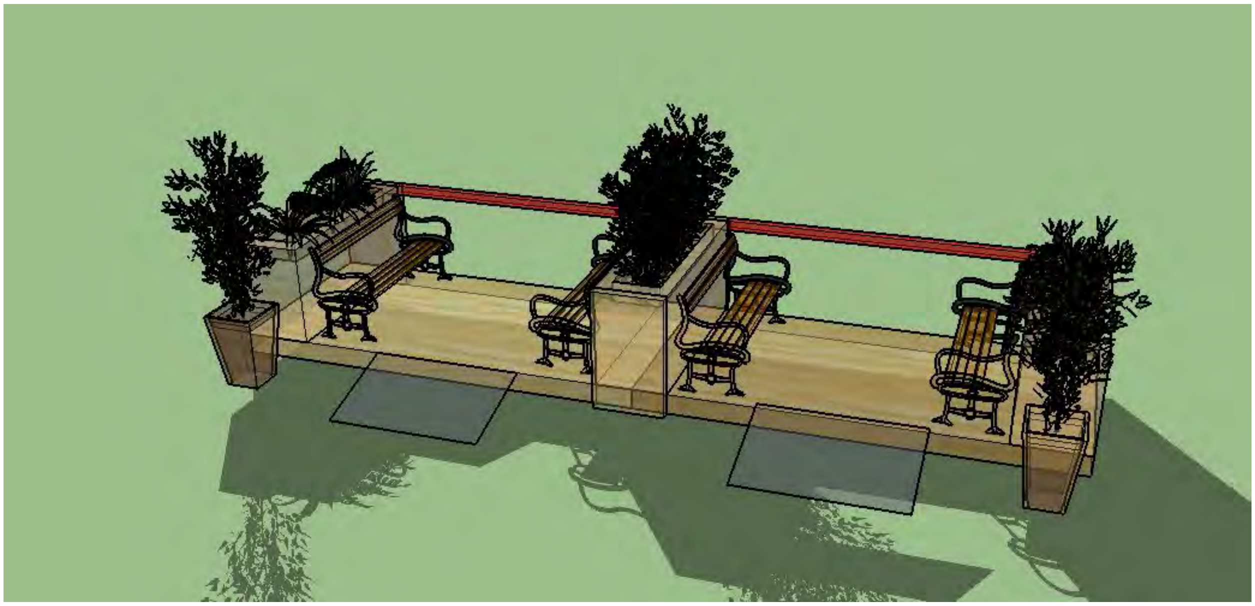
[Fig. J10] Modular Furniture Library Design



[Fig. J11] More Complex Modularity with Trailer Volume



[Fig. J12] Visual of Chalkboard Floor



[Fig. J13] Simple Seating Parklet

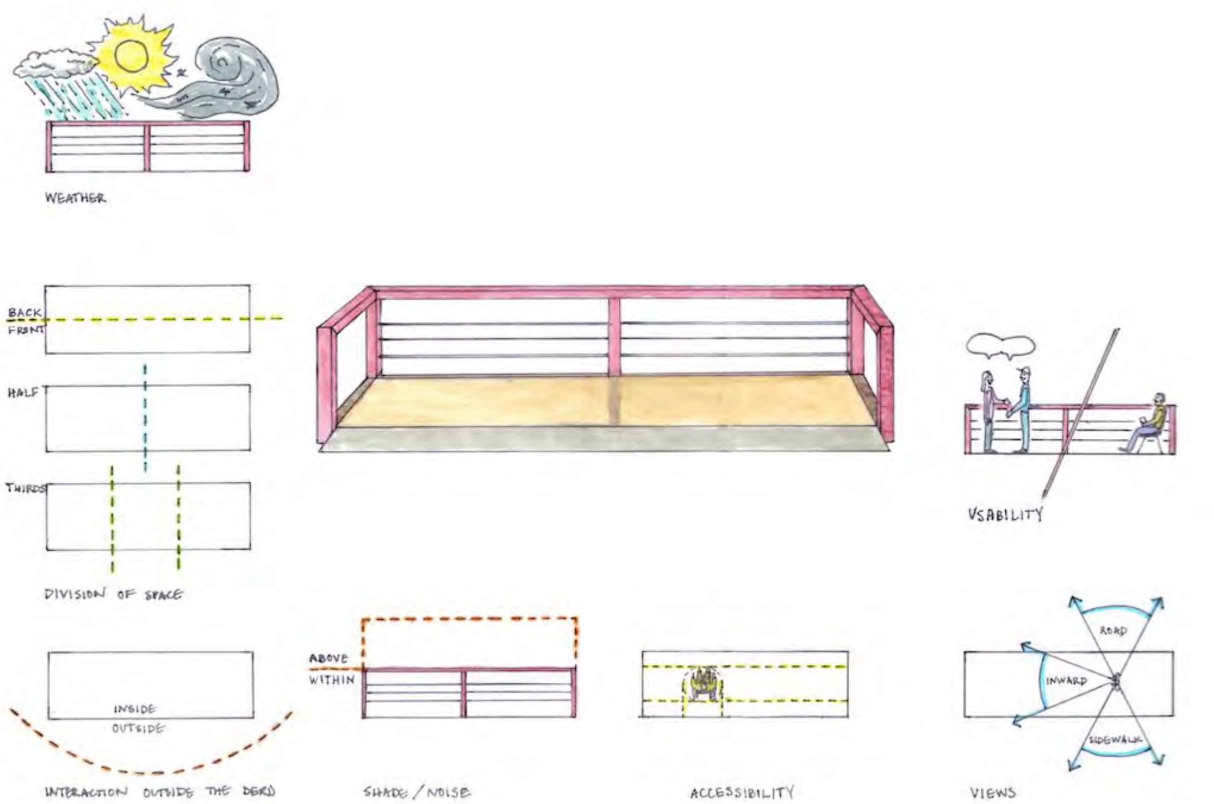
[Fig. J14] Simple Dero with Furniture and Bike Rack

Appendix K: Proposed Upper Design Documentation

In designing of the upper layout of the Dero, the spring semester was divided in three parts: identifying and designing four core themes, researching and designing modularity pieces, and focusing on one design of modularity and refining specific design ideas. All of the conceptual designs in this Appendix were explored in detail, focusing on accessibility, sustainability, and urban outreach, with specific design for the Dero unit.

Part I: Four Designed Themes

From a brainstormed list, we narrowed down to the four conceptual designs, which are ‘Sustainability,’ ‘Library,’ ‘Kid’s Corner,’ and an ‘Restaurant Extension,’ as depicted in Fig. K1-K9. The process began with an assessment of the Dero itself. Components that were considered for each design are identified through diagrams in Fig. K1. These include weather, spatial organization, accessibility, views, and visibility. The close examination of the Dero helped with the designs of the space. None of the four themes were fully detailed, but were conceptual interpretations that the city of Northampton could access and then easily purchase the furniture.

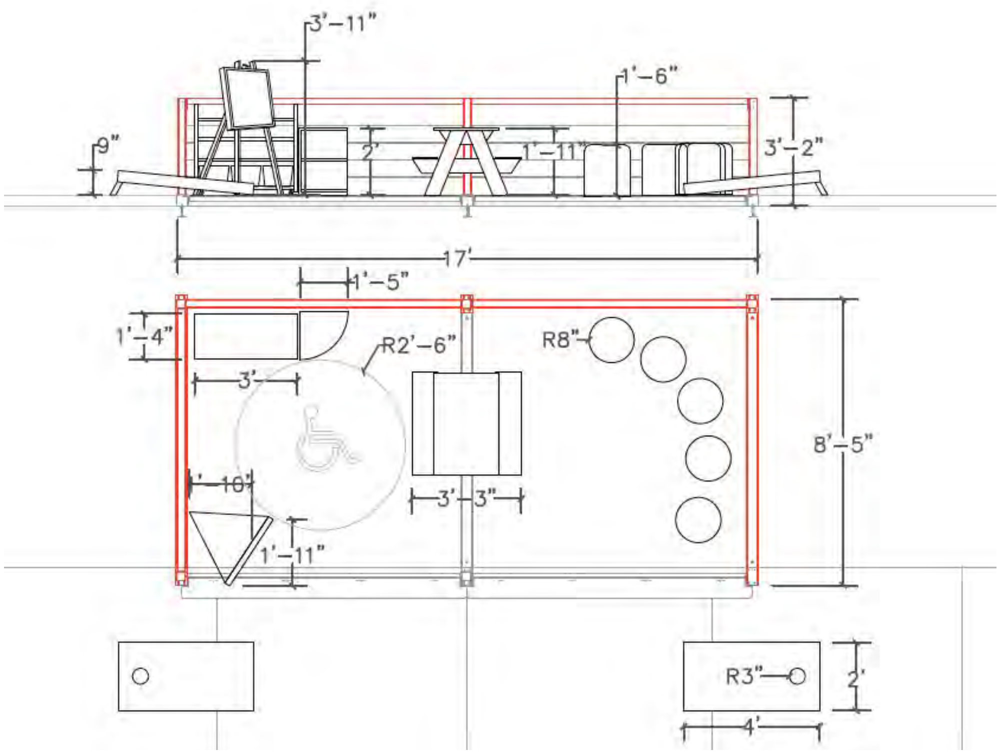


[Fig. K1] Hand drawings depicting the space of the Dero unit and the uses

Kid's Corner

This design focuses on a fun, creative space mainly designed to the height of children. The deck of the Dero is proposed to be made out of a chalkboard material. There is a small picnic table to the height of a child for drawing, making crafts, and playing chess. Colorful, individual adult seating is placed on the side in the shape of a caterpillar. A lockable shelf holds arts and crafts supplies with a tripod to showcase the "craft of the day" or workshops.

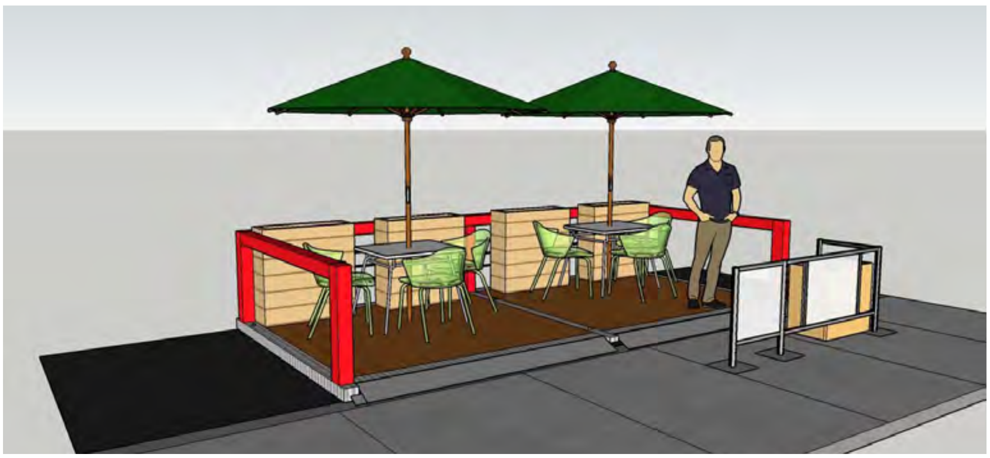
[Fig. K2] Conceptual SketchUp image of the *Kid's Corner*



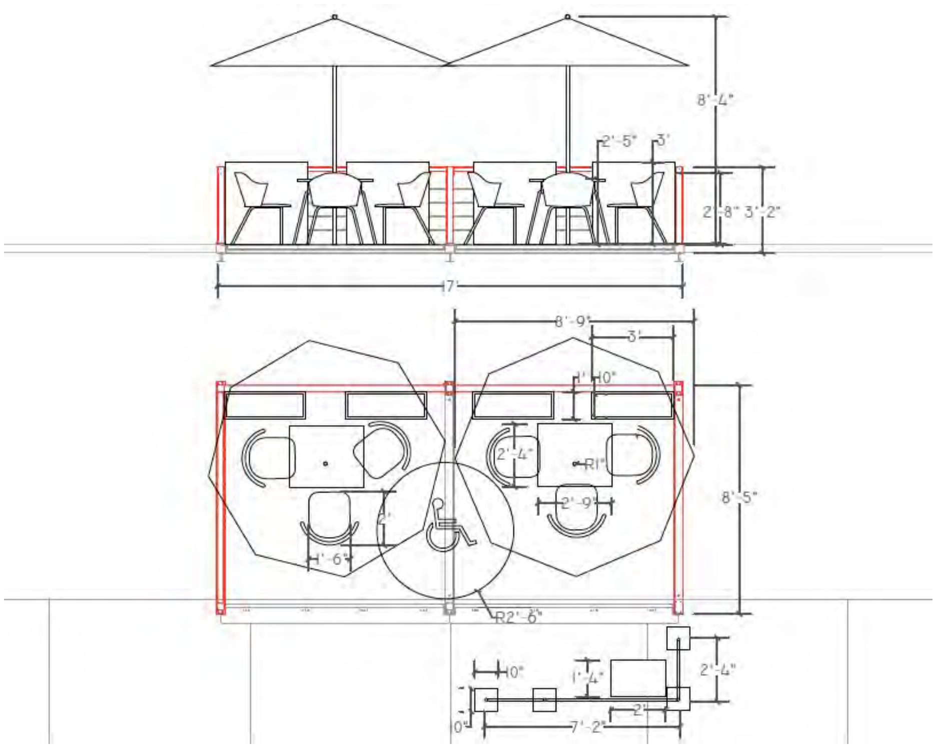
[Fig. K3] Conceptual AutoCAD image of the *Kid's Corner*

Restaurant Extension

We propose the Restaurant Extension design to be located in front of a restaurant or cafe in town. The lightweight chairs and tables can be arranged and moved to accommodated various accessibility needs. The umbrellas provide shade to make the area more comfortable for extended eating. There are planters along the back edge of the Dero as a separation barrier from traffic. The busking area can be included for restaurants that want to use the Dero as served seating, or could be removed if the seating is for a cafe in which customers purchase coffee and food before sitting. The Dero platform could also act as advertisement to the adjacent restaurant.



[Fig. K4] Conceptual SketchUp image of the *Restaurant Extension*

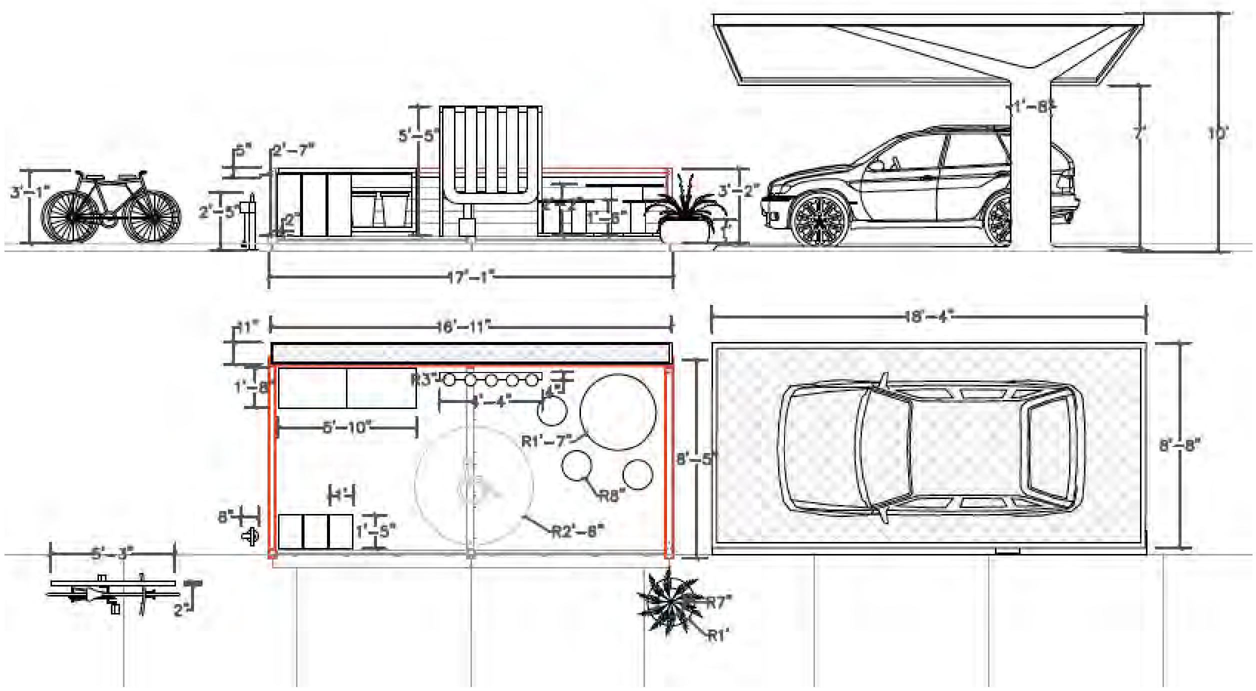


[Fig. K5] Conceptual AutoCAD drawing of the *Restaurant Extension*

Sustainability

The layout of this Dero focuses on sustainable methods. There are ample solar panels, one for a car charging spot adjacent to the Dero, and a solar panel that runs along the back railing that would provide power to a charging station. There are methods for green gardening, including a vertical hydroponics garden and a planting station for planting workshops. There are composting, trash and recycling bins, a tire planter, and seating made up of recycled cable spools. This parklet advertises a reusable lifestyle and could be easily implemented if the materials were collected.

[Fig. K6] Conceptual SketchUp image of the *Sustainability Parklet*

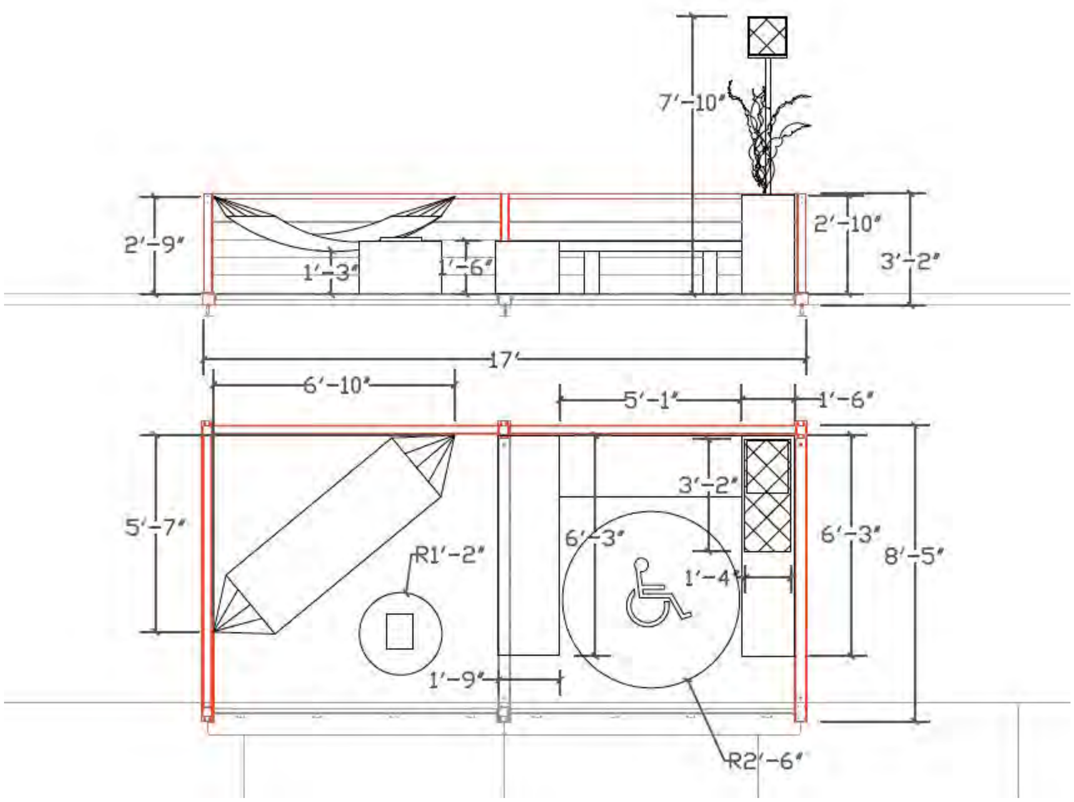


[Fig. K7] Conceptual AutoCAD drawing of the *Sustainability Parklet*

Library

The focus of this design is a relaxing, comfortable space for reading. There is a lend-a-book library with sliding glass doors to protect the books in rainy conditions. A solar panel extends above the Dero to power a charging station for small devices. Comfortable benches and a hammock provide a range of seating for various users.

[Fig. K8] Conceptual sketchUp image of the *Library Parklet*



[Fig. K9] Conceptual AutoCAD drawing of the *Library Parklet*

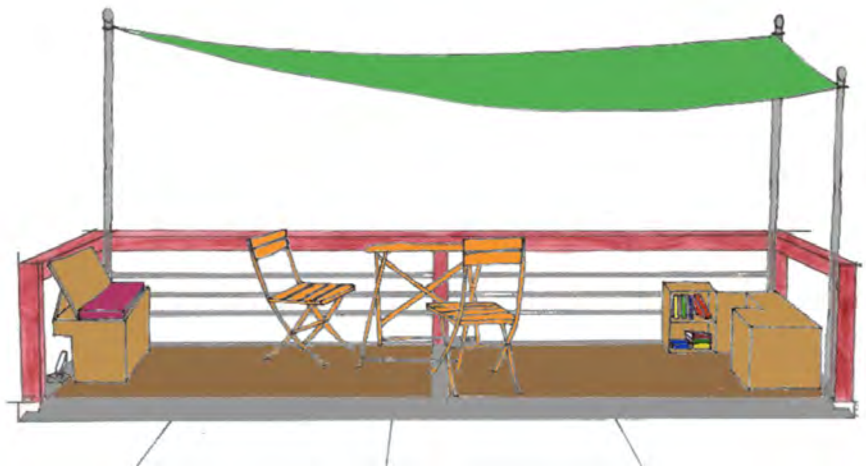
Part II: Modular Research

Modular was a key aspect of this project that we believed would pair well with the mobility of the Dero. The next part of the semester was researching modularity for the furniture on the Dero. The research identified other cities that have done similar modular furniture pieces as outreach programs. The Uni Project, a nonprofit based in New York, has boxes that are able to roll along the sidewalk, and then when placed, unfold to reveal bookcases holding modular chairs and books. This innovative project sparked ideas of what the modular components for the Dero could look like.

[Fig. K10] Uni Project installed in New York, NY

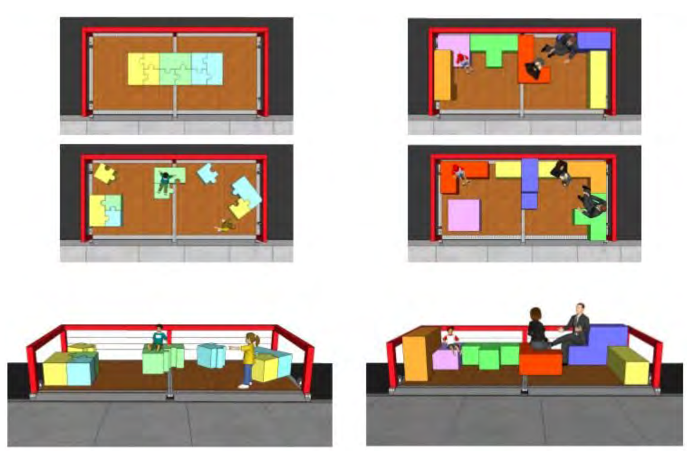
[Fig. K11] Uni Project unit enclosed and being moved in Boston, MA

In designing furniture for the Dero, a large design constraint was the wheels on the deck of the parklet. We had to make sure that they would not be a tripping hazard or an eye sore. One modular design for the Dero focuses on two boxes, one that could fit in between two wheels, and one that would cover the wheels. Both boxes would act as benches when installed, with storage space for tables and chairs. One has a folding up reclining back with inner storage to hold a table and a few chairs with a cushion, and the other box with a hinged bookcase that could swing out, as well as more storage for other chairs.

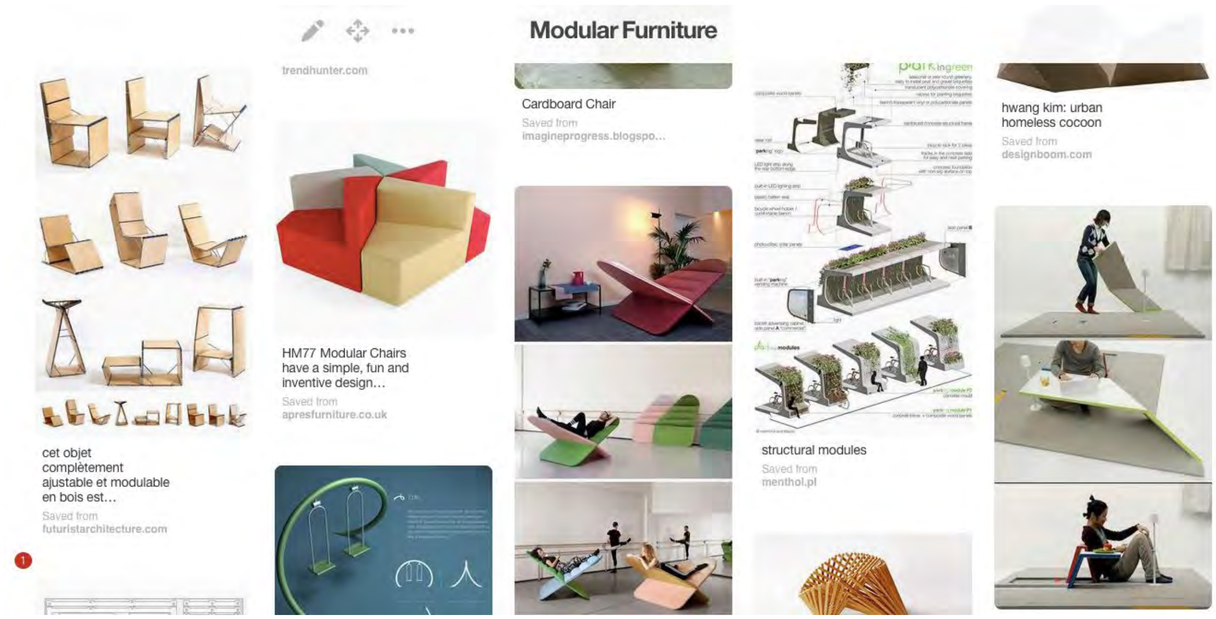


[Fig. K12] Hand drawing of the two box units, with components that would be stored within the boxes.

Another aspect of modularity are assembled or folded pieces that form furniture, or a set of pieces that are then arranged into various shapes on the base of the Dero. We used a Pinterest board to collect ideas and case studies of modular pieces of furniture (see Fig. K14). SketchUp drawings were created to explore modulars that when placed together, make one contained shape (see Fig. K13). These components are creative suggestions of what the furniture could be, and would require more thought and designing when moving forward with the furniture.



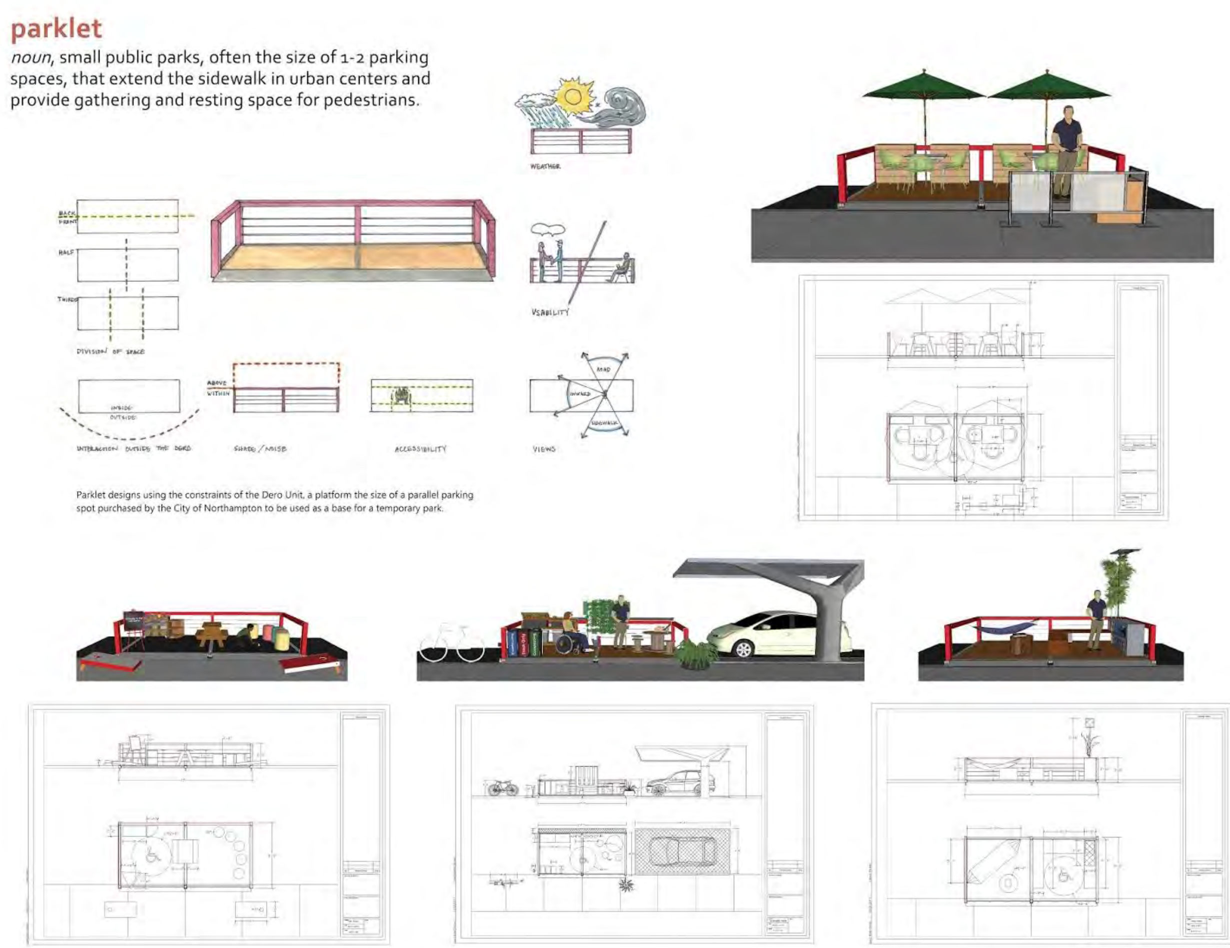
[Fig. K13] SketchUp image of colorful, noticeable pieces that then fit together



[Fig. K14] Screenshot of Pinterest board titled, *Modular Furniture*

Part II.a: Critique

On March 31, 2017, we presented upper designs and mapping components of the project at a critique in order to collect feedback and showcase our work. During both presentations, we had an anonymous document that the people who attended could use to write down their ideas and suggestions. Some suggestions included thinking about the bike share initiative that Northampton will have soon and how the parklet could add to that or be its own separate entity. Theft of furniture was also mentioned along with maintenance. Who would monitor the parklet and could there be a sponsor for the space? The feedback was positive overall and people listed interest in the future design development of the parklet. Most comments suggested interest in the puzzle piece and tetris modules as ideas that would fit well with Northampton and that people would enjoy to sit on and play with.



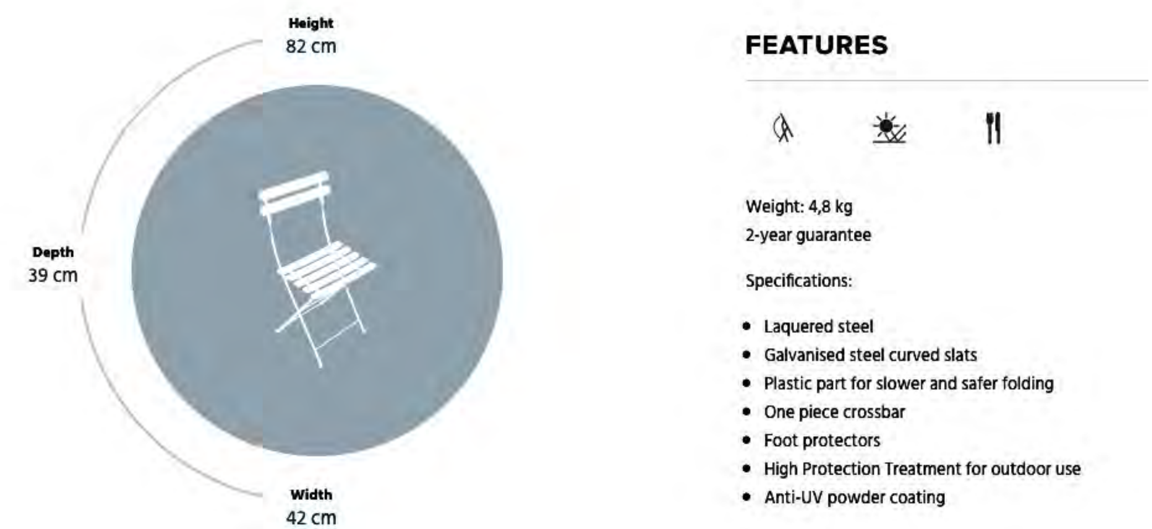
[Fig. K15] Image of one of two posters presented at the critique

[Fig. K16] Image of second poster presented at the critique

<u>Part III:</u> Focusing on One Modular Design

The modular puzzle pieces and tetris blocks were selected as designs to be further developed post-critique. These could be an eye-catching design that would add to the artistic urban landscape of Northampton, MA. The shapes could form blocks that could then be moved around on a bike trailer for ease of mobility. The individual blocks should be lifted with two people and pushed on the deck by one person. Theft was a consideration of the design. We believe that the hefty, rectangular shape of each modular would make it awkward to travel outside of the Dero. The proposed material would be a recycled plastic or marine plywood, that would have components on the bottom so that it will be slip resistant.

We understand that these designs are complicated and require more design development. To gain public interest in the parklet in the short term, we propose that the City of Northampton purchase the same chairs and tables as Pulaski Park. These pieces would add consistency to the city and would be an easy solution for the first iteration of the parklet. We propose three Fermob Bistro 24" Tables and nine Fermob Bistro Chairs, in the colors 'Turquoise,' 'Grass,' and 'Honey.' See Fig. K17 for specifications. Prices are listed in the invoice in Fig. K18.



[Fig. K17] Specifications of Fermob chair, as stated on Fermob.com

ClickToShop, Llc / BistroFurniture.com

2001 County Rd C2 W
Roseville, MN 55113
brendan@bistrofurniture.com

INVOICE

INVOICE #	DATE
102565	2/25/16
CUSTOMER ID	**TERMS**
-	Upon Receipt

BILL TO

Liam Collins
Project Manager
MA. Certified Arborist
Mountain View Landscapes
C: 413-246-2655
F: 413-536-5607
Liamc@mountainviewinc.com

SHIP TO

Liam Collins
TBD
Mountain View Landscapes
C: 413-246-2655
F: 413-536-5607
Liamc@mountainviewinc.com

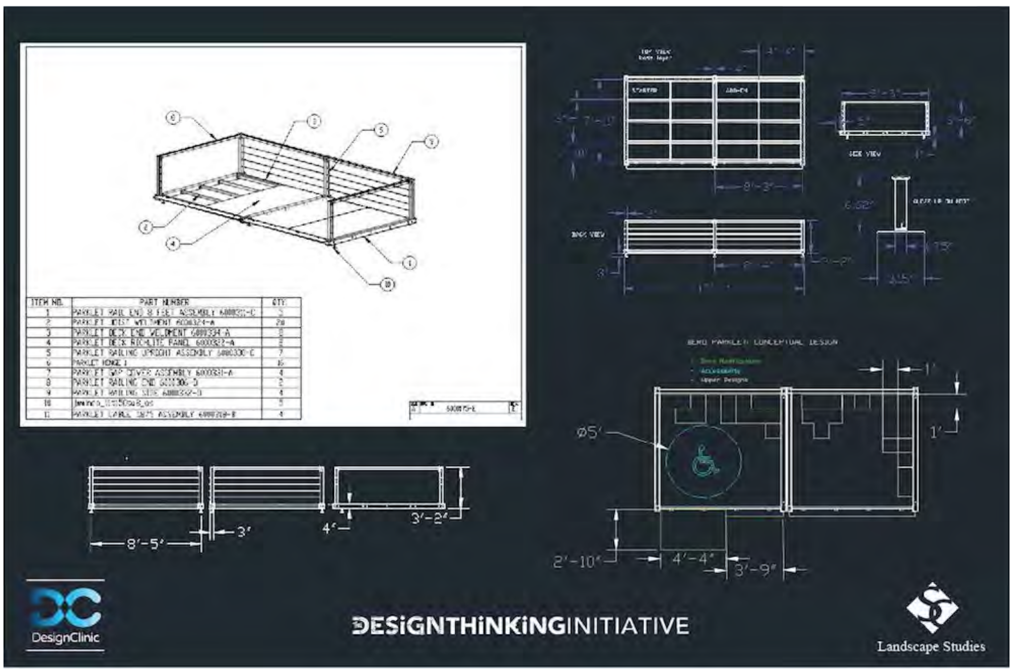
SKU	DESCRIPTION	QTY	UNIT PRICE	AMOUNT
0101-27	Fermob Bistro Chair - Turquoise	2	76.00	152.00
0101-	Fermob Bistro Chair - Verbena	2	76.00	152.00
0101-	Fermob Bistro Chair - Grass	2	76.00	152.00
0101-	Fermob Bistro Chair - Honey	2	76.00	152.00
0101-	Fermob Bistro Chair - Carrot	4	76.00	304.00
0101-	Fermob Bistro Chair - Fuchsia	2	76.00	152.00
0245-	Fermob Bistro 24" Table - Turquoise	1	179.00	179.00
0245-	Fermob Bistro 24" Table - Verbena	1	179.00	179.00
0245-	Fermob Bistro 24" Table - Grass Green	1	179.00	179.00
0245-	Fermob Bistro 24" Table - Honey	1	179.00	179.00
0245-	Fermob Bistro 24" Table - Carrot	2	179.00	358.00
0245-	Fermob Bistro 24" Table - Fuchsia	1	179.00	179.00
				-
				-
				-
				-
				-
				-
	Thank you for your business!	**SUBTOTAL**	**$**	**2,317.00**
		Shipping	**$**	**337.00**
		TOTAL	**$**	**2,654.00**

If you have any questions about this invoice, please contact
Brendan McCarthy, brendan@bistrofurniture.com

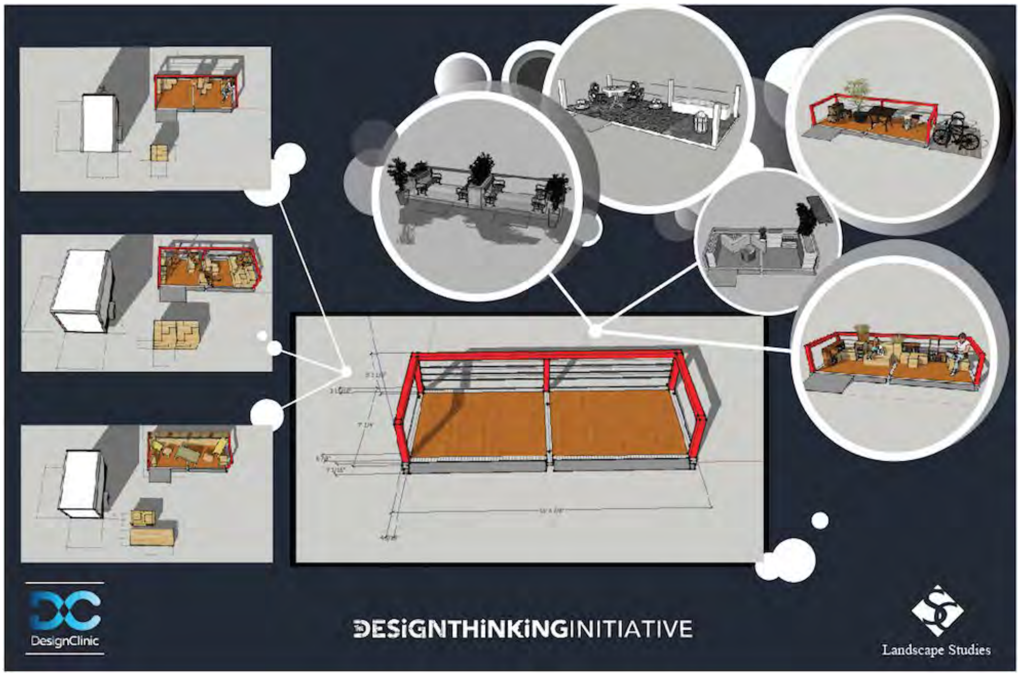
[Fig. K18] Invoice of tables and chairs received in an email from Northampton DPW

Appendix L: APE Gallery

The APE Gallery was a presentation on the project and work we did in the fall semester in order to show the community our ideas and to receive feedback from them. It ran from 4-10 December 2016, and we hosted an evening open house on December 6 to ask questions and gage the interest of the public. We received a lot of positive feedback as well as some good ideas for its potential and some concerns. Some of the possible concerns included the industrial look of the Dero not fitting in with Northampton's aesthetic, the ramp running into the sidewalk traffic, the possibility of the homeless making shelter there, etc. We took these helpful thoughts and considered them in them Spring semester. Figures L1-L3 show pictures of our posters and the interactive setup we brought.



[Fig. L1] Poster of engineering drawing for the Dero base

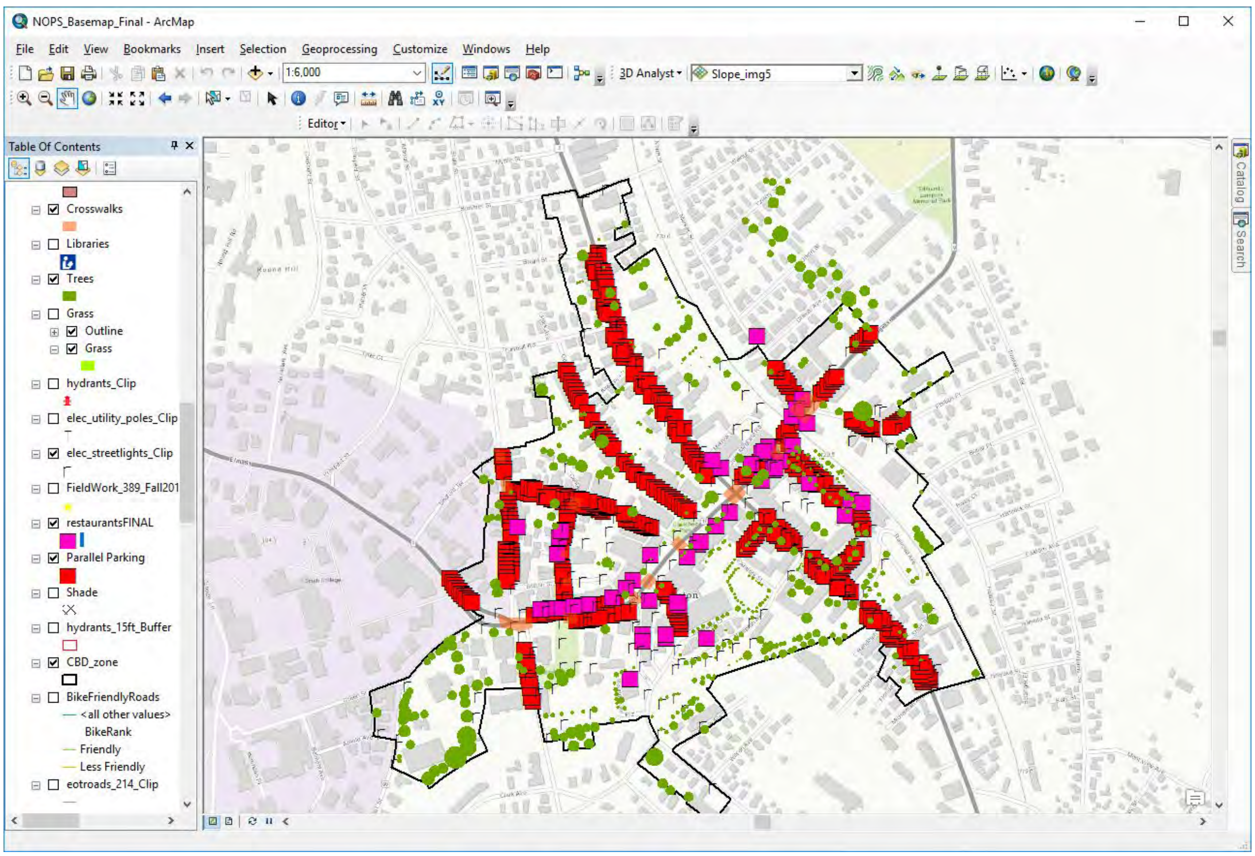


[Fig. L2] Poster of conceptual designs for parklet

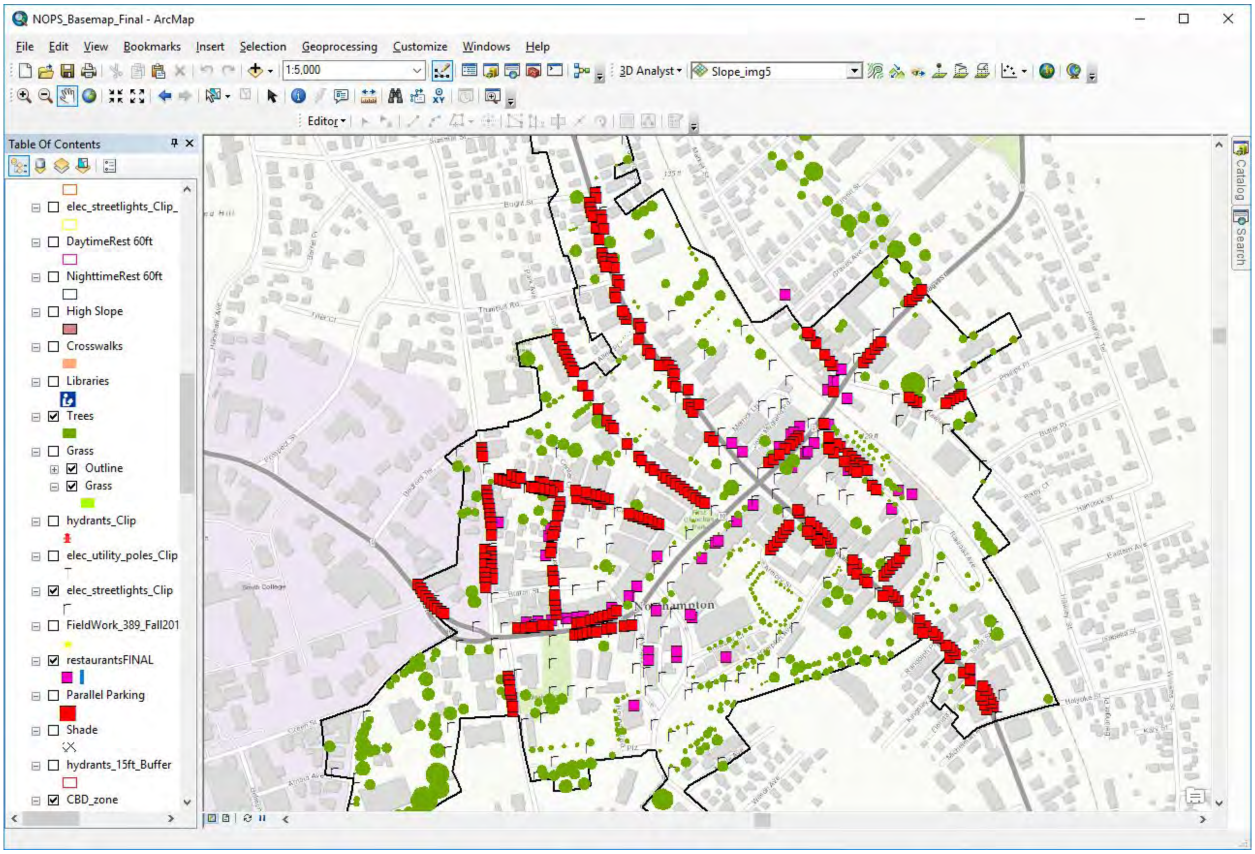
[Fig. L3] Interactive layout we set up for people to try out designs on the parklet model

Appendix M: GIS Mapping

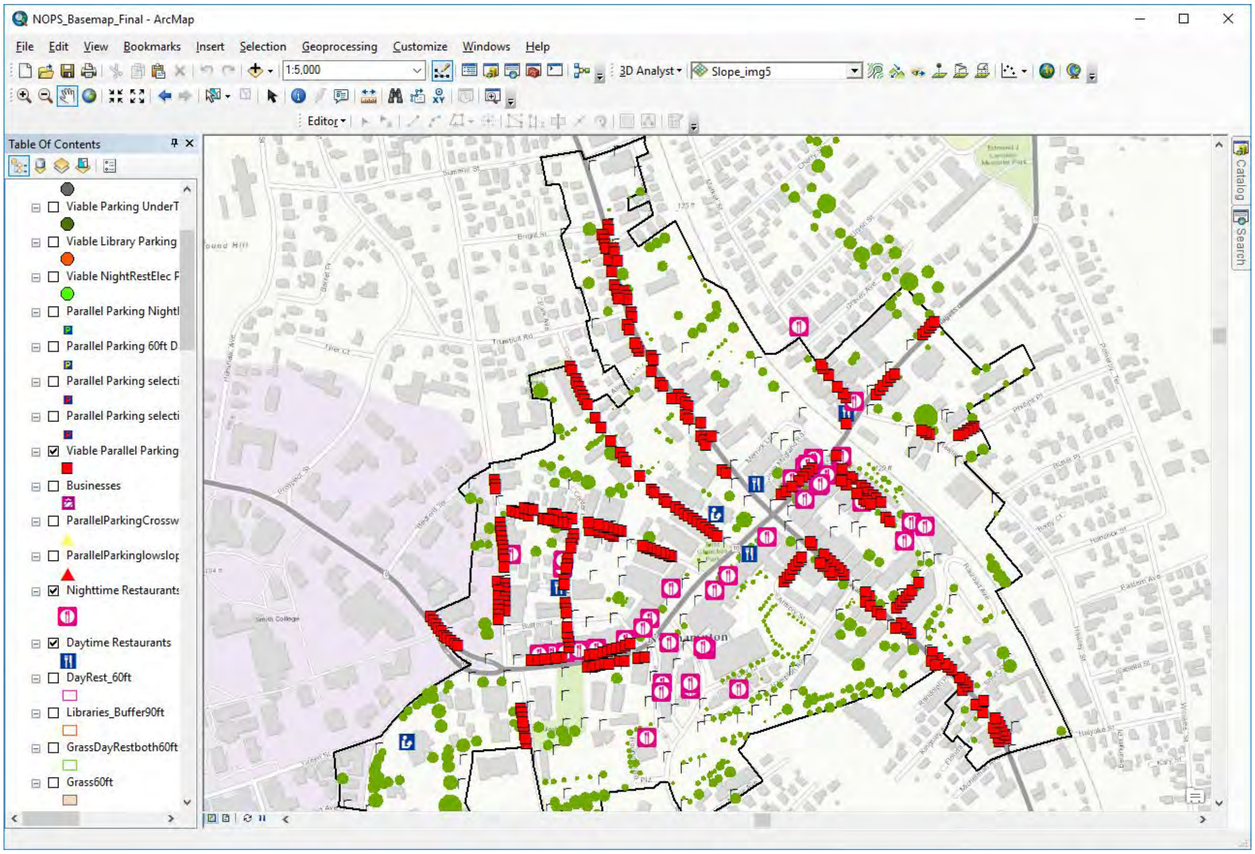
This appendix shows the GIS map-making and analysis we did for this project, and the phases we went through with these maps in order to find the most ideal spots Dero parklet. When we started our site analysis, we had several rich data sets to sort through and analyze, which we were eventually able to narrow down and organize into readable information. From there, we produced several sets of maps, and presented these maps during our critique in late March. During this critique, Wayne Feiden from the Office of Planning and Sustainability gave us feedback about what would be most realistic for the city, such as that the most likely installation of the Dero would involve placing it in one spot for months rather than days at a time, and some additional thoughts about search criteria that we could add were we to do another iteration of the map-making process. Overall, Wayne approved our methods and seemed to find our suggestions helpful. Figures M1-M6 show supplemental images of our process to complement the images in section 4c of the body of the final report.



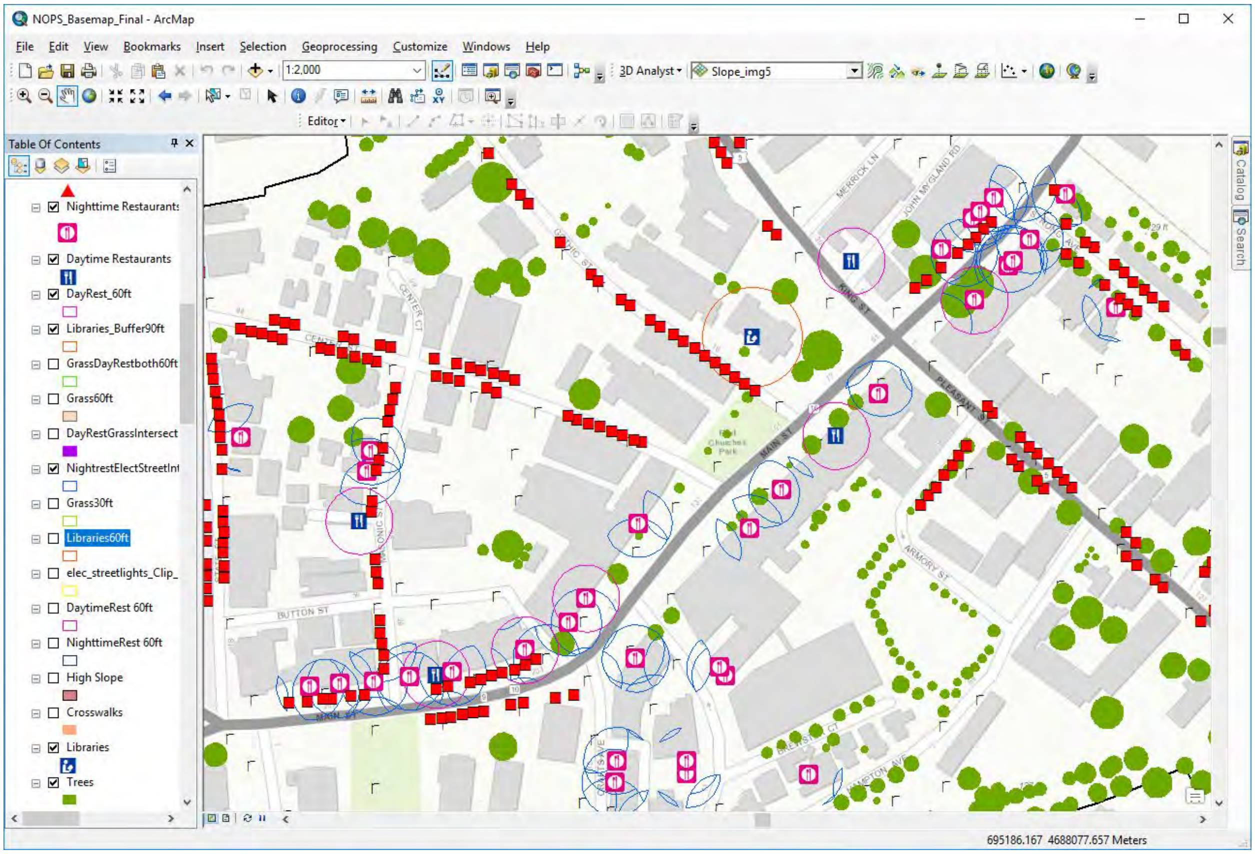
[Fig. M1] Screenshot of initial map at full extent



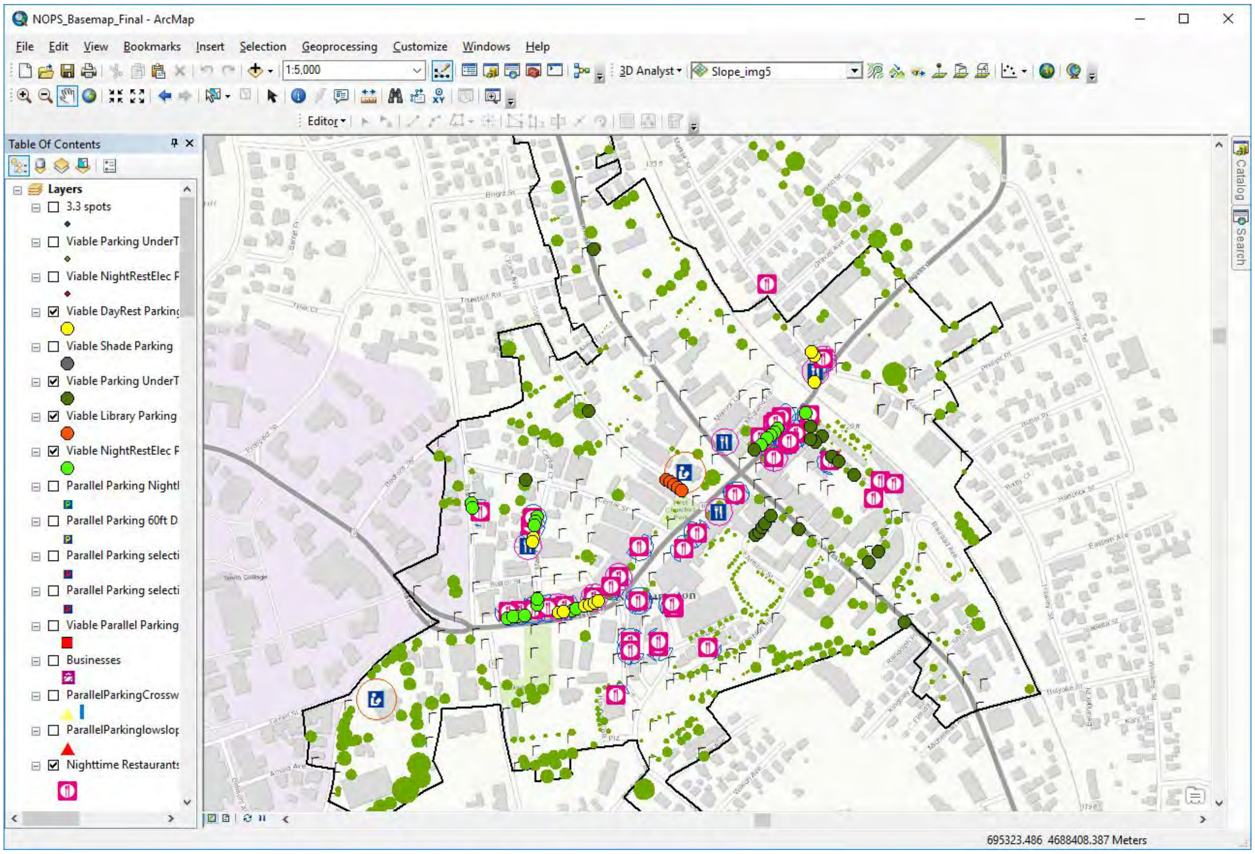
[Fig. M2] Screenshot of ArcGIS map at full extent, with parallel parking spaces remaining after first round of elimination in red, and restaurants in pink



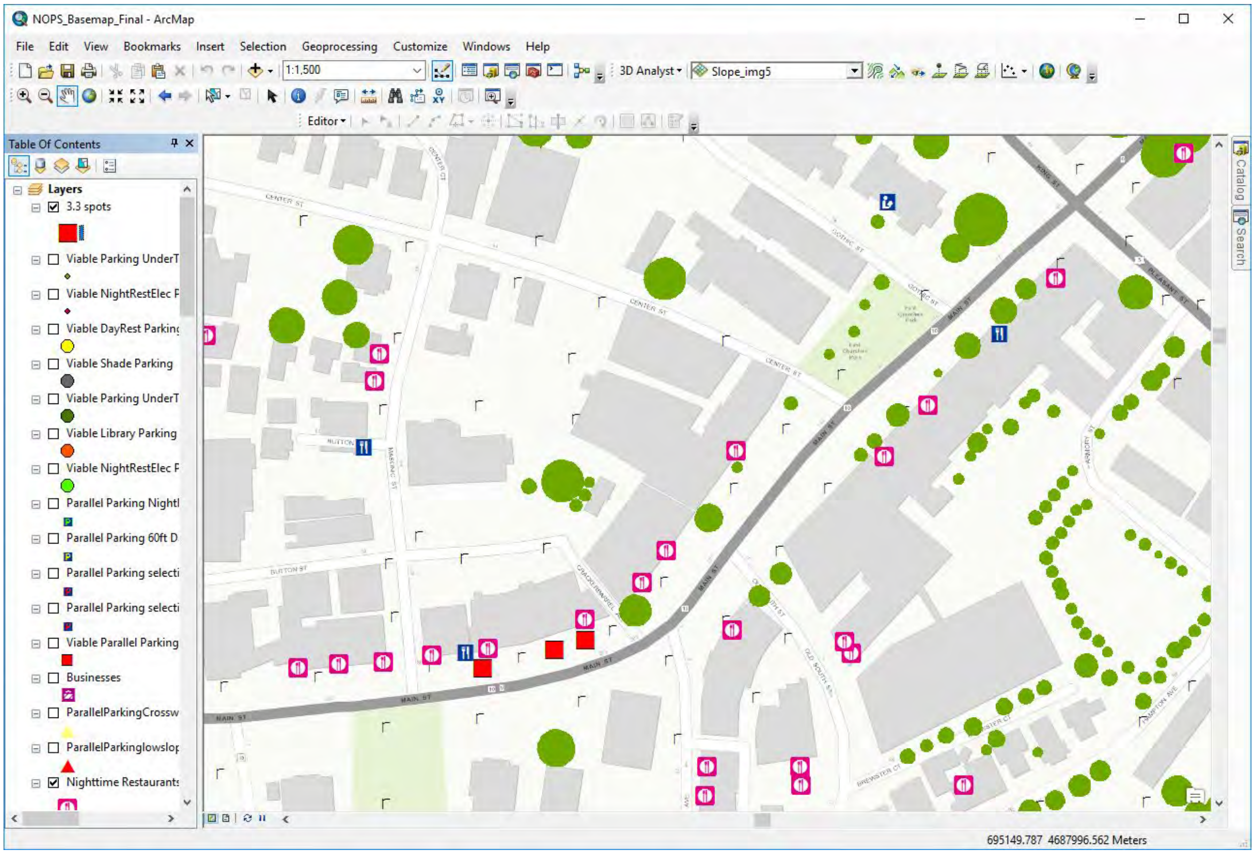
[Fig. M3] Screenshot of ArcGIS map at full extent, with parallel parking spaces remaining after first round of elimination in red, and restaurants with day hours only in blue and restaurants with night hours in pink



[Fig. M4] Screenshot of ArcGIS map detail, with 60 foot buffers around restaurants, and 90 foot buffers around libraries

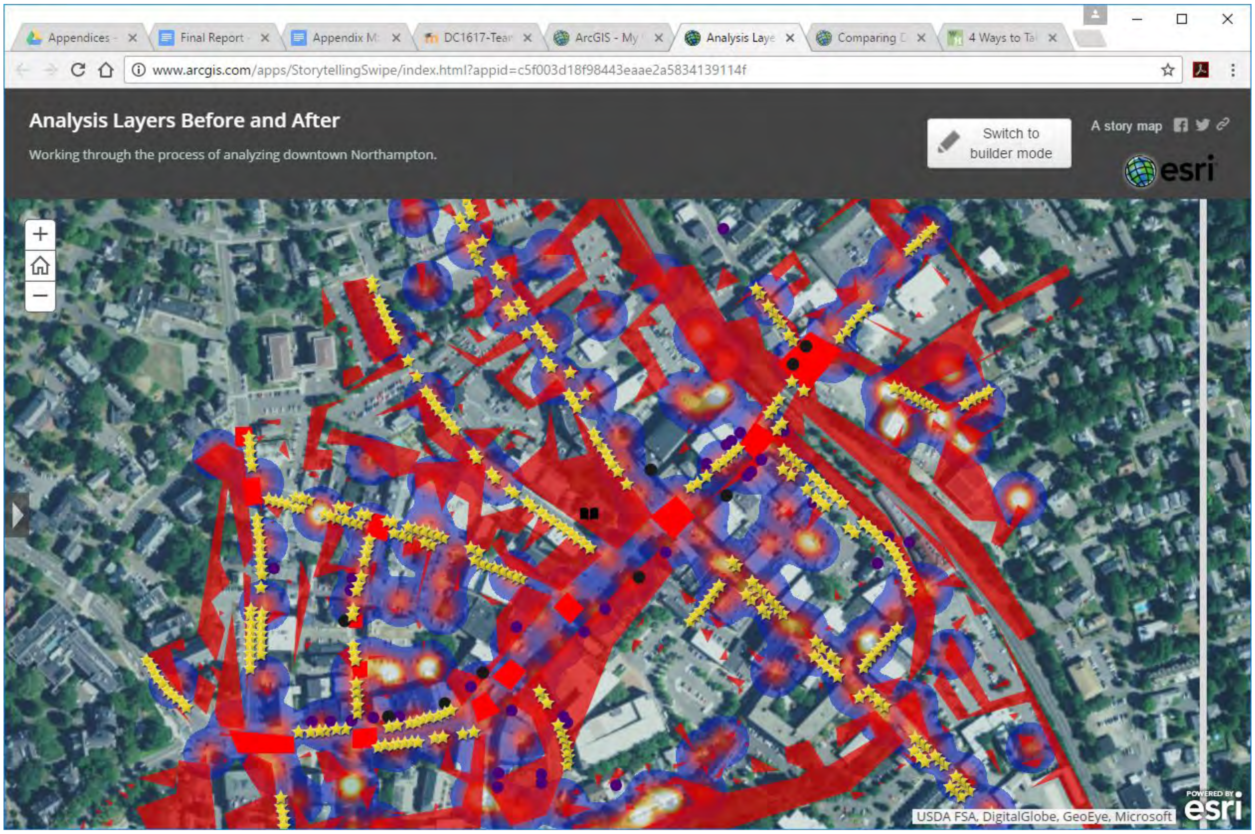


[Fig. M5] Screenshot of ArcGIS map at full extent, with viable parallel parking spots within 60 feet of a restaurant with nighttime hours in bright green, viable parallel parking spots within 60 feet of a restaurant with daytime hours in yellow, viable parallel parking spots under trees in olive green, and viable parallel parking spots within 90 feet of a library in orange

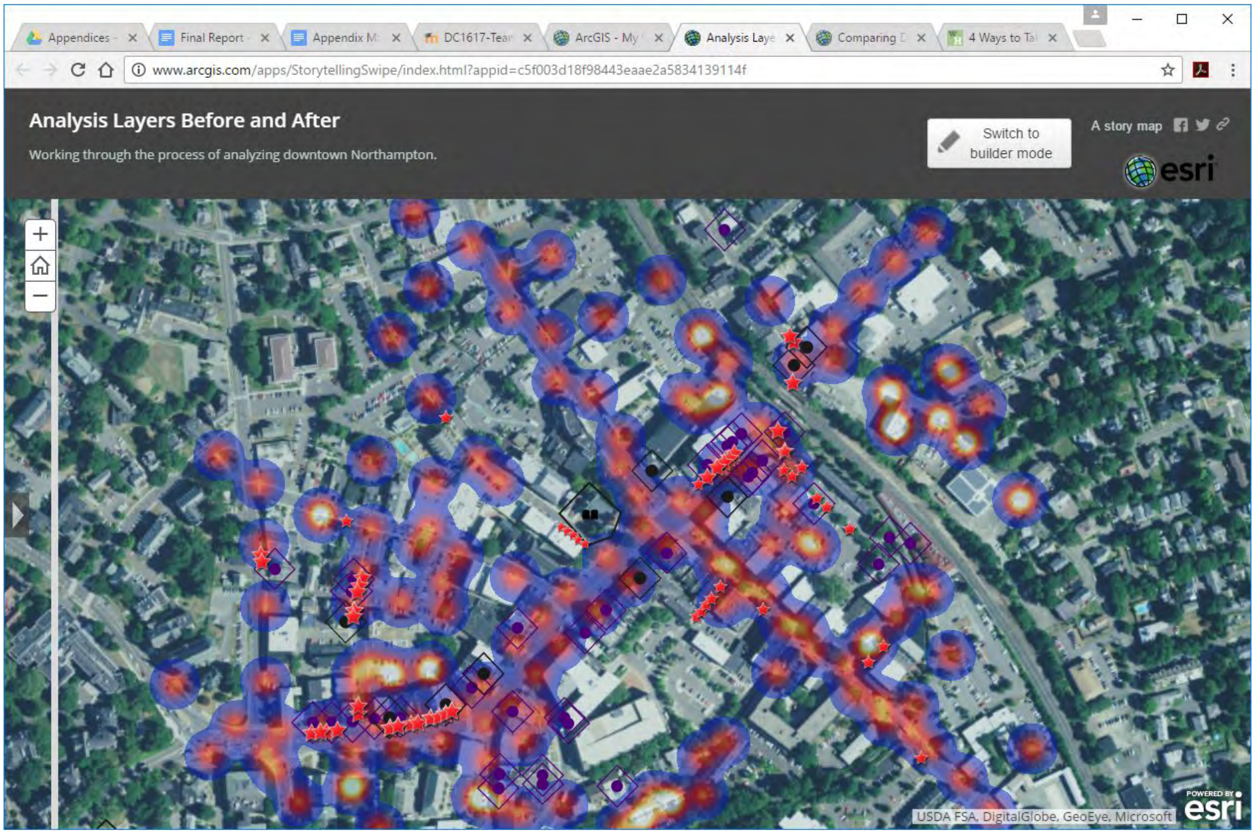


[Fig. M6] Screenshot of ideal spaces for the Dero parklet as it currently is built, ideal spaces in red

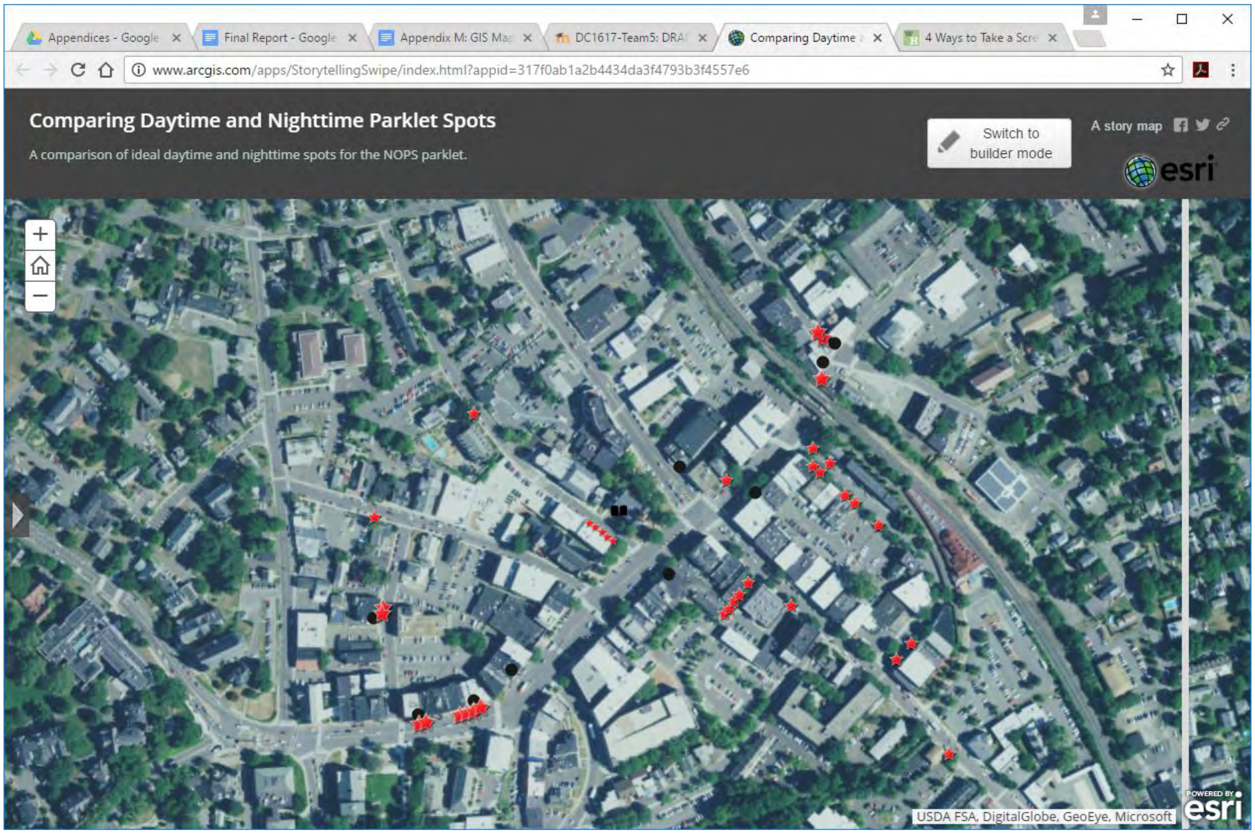
After completing our process on the desktop version of ArcGIS, we exported our maps to ArcGIS online so that our maps would be shareable and available to the public. Figs. M7-M10 show screenshots of our process in online interactive maps, starting with a map summarizing our initial criteria and ending with the maps of ideal spots for the Dero as it is now, and spots for future installations of the Dero when it may have the foot extensions we are proposing. The web addresses for these maps can be found here and here.



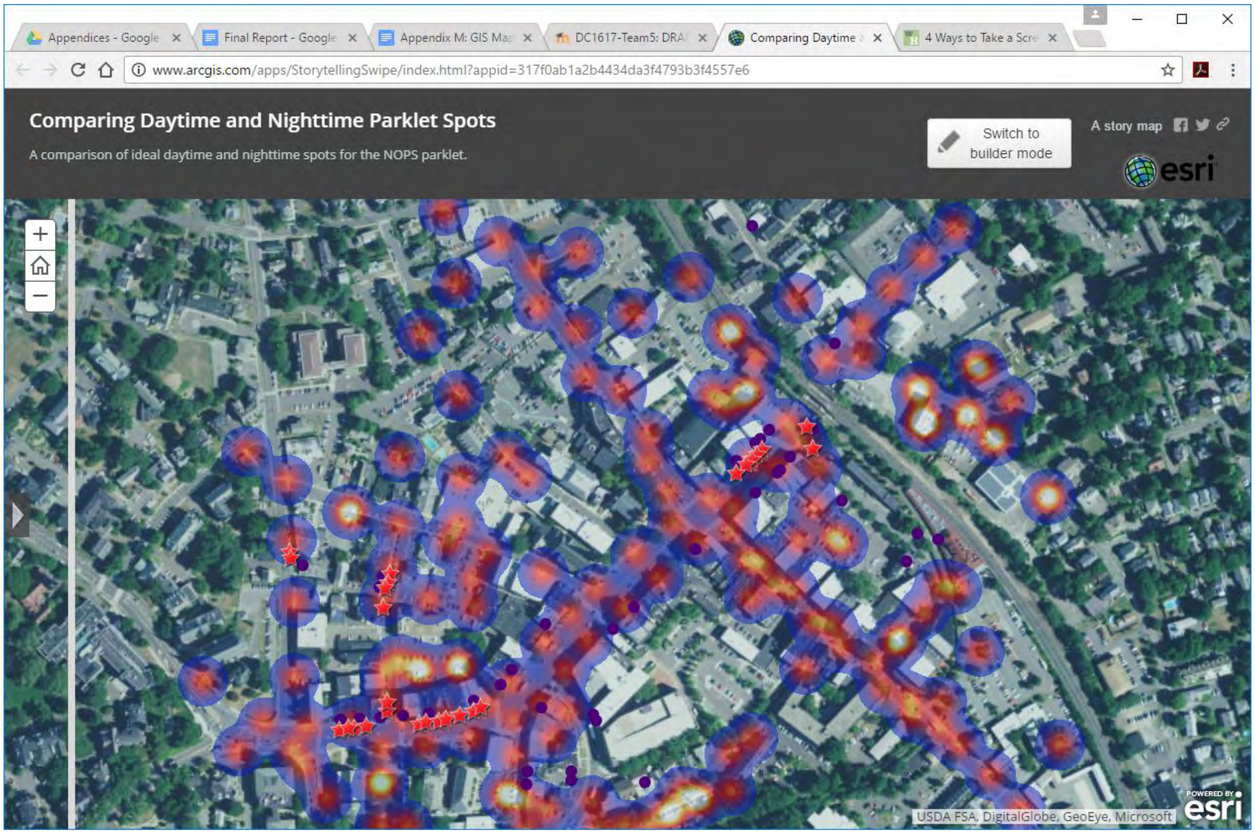
[Fig. M7] Screenshot of online map detail with all parallel parking spots downtown in yellow stars, restaurants in black and purple dots, areas of high slope in dark red, areas of traffic intersections in bright red, and areas with light poles in an orange to purple heat map



[Fig. M8] Screenshot of online map detail of after removing spots within a high slope area, a traffic intersection area, an area without light poles, and/or an area not within 60 feet of a restaurant



[Fig. M9] Screenshot of online map detail with daytime points of importance, with viable parallel parking spots in red, restaurants with daytime hours in black dots, and Hampshire Law Library in a black book symbol



[Fig. M10] Screenshot of online map detail with nighttime points of importance, with viable parallel parking spots in red, and restaurants with daytime hours in purple dots