

Christmas Ornament Display Structure

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Team 07

Midpoint Review Document

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PROJECT BACKGROUND

My Star of Bethlehem LLC is a small online business founded in October of 2011 and based in Sedona, Arizona. My Star of Bethlehem LLC sells Christmas ornaments which are both manufactured and imported directly from Germany.

In order to help market these Christmas ornaments, My Star of Bethlehem LLC would like to have a portable display stand designed and manufactured to highlight their products at venues such as store fronts and malls. The structure will display up to three ornaments at a time elevating them at least six feet above the ground. The design needs to be collapsible, lightweight, easy to setup and easy to take down.

My Star of Bethlehem LLC, indicated that they do not have an aesthetically pleasing way to easily display their Christmas ornaments when marketing their products locally. Presently, when the company is promoting their products they use a square four legged tent with three tables setup underneath in a U-shaped configuration. The Christmas stars are both displayed on these tables and hung from the top of the tent frame.

The goal is to design a better way to display the Christmas ornaments when My Star of Bethlehem LLC is marketing their products to potential customers. This design will provide an effective means to showcase their products at trade shows, private properties, shopping malls etc. Currently, this display stand is being designed for promotional applications; however, it may also have potential consumer applications depending on costs and other design criteria.

FINAL DESIGN

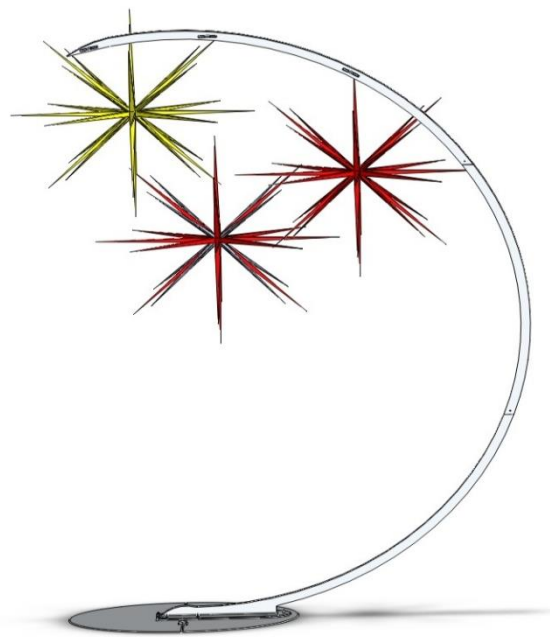


Figure 1: Sideways Arch with the 3 largest ornaments shown

Figure 1 illustrates what the Sideways Arch design will look like when fully assembled and with 3 ornaments hanging from it. The star configuration shown above is one of many possible configurations and does not necessarily represent what the final arrangement will be.

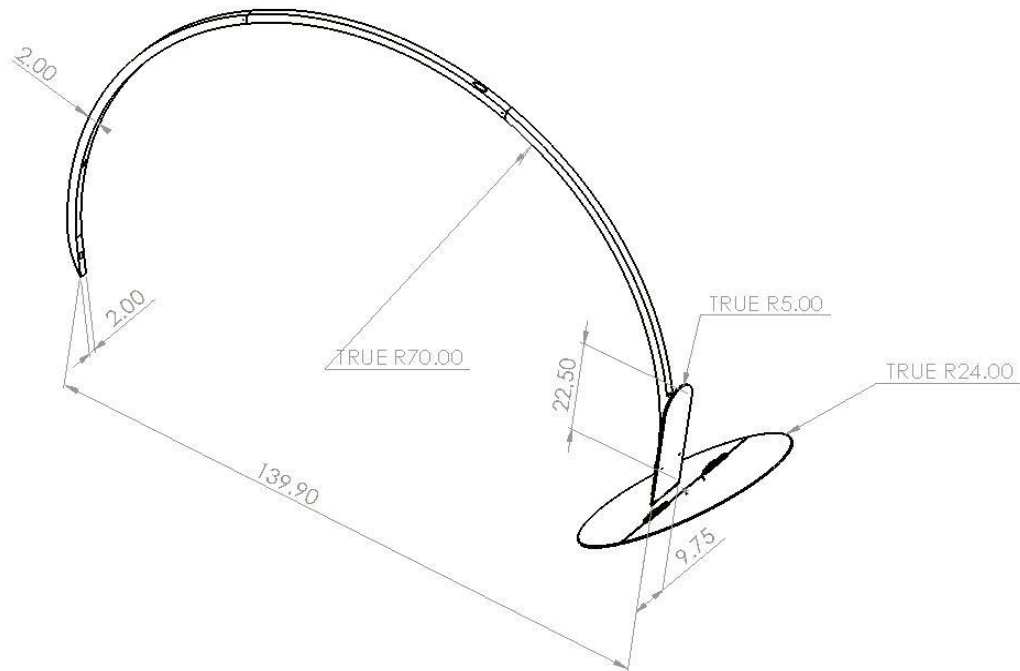


Figure 2: Sideways Arch during arch assembly. Dimensions are in inches

Figure 2 highlights the dimensions of the display stand in addition to showing how the arch will attach to the hinge plate prior to its fully erect state. Two design modifications have been made to the stand since the Progress Report. The modifications include installing collars at the arch interfaces (see Figure 3) and relocating 2 studs in the base plate further back (see Figure 8). The collars will be used to reinforce the arch at its weakest points where the arch sections come together. This will also add strength and stability to the arch. The purpose of moving the 2 studs in the base further back was to decrease the angle at which the hinge plate comes into contact with the studs. By decreasing the angle, the obstruction between the hinge plate and studs is also reduced.



Figure 3: Middle arch section with collars at the interfaces

MANUFACTURING

The initial manufacturing plan was to acquire three lengths of 2 inch x 2 inch square aluminum tubing that had a 1/8 inch thickness. The material was readily available and fairly inexpensive; however, the manufacturing expense associated with the time and money required was substantial. This major expense occurred due to the inability of every local or state machine shop being able to bend the square tubing into the desired shape as designed. In response to this major expense it was decided instead to order a 4 foot x 12 foot sheet of aluminum with a 1/8 inch thickness from which all 4 sides of each of the 3 arch sections could be cut (see Figure 4).

These 4 sides will be assembled by using an industrial grade aluminum specific epoxy to create a 3 inch x 2 inch rectangular aluminum tube that has the desired shape. To facilitate the adhesion of the adjoining sides, a groove will be cut into the curved sides that are 0.13 inches wide by 0.0625 inches deep and 0.0825 inches from the edge of the curve. The plain sides (front and back) of the arch will then be placed into these grooves with the adhesive and allowed to dry for 24 hours. Figure 4 below is a diagram of how the 4 sides composing the arch will be cut from the sheet.

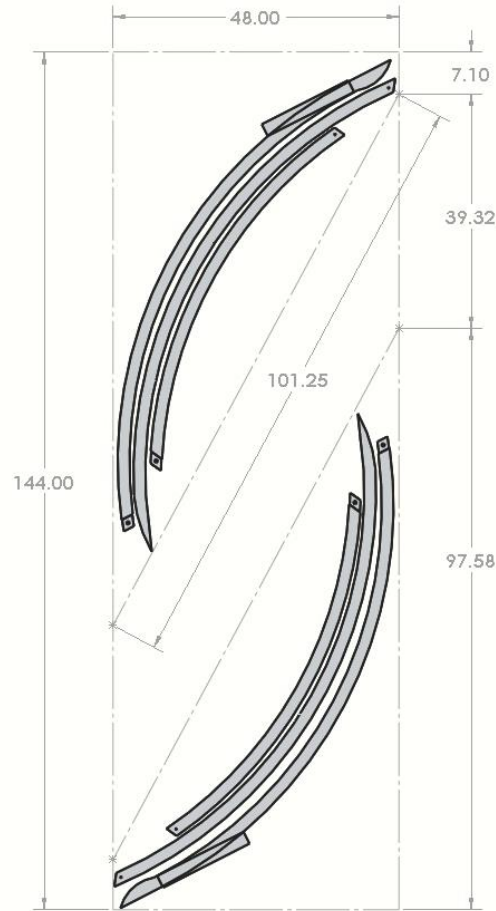


Figure 4: 4 x 12 foot aluminum sheet used for cutting arch sections. Dimensions are in inches

Figure 4 also shows the dimensions of the aluminum sheet and 2 of the curved sides composing the arch. The material forming the parallelogram in the middle will be used to cut the 2 remaining rectangular sides of the arch.

The curved sections that are cut from this sheet (shown above) will contain the grooves that were mentioned previously. These grooves will facilitate the joining of the 2 rectangular sides to the 2 curved sections forming the 4 sides of the tubing. To join the curved arch sections together once they are completed, 2 smaller lengths of rectangular tubing with a smaller cross sectional area will be constructed as shown in Figure 5 to fit in the open ends of the top and bottom arch sections. These smaller lengths will be 6 inches long and constructed with the same curve as the arch so that three inches of these sections can be inserted into either open end of the arch, see Figure 7 for joint locations.

To secure the interlocking sections of the arch together, a spring loaded locking plunger system will be implemented. Two plungers will be located on opposing sides at each of the 2 joints. The arch sections will feature either male or female parts with regard to their attaching sections. These female attachments will be created by leaving an open end within the aluminum tubing for the male component to mate with. To create the male attachment, 2 curved and 2

rectangular 6 inch long x 2 ¼ inch wide pieces of aluminum will be cut from the sheet seen in Figure 4 and glued in place after being assembled (see Figure 5) onto the inside of the curved tubing walls leaving an 1/8 inch gap on either side. This will allow for the corresponding mating section to be attached.

The base has been constructed out of two 1/4 inch thick aluminum plates. These plates measure 2 feet x 4 feet and have been cut into semicircles with a 2 foot radius. These semicircles have been aligned with their straight edges. Two hinges have been placed over the seam made by the two semicircles at either end and fastened in place using 8 PEM studs. These hinges utilize a quick release pin so that once removed, the hinges will separate allowing the base plates to be carried separately.

Once the hinge plate has been attached to the base plate (see Figure 8) by fastening half of the hinge in place on the base plate and half of the hinge on the hinge plate using PEM studs and a quick release pin the base and the hinge plate can be joined together. The lower arch section will fasten to the hinge plate by means of another plate (arch plate) that has been welded to the bottom of the extruded rectangular portion of the curve (see Figure 8). The arch will then fasten to the hinge plate using 3 PEM studs that have been mounted in the hinge plate. To secure the hinge plate to the base during operation, there will be 2 PEM studs mounted in the base plate that will penetrate through both the hinge plate and the arch plate so that the entire structure can be secured together disabling the hinging capability of the stand.

Once the bottom section of the arch is attached to the hinge plate and the hinge plate has been attached to the base, the next step is to assemble the remaining 2 sections of the arch. After the two arch sections are in place, there will be a mock presentation of the stand with some proposed ornament configurations which will be voted on and selected by the client. Once the ornament configuration is selected holes will be made in the underside of the top arch section to facilitate the threading of the electrical cords through the hollow tubing. Then, depending on where the client wants to retrieve the end of the cord with the plug, a location for a retrieval opening can be determined.

After the locations of the holes for the electrical connections have been determined, two dock cleats will be mounted on either side of these holes. These cleats will aid in stabilizing the ornaments while on display. To mount these cleats, flare headed sheet metal screws will be used to secure the cleats in place.

Once fully manufactured, the stand will be abraded with a wire wheel to give it a brushed aluminum finish.

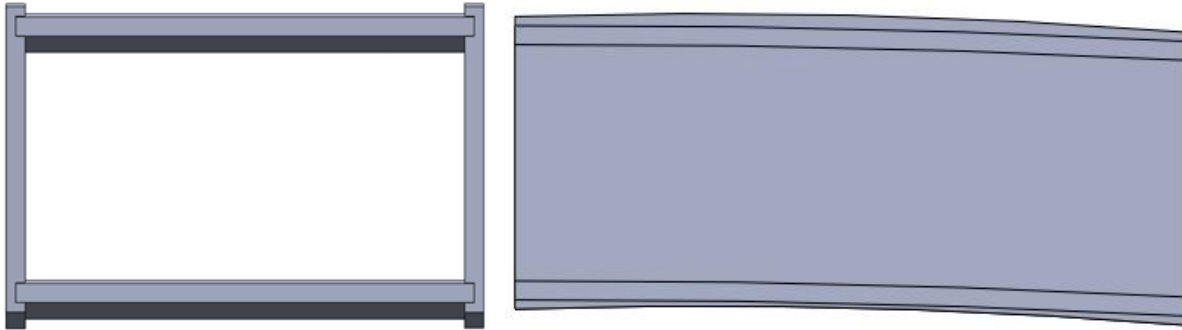


Figure 5: Arch cross section (left) and curved side with grooves (right)

COST ANALYSIS

The overall cost for the first prototype thus far is shown below in Table 1. Up to this point all manufacturing has been done in the campus machine shop and as a result, manufacturing costs have been kept to a minimum. An additional \$280 has been spent since the Progress Report was written. This was a result of changing the manufacturing process as previously mentioned. These costs were necessary to accommodate the new method of manufacturing. Although the final cost now exceeds the last budgetary goal of \$1000, all costs have been approved by the client and the project continues to move forward. The project still remains within the flexible budget set forth by the client. Although a fixed budget was never set because manufacturing costs were unknown at the time, the client has always been agreeable to costs ranging from hundreds to low thousands.

Table 1: Cost estimate for prototype

Qty	Item Description	Size (w x t)	Length	Price (each)	Total Cost
1	6061-T6 Aluminum Sheet	48 x 0.13	144	\$295.80	\$295.80
2	6061-T6 Aluminum Plate	24 x 0.25	48	\$115.55	\$231.10
2	6061-T6 Aluminum Plate	12 x 0.25	24	\$62.65	\$125.30
		Size (D)			
4	18-8 Stainless Steel Quick-Release Pin	0.19	3	\$2.18	\$8.72
4	Retractable Captive Panel Plunger Press in	0.25 (pin)	0.75	\$4.12	\$16.48
6	Surface-Mount Lift-Off Hinge without holes	0.19 (pin)	2	\$3.56	\$21.36
6	Rope Cleat Wing Style	0.25 (rope)	3.5	\$0.92	\$5.52
1	Press-In Captive Stud 18-8 Stainless Steel (Pack of 10)	0.25	1.5	\$9.26	\$9.26
	Fasteners, quick release pins, adhesives, hinges, drill bits ect.				\$280.50
				Sales Tax	\$60.66
				Shipping	\$73.50
				Final Cost	\$1128.20

All dimensions are in inches

w = width, t = thickness, D = diameter

Sales tax only applies to products bought in Arizona

PROJECT PLAN

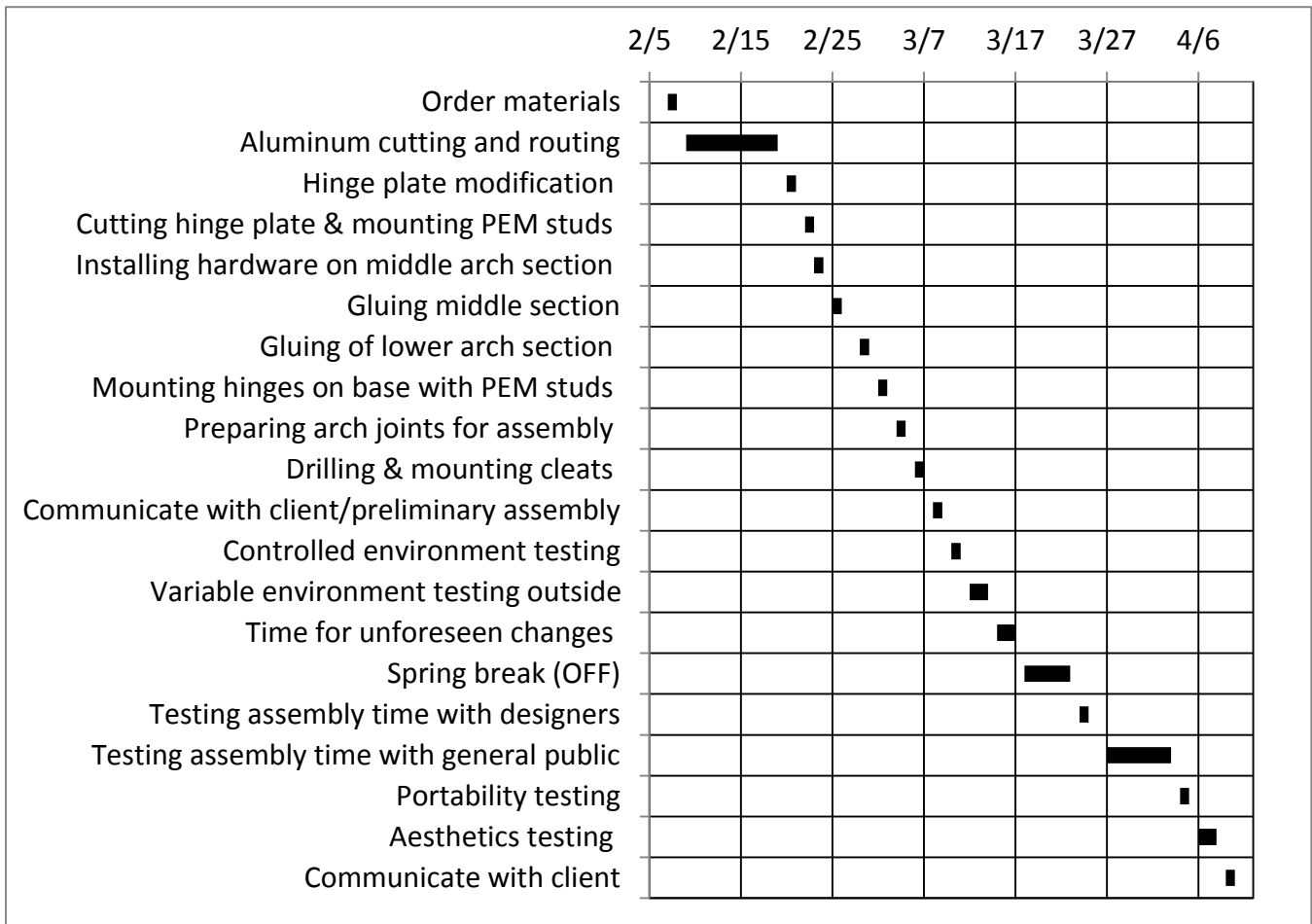


Figure 6: Project timeline for spring 2012

Figure 6 highlights the tasks associated with manufacturing and testing that have or will be completed. The project timeline had to be updated to account for the change in manufacturing. This update included modifying some of the former tasks and rearranging the order in which those tasks are completed. So far, all tasks up through “mounting hinges on base with PEM studs” have been finished. Currently, the prototyping phase is scheduled to conclude roughly a week prior to spring break while the testing phase should begin just before spring break and be complete by the end of the first week in April. Changing the manufacturing process has not delayed the project.

CONCLUSION

My Star of Bethlehem LLC is a small online business based in Sedona, Arizona and sells decorative ornaments that are both imported from and manufactured in Germany. My Star of Bethlehem LLC would like to have a portable display stand designed and manufactured to highlight their products at various marketing locations. The final design chosen to satisfy this need will be able to support up to 3 of the largest ornaments sold by My Star of Bethlehem LLC. Few modifications have been made to the display stand over the last month which consists of installing collars at the interfaces where the arch sections come together and relocating the two studs secured in the base plate. Additional changes have been made to the manufacturing process which includes creating grooves in 2 of the 4 sides that make up the arch sections, using fasteners to secure the hinges instead of welding and using an aluminum specific epoxy to assemble the arch sections instead of welding the seams. These grooves will simplify the assembly process of the arch sections and will provide for a stronger cross section. Lastly, the stand will have a brushed aluminum finish which will give it a shiny polished look. At this point, the entire base and corresponding hinge plate have been assembled as well as the middle arch section. As a result of changing the manufacturing process, some of the tasks in the project timeline had to be modified and rearranged but the project is still on schedule to be completed by spring break so that testing can begin just before or after.

REFERENCES

- [1] Industrial Metal Supply Co. (2010). *Industrial Metal Supply Co.*
Retrieved from <http://www.industrialmetalsupply.com/>
- [2] McMaster-Carr. (n.d.). *McMaster-Carr*. Retrieved from <http://www.mcmaster.com/#>
- [3] Otte, Dieter. (2012). *My Star of Bethlehem; The Star That Keeps on Giving*.
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APPENDIX: ADDITIONAL DISPLAY STAND FIGURES

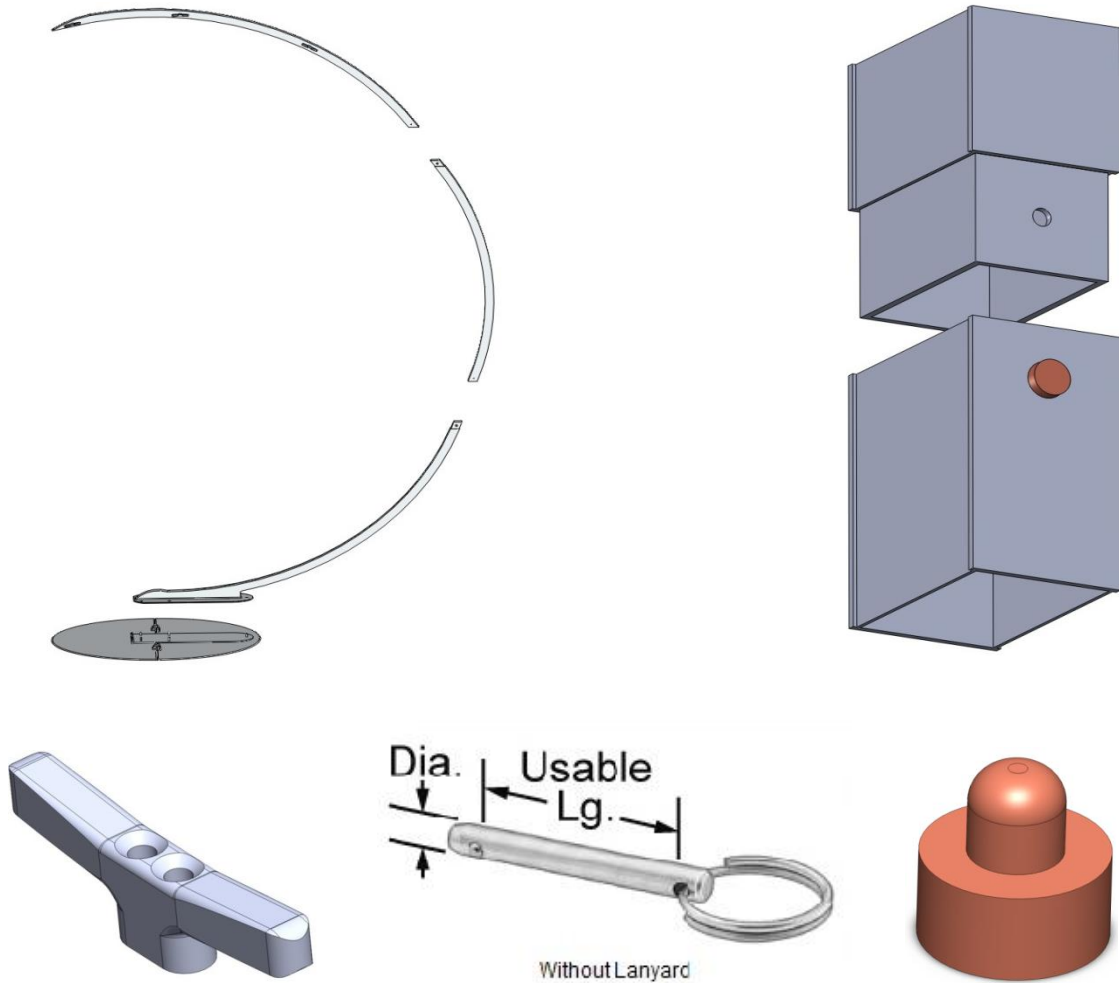


Figure 7: Exploded views of Sideways Arch including quick release pins

Figure 7 illustrates how the bottom section of the arch will attach to the hinge plate. Three studs, 2 in the front near the hinge and 1 in back, will facilitate the attachment. Another 2 studs in the base near the back will attach the hinge plate to the base.

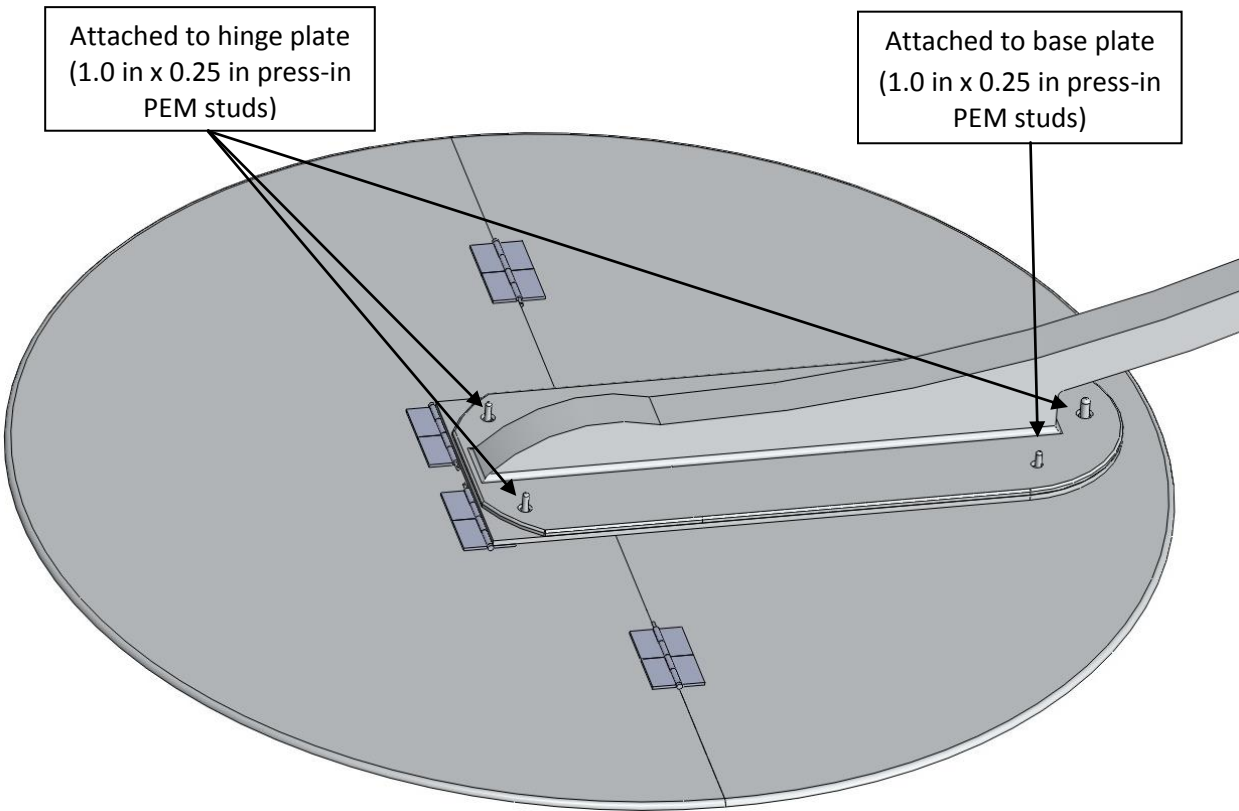


Figure 8: Base with bottom of arch attached to hinge plate

COMPLETED SO FAR

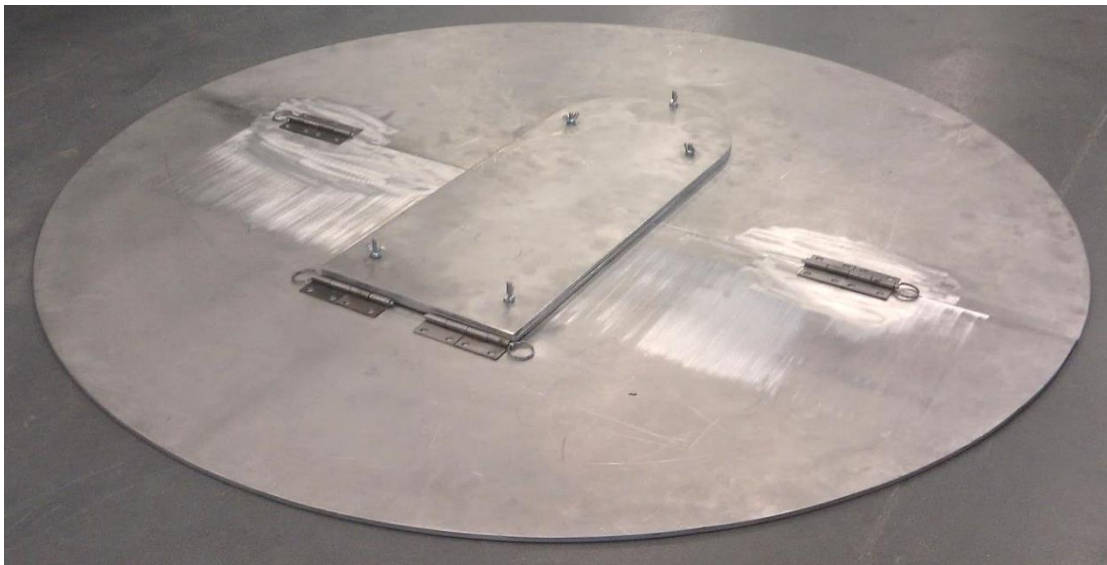


Figure 9: Base with hinge plate and hinges attached



Figure 10: Middle arch section assembled