Baby Bathtub Divider

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ME 3201 Section 02: Product Realization

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December 7th, 2022

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Abstract

The world we currently inhabit continuously strives to provide efficiency, comfort, and safety in all aspects of our daily lives. This does not exclude simple and recurring tasks at home, like that of showering. At first glance, showering may not seem like an activity that could potentially be precarious or dangerous to the individual. However, parents of young children or toddlers may disagree. The simple task of showering now then transforms into a stressful and potentially harmful action when you have small children. There's a risk of slipping, falling, tripping, or even dropping the child which could potentially cause a fatal injury to either the parent, child or both. Not to mention the constant worry and stress parents undergo while trying to decide whether to shower with or without their children, having to choose between privacy or efficient use of their available time. Taking this into consideration, the decision was made to design an apparatus (a baby shower crib so to speak) that would confine the child to one end of the bathtub (or shower) allowing for the parent to supervise and comfortably shower along with their baby. The idea consists of having the divider be made mostly of polyethylene, having a silicone lip, that allows for different size settings and malleability in order to fit varying bathtub and shower designs while having the capability to be easily stored. In addition, the bathtub divider has a hole on its center to allow for water to flow freely out of the crib without retaining water past a certain height and posing a threat to the child's safety. The baby bathtub divider will be held securely in place by suction cups on the sides, which if installed in a bathtub, the side mounts would be cross compatible as well to account for size and design variations. This in turn would ensure the safety, comfort, ease and peace of mind for all parties involved, making headaches in the shower a thing of the past for the parents of young children.

Introduction & Background

Baby Bath Safety:

The main risks associated with bathing toddlers and children are scalds and drowning. While scalds are easily preventable, drowning for toddlers has a higher chance of death and not as preventable in comparison, due to factors regarding varied movement. The main solutions in the market are BabyDam™ and separate, smaller bathtubs. BabyDam aims to create a small, enclosed area in which toddlers are able to bathe safely within the confines of the divider. The design is simple in nature, and accommodates some bathtubs due to its flexible property. However, their design does not accommodate all bathtubs, nor can it withstand strikes from toddlers as they age and grow stronger. To circumvent this issue, a design change using an adjustable shaft would be needed, as well as a thicker frame. While the flexibility of the frame will be decreased, the durability and longevity of the product will be increased, as the new design will accommodate higher age ranges.

Many parents opt to wash their child without the use of a divider, and the risk of injury from slip and fall or drowning is ever present. The use of a divider allows for more efficient use of time, higher comfort for the child, and decreased risk of injury. While there isn't much documented information on the effects of decreasing bathtub space on the safety of children, this product aims to do so.

Methodology

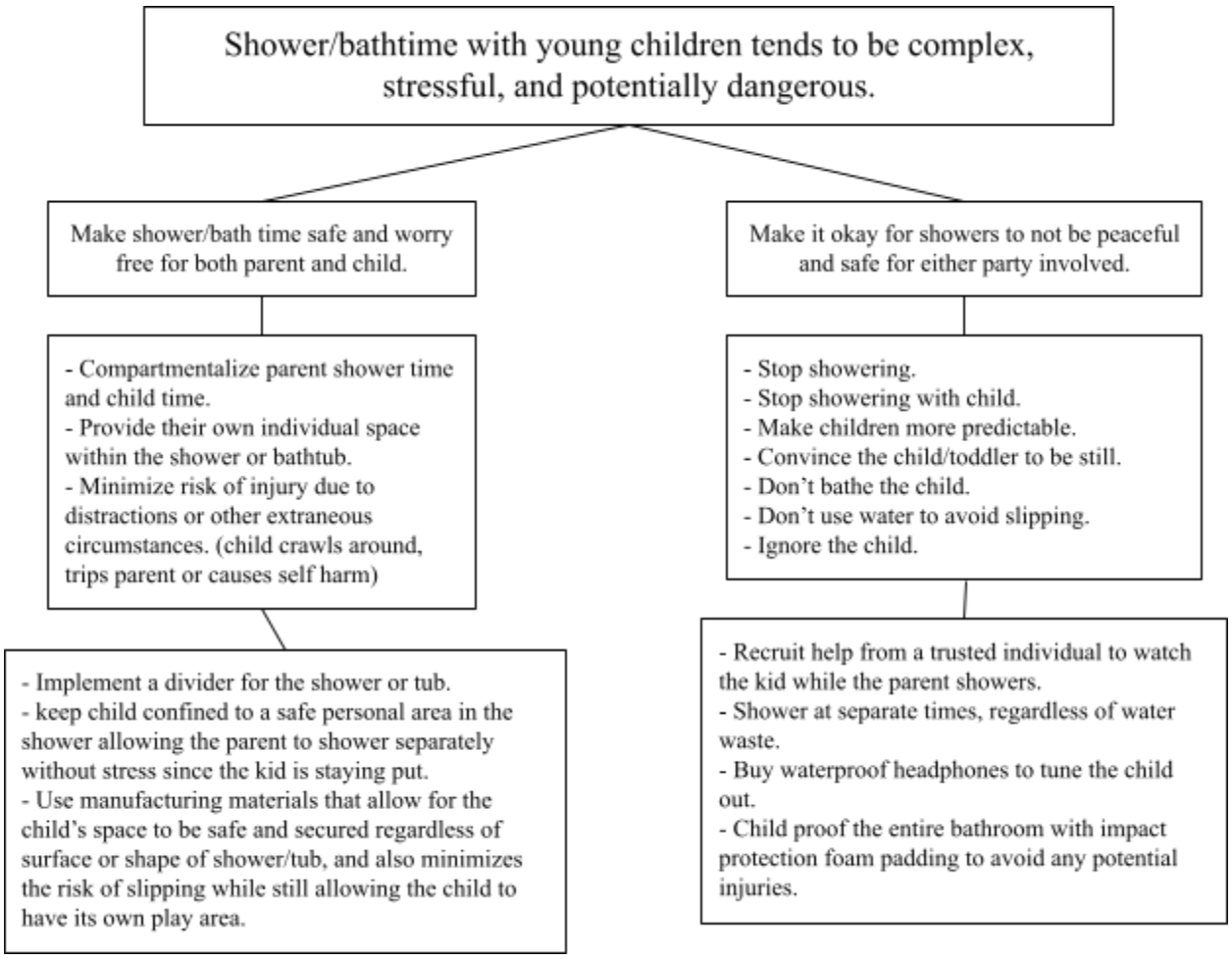
In order to properly address the situation it was necessary to determine the root and causes of the risk factor of showering with toddlers. The following Why-Why table was created in order to identify the causes of this particular problem. There were five primary sources for the aforementioned problem. Each was extensively studied and analyzed in order to further narrow down the plausible causality.

Why-Why Table

Problem	Why	Why
Hard to shower with toddlers	Risk of injury	Accidentally dropping baby
		Baby trips and falls
	Too much space for movement	For toddlers, baths and showers are spacious (made for adults)
		Showers/bathtubs aren't designed for children's physical proportions
	Children get restless	Children have short attention spans
	Require undivided attention	Small and frail
		Have no sense of consequence or danger
	Current designs not all encompassing	Lack of ergonomic compatibility
		Minimal number of designs available

Duncker Diagram

The Duncker Diagram was used during the design stages of the process allowing for the development of different solutions for the aforementioned problem: showering with toddlers can be difficult and potentially dangerous. After completing the diagram and thoroughly examining the results and plausible solutions, it was determined that the best course of action was to combine several solutions onto the final design.



Design Constraints/Specifications (QFD)

Constraints:

The ideal height of the bathtub divider is below the height of the bathtub lip and above the height of an average human toddler/child. The divider needs to support ~100 lbs of force from water buildup and any strike from the child onto the divider. The divider cannot support water above the waist of an average human child, and must automatically remove water once it reaches a certain point. An ideal height would be 12” - 14” and an ideal width would be to the inner rim of an average-sized bathtub.

Specifications:

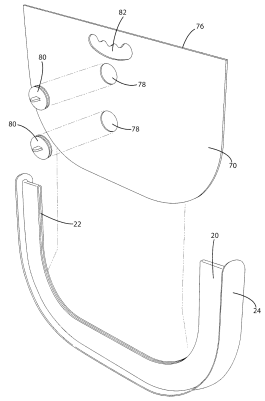
All components must not be able to oxidize and have a life of 5 years. No edges on any part will have sharp edges and all parts must be replaceable. The shaft must be adjustable to account for variance in bathtub width, and must be able to lock.

Information Research (patents/articles)

After completing a patent search on patents.google.com:

US20130000033A1 (2013)

A barrier for a tub comprising of a center portion and a seal. Center portion or barrier can be installed into a bathtub using suction cups. Center portion can also have plugs to control depth of water.



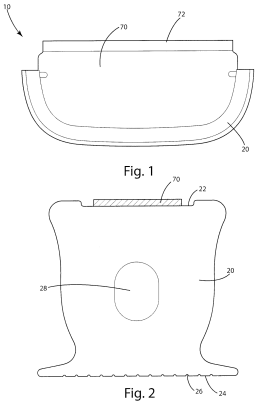


Fig. 1

Fig. 2

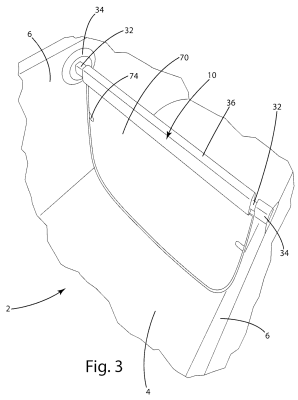


Fig. 3

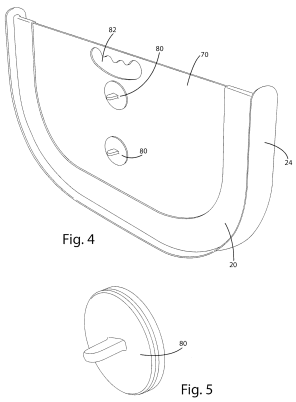
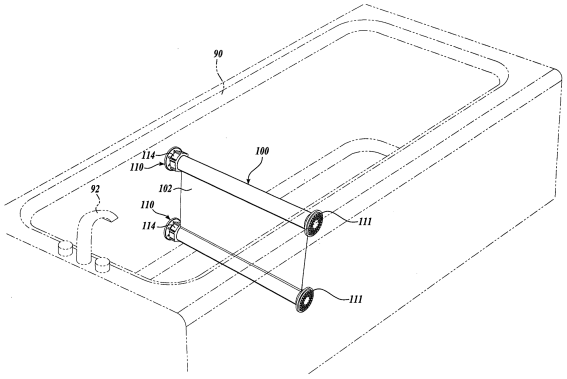


Fig. 4

Fig. 5

US20070079435A1 (2007)

Bathtub barrier comprising of a pliable panel attached to two telescoping rod assemblies with nonskid outer face on both sides of rods.



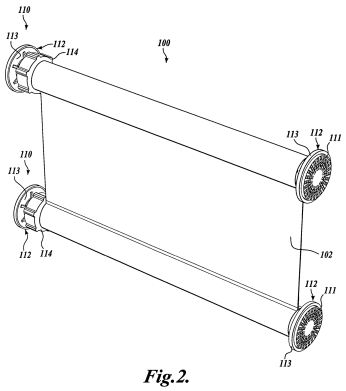
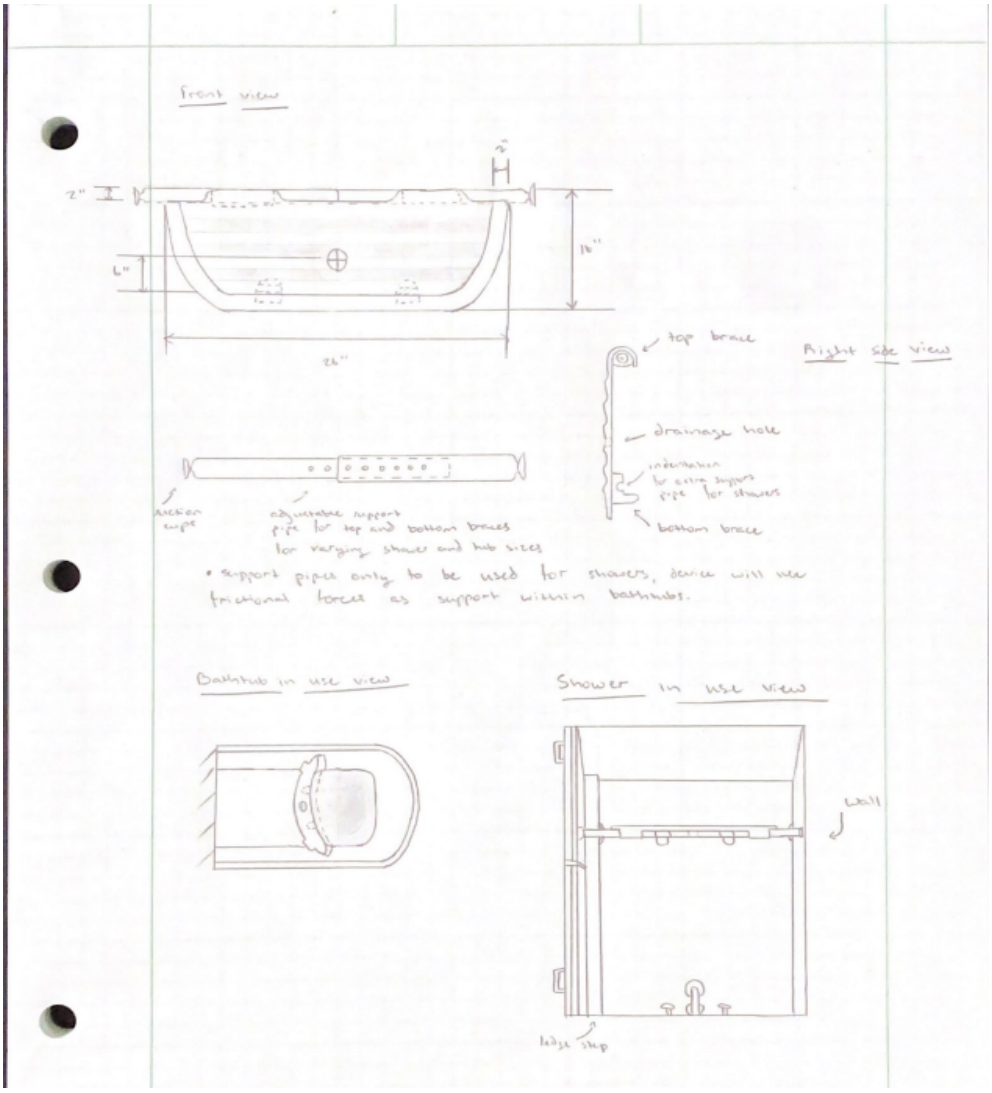
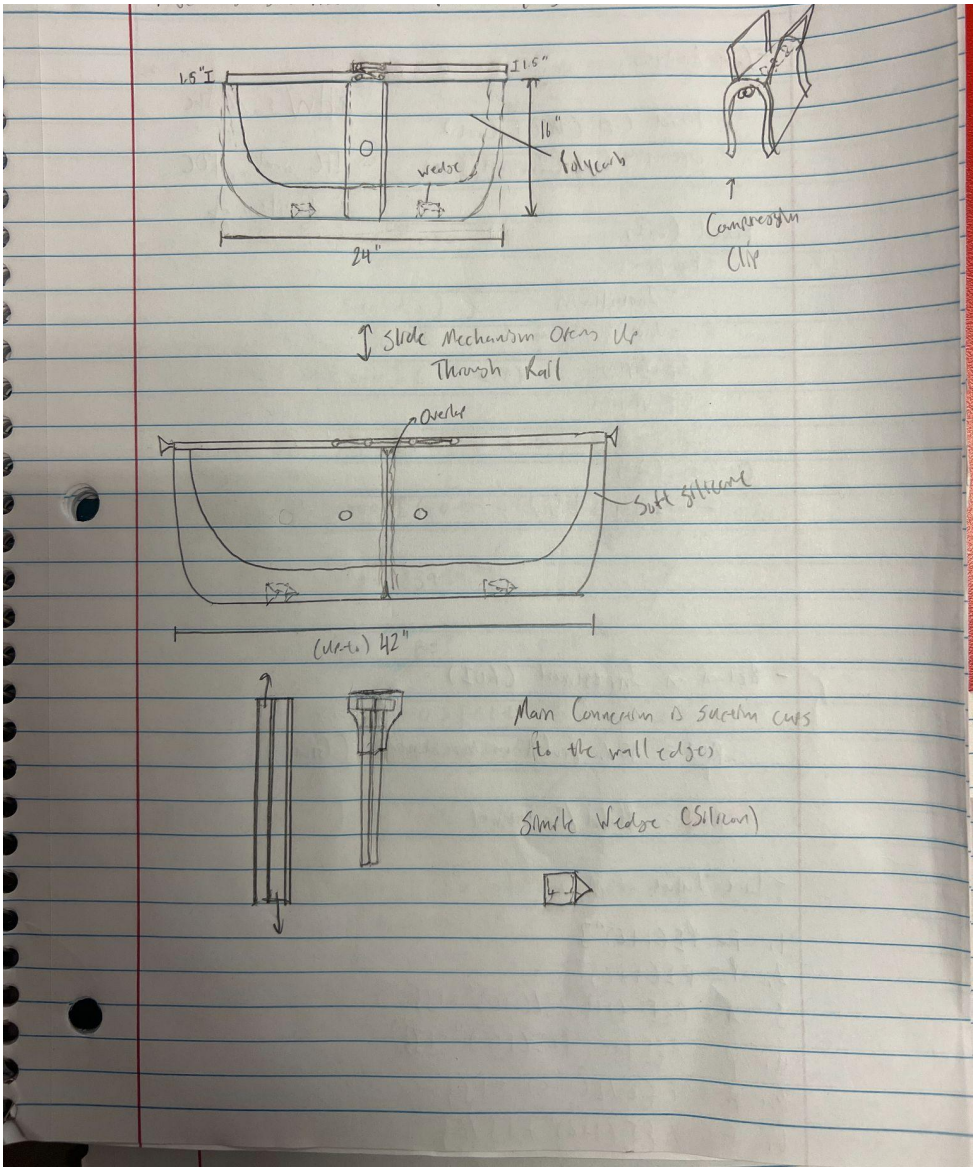


Fig.2.

Design ideas w/ explanations

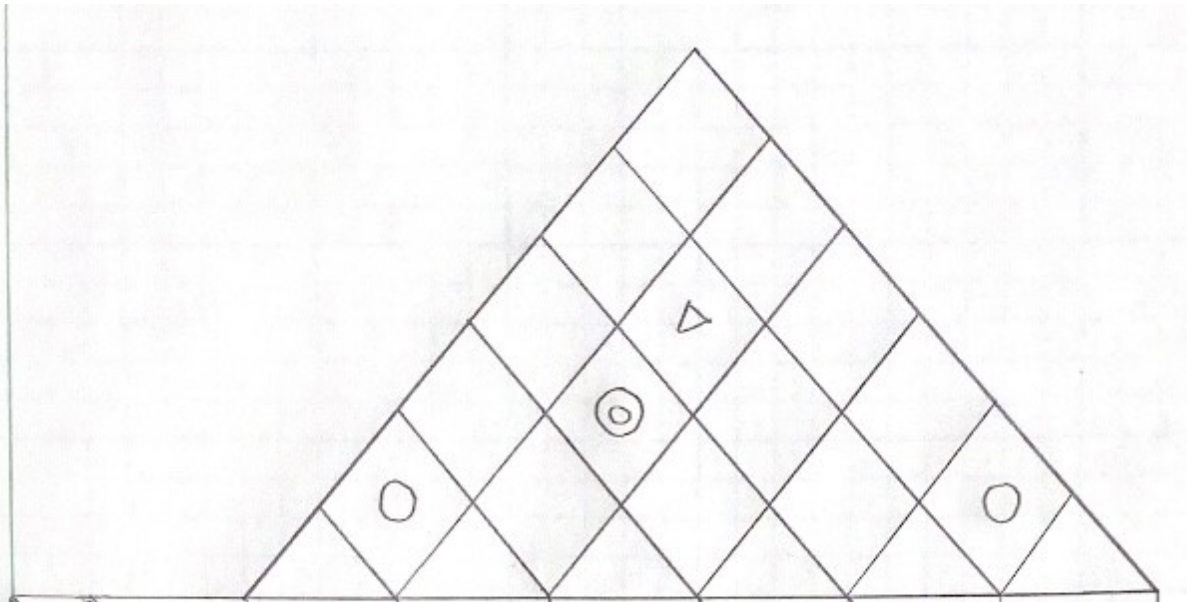


The design is meant to be ergonomic towards varying sizes of bathtubs and standing showers. It has adjustable sizing for the bracing pipes and it has malleability to conform to the shape of the tub. In addition the edges are rounded off and lined with a silicon lip to provide extra support from frictional forces. Furthermore, it has a drain hole located 6 inches from the bottom of the tub to ensure the child's safety within the confined space. This in turn allows for the comfort and safety of the child while giving the parent peace of mind.



The design was meant to be accommodating to all known bathtub design, with the cost of less resilience to strikes from children in the middle. The slide mechanism for the frames would be simple to operate, and the simplicity allows for easy cleaning and repair. This alternate design was not pursued due to the reduced resilience of the assembly structure, as well as multiple moving parts.

House of Quality



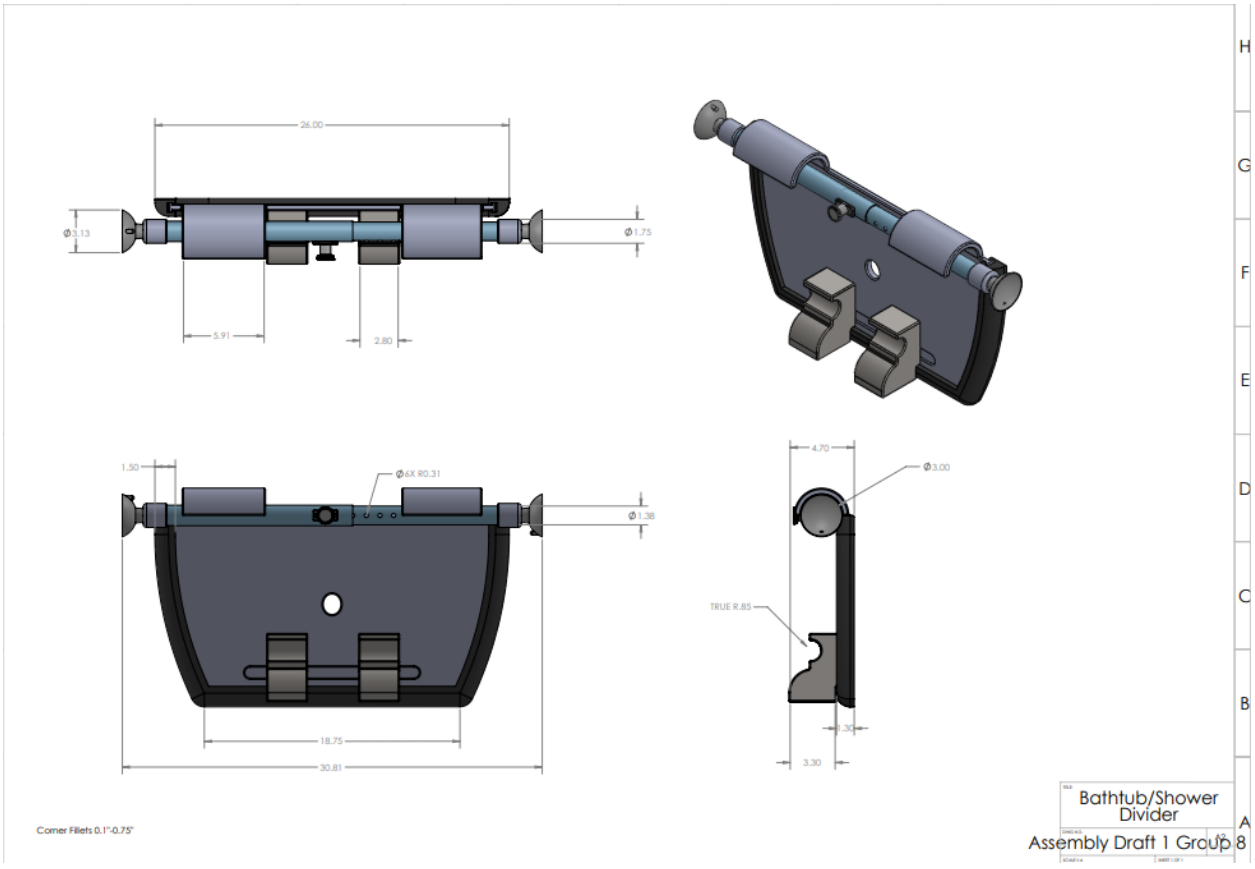
Importance to customer / Customer requirement \ Mechanical Requirements		Frame Thickness	Silicone Adhesion	Modular Design	Support Chasis	No sharp edges	Welding Metal Components
Withstand Water Pressure	2	○	◎		◎		△
Prevent Movement of child	3	△	◎		○		
Safety of child	3		△		○	◎	
Ease of Personal Assembly	1			◎	△	○	○
Importance Weighing		9	48	9	33	30	5

△ = 1 ○ = 3 ◎ = 9

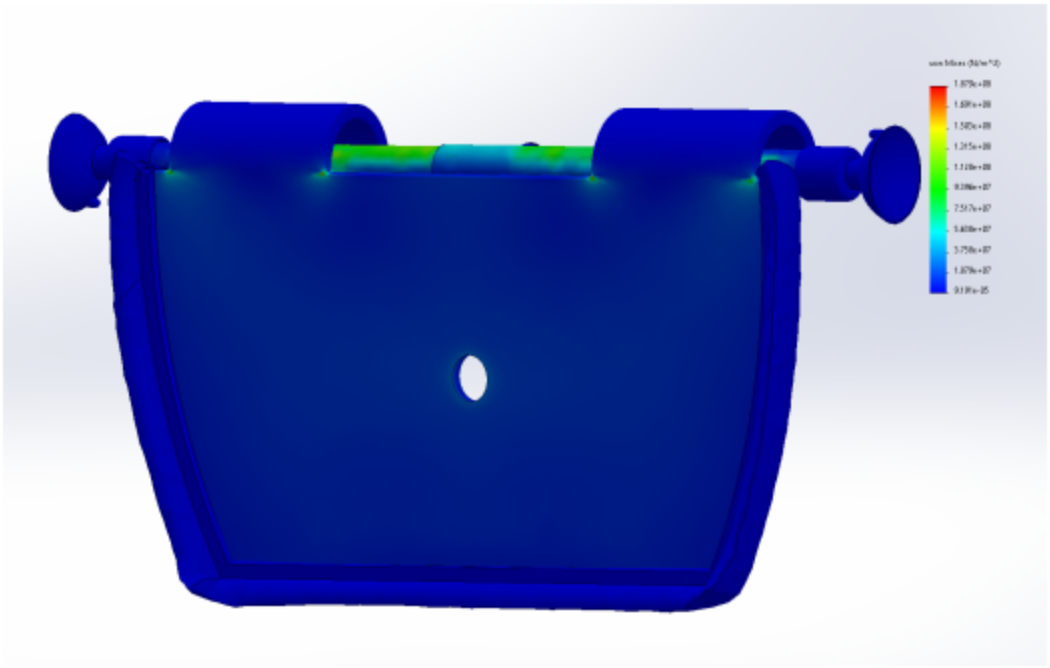
Decision Matrix

Goals	Performance	Minimum Maintenance	Aesthetics	Cost	Availability of parts	Ease of use	Versatility	Portability	Total
Weighing Factors									
Design Alt.	100	90	10	90	30	90	70	40	
Design1	10	9.5	6	8	9	8.5	7	8	4480
Design2	8	9	7	7	8	9	9	8.5	4330

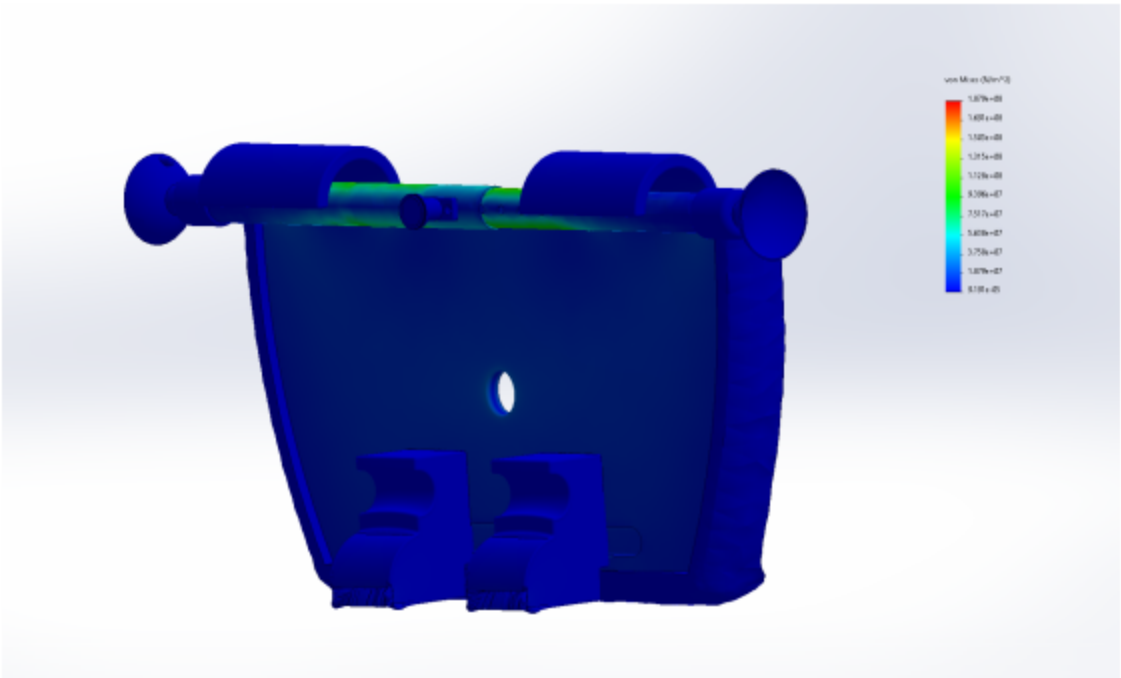
Final Design/FEA Analysis



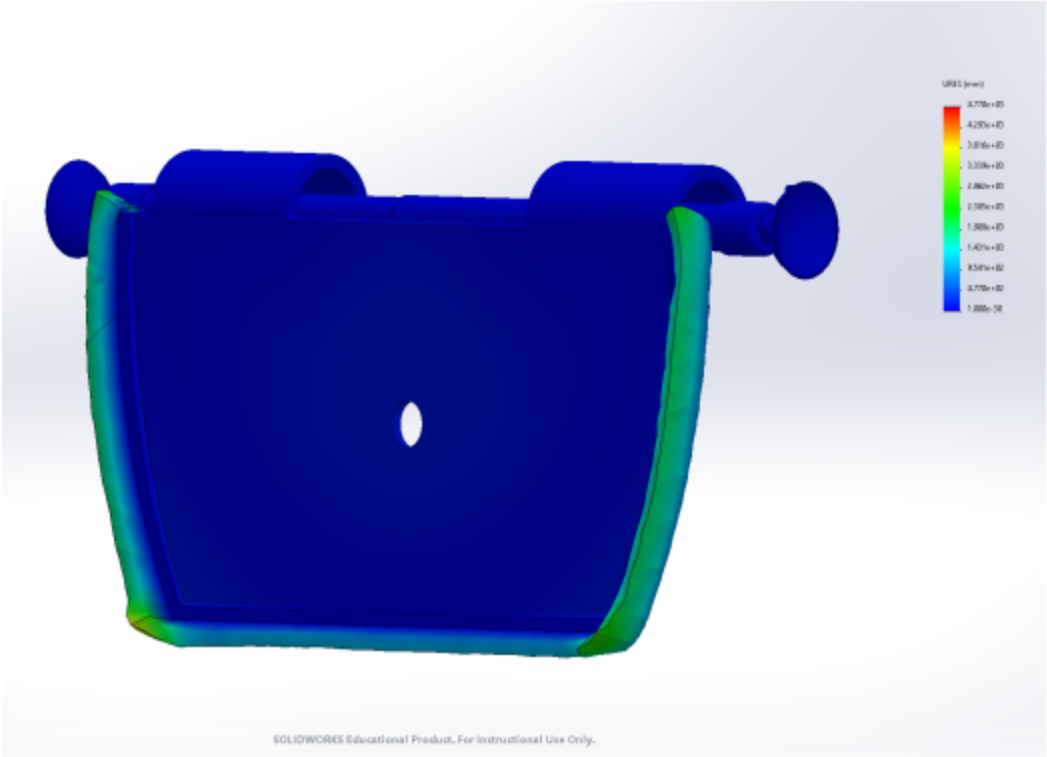
Von Mises FEA [Front]



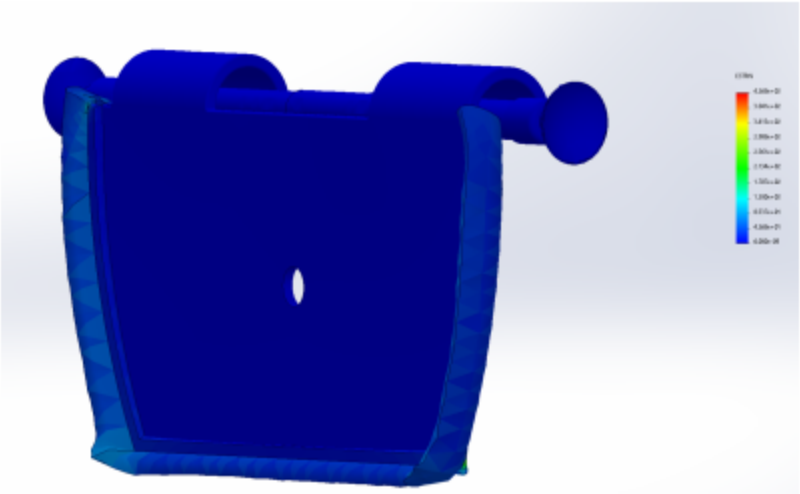
Von Mises FEA [Back]



Displacement FEA



Strain FEA



Cost Analysis and BOM

Cost Analysis if launched as a business with this product.

Item	Cost ($)
Raw Materials	127.76/unit
Operating Labor	50/hr
Rent	1164/month
General Expenses (Marketing/Selling)	50/hr

Most parts will be outsourced and then assembled in house. The rest of the expense will go towards marketing and selling the product.

Bill of Materials		
Part Name	**Total Quantity Required**	**Unit Cost ($)**
Frame	1	12.45
Silicone Frame	1	12.30
Pipes	2	15.95
End/Pipe Caps	2	0.96
Thread-On Feet	2	5.53
Supports/Backstops	2	12.45
Spring lock	1	33.23

Total ($): 127.76 (if Made in USA)

Conclusion

The main goals of this product were to increase the safety of a child during bathing, increase the efficiency of the parent washing the child, last until the child reaches adolescence, and have it easily assembled and disassembled.

With its modular design and simplicity of parts, the product is easily serviceable and self-repaired. The use of a polycarb frame and silicone lips are easily manufactured through injection molding and will last until the expected lifetime of the product. The use of aluminum pipes for the shafts allow for cheap replacements while maintaining adequate support for the forces exhibited during use.

Finally, use of the product is simple, as it only requires a connection from the suction cups to the bathtub inner rim, and the frame hangs over the shafts. This allows for easy removal of the frame and provides standing support for children.

References

1. https://raisingchildren.net.au/babies/safety/bath-water-safety/bath-safety#:~:text=Drowning%20and%20scalds%20are%20the%20two%20main%20risks%20with%20bath,children%20or%20siblings%20to%20supervise.

2. https://patents.google.com/

3. https://www.mcmaster.com/