Easy Access Bathtub Retrofit

Bianca Giorgi, Madi Given, Ryan Pilon, Trajan Pripps

Project Description and Justification

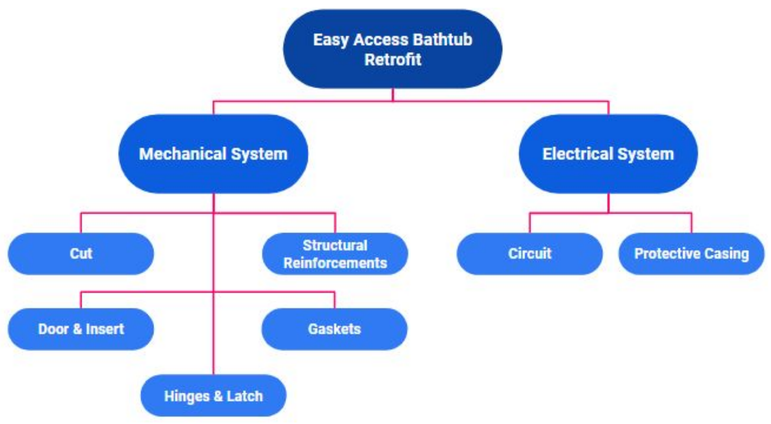
The Easy Access Bathtub Retrofit is a project heavily driven by customers' input and feedback as it is aiming at ultimately filling a void in the marketplace for a product that is both cost-effective and useful in aiding those who have little to no mobility and strength regain a sense of independence. More specifically, the Easy Access Bathtub Retrofit prototype is to be developed to fit most, if not all, fiberglass tubs by using the principles of both mechanical and electrical engineering. The design will allow the users to step over a lower threshold into their existing bathtub through a unit with a door that seals tight, discouraging any leakage from occurring, as well as giving the customers the opportunity to choose between showering and bathing.

Functional Requirements & Engineering Standards

In order to present a product that is competitive and cost-effective in the marketplace, the success of the Easy Access Bathtub Retrofit hinges on a series of functional requirements listed and described below. To meet these primary and secondary requirements, the final design for the universal unit was divided into two main categories: the mechanical system and the electrical system.

Primary Functional Requirements		
Requirement Description	**Measurable Indicator(s)**	**Target**
Leak Rate (door closed)	Water Escape from Tub with Door Closed	0%
Step Over Height (door open)	Height of Threshold for single layer is ≤ 4″	≤ 4″*
Circuit Must Be Water Resistant	Water does not interfere with the circuit's functionality nor does it get into contact with the circuitry itself.	Y/N
Minimum Entrance Width Required	Handicapped-accessible bathrooms must have doors wide enough for standard wheelchairs to pass through unimpeded.	18″
Maximum Door Length Required	The door does not come into contact with the opposing inside tub wall when it is swung upon into the tub, towards the faucet and drain.	< 20″
Positioning of Tub Cut	Give user maximum room inside the tub when closing and opening the door	6″ offset from center.
Battery Life	The battery life will not require the user to change them out too often.	> 2 years
Secondary Functional Requirements		
Install Time	Overall installation time per unit does not surpass the target.	≤ 4 hours

Engineering Standard	How/Why Does It Apply?
ADA 404.2.3 Clear Width	Meets 'Minimum Entrance Width' requirement and is in accordance with handicapped-accessible bathroom regulations.
ICC A117.1 - 404.2.6 Door Hardware	Meets users' feedback which considers customers with conditions such as arthritis.
ADA 404.2.8.2 Spring Hinges	The final design involves the use of a spring-operated hinge to fix the door to the unit insert.
ADA 404.2.9 Door and Gate Opening Force	Takes into consideration the customers' feedback in regard to the age and, consequently, the strength of the targeted demographic itself.
IP 57, 6	Meets 'Circuit Must Be Water Resistant' requirement.

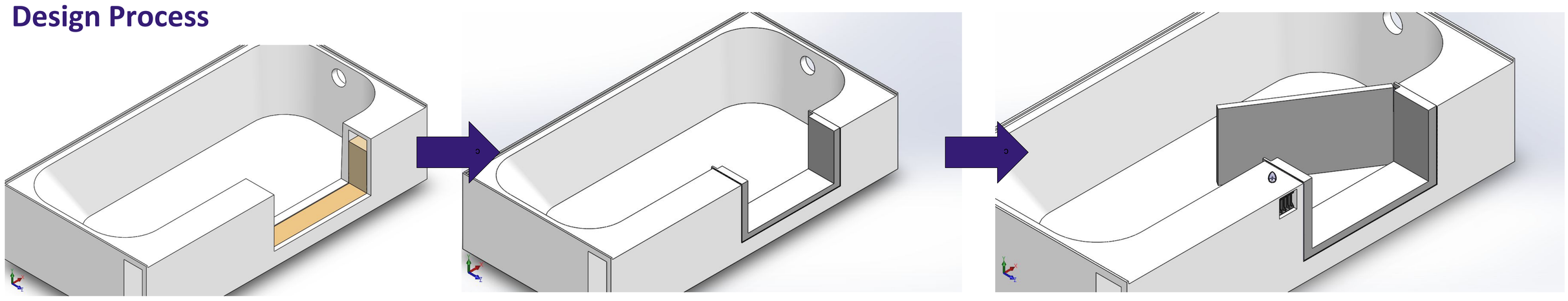


Verification Tests

Completed Verification Tests		
Functional Requirement	**Target**	**Verification Test Result**
Step-Over Height (door open)	≤ 4″	3.5″
Minimum Entrance Width Required	18″	18″
Maximum Door Length	≤ 20″	20″
Minimum Battery Life	≥ 2 Years	~ 4 Years

Incomplete Verification Tests		
Functional Requirement	**Target**	**Measurable Indicator**
Leak Rate (door closed)	0%	Determine if water can escape from the tub while the door is in the closed position. Physical setup and environment are required.
Circuit Must Be Water Resistant	IP 57, 6	The circuit is encased in a waterproof capsule, which will be tested according to the IP 57,6. If the case fails, the circuit will fail also, so, for safety reasons, only the case will be involved in the verification testing.
Presence of a Seat is Considered (door open and closed)	Cut and Unit Positioned 6″ Offset from Center	Determine the maximum dimensions that the seat can possibly have at each respective angle of aperture of the door's opening and closing.

Design Process



The tub cut is the first step to complete to retrofit an existing tub. Then, both horizontal and vertical reinforcements are placed within the cut and flush against the inside walls to provide stability to the tub. Afterwards, the construction process involves building and assembling the unit out of fiberglass reinforced plastic (FRP) and attaching it on top of reinforcements within the cut. Lastly, the mechanical components are added to the FRP unit and two additional holes are created on the tub for the electrical system.

First Prototype - Alpha Stage

Image 1. Top View of the Bathtub

Image 2. Isometric View of the Bathtub

Image 3. Close-Up View of the Insert

Electrical System

Purpose: provide visual assistance to the users to ensure safety and peace of mind when operating the door.

Function:

1) notifying the user if the door has not been properly closed by turning an LED on;
2) alerting the user if the batteries powering the system are low by making a second LED blink instead.