

# Aqua Egression

## Team Members:

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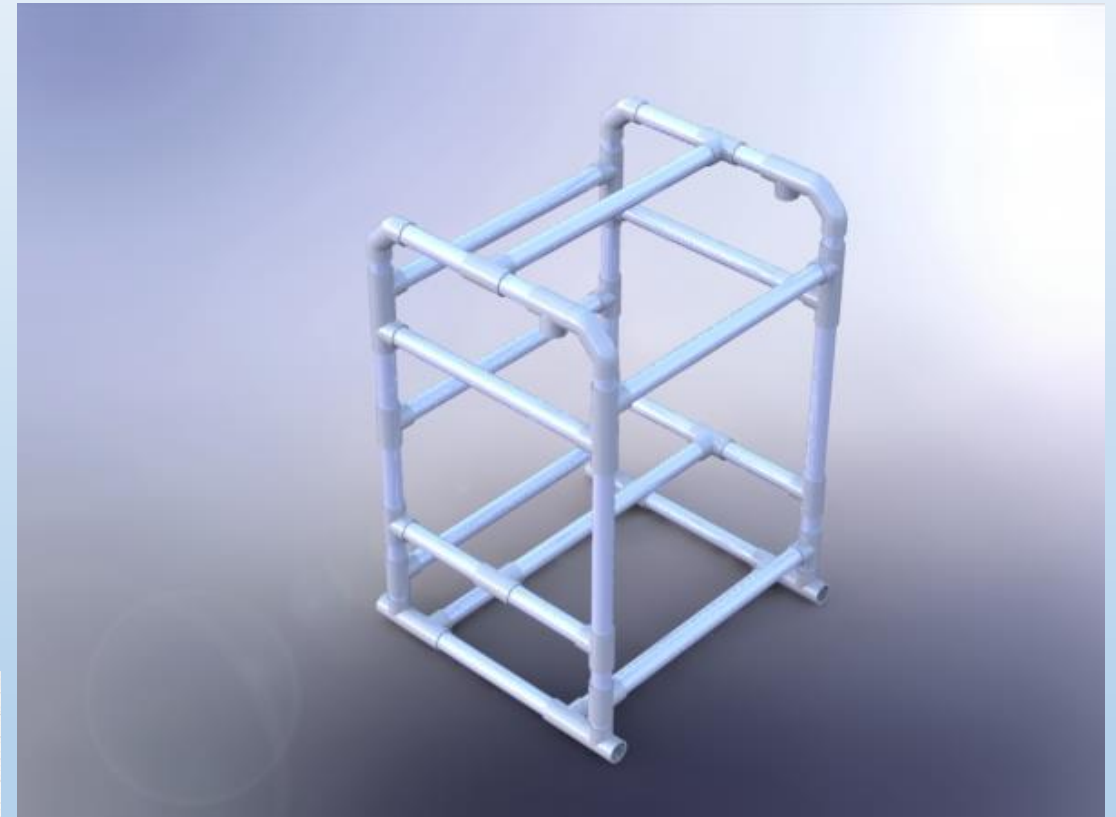
## Sponsor:

- US Department of Interior



# Problem Statement:

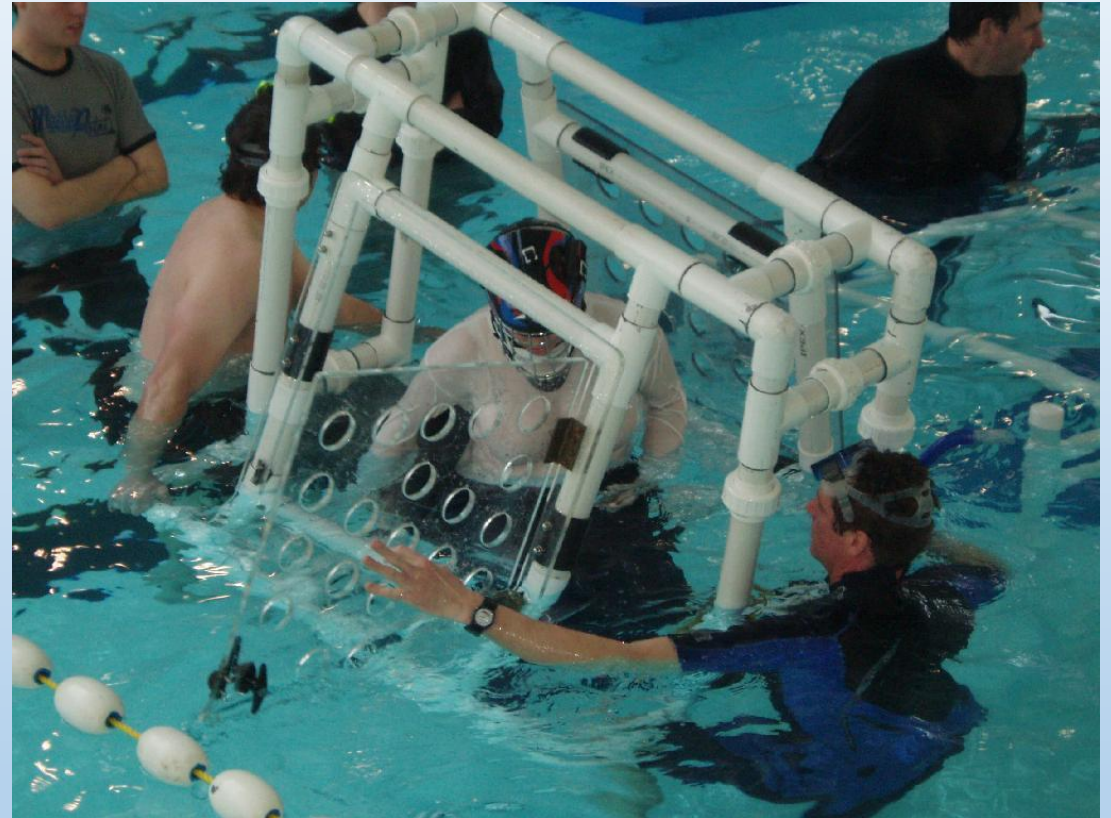
- The Aqua Egression team set out to develop a prototype for a water egress simulator that is more durable, cost effective and transportable than the previous model.



Catia render of original prototype.

# Project Goals:

- Reduce cost from original amount. (<\$2200).
- Disassembly/assembly time for two people in one hour or less.
- Keep weight in shipping at 75 lbs/box or less.
- Create a prototype easily replicated.

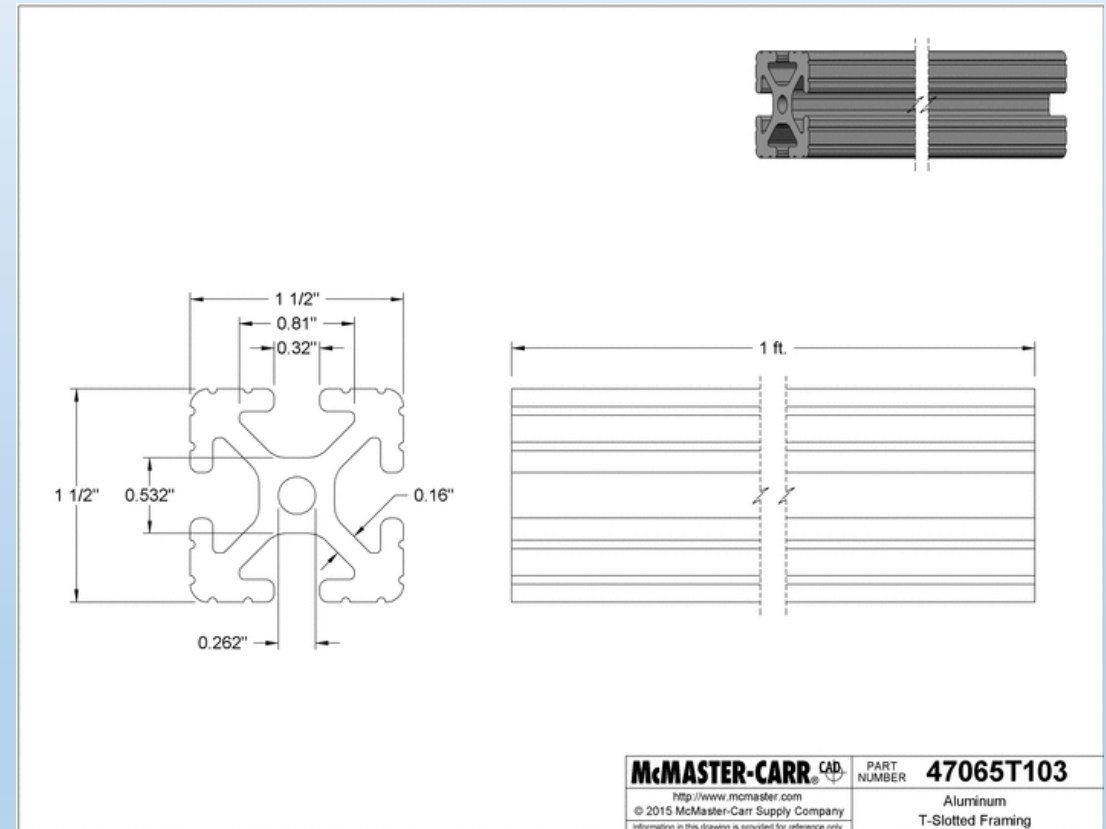


# Design Process: Material Acquisition.

- Our first objective was to determine what material(s) would be most effective in combining lightweight modularity with high strength durability. This led us to using 8020 T Slot Aluminum extrusions.

## Advantages:

- High strength to weight ratio.
- Modularity means faster assembly time.
- Anodized finish protects against corrosion.



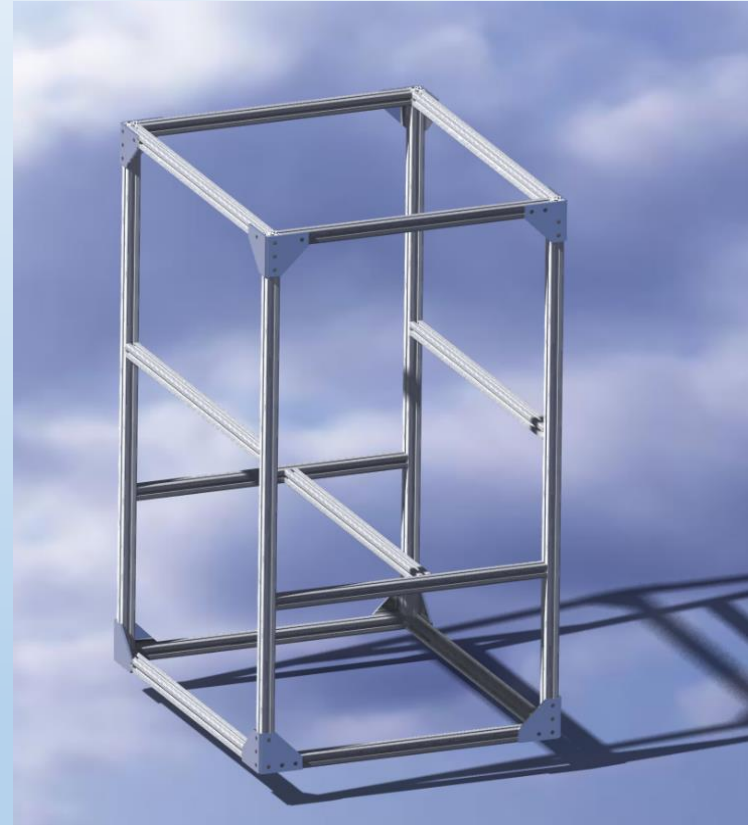
# Design Process: Initial Prototype

- Dimensions were 2.5' x 3' x 5'.
- Required 56' of T-slot.
- Used 5 point brackets as connections for corners.

## Problems:

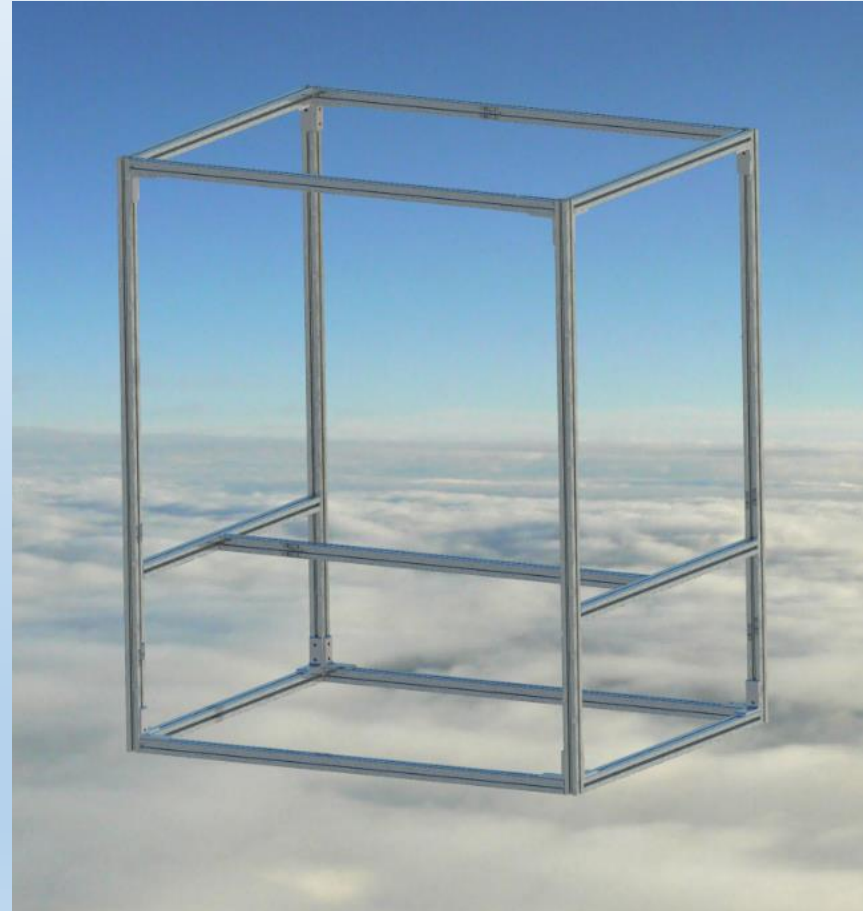
- Dimensions were not big enough for two people.
- Brackets on the outside would cause damage to the pool.

Solution: Eliminate brackets, make dimensions larger!



# Design Process: Modifications

- To accommodate the necessary space, we added width and depth, upscaling from 2.5' deep to 3', and from 3' wide to 4'.
- To limit the outside exposure of the structure, we replaced the 5 point plate brackets with "L" brackets.



# Design Process: Final Decisions

- Added a second cross bar to support seats instead of one. Reduces stress on bolts and eliminates twisting.
- Placed UHMW strips on the bottom and all corners. Reduces friction for moving and plastic exterior won't leave damage on pool.

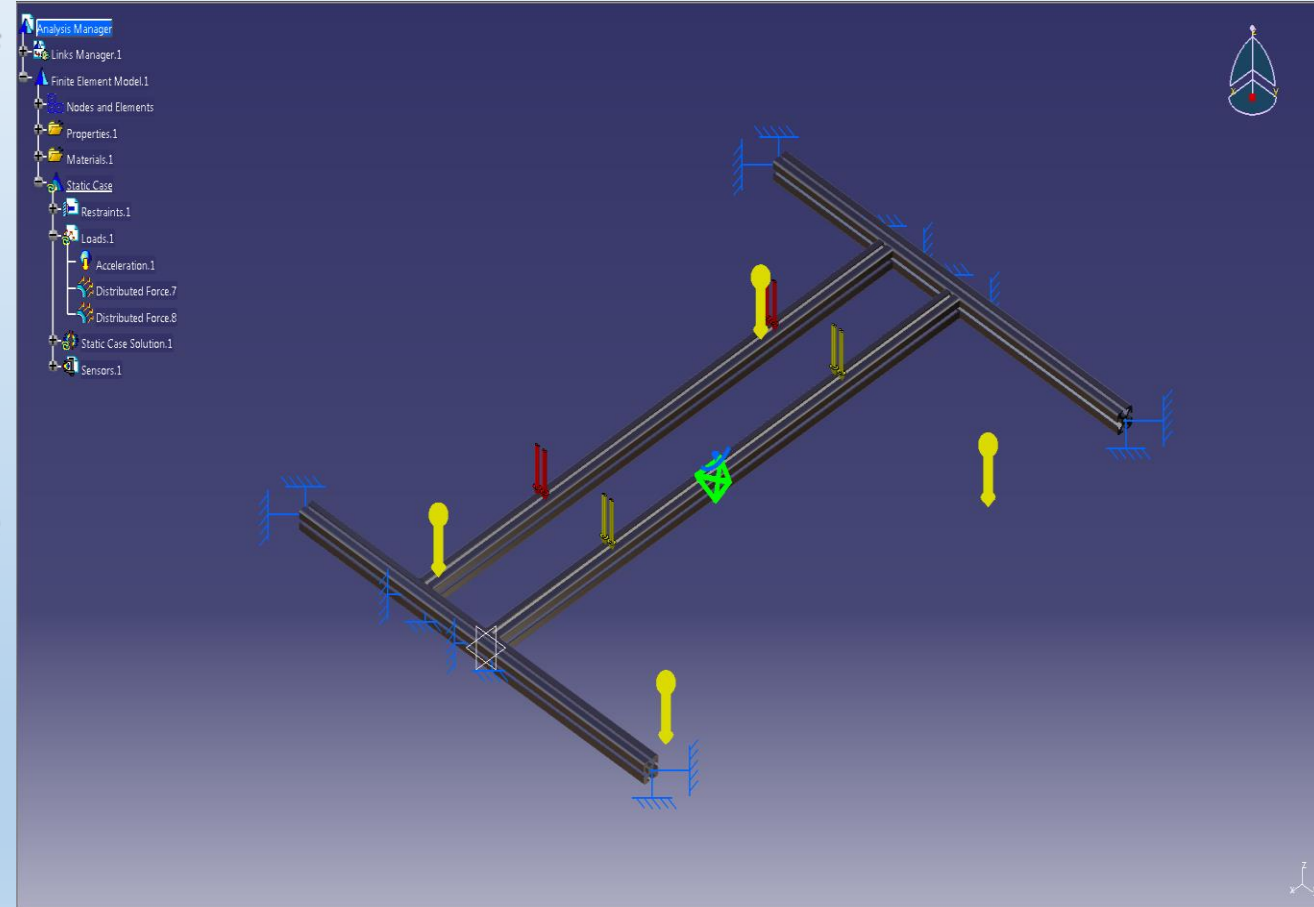


# Analysis: Testing the Design.

While there were no concerns about the durability of the material, the structural integrity of the design needed to be examined.

Using Catia, we could identify the potential weak points and their impact.

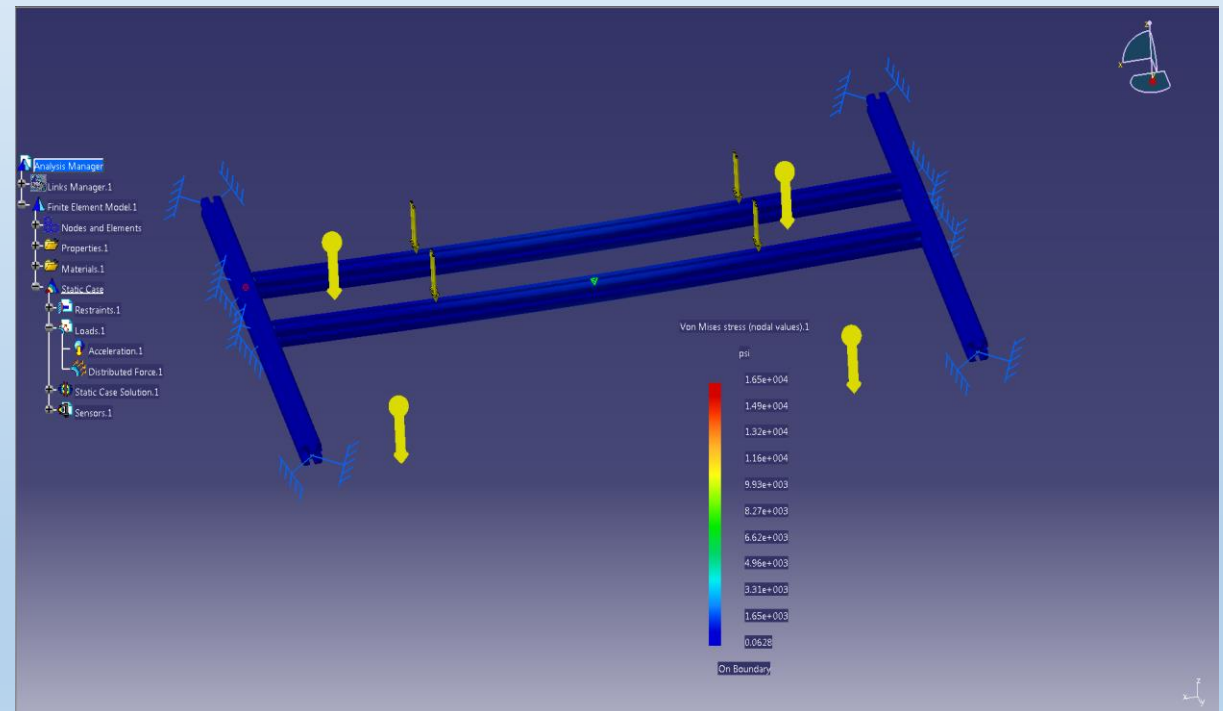
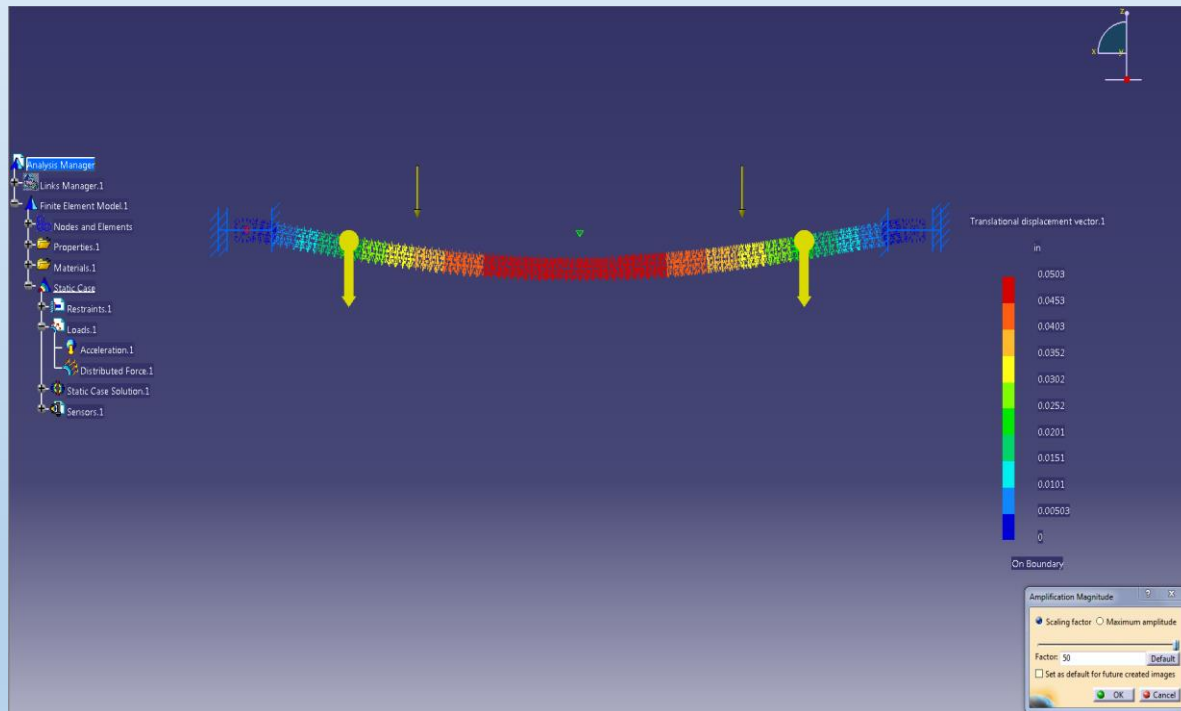
Due to the nature of Catia, we needed to simplify the assembly configurations in order to conduct a proper analysis.





# Finite Element Analysis:

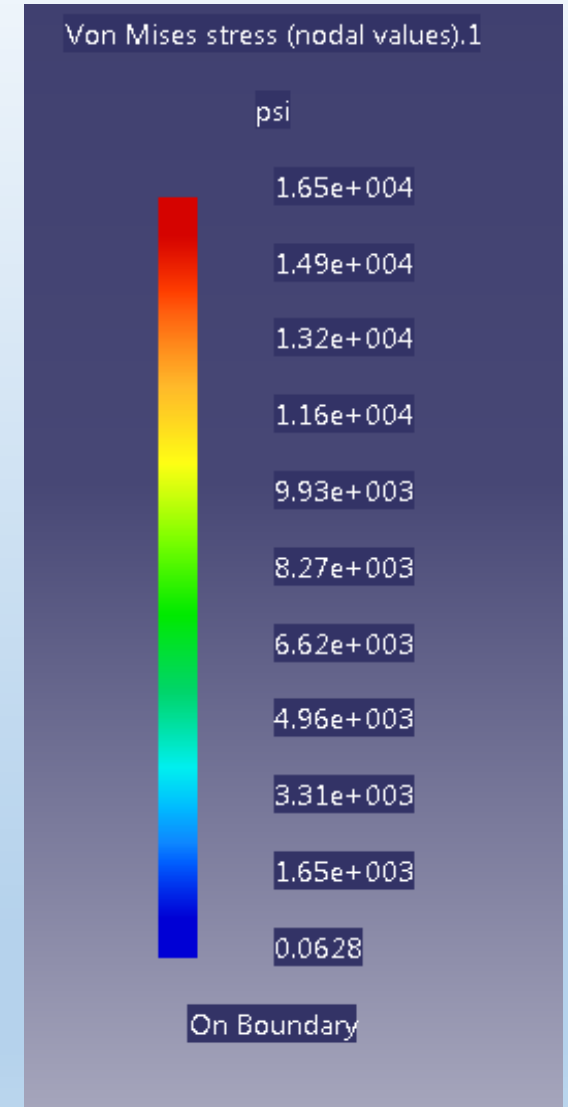
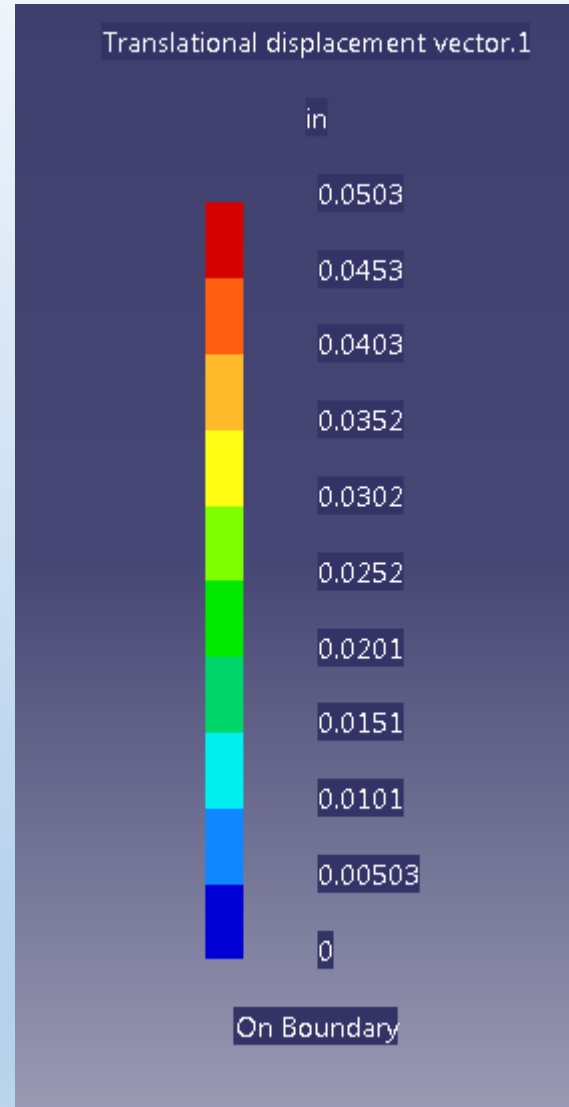
Using Catia's FEA ability, we could analyze the impact of a distributed load on the cross members, representing two seated individuals. Assuming 250 LBF per member, we were presented with the following results:



# FEA Results:

- Von Mises Stress (highest point) 16,500 PSI
- Displacement (highest point) 0.0503 inches.

The yield strength for 1515 T-slot aluminum is 35,000 PSI. With a load of 250 LBF per cross member, we are still well below the yield limit and can feel confident in the strength of the design.



# New and Old Design Comparisons:

- Original Design cost: \$2217
- Original Design weight: 100 lbs
- New Design cost: \$1812.71
- New Design weight: 106 lbs
- While there is a slight increase in weight, there is a greater than \$400 savings.

Water Egress Simulator- Bill of Materials				Team Aqua Egression		12/2/2015	
Item:	Quantity:	Unit Price:	Location:	Product Number:			
1515 Solid, 4'	2	\$32.19	8020.net	1515			
1515 Hollow, 4'	5	\$23.55	8020.net	1515-LITE			
1515 Solid, 5'	4	\$33.75	8020.net	1515			
1515 Solid, 3'	4	\$21.03	8020.net	1515			
1515 Hollow, 3'	2	\$18.15	8020.net	1515-LITE			
SUM-G1100 Racing Seat	2	\$34.97	summitracing.com	SUM-G1100			
3" Aluminum Brackets	16	\$6.96	mcmaster.com	47065T241			
Phillips 3/8 -16 x 2"	18	\$1.70	Lowes	438335			
UHMW Plastic Strips, 6'	6	\$45.21	mcmaster.com	47065T839			
End Caps, 1.5"	8	\$1.50	mcmaster.com	47065T87			
Total cost:		\$932.71					
Add two Pelican 1780 cases.		\$1,712.71					
Add in seatbelts.		\$1,812.71					
Cost difference from original design:		\$405.09					
Total weight:		105.8872					

Questions?