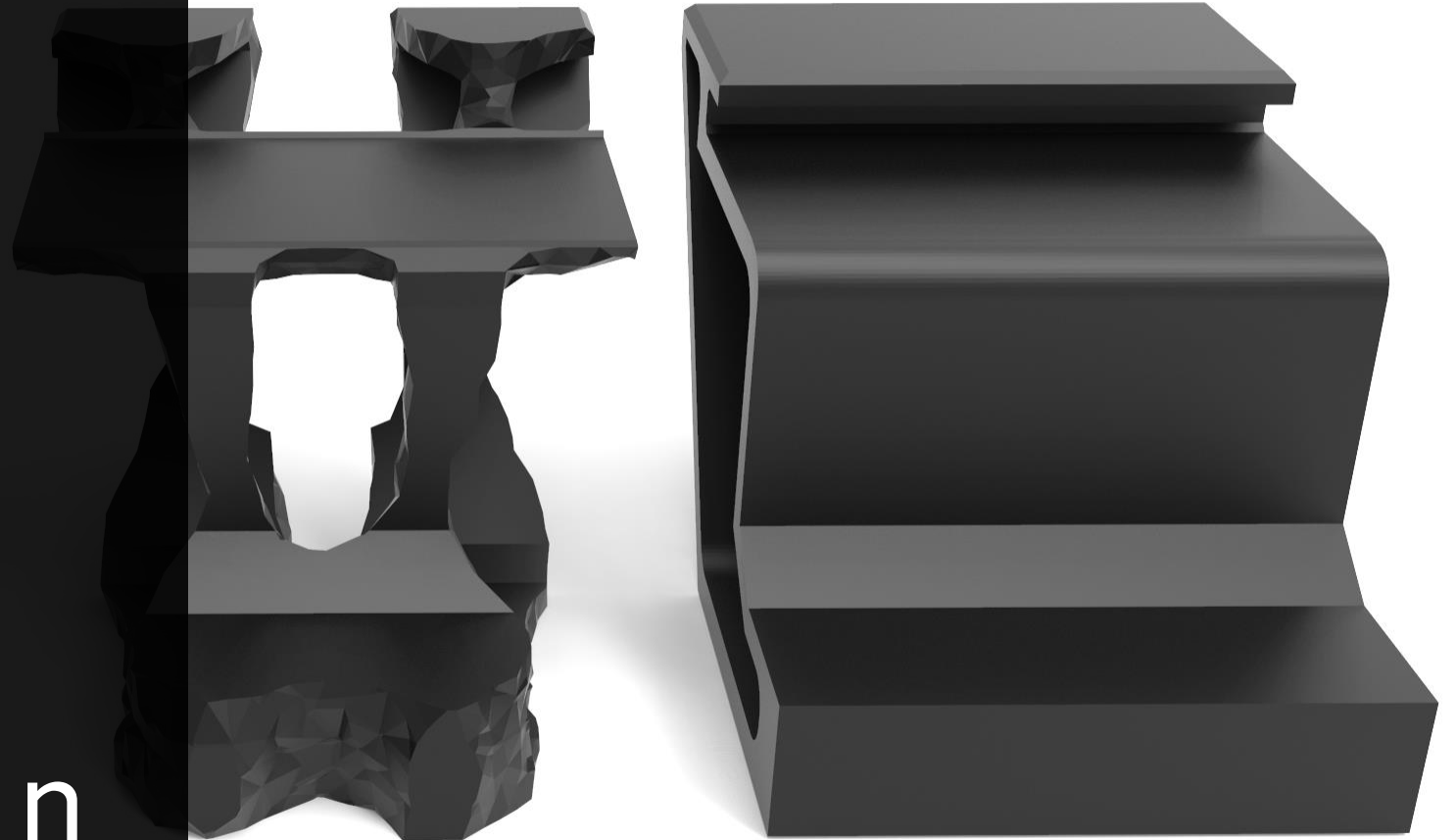


Shape Optimization

PRO V5 FIE



DESIGN

Make It Real CAD Engineering Challenge Sponsored by Autodesk ®

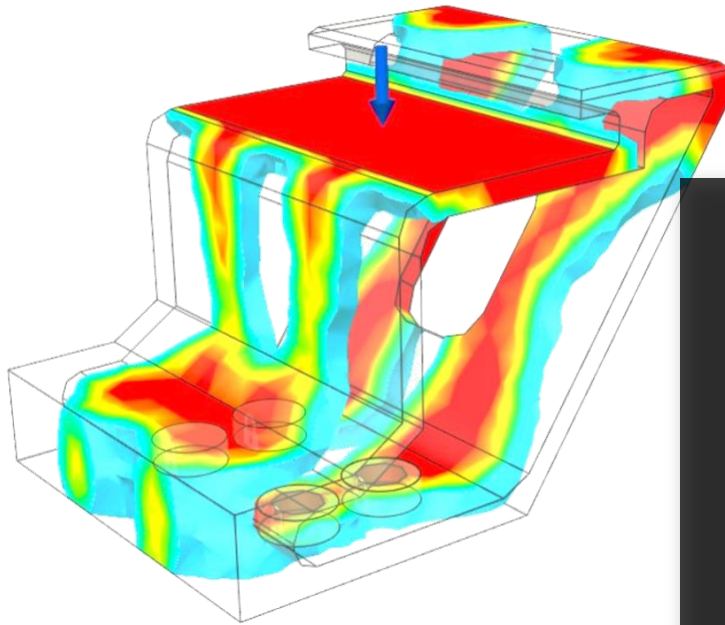


Implementation

FIE – Shape Optimization

The analysis was an experiment aimed at the application of the topological optimization in a molded and validated component with the use of the additive manufacturing process. The engineering application explores possible strategies to reduce material consumption by optimizing the design of robotic elements.





FIE

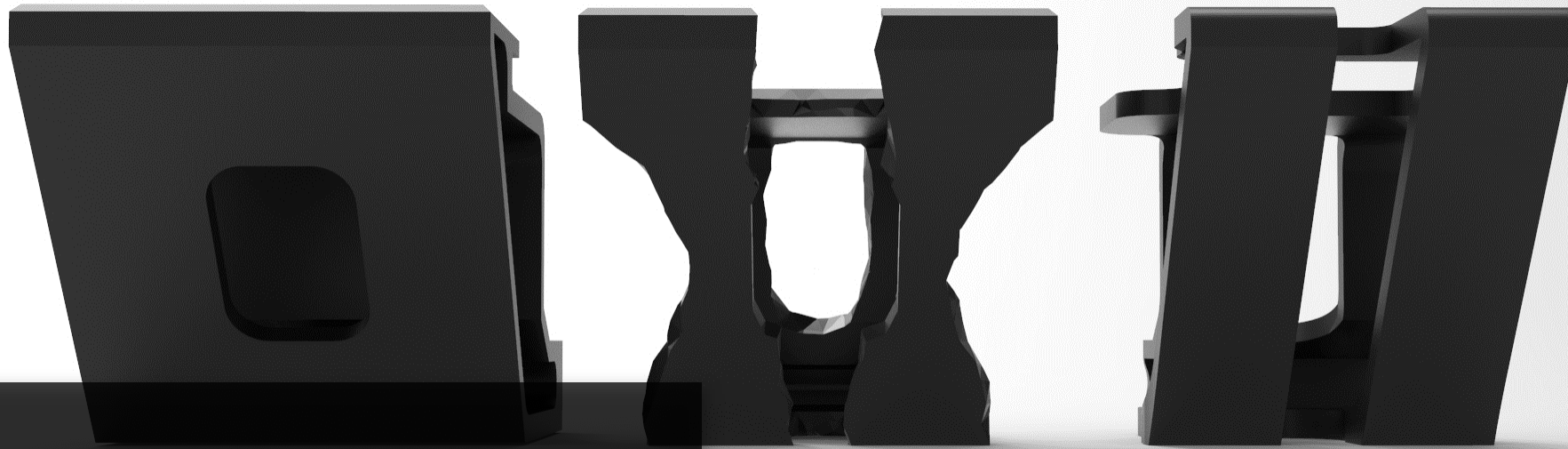
Shape Optimization

For the purposes of this analysis, it was considered a component responsible for the fixation and integration between electronic components of the VEX Robotics Platform. The work is divided into three phases.



Processes

Mechanical Engineering Analysis

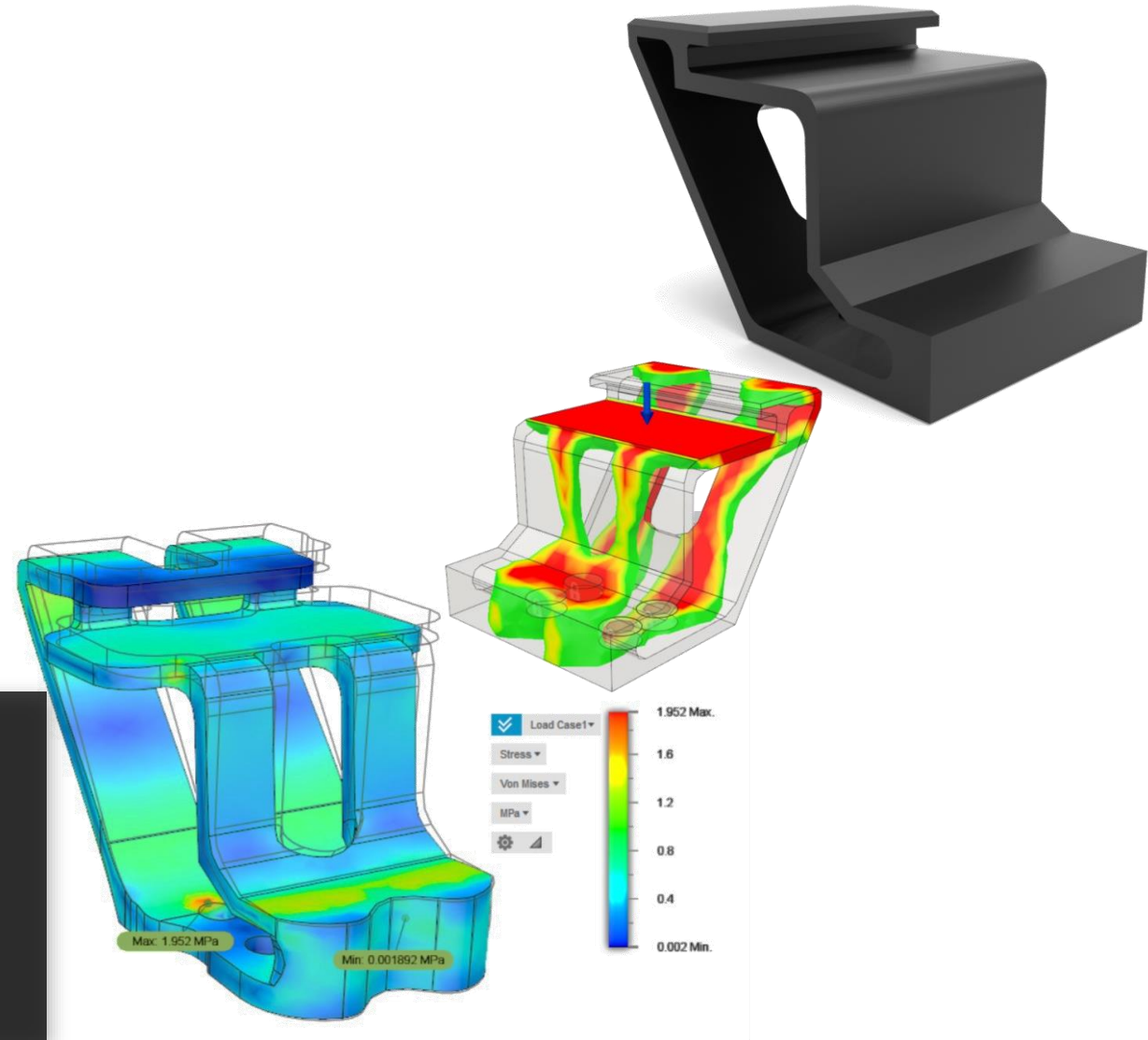


Utilizing key mechanical design features in search of high throughput in manufacturing.

The first phase involved designing the structural element. The second step was to develop strategies for the implementation of topology optimization by analyzing the use of material and its reduction. The last step involved creating the best modeling strategy from the results collected from the optimization simulation, thus redesigning a new component for the additive manufacturing process.

TOPOLOGICAL OPTIMIZATION

To optimize the distribution of material on the creation of the new component, the excess material is digitally sculpted using the Fusion 360 software optimization simulation. The software is used to calculate the topology with the constraints and criteria implemented by the engineer responsible for the development of the product.



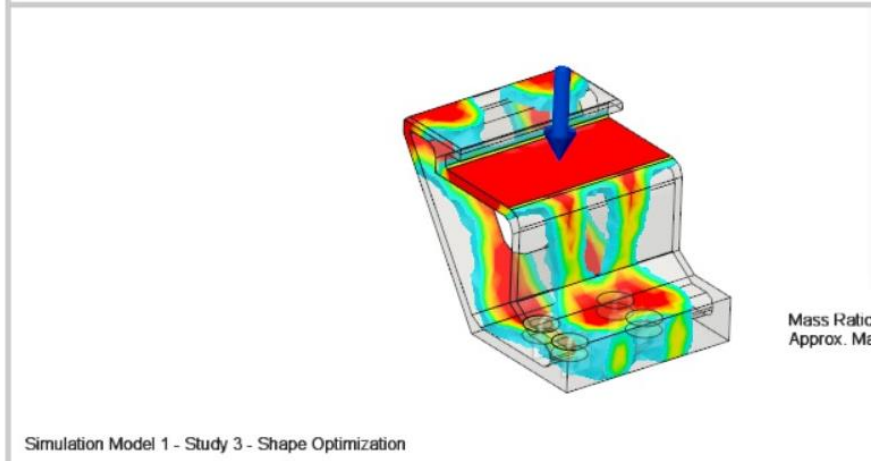
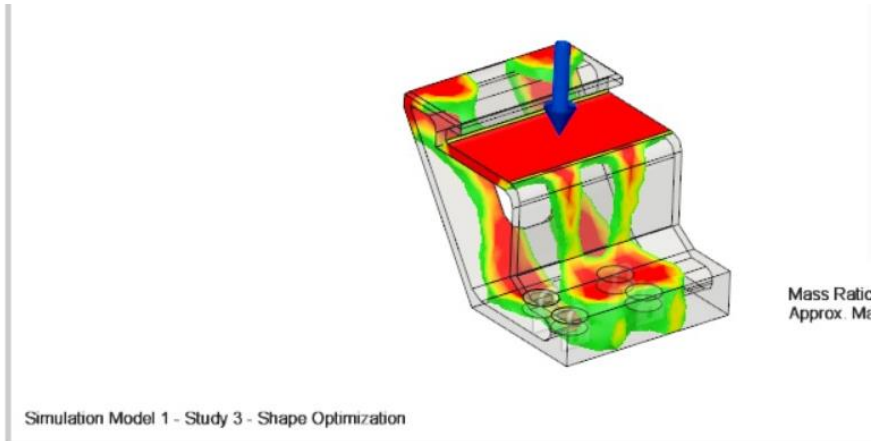
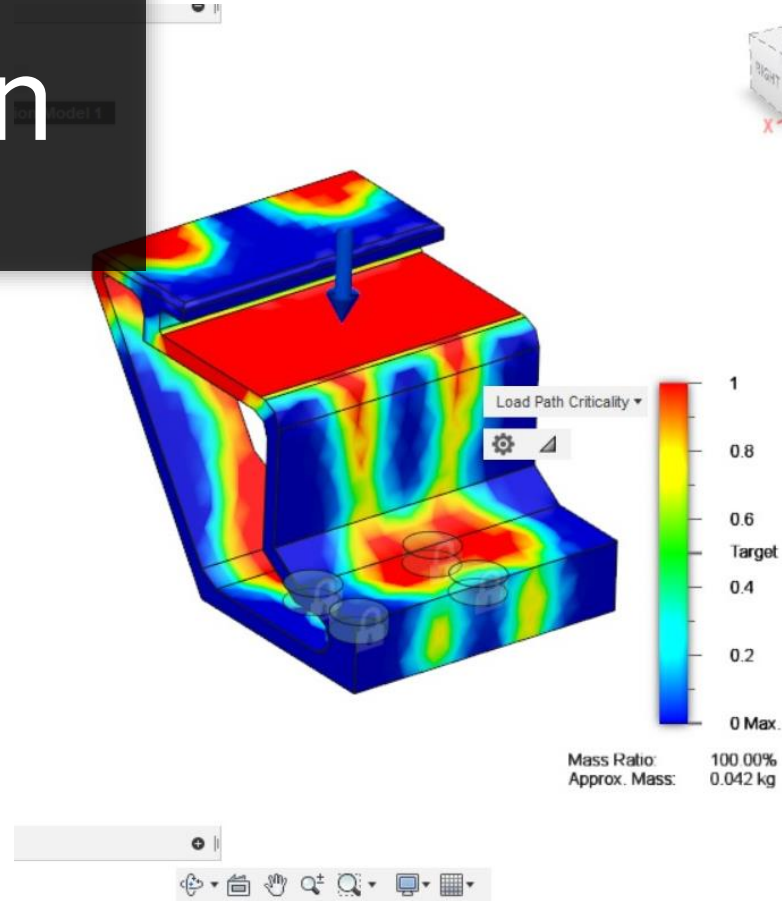
First validated version of component



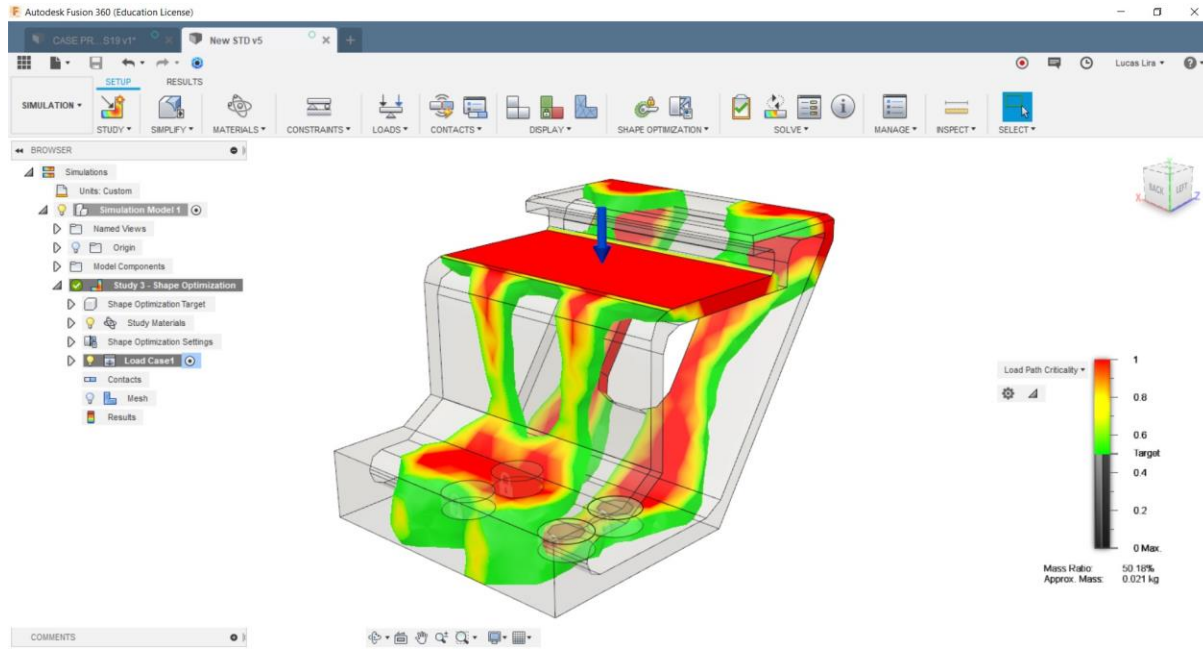
Material selection: Material selection as it has a great impact on safety, reliability and performance. To ensure the proper selection of material market research is done.

As our main aim is to provide High factor of safety to the part, lower weight and cost of the material is also considered while selection of material.

Shape Optimization



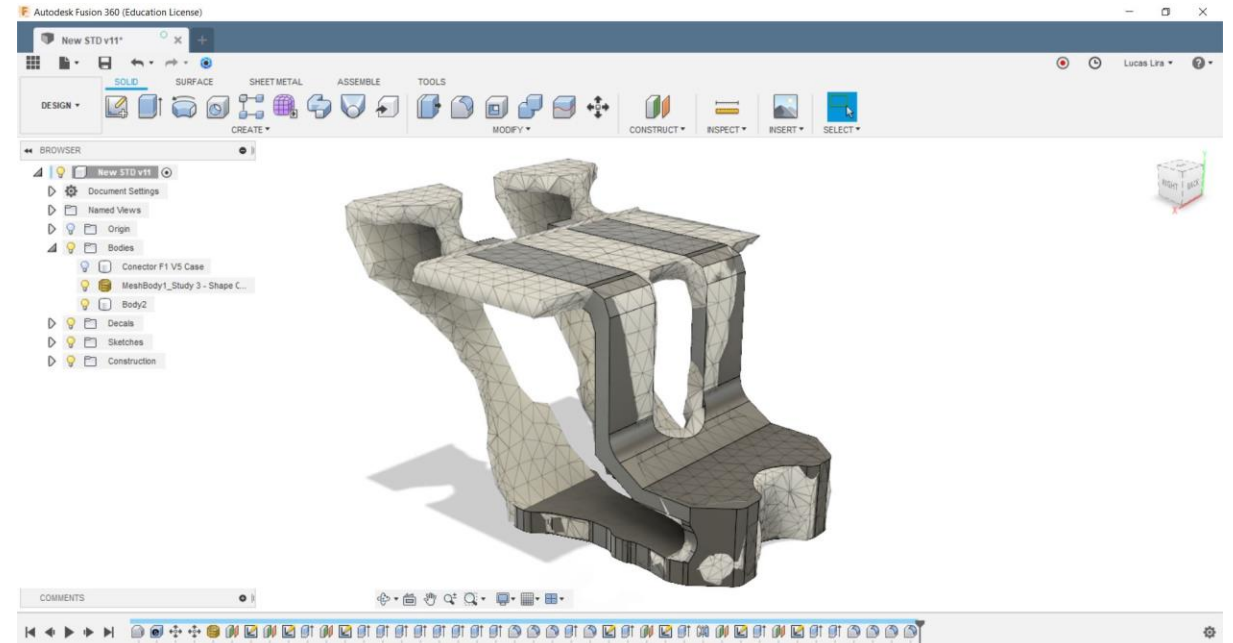
Shape optimization- This optimization is carried out to change inner/outer shape of an object. It gives an object a particular shape depending upon the stress generated in a particular area. It takes out the material from the area where minimum amount of stress is generated. In that case the material is removed from the outer boundaries where the stresses are minimum. By doing this the weight of the object reduces without actually reducing the factor of safety.



Shape Optimisation

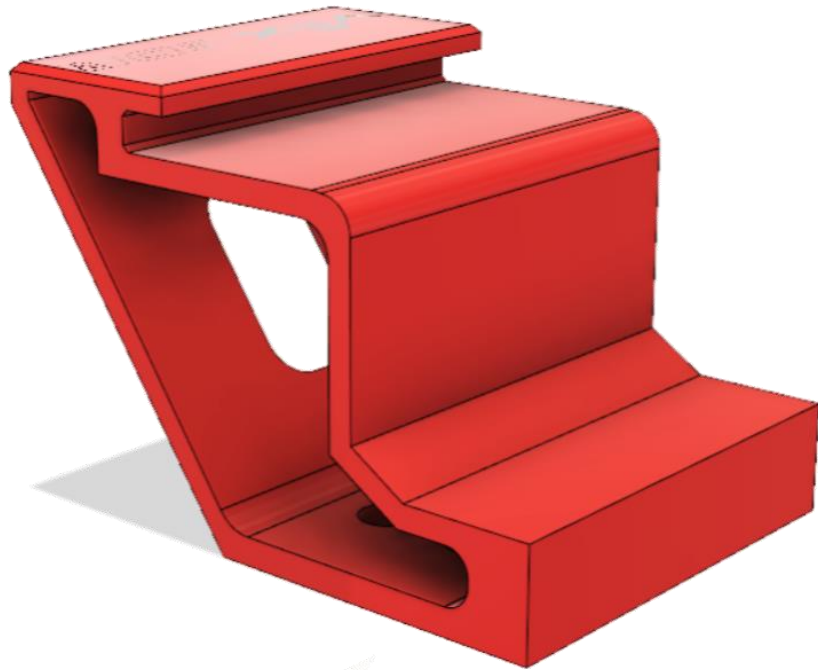
ABS Plastic

Density	1.06E-06 kg / mm ³
Young's Modulus	2240 MPa
Poisson's Ratio	0.38
Yield Strength	20 MPa
Ultimate Tensile Strength	29.6 MPa
Thermal Conductivity	1.6E-04 W / (mm C)
Thermal Expansion Coefficient	8.57E-05 / C
Specific Heat	1500 J / (kg C)



Mechanical Engineering Analysis

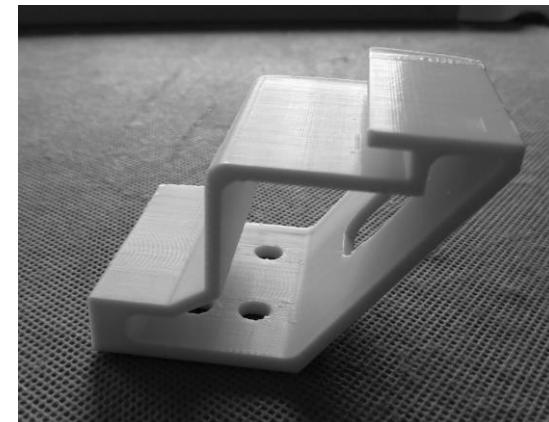
FIE - Optimization



Component Physical Properties

Component in your first validation version.

Physical Material	ABS Plastic
Area	2.442E+04 mm ²
Density	0.001 g / mm ³
Mass	41.481 g
Volume	3.913E+04 mm ³
Appearance	Plastic - Glossy



Component Physical Properties

Features analyzed after engineering optimization application and construction of a new product with Fusion 360 software data.

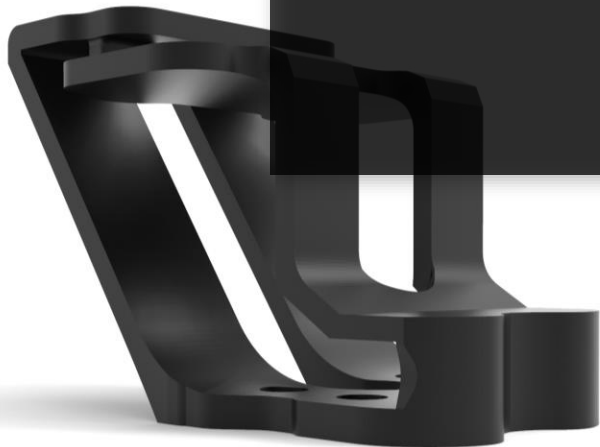
**Mass Reduction in:
% 36,366047**

Physical Material	ABS Plastic
Area	1.733E+04 mm ²
Density	0.001 g / mm ³
Mass	26.396 g
Volume	2.490E+04 mm ³
Appearance	Plastic - Glossy



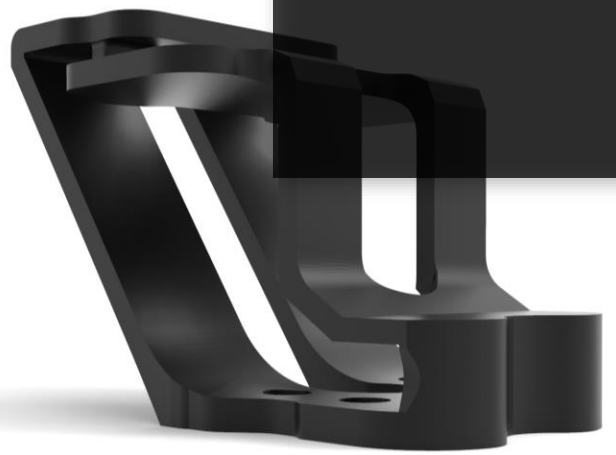


“Solve design challenges in new forms of learning.”



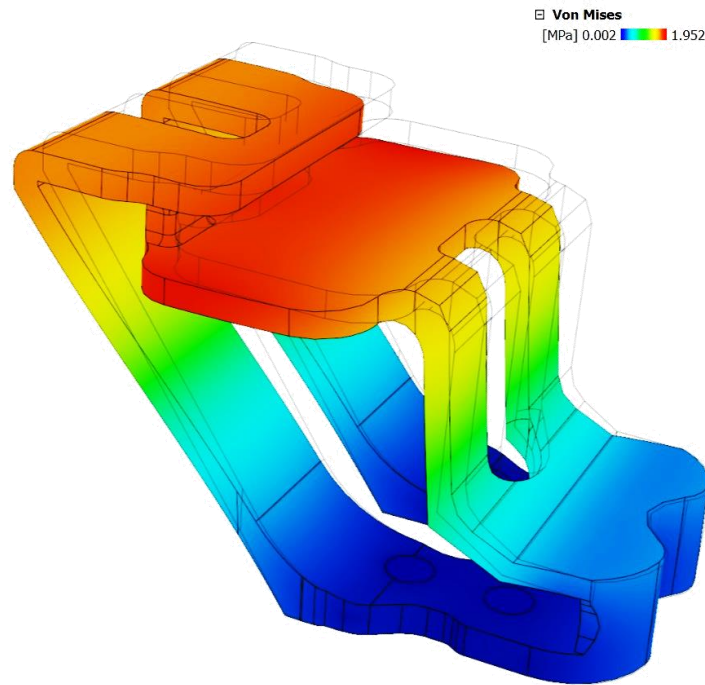


"Designing for the future."

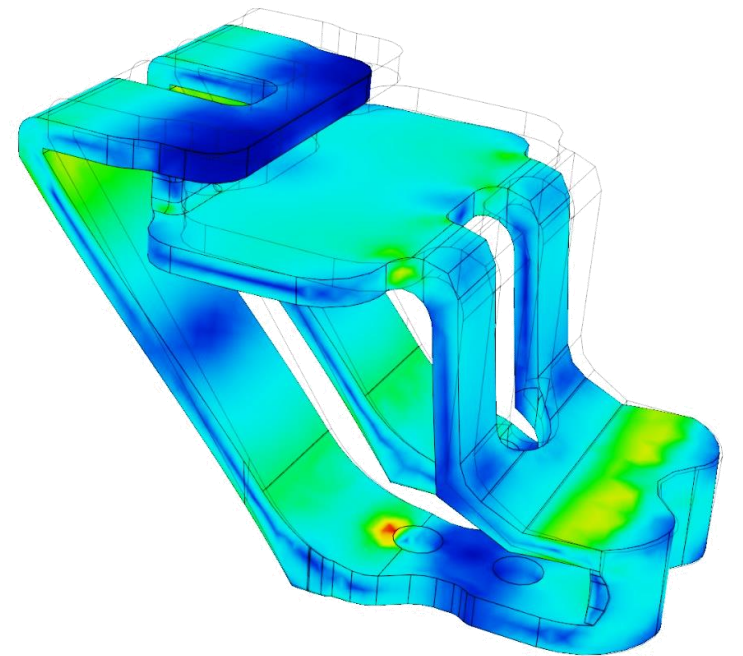




E Total
[mm] 0 0.2514



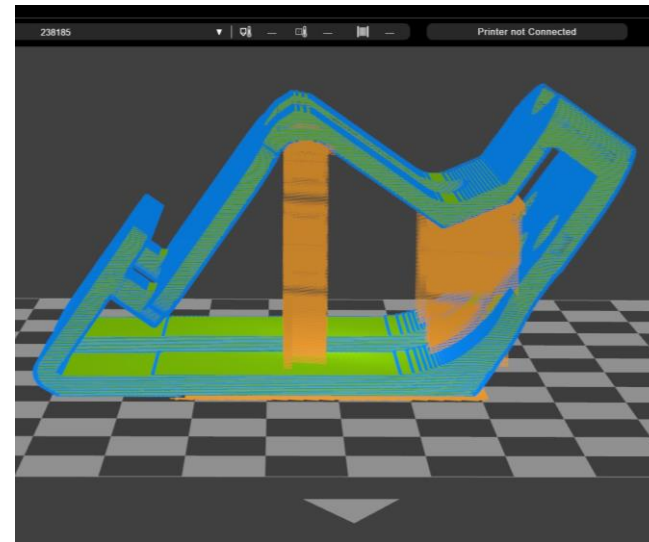
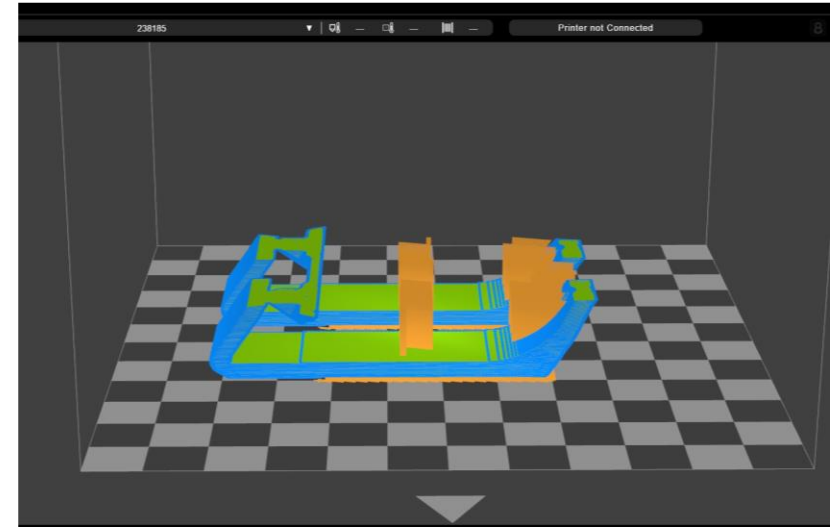
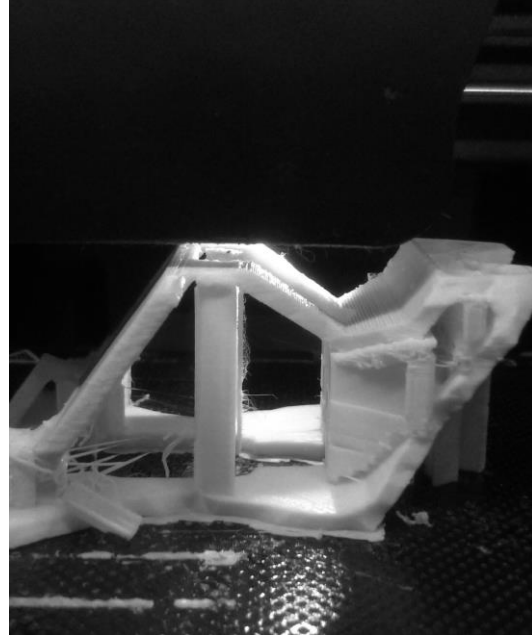
Von Mises
[MPa] 0.002 1.952




Manufacturing Process - Post Analysis

PRO V5 FIE







PRO CASE CLIP.stl Delete

52.4 × 73.9 × 55.8 mm [Change units](#)

[Printable with FDM](#)

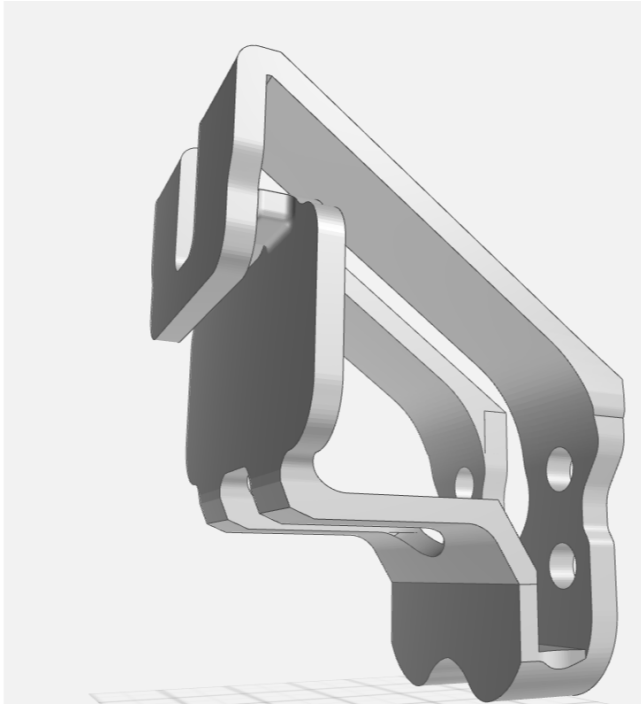
Qty: [Show bulk pricing](#) **\$6.95**

Manufacturability analysis


3D printing - FDM

Passed checks

- ✔ Thin walls Very good
- ✔ Intricate details Very good
- ✔ Hard to remove support Very good
- ✔ Mesh integrity Very good



Selected material [Close ^](#)



Standard PLA - FDM

[Show material description](#)

Infill - 6 options

20% ▼

Layer height - 3 options

200 μm ▼

Color - 7 options

White ▼

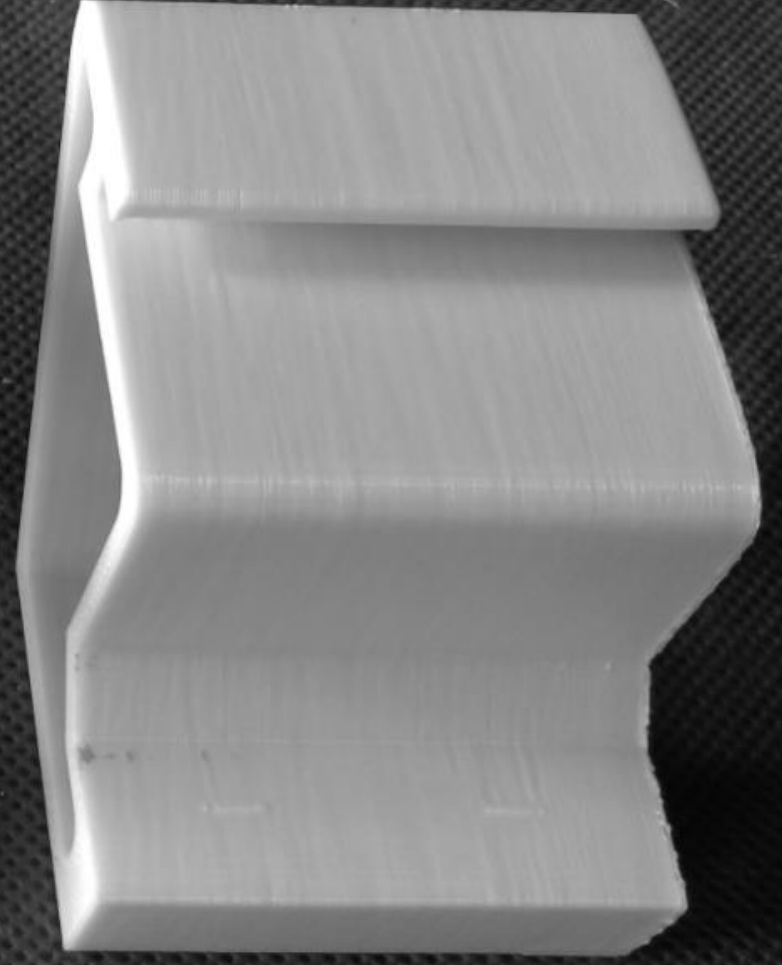
Subtotal
\$6.95

Cost reduction for unit component production at % 33.365292 after design optimization.

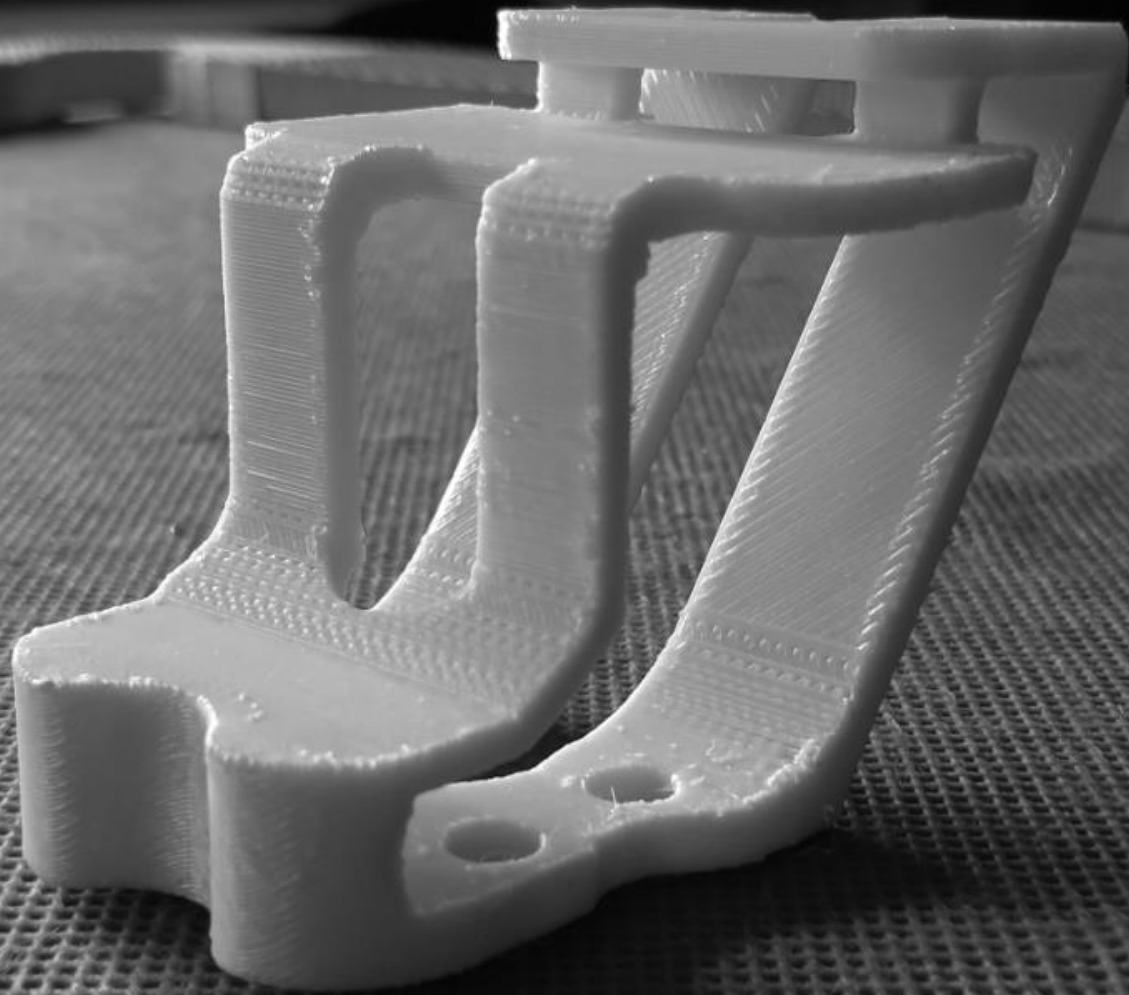
Product Deployment

This exercise was a step in the attempt to guide the discussion in the field of mechanical practice in the conservation of resources and the use of computer tools such as (Fusion 360) to produce components and efficiency projects. The processes used in this work can demonstrate the efficiency of the topological optimization application integrated with the Additive Manufacturing process. The activities developed can not only help reduce the material consumed but can also promote lighter components and also effectively reduce the cost of the project.

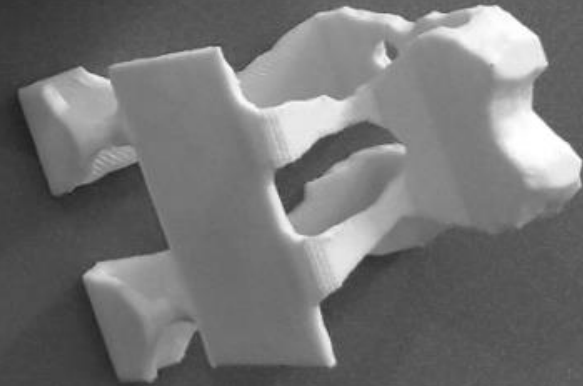
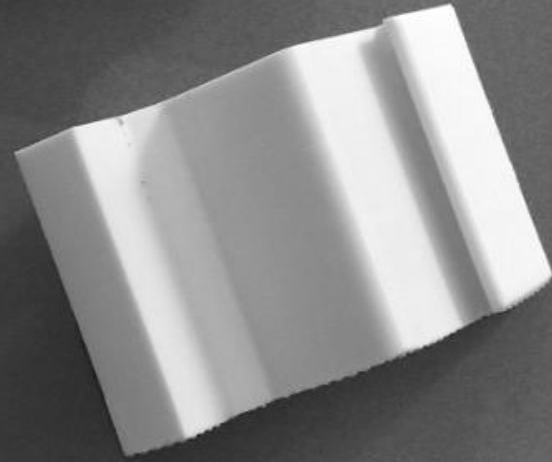














Lucas Lira Santos

Student Ambassador Autodesk / Microsoft MIEE

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