AUTODESK UNIVERSITY

A practical guide for Generative Design in Product and Industrial Design

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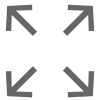
Class Summary

Learn best practices for effectively running generative design studies and integrating them into product and industrial design.

Learning Objectives

Define best practices for setting up and running a generative design study.



Use obstacles and preserved geometry to obtain results that align with specific design intent.

Setup forces, constraints and other technical details of a study in a practical way.

Combine generative design geometry with components modeled directly in Fusion 360.

Introduction to Autodesk Generative Design

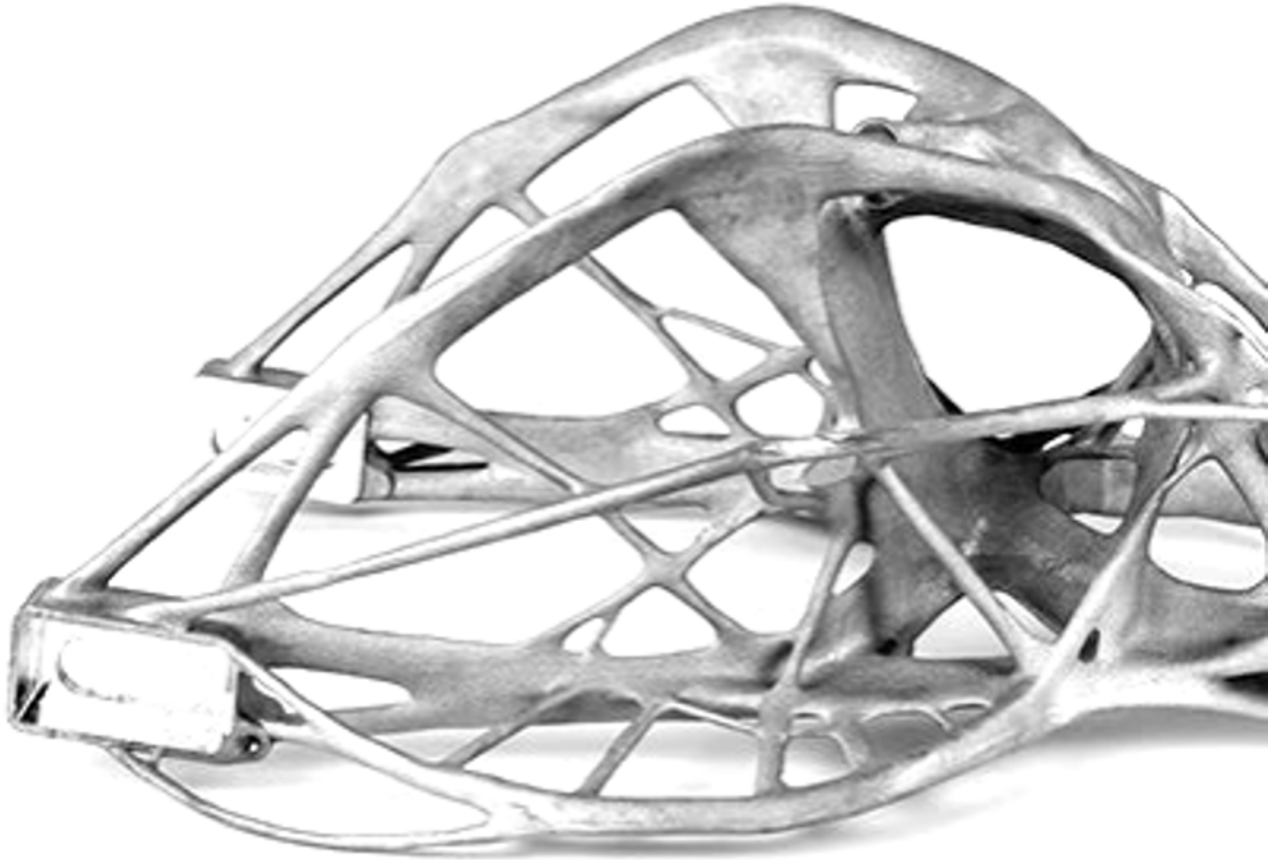
Autodesk Generative Design

Set within Fusion 360

Users set performance goals and technical parameters.

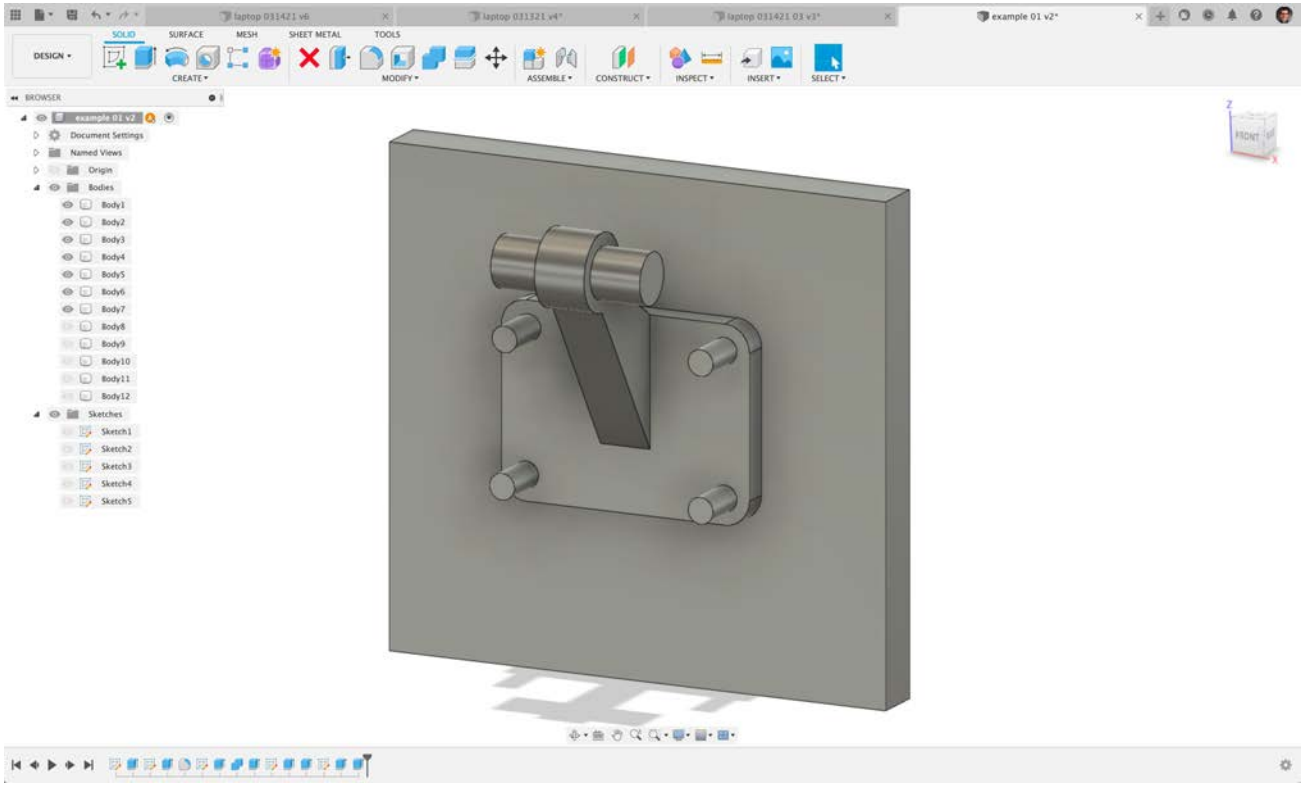
GD generates multiple models that meet the set criteria.

Models can be exported as Fusion 360 or mesh models.



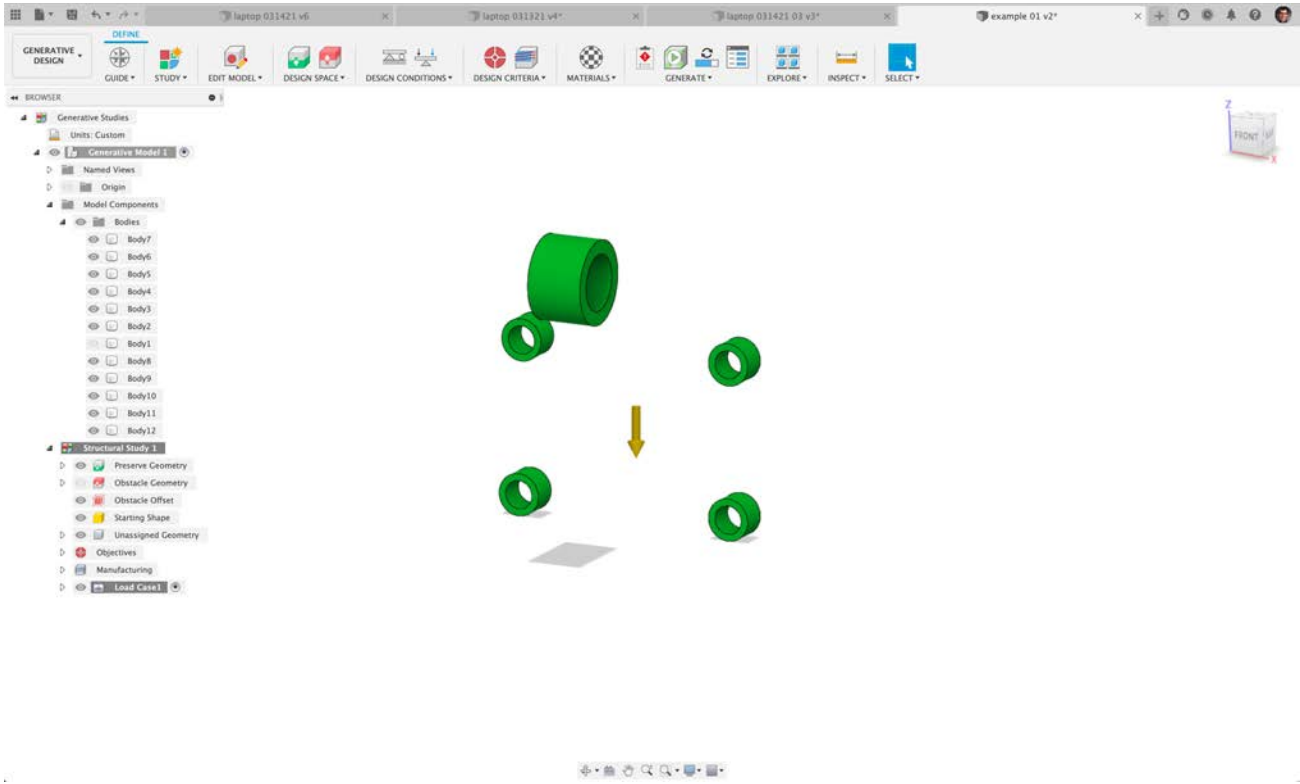
Generative Design steps

Create base design



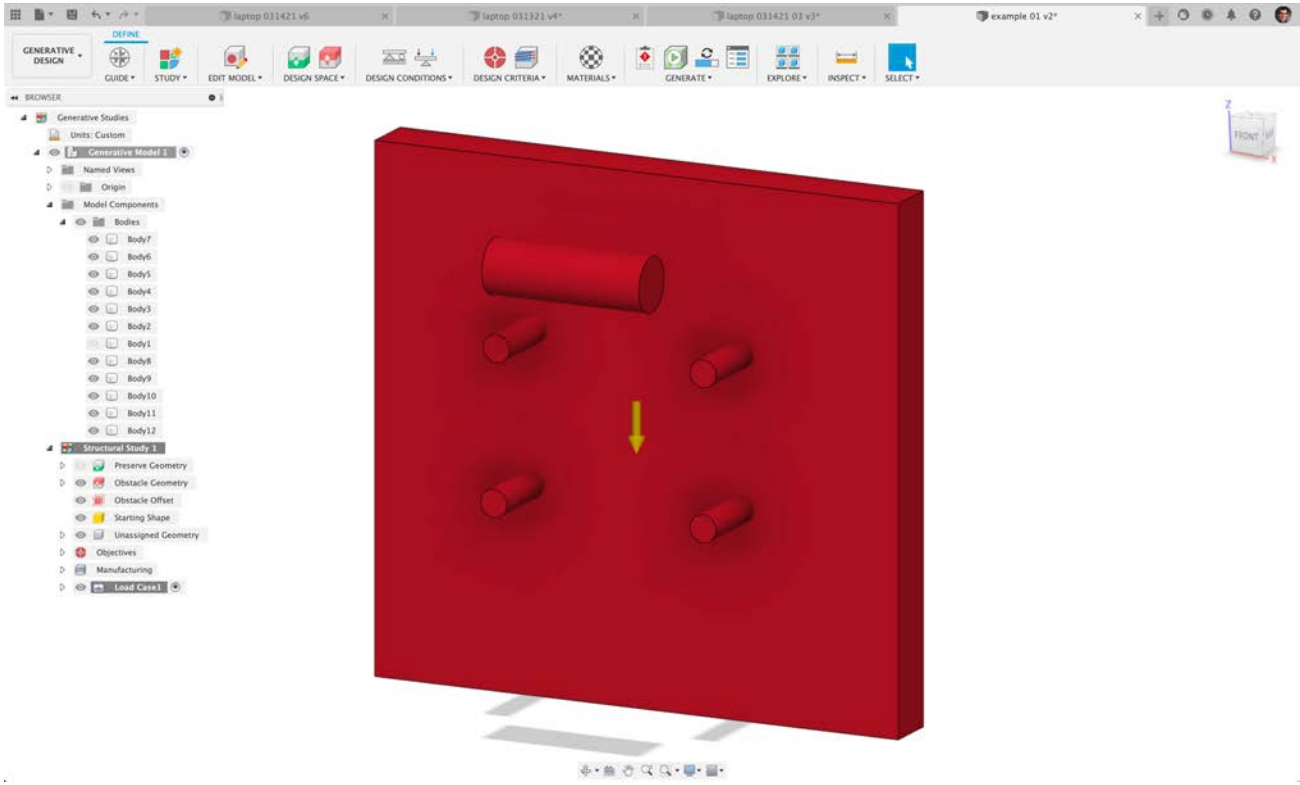
Generative Design steps

Create base design
Set preserve geometry



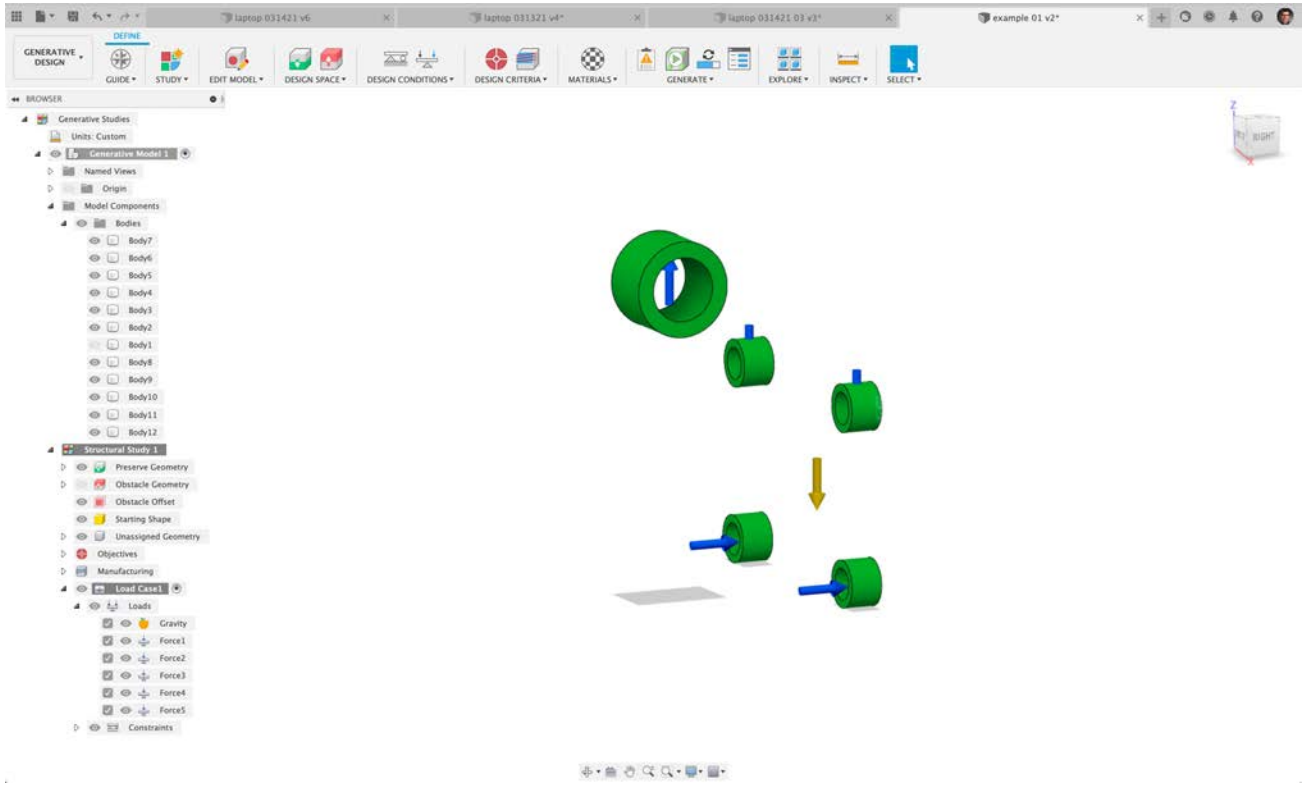
Generative Design steps

Create base design
Set preserve geometry
Set obstacle geometry



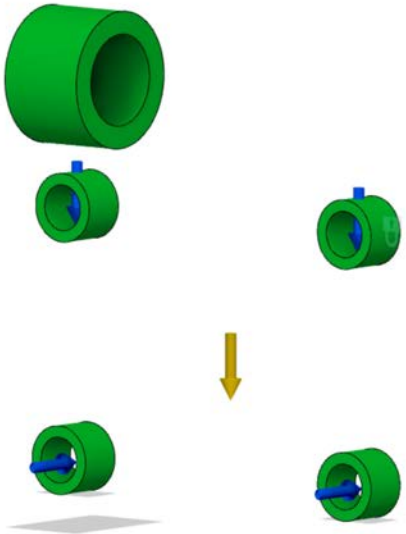
Generative Design steps

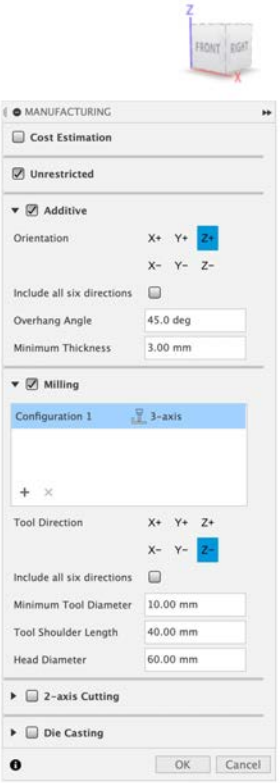
Create base design
Set preserve geometry
Set obstacle geometry
Apply loads and forces



Generative Design steps

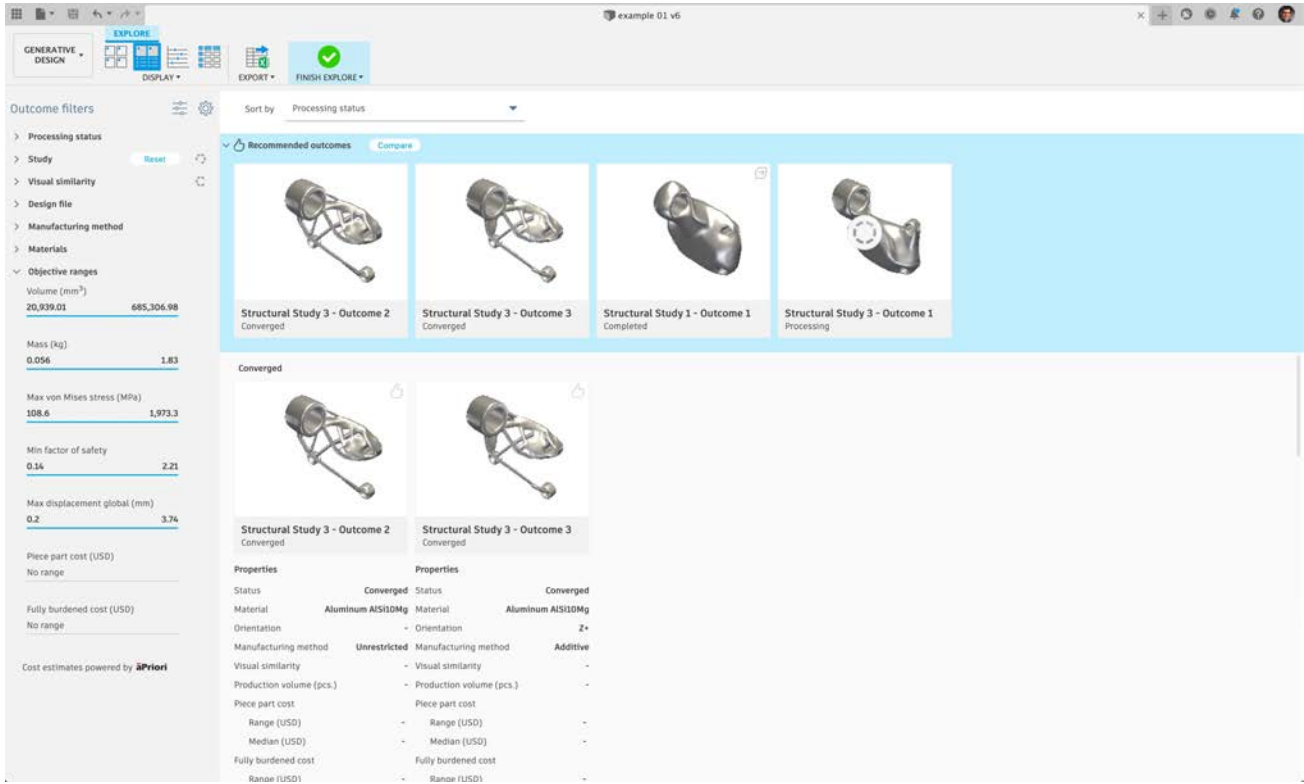
Create base design
Set preserve geometry
Set obstacle geometry
Apply loads and forces
Set manufacturing details





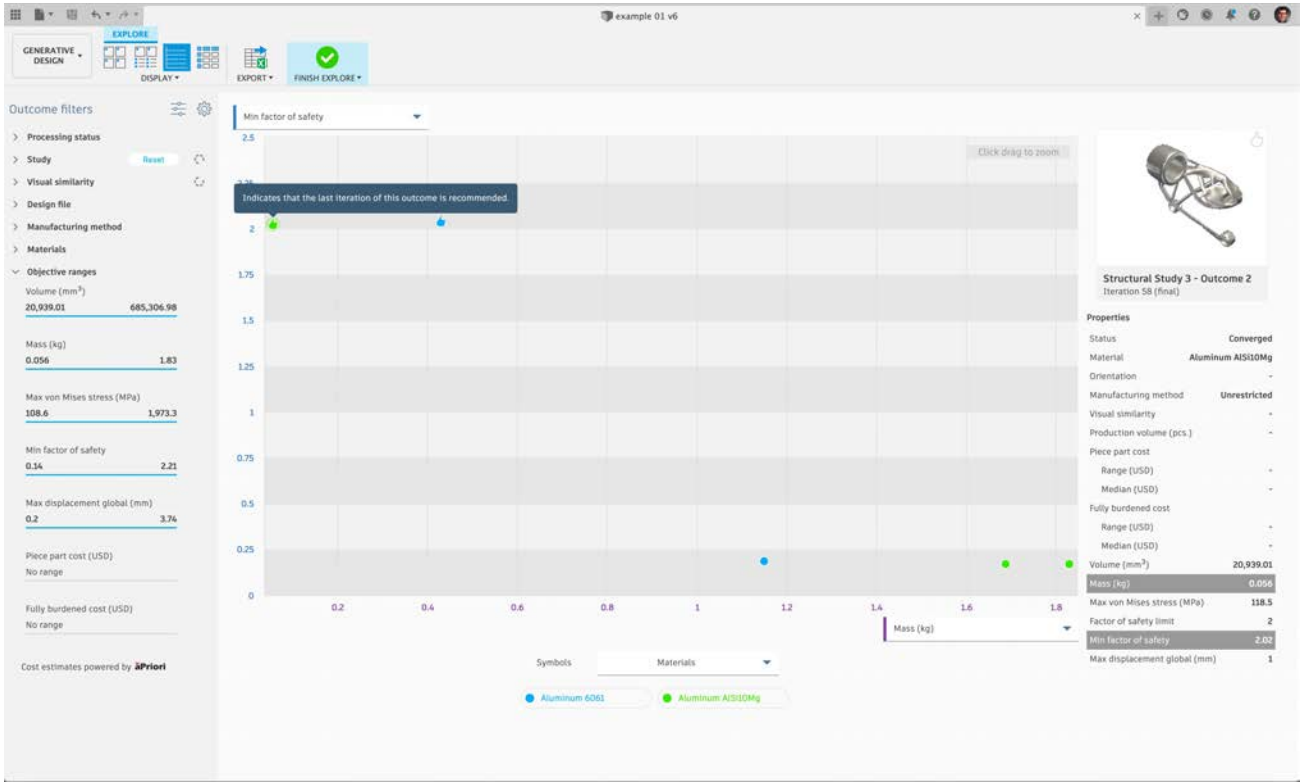
Generative Design steps

Create base design
Set preserve geometry
Set obstacle geometry
Apply loads and forces
Set manufacturing details
Run study



Generative Design steps

Create base design
Set preserve geometry
Set obstacle geometry
Apply loads and forces
Set manufacturing details
Run study
Select best option & export



Generative Design steps

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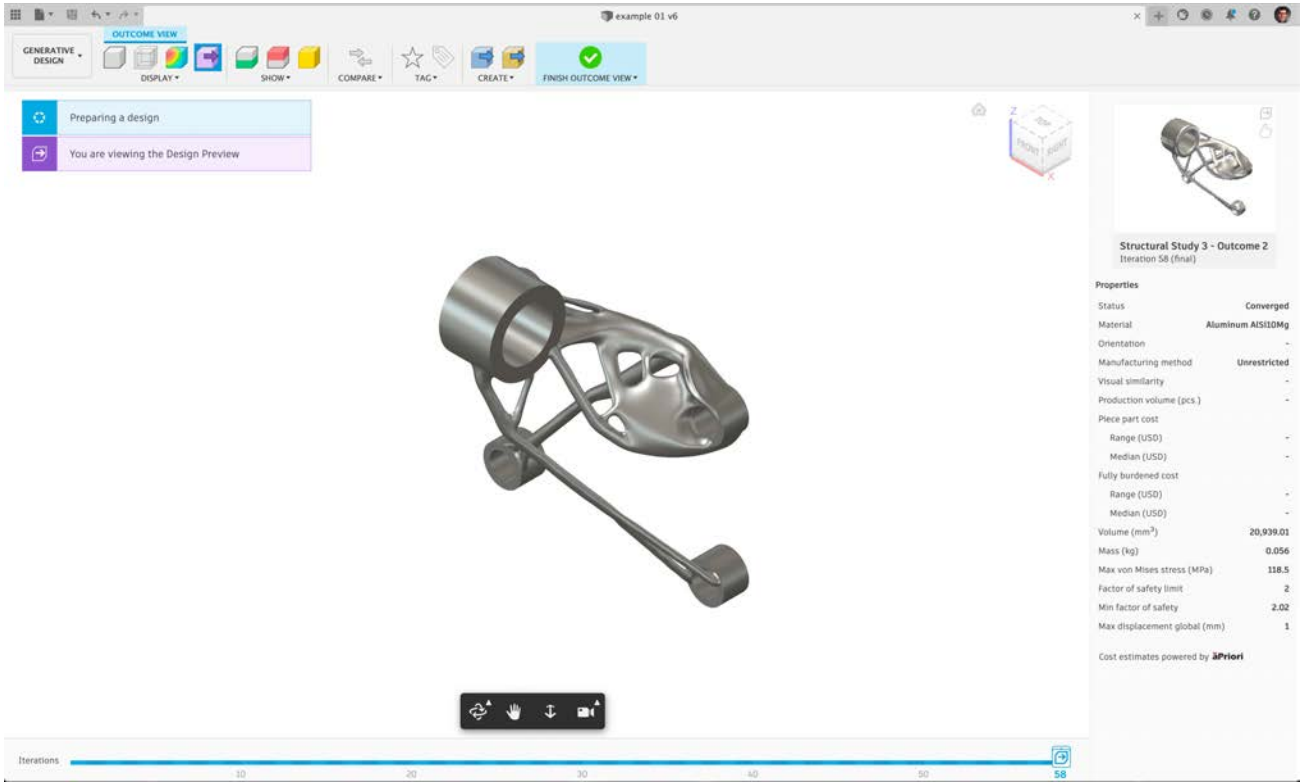
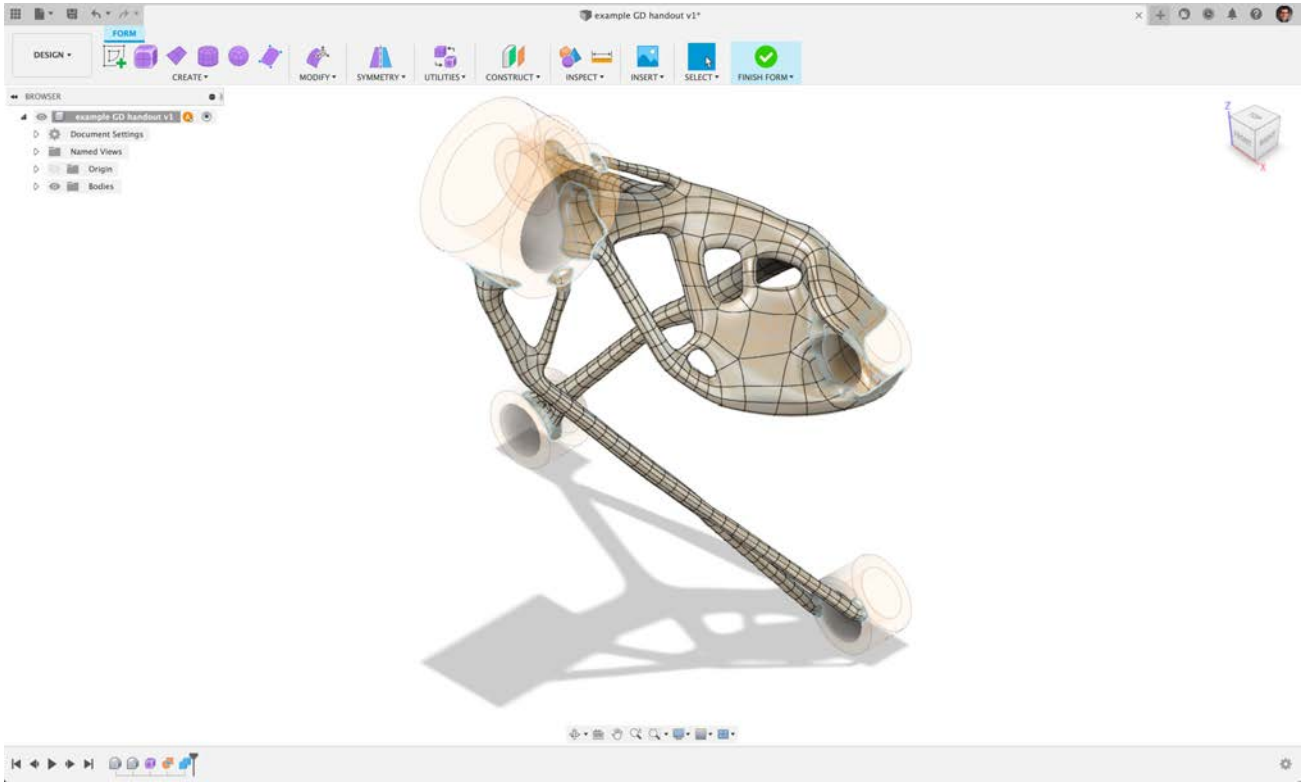
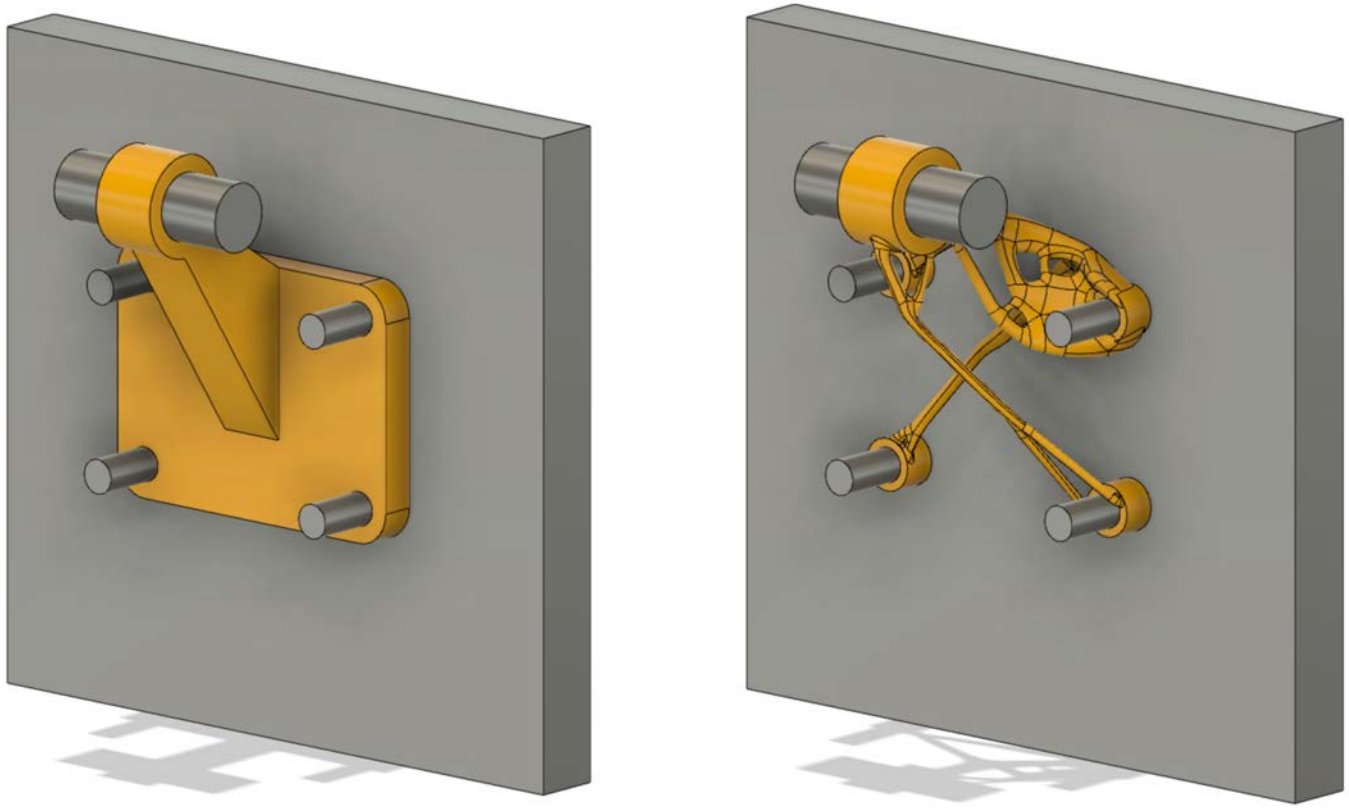


Generative Design steps

Create base design
Set preserve geometry
Set obstacle geometry
Apply loads and forces
Set manufacturing details
Run study
Select best option & export
Open in Fusion 360 & Edit



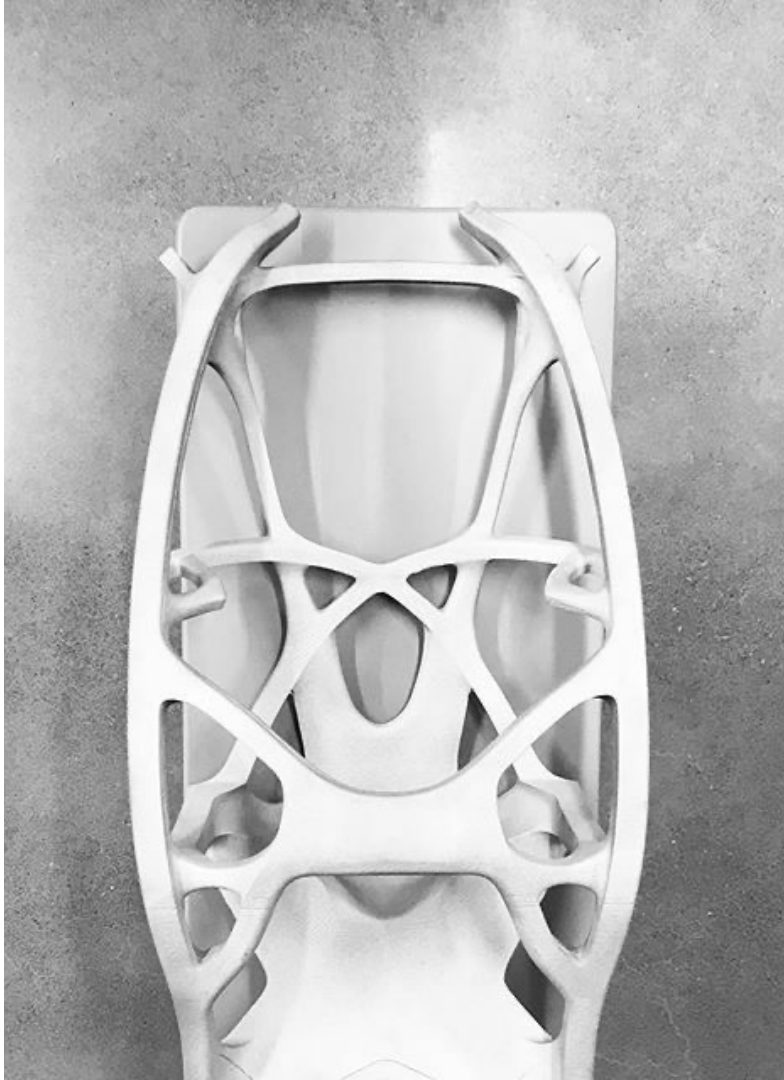
Generative Design steps

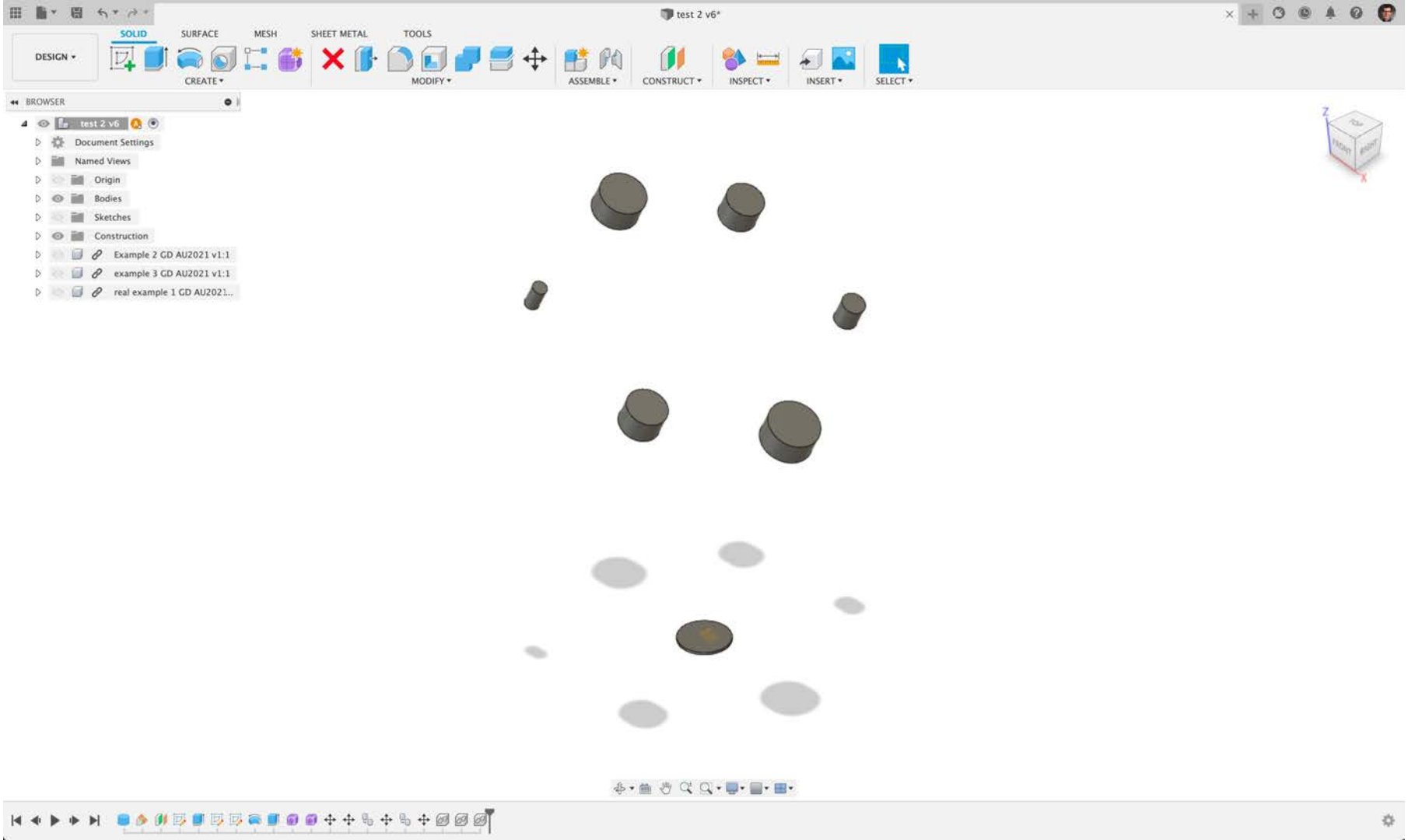


Using Obstacles to your Advantage

Using GD as design collaborator

- GD can generate solutions unimaginable to humans.
- The key is to give GD space to be ”creative”… just like when collaborating with someone.
- Obstacles and negative space are a good way to let GD shine.
- Keep obstacles at a minimum first, adding only what is necessary.

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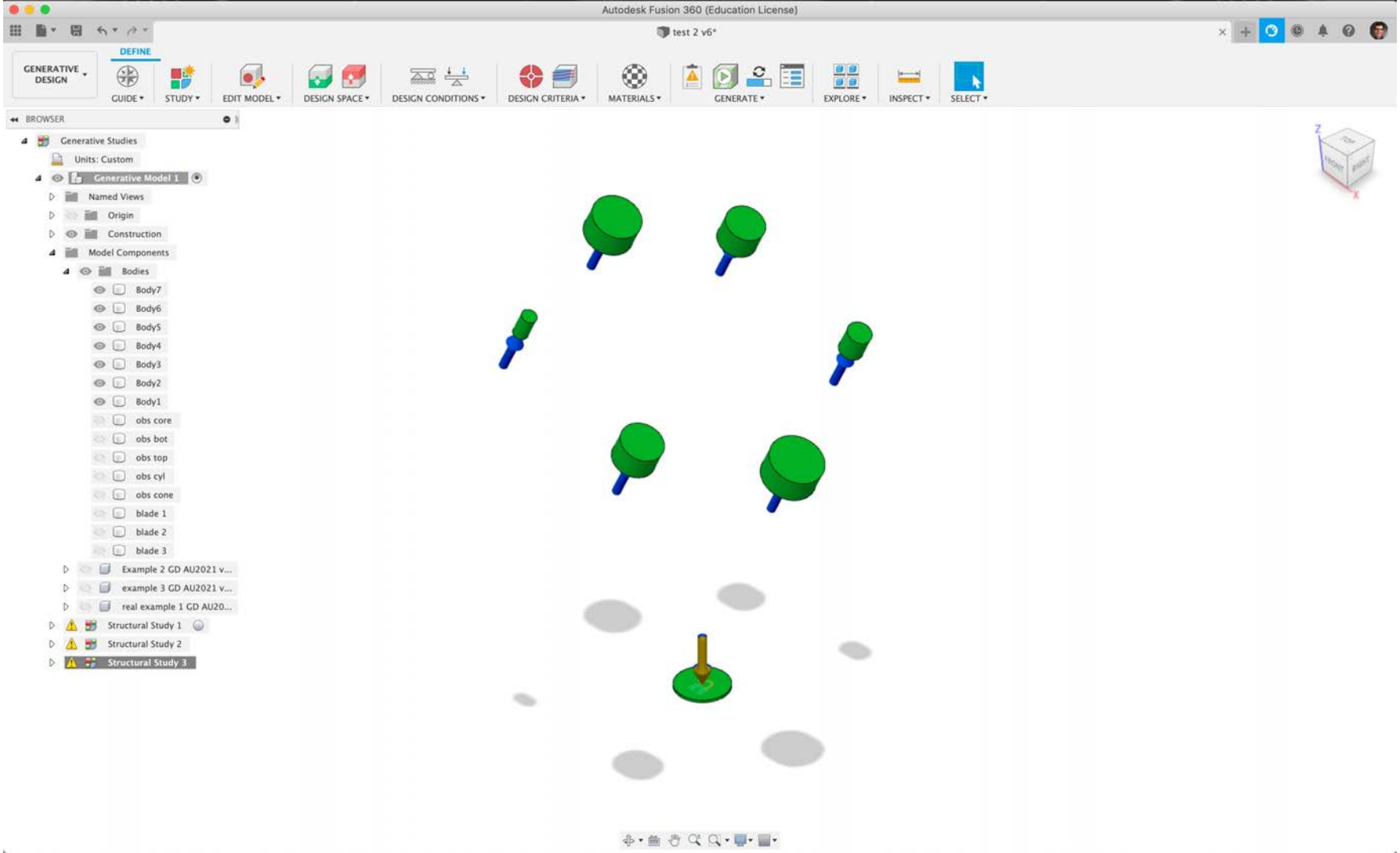
real example 1 GD AU2021...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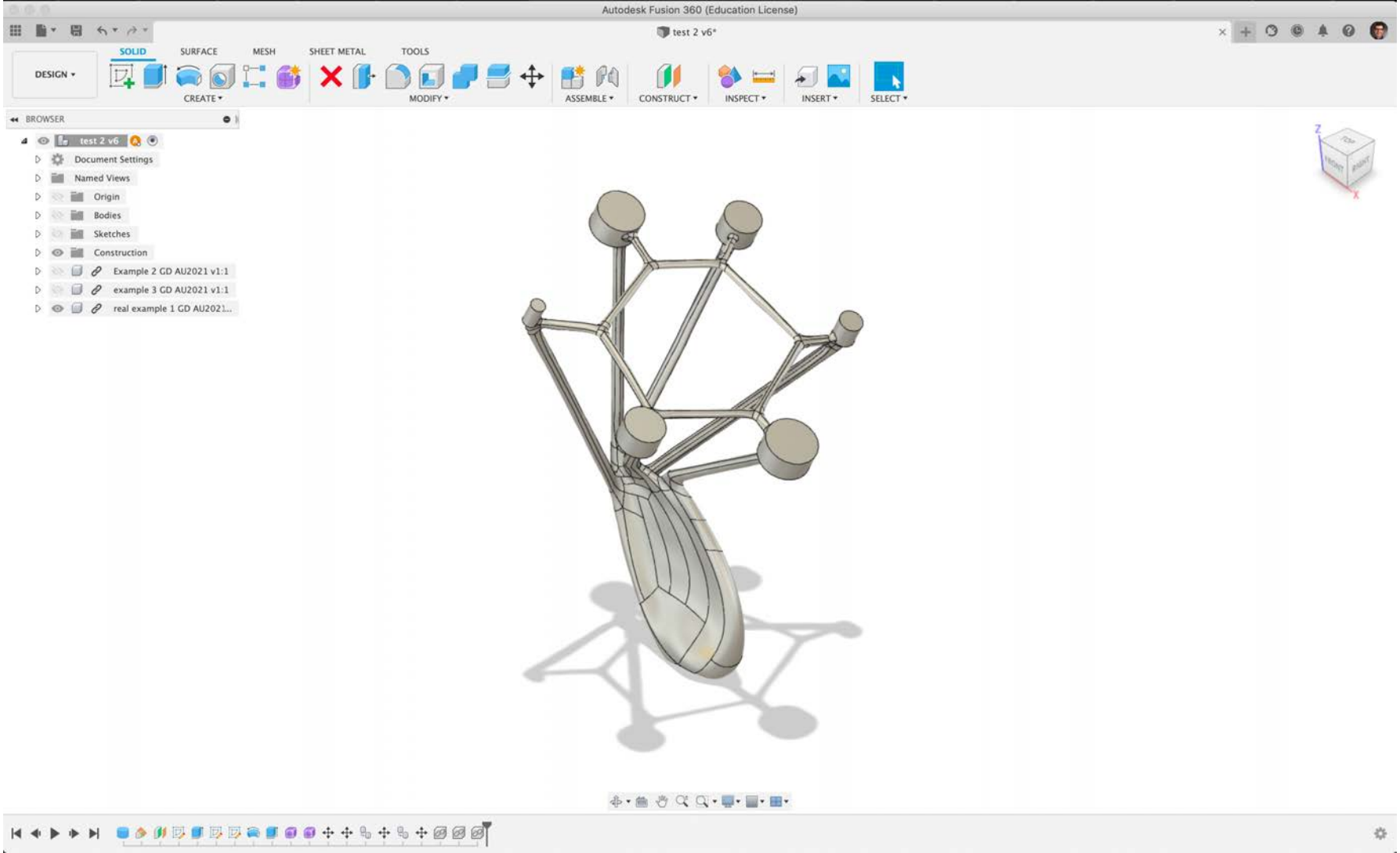
Structural Study 1
Structural Study 2
Structural Study 3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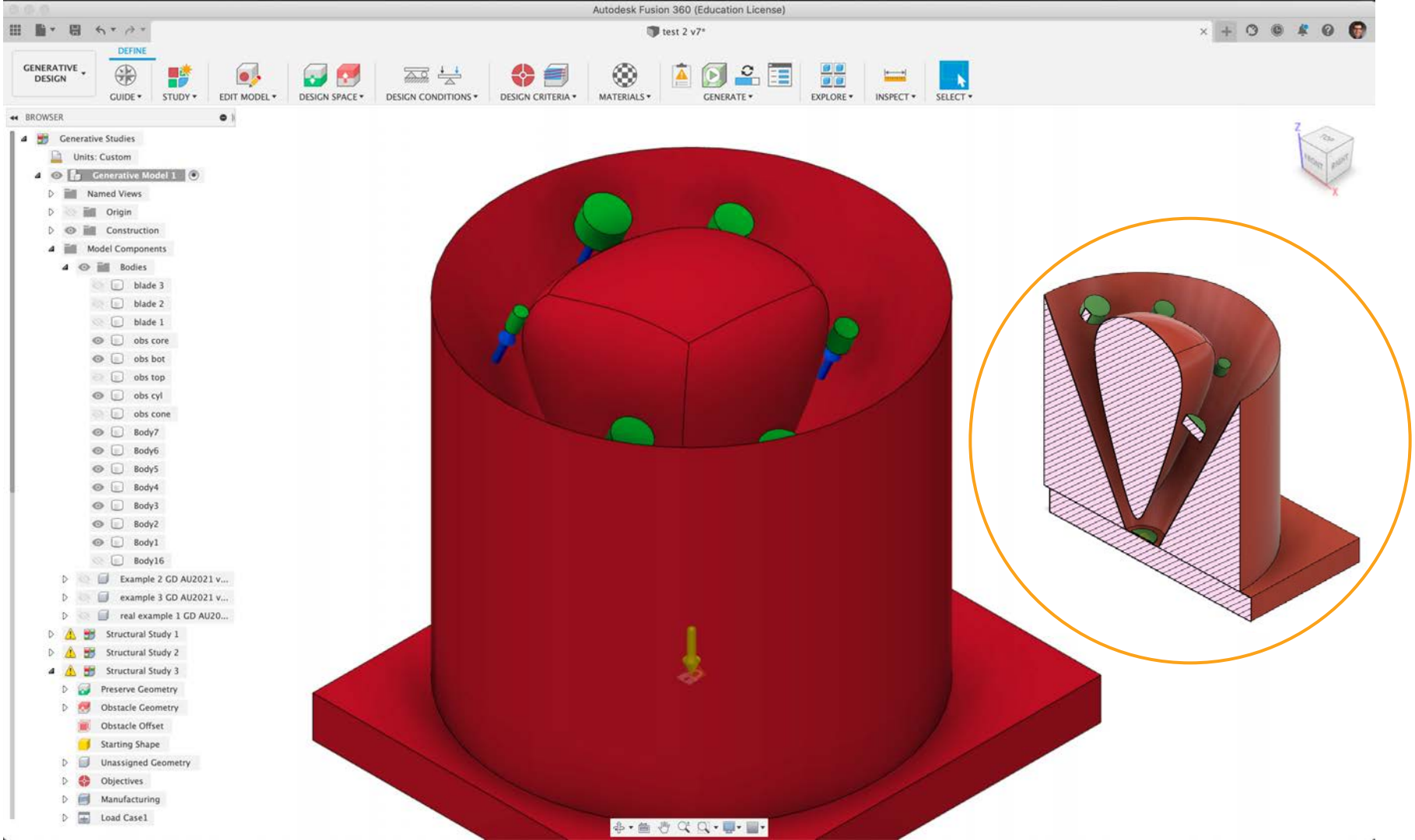
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Structural Study 3
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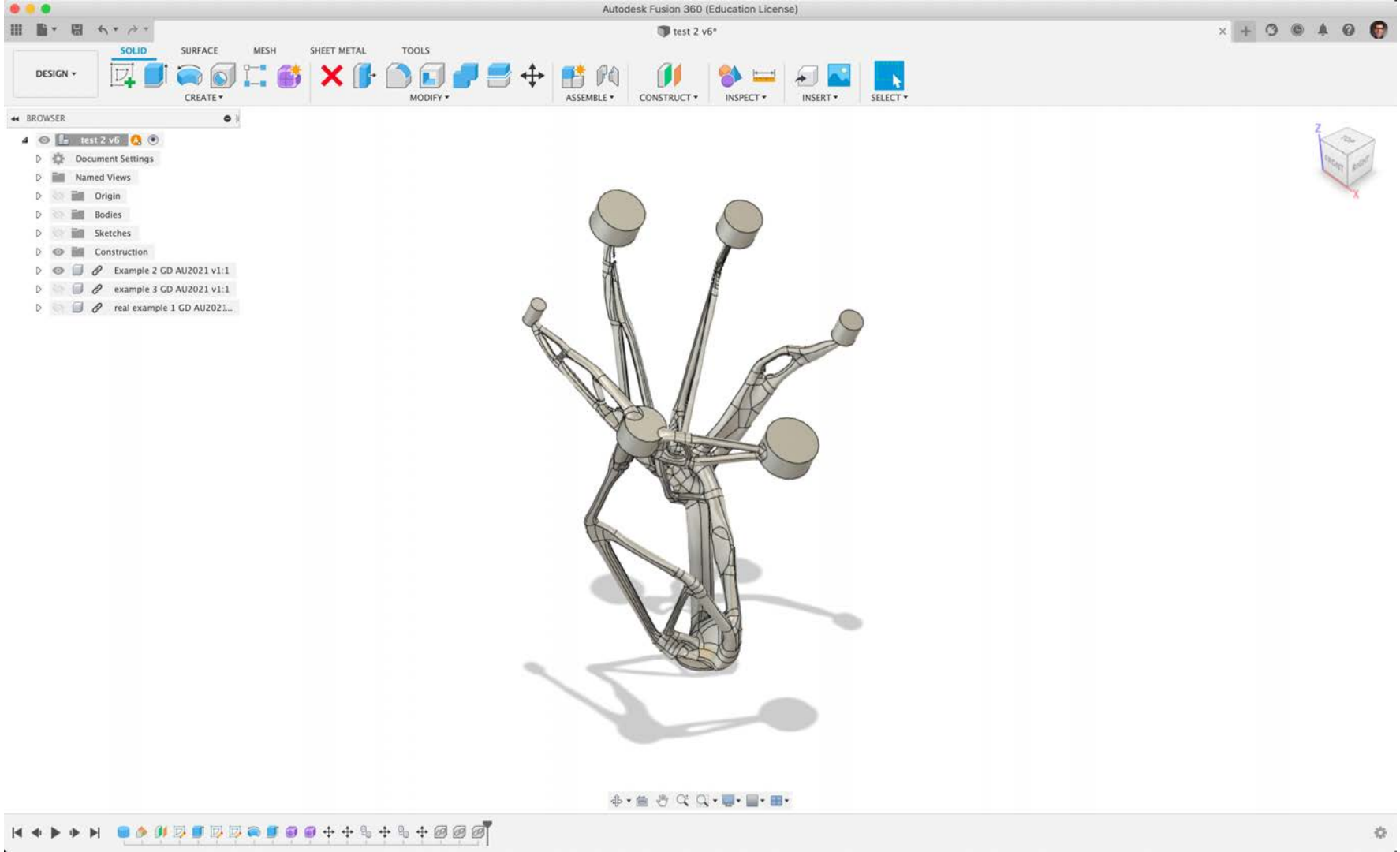
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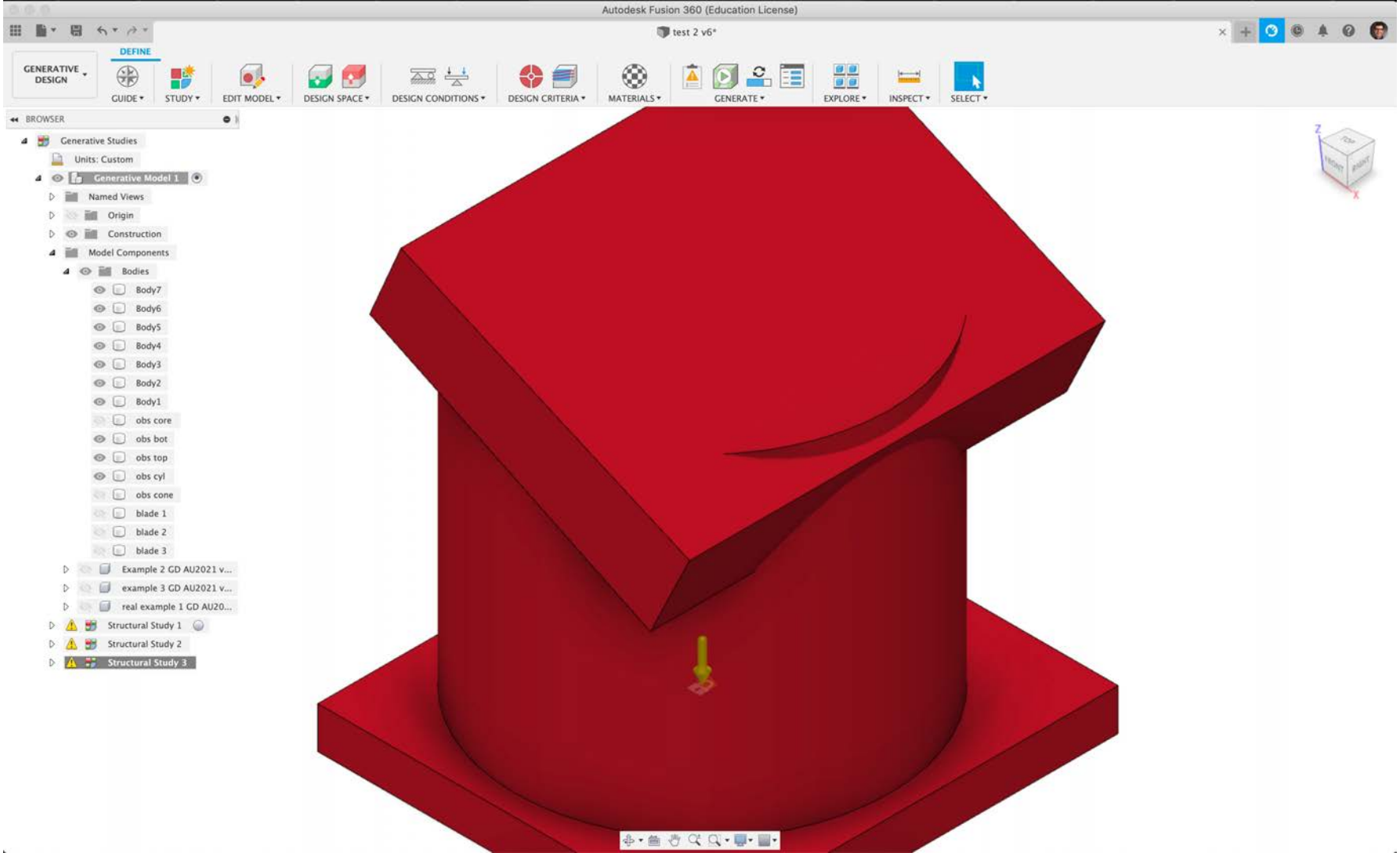
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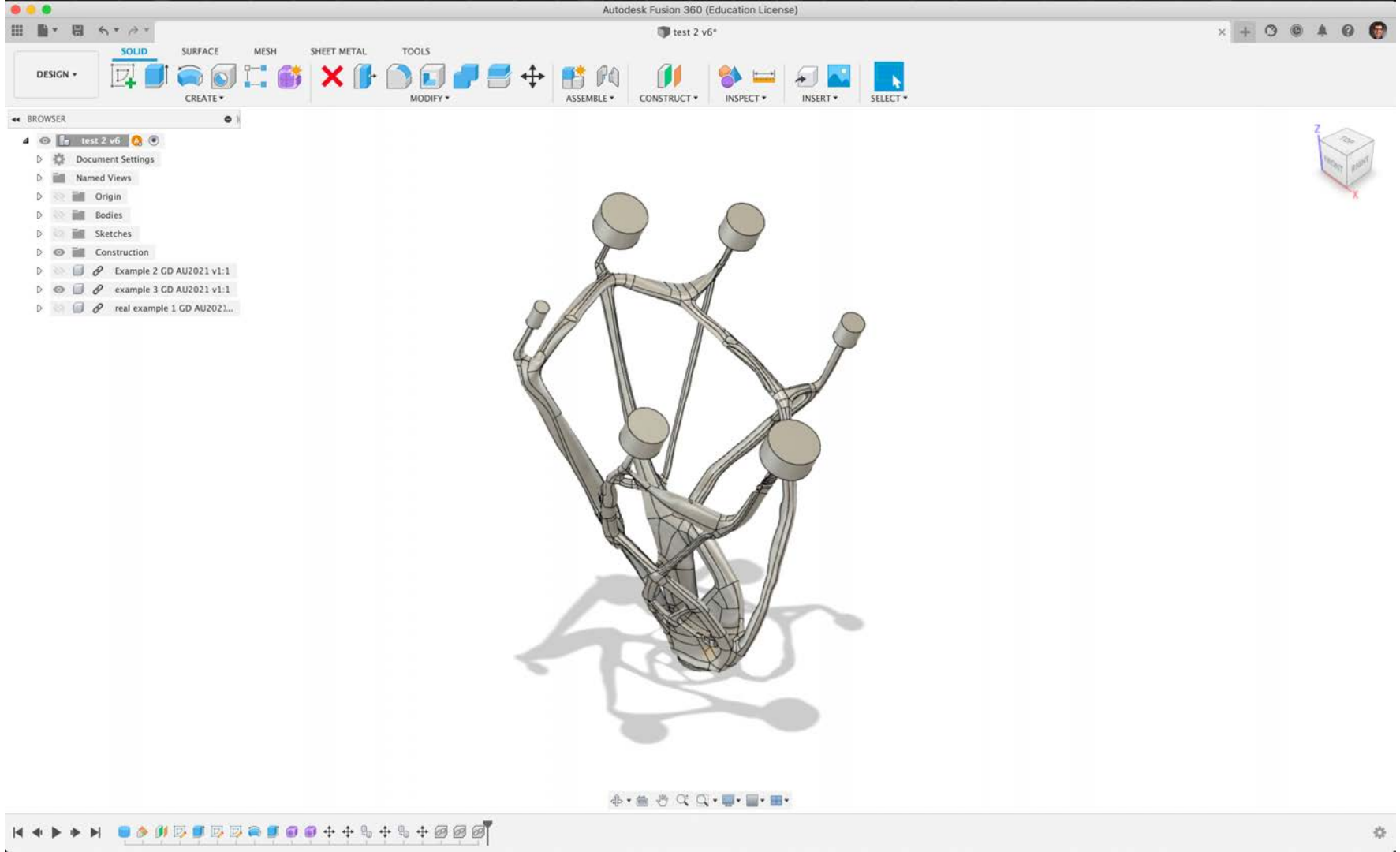
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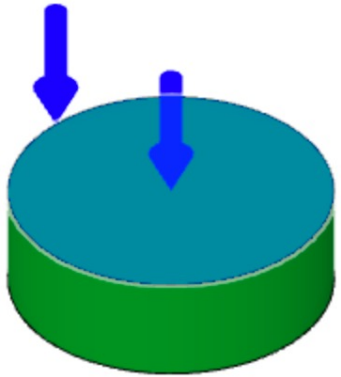
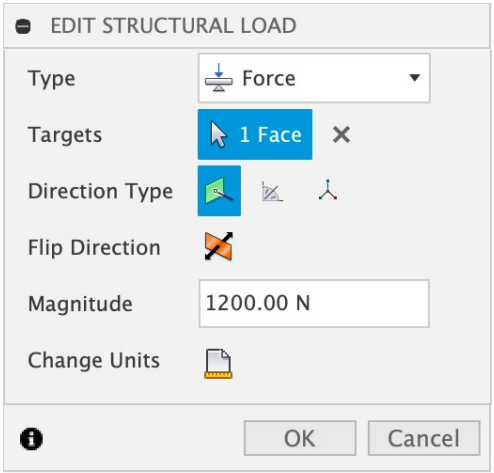
Using the correct values

Using the correct terms and values when setting up loads/forces

- Terms are common in engineering but not in design.
- Non-engineer users can get lost and/or overwhelmed when applying forces.
- Results can be inaccurate (fail or overperform).





Using the correct terms and values when setting up loads/forces

f = ma

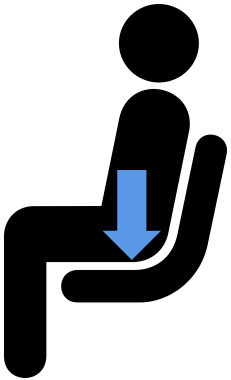
force (N) = mass (kg) x acceleration (m/s^2)

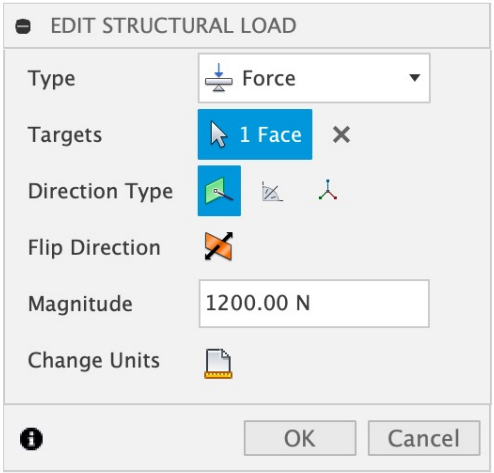
Example

Chair supporting 250lb (114kg)

f= 114kg x $9.8m/s^2$

f= 1117N





Common forces for everyday applications

250lb person standing	1117N
Opening door (residential)	22N
Opening door (commercial)	66N
Bicycle pedaling	700N
Punch (low force)	2500N
10lb object fall (4ft)	530N*

*Free fall adds acceleration to the calculation, which was determined using this calculator: http://hyperphysics.phy-astr.gsu.edu/hbase/flobi.html

Refining GD outcomes

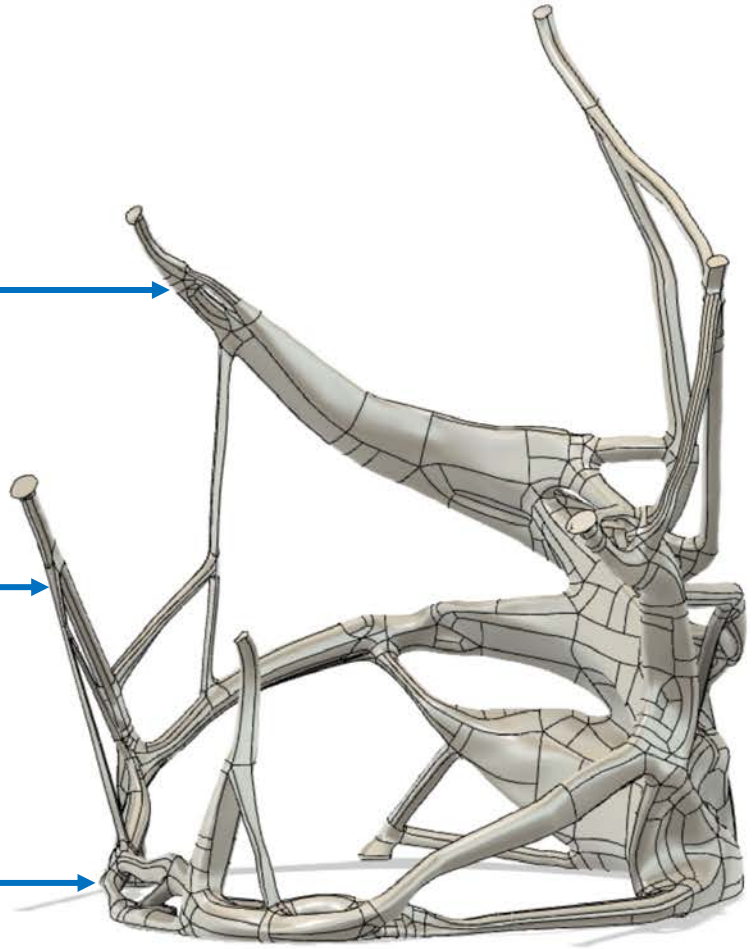
Common issues with GD outcomes

Common issues with GD outcomes

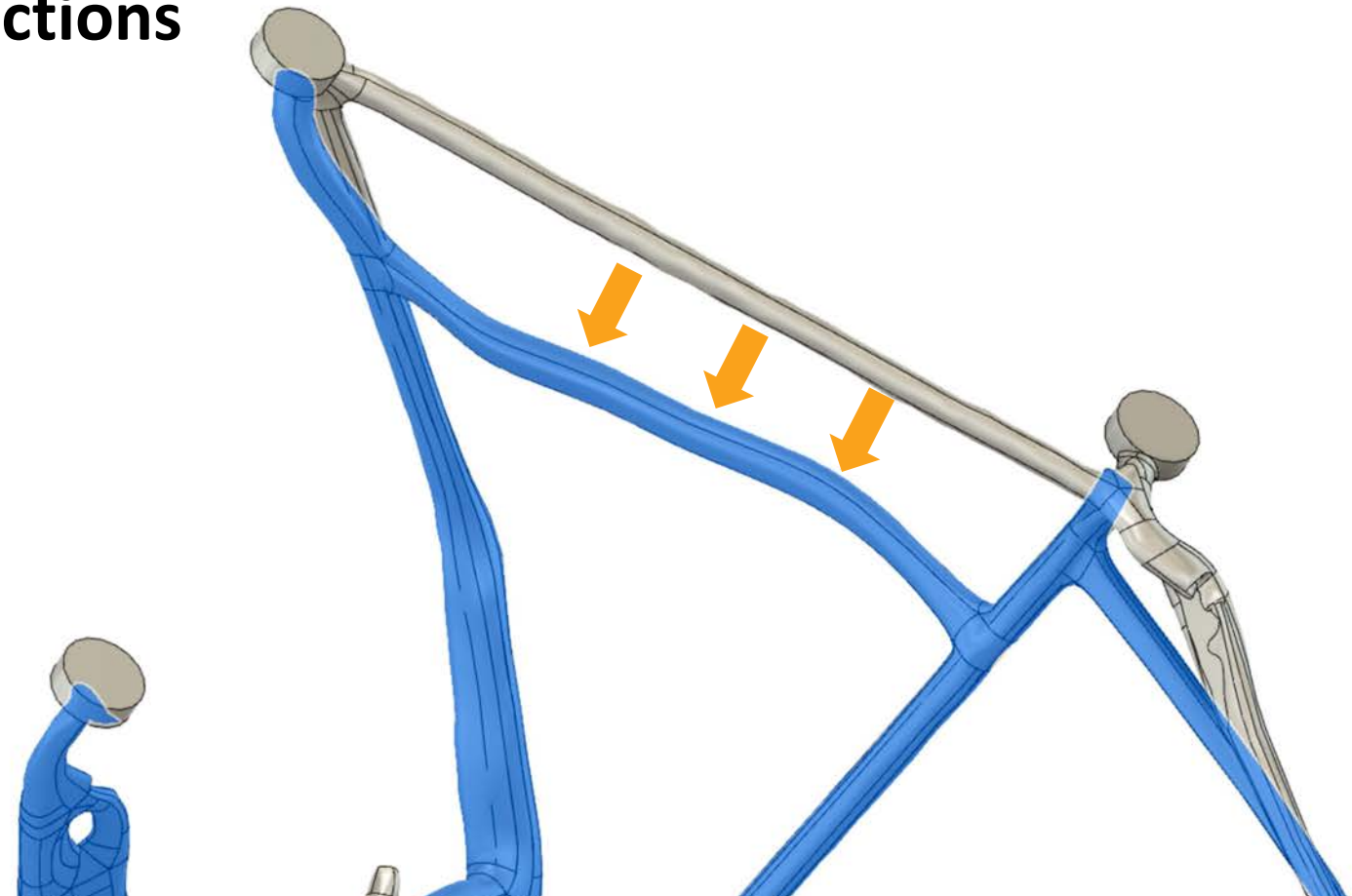
Section interferes with another component

Random bumps

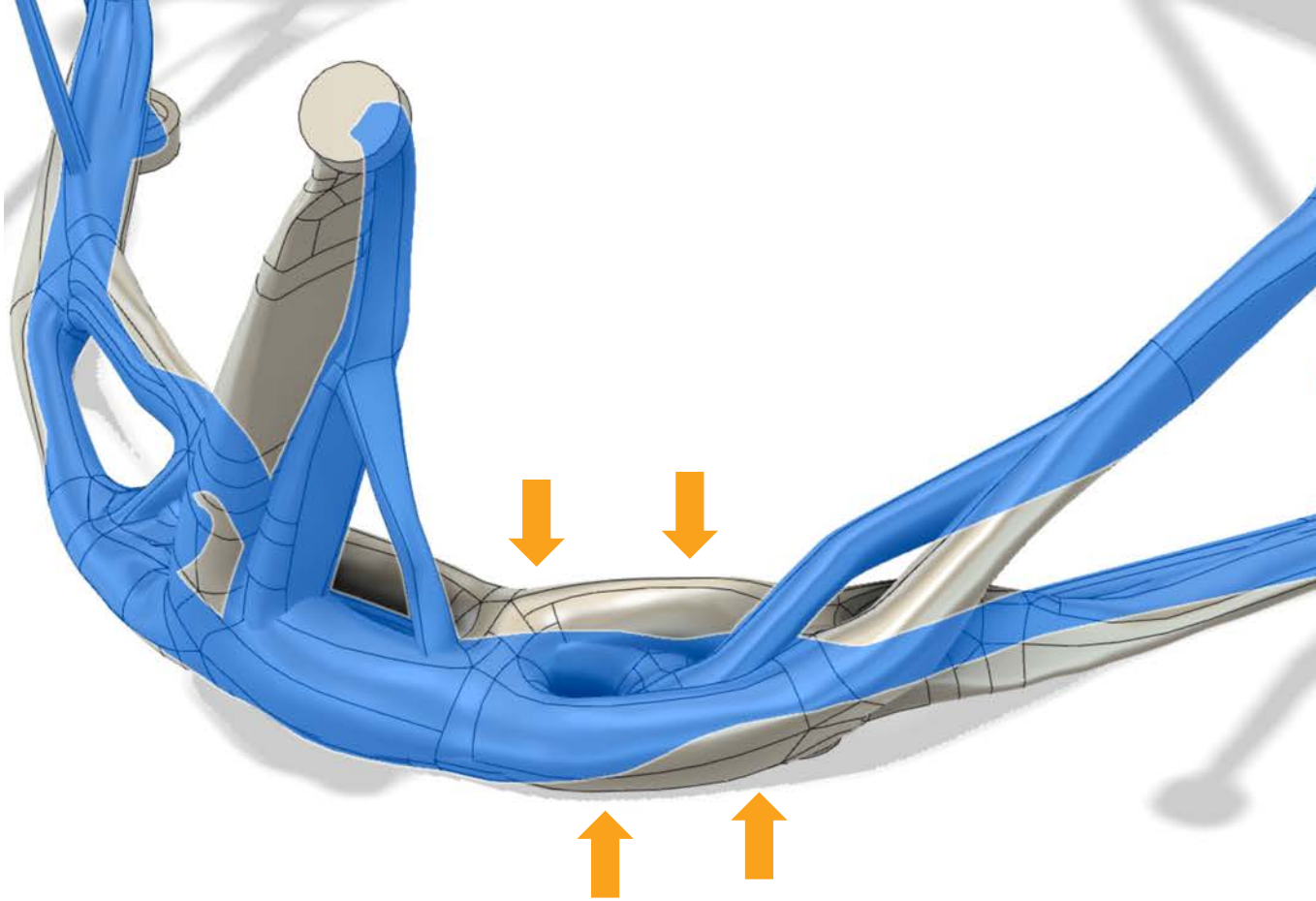
Section too thick



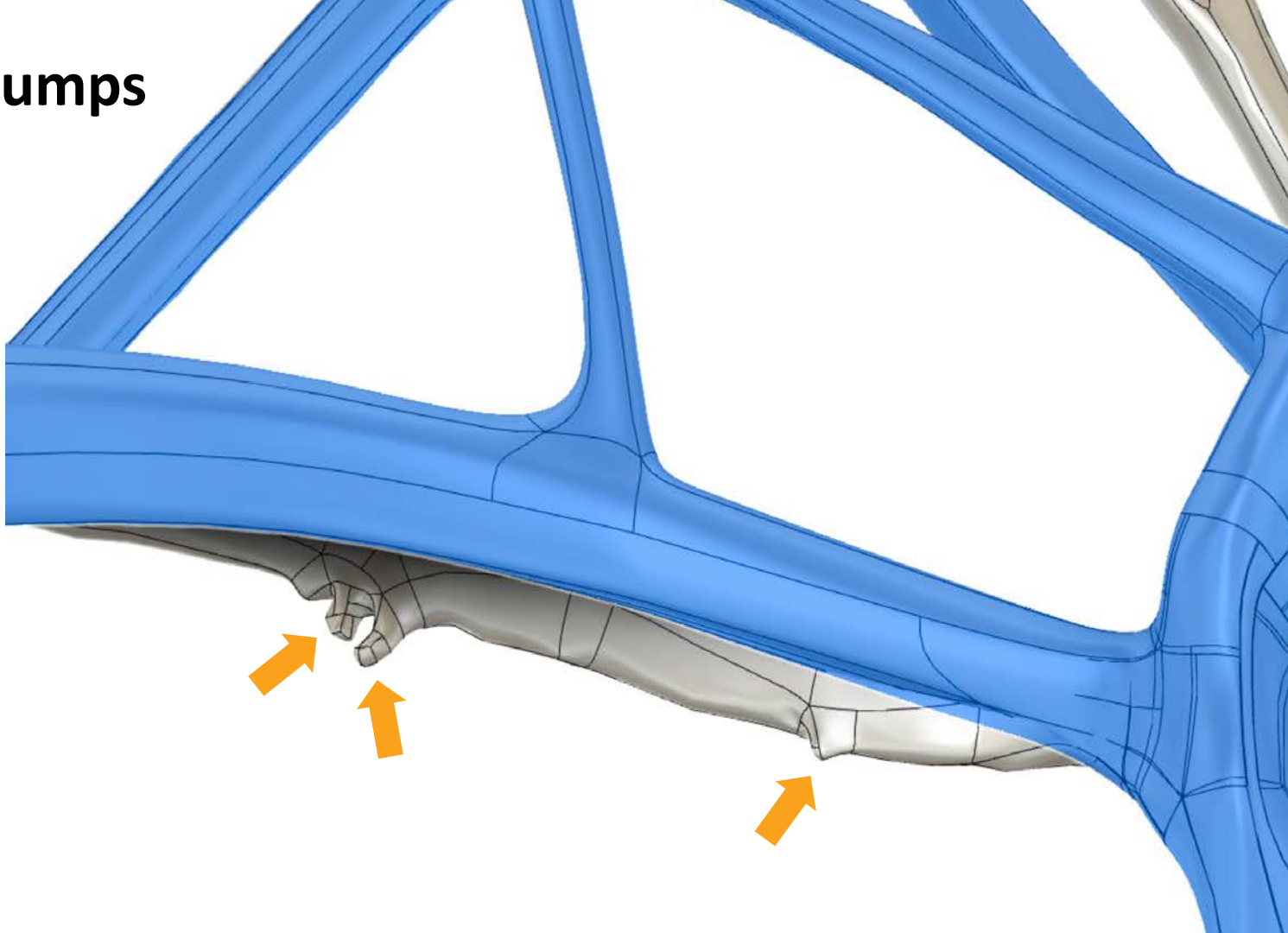
Repositioning or rebuilding sections



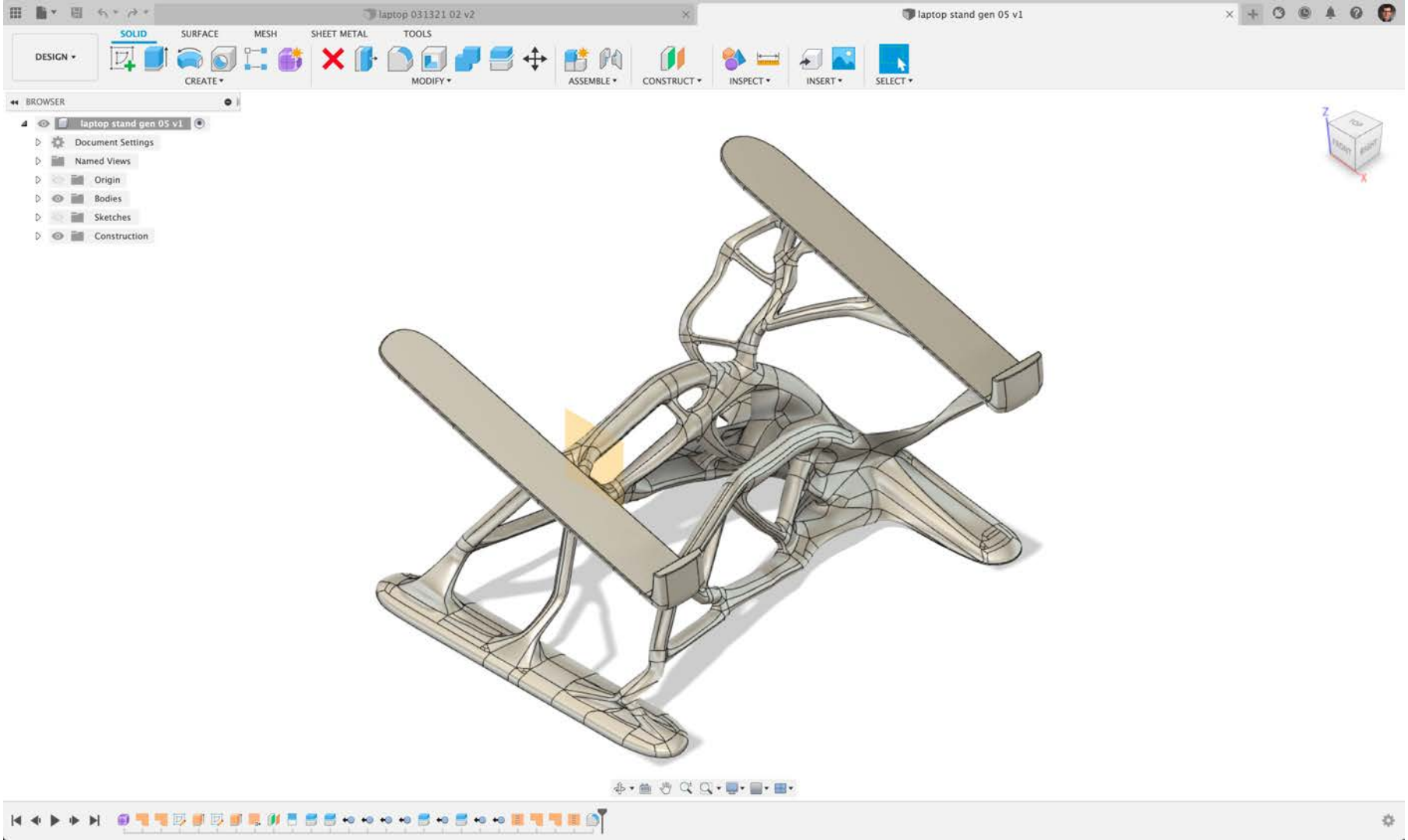
Scaling sections



Removing bumps



Further refinement for fabrication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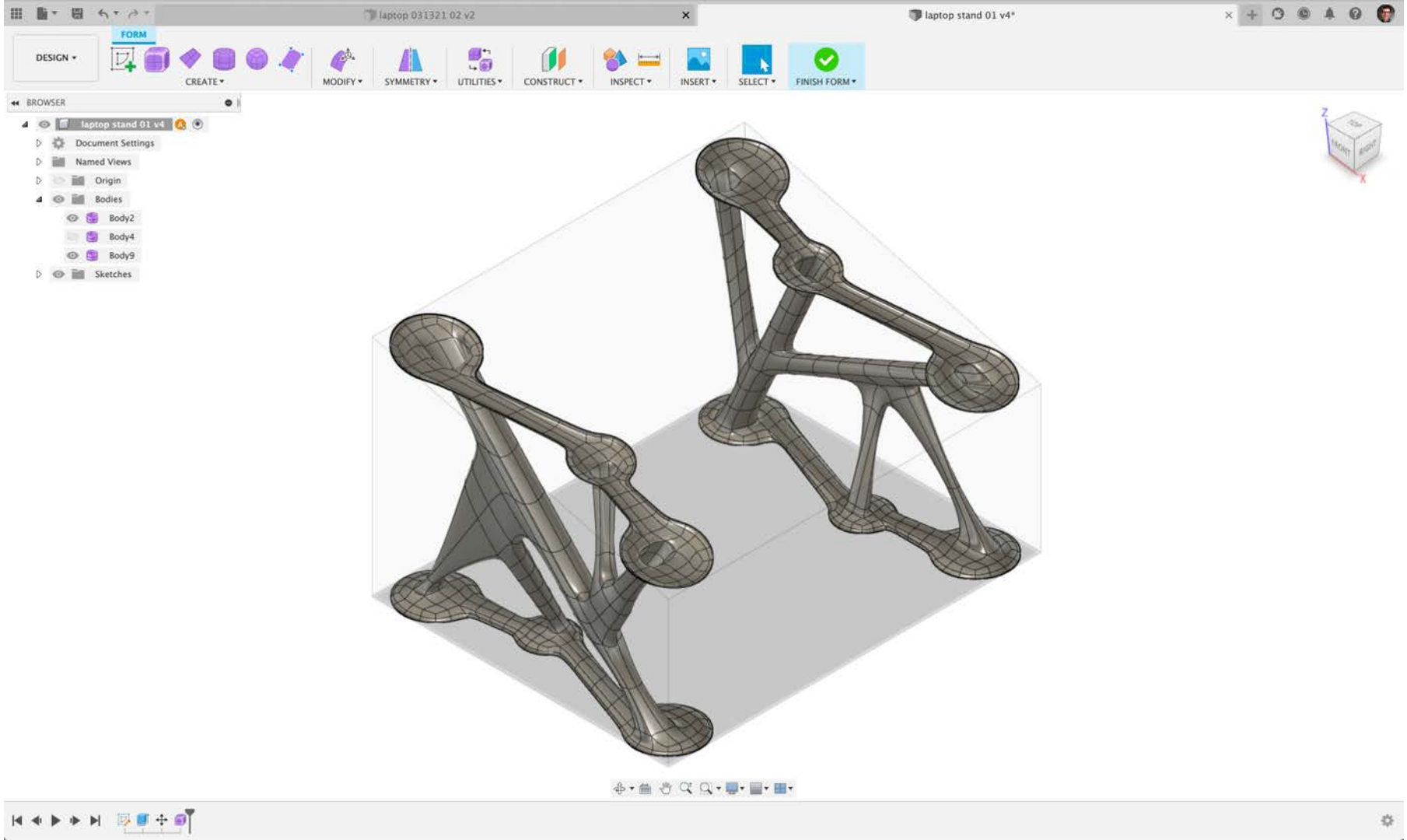
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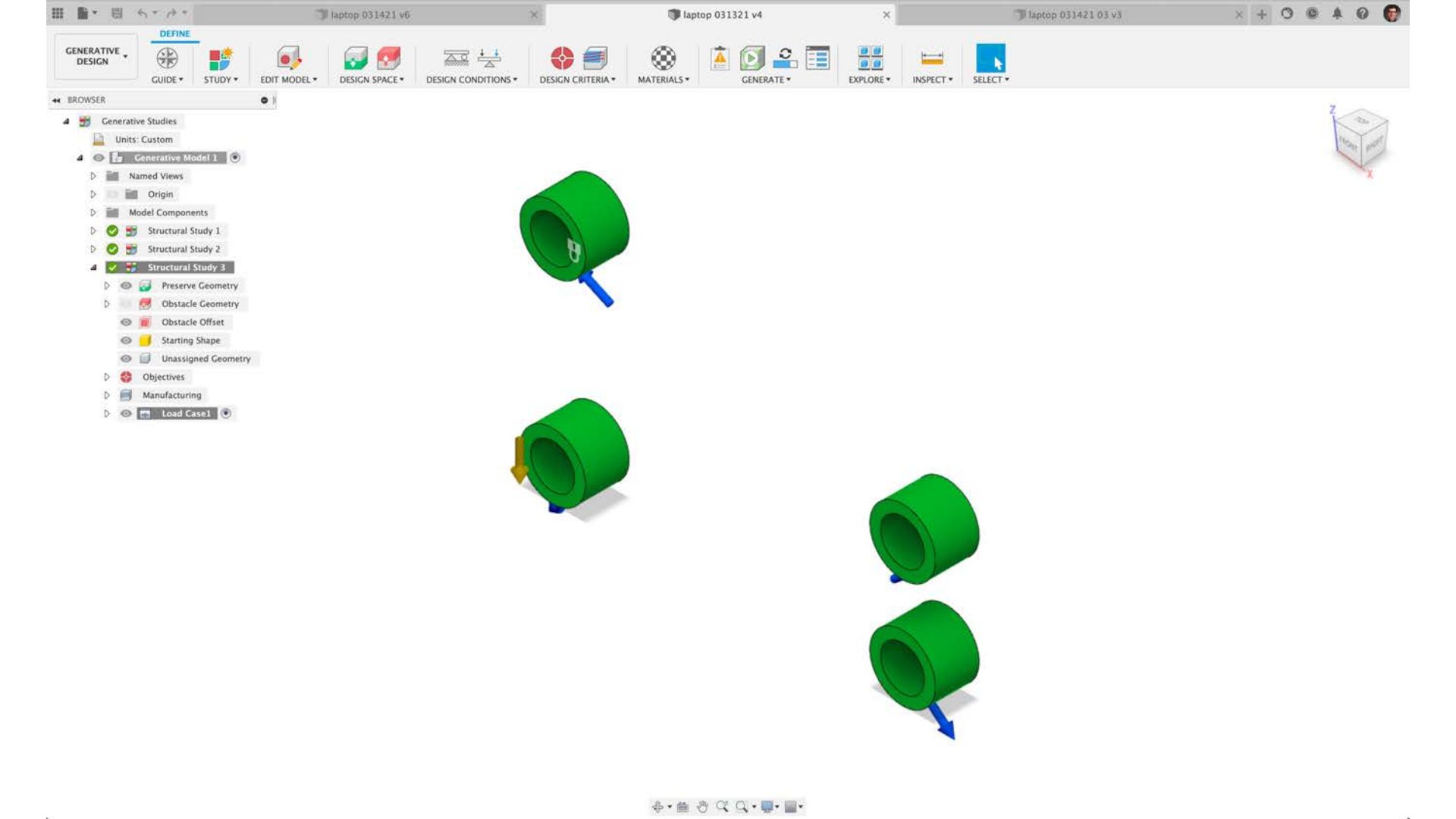
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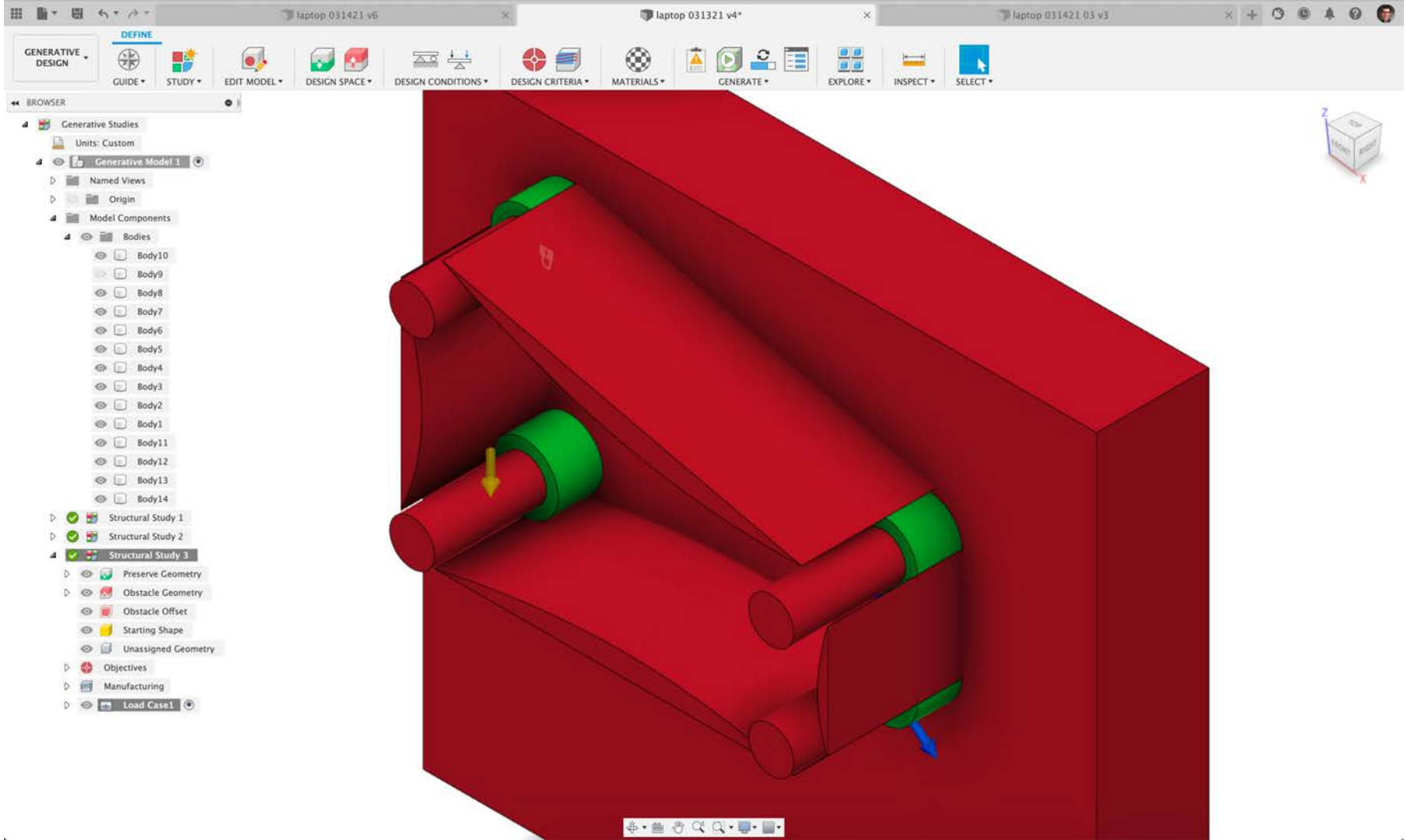
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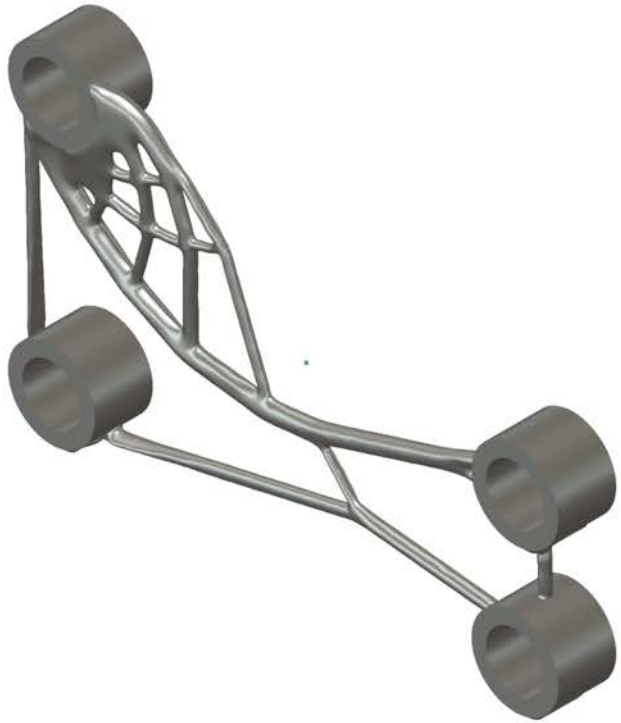
GENERATIVE DESIGN

OUTCOME VIEW

DISPLAY | SHOW | COMPARE | TAG | CREATE | FINISH OUTCOME VIEW

You are viewing the Design Preview



Study 3 - Outcome 3
Iteration 44 (final)

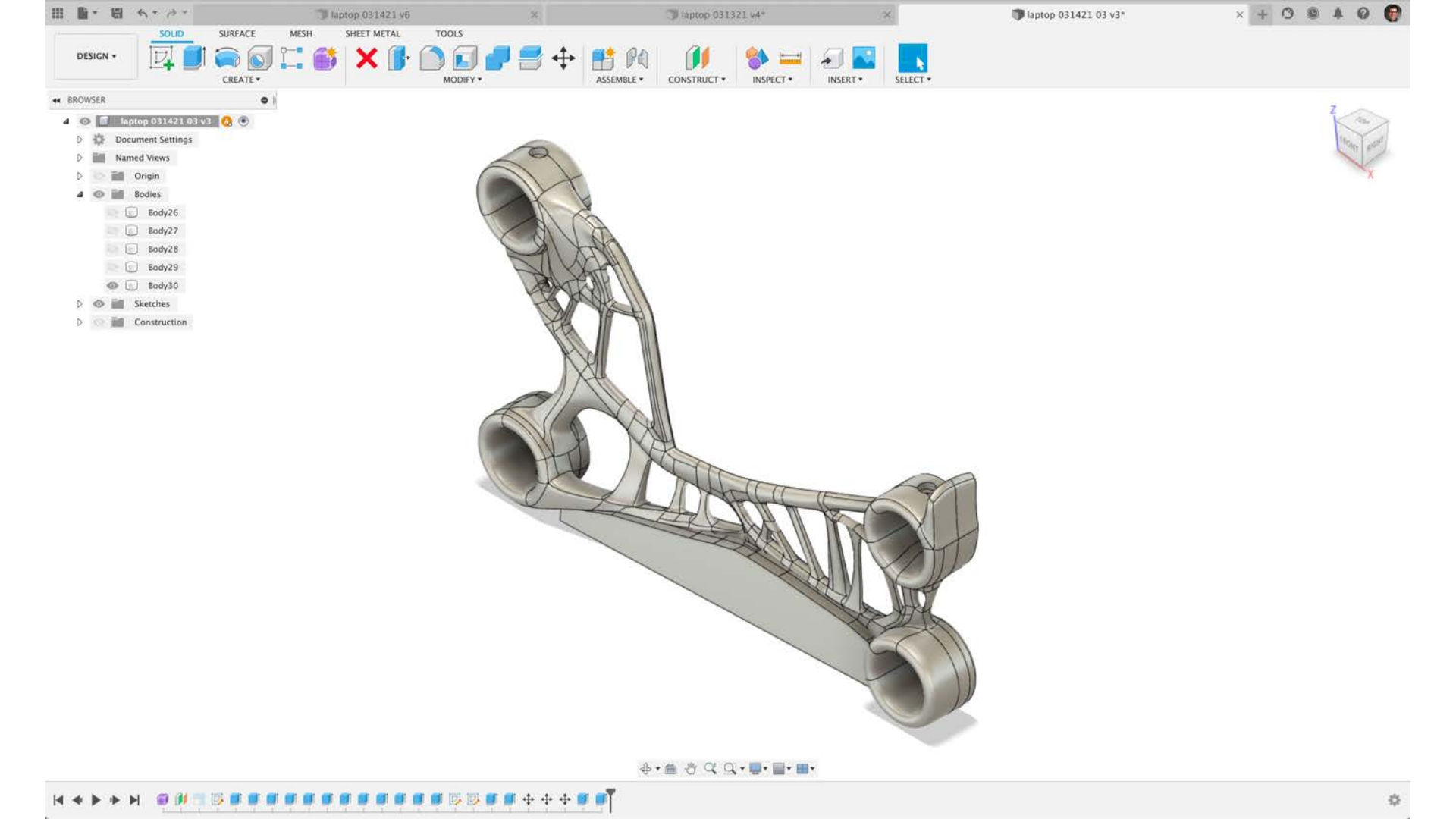
Properties

Status	**Converged**
Material	**Aluminum AlSi10Mg**
Orientation	**Z+**
Manufacturing method	**Additive**
Visual similarity	**Unique**
Production volume (pcs.)	-
Piece part cost	
Range (USD)	-
Median (USD)	-
Fully burdened cost	
Range (USD)	-
Median (USD)	-
Volume (mm^3)	**96,067.02**
Mass (kg)	**0.256**
Max von Mises stress (MPa)	**12.3**
Factor of safety limit	**2**
Min factor of safety	**19.51**
Max displacement global (mm)	**0.1**

Cost estimates powered by **aPriori**

Iterations

10 20 30 40 44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Body28
Body29
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Sketches
Construction

chair bubble GD 072021 v48*

DESIGN

SOLID SURFACE MESH SHEET METAL TOOLS

CREATE MODIFY ASSEMBLE CONSTRUCT INSPECT INSERT SELECT

BROWSER

- chair bubble GD 072021...
  - Document Settings
  - Named Views
  - Origin
  - Bodies
  - Canvases
  - Sketches
  - Construction
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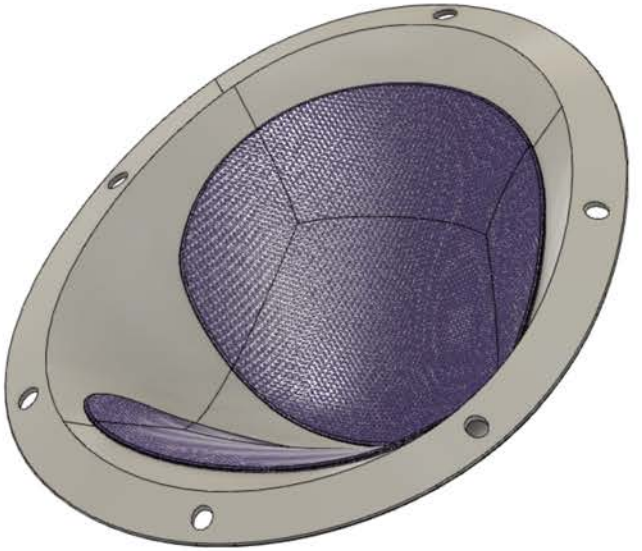
  - leg 04 jul 20 v2:1
  - leg 03 jul 20 v1:1
  - leg 02 jul 20 fix v2:1
  - egg GD frame fix1 v24:1



chair bubble GD 072021 v48*

DESIGN

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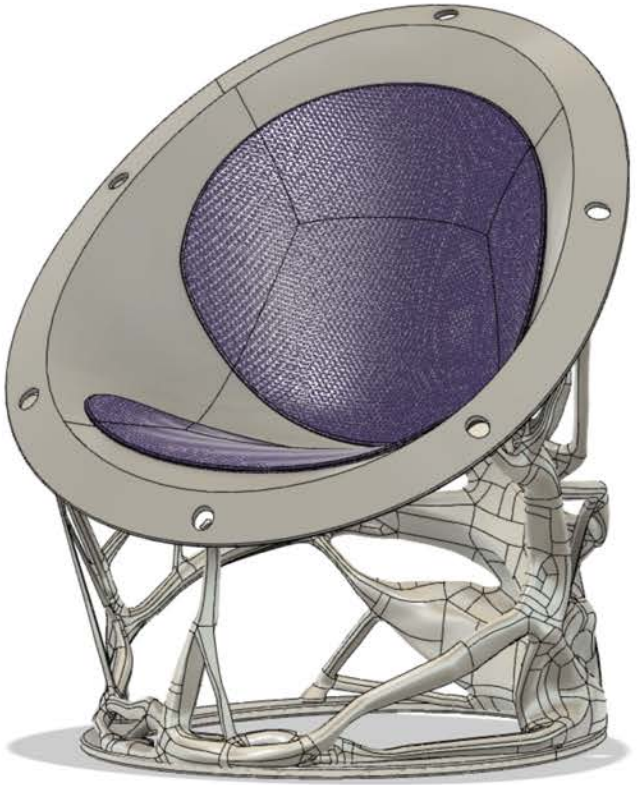
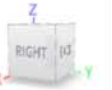
  - Sketches
  - Construction
  - leg 01 - jul 20 v1:1
  - leg 04 jul 20 v2:1
  - leg 03 jul 20 v1:1
  - leg 02 jul 20 fix v2:1
  - egg GD frame fix1 v24:1





chair bubble GD 072021 v48*

DESIGN

SOLID SURFACE MESH SHEET METAL TOOLS

CREATE MODIFY ASSEMBLE CONSTRUCT INSPECT INSERT SELECT

BROWSER

- chair bubble GD 072021...
  - Document Settings
  - Named Views
  - Origin
  - Bodies
  - Canvases
  - Sketches
  - Construction
  - leg 01 – jul 20 v1:1
  - leg 04 jul 20 v2:1
  - leg 03 jul 20 v1:1
  - leg 02 jul 20 fix v2:1
  - egg GD frame fix1 v24:1

Z RIGHT X Y

chair bubble GD 072021 v48*

DESIGN

SOLID SURFACE MESH SHEET METAL TOOLS

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BROWSER

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chair bubble GD 072021 v48*

DESIGN

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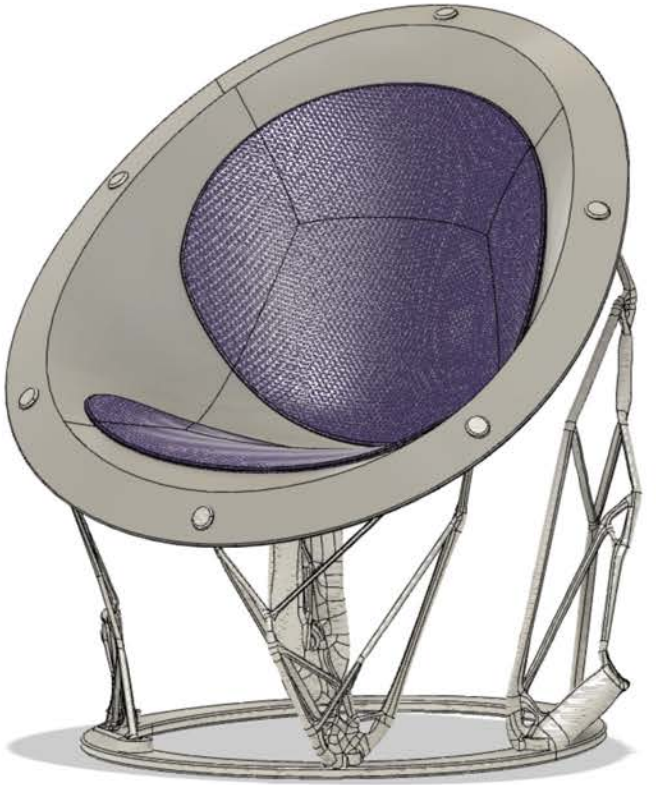

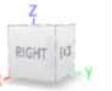

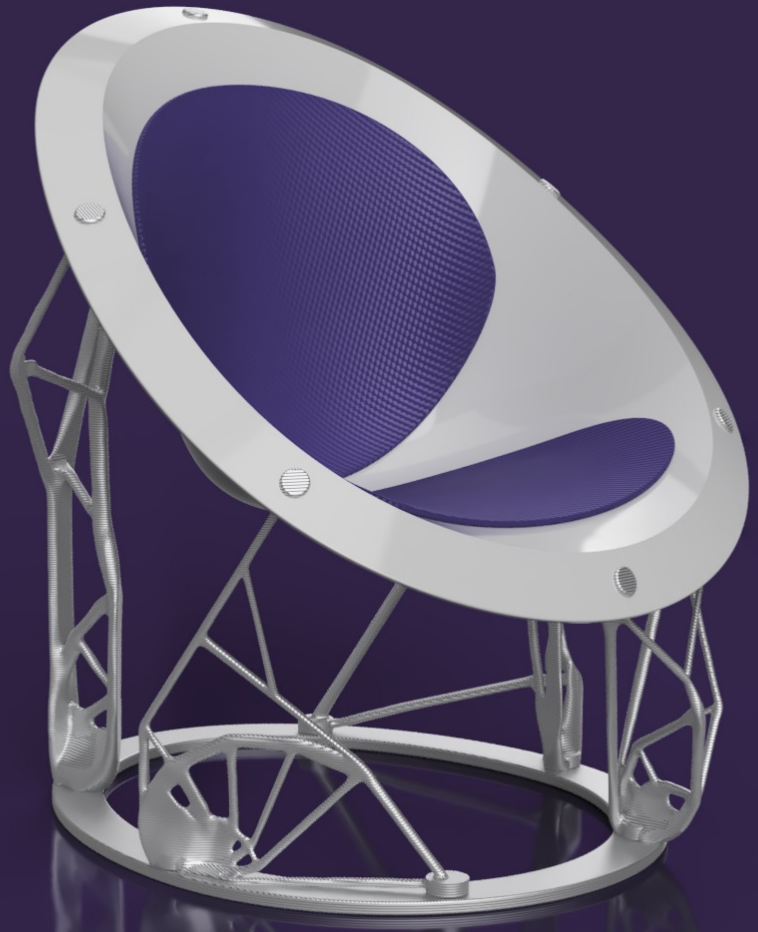

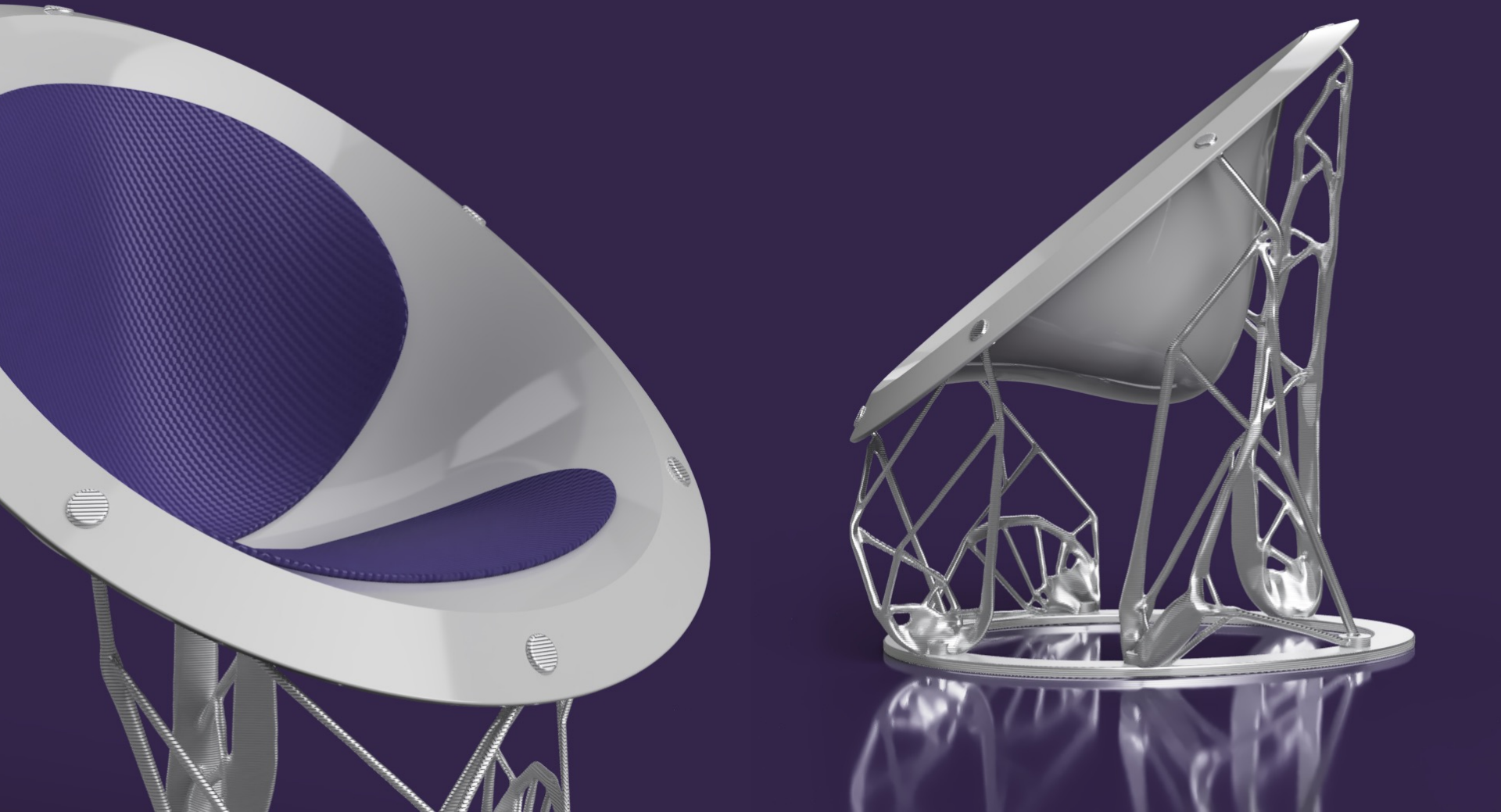

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A practical guide for Generative Design in Product and Industrial Design

Alex Lobos

Rochester Institute of Technology | @lobosdesign