

# Fusion 360 simulation for dummies

Harv Saund

Technical Specialist – Fusion 360

Wasim Younis

Simulation Sales Manger - Symetri

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# About the Speakers



## Harv Saund

Technical Specialist – Fusion 360, Autodesk UK

harv.saund@autodesk.com | @harv\_saund

Joined Autodesk in 2016.

Prior to Autodesk, 5 years as a Solidworks technical consultant, 2 years spent in Race Engine Development & a degree in Motorsport Engineering

Product focus is the Fusion 360 platform incl. CAM, Eagle, FEA, Generative Design & Library.IO

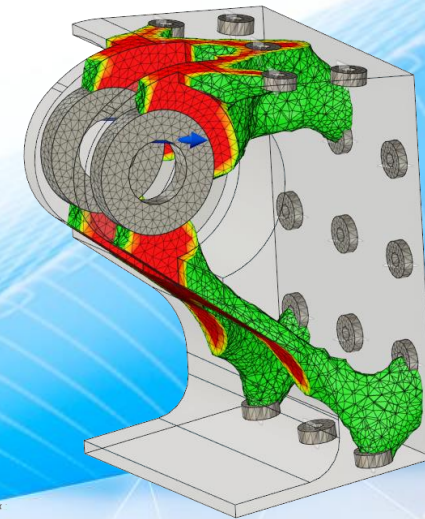
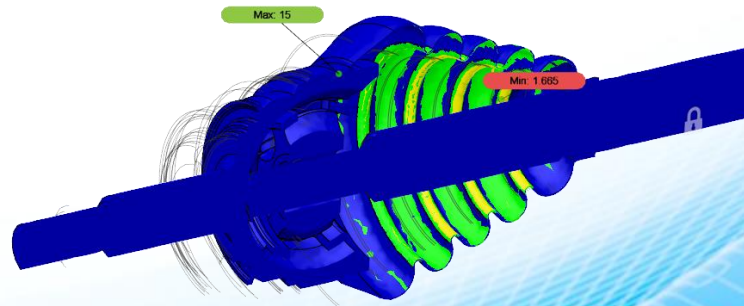
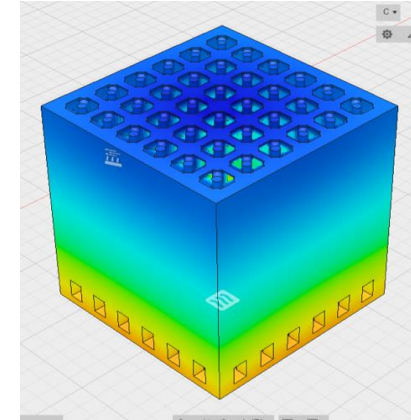
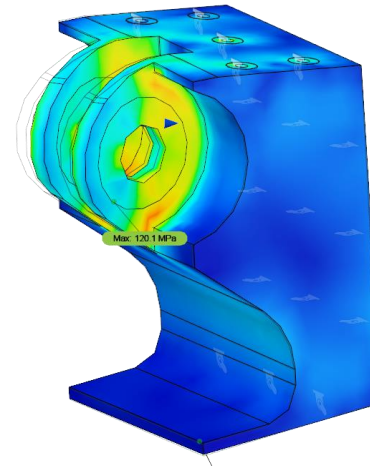


## Wasim Younis – Symetri

Wasim Younis has more than 20 years of experience in the manufacturing field and has been presenting at Autodesk University for more than 7 years. He has been involved with Simulation software since Autodesk, Inc., first introduced it. He is well known throughout the Simulation community, and has authored the Up and Running with Autodesk Inventor Simulation books, available worldwide.

# Class Agenda

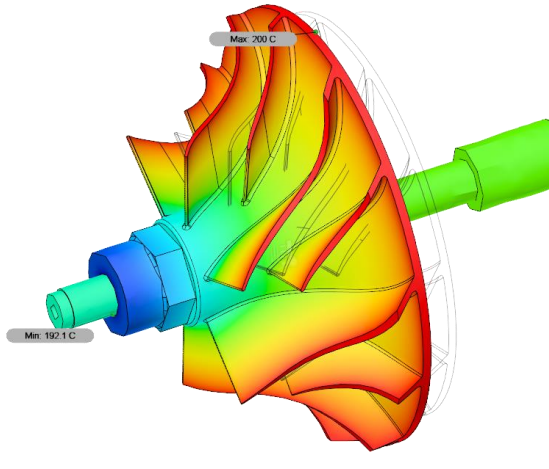
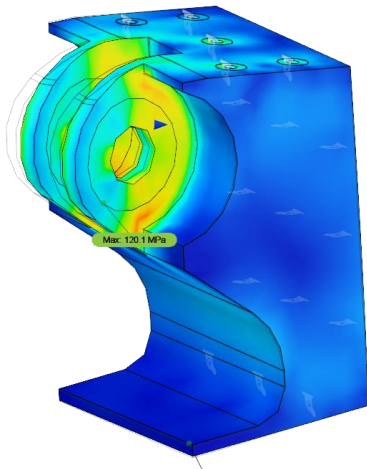
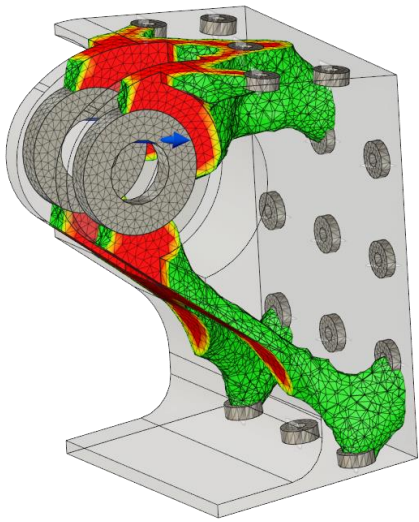
- What is FEA?
  - Mesh
  - Contacts
  - Constraints
  - Loads
- Static Stress – HANDS ON
- Thermal – HANDS ON
- Non Linear – HANDS ON
- Shape Optimisation – HANDS ON
- Summary



# What is FEA?

# What is FEA?

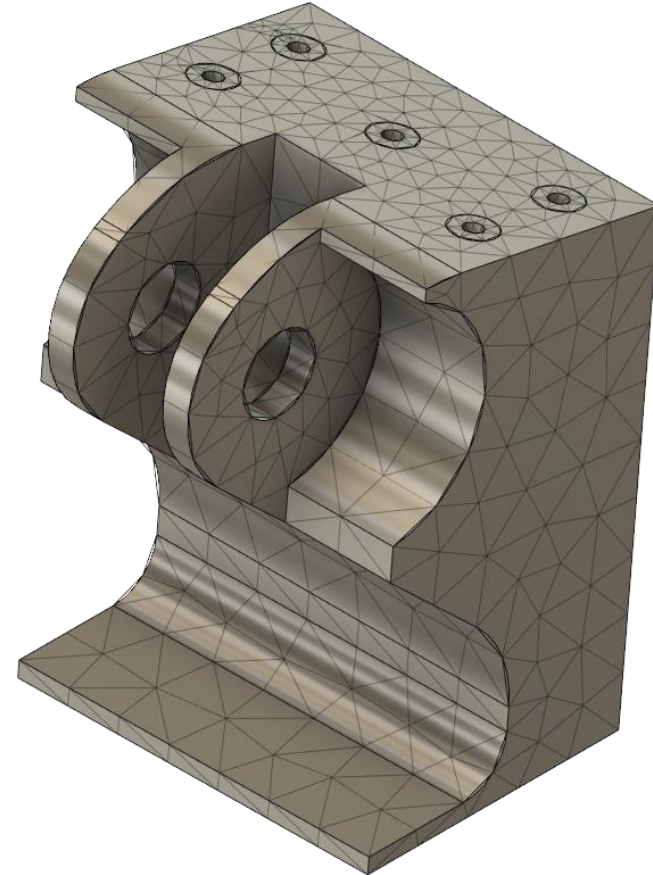
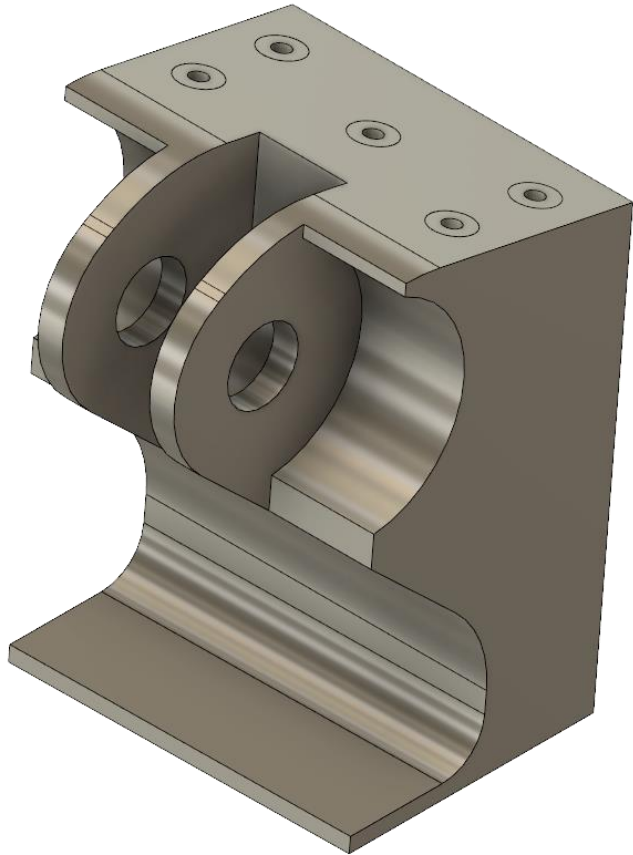
**Finite Element Analysis (FEA)** is a computer based method of simulating / analyzing the behavior of engineering structures and components under a variety of conditions. It is an advanced engineering tool that is used in design and to augment, complement or replace experimental testing.



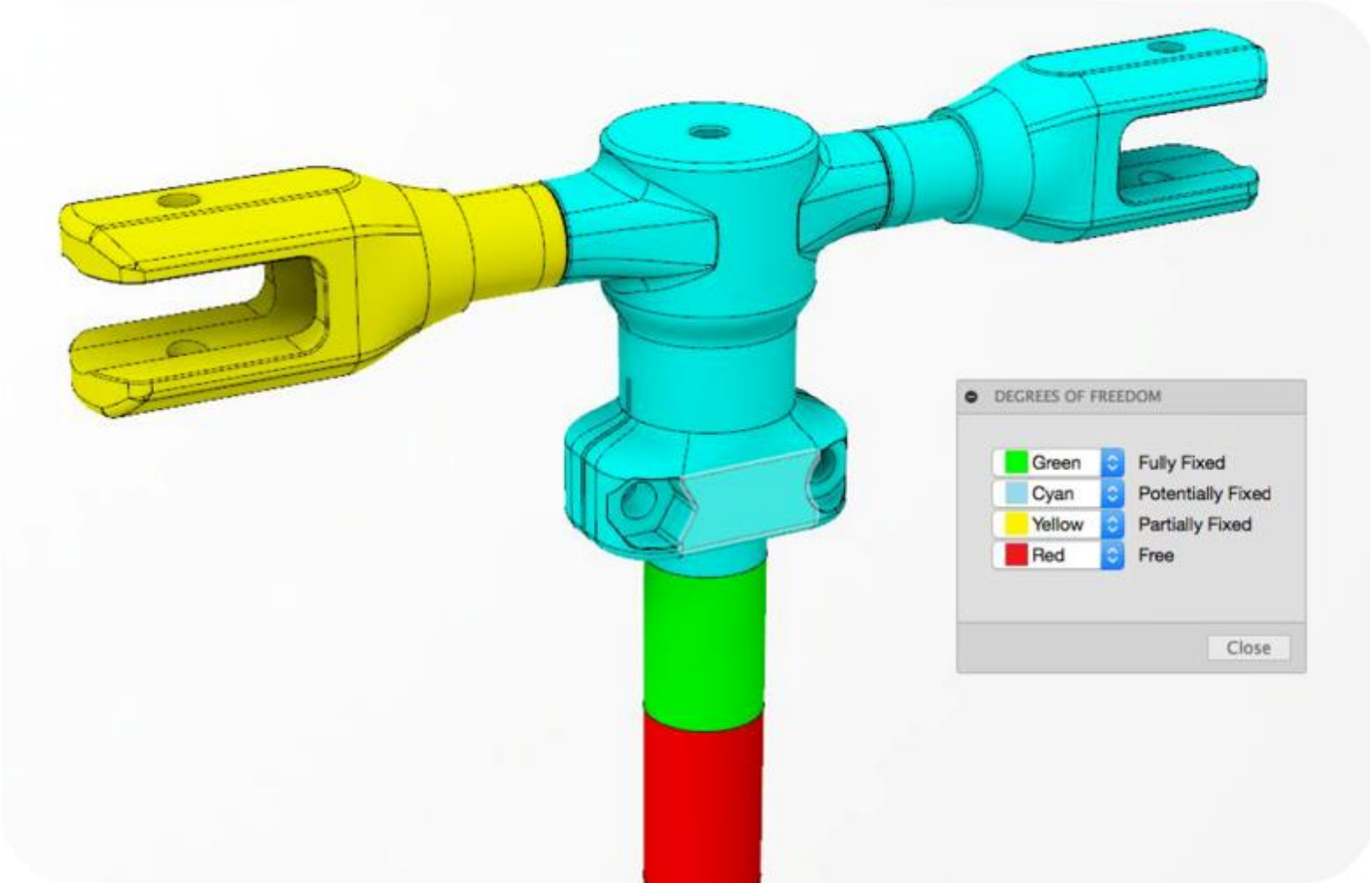
Quote from HERA ([www.hera.org.nz](http://www.hera.org.nz))

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# What is a mesh?

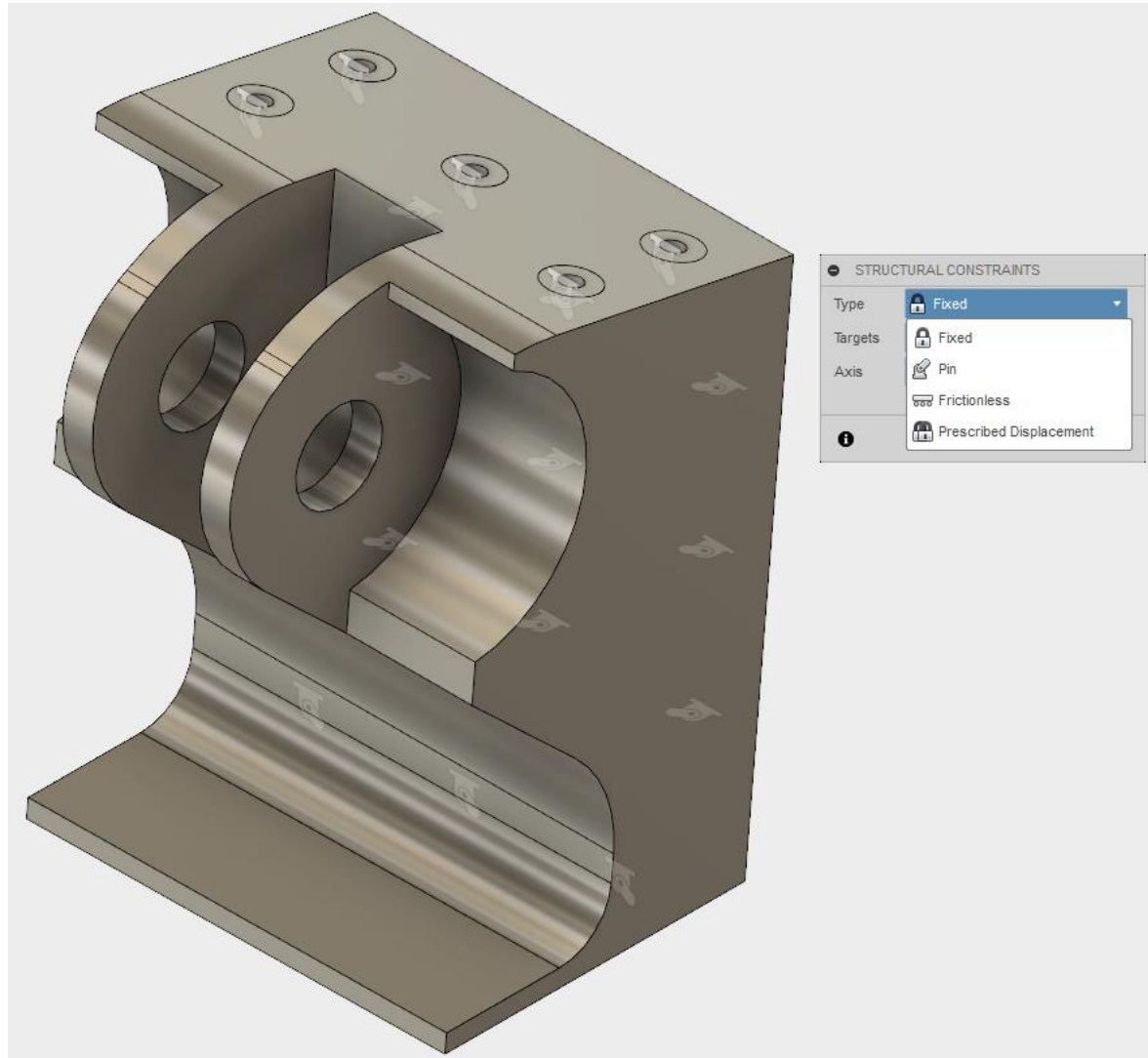


# Contacts



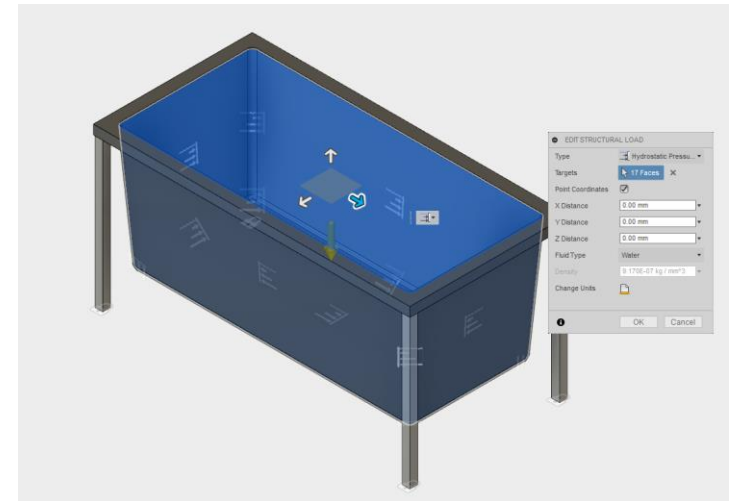
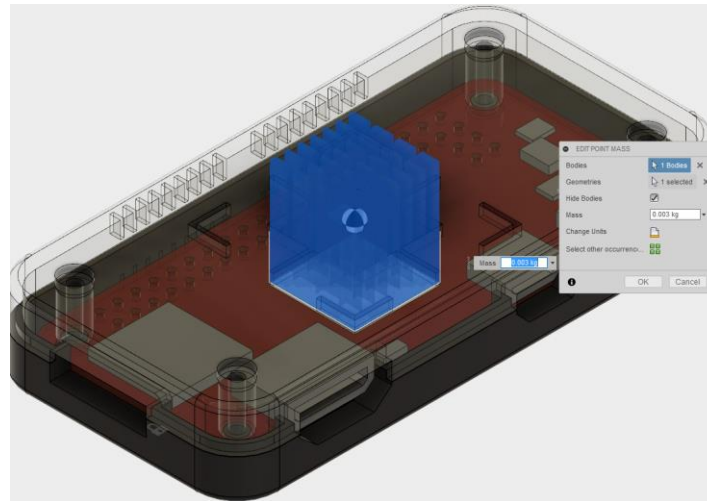
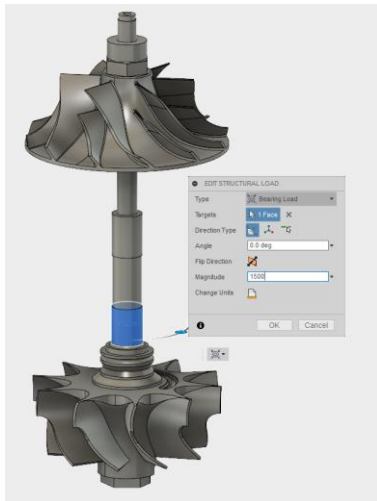
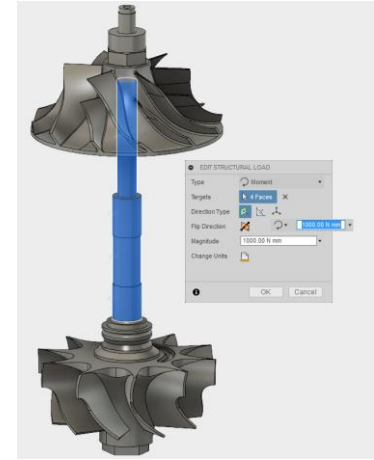
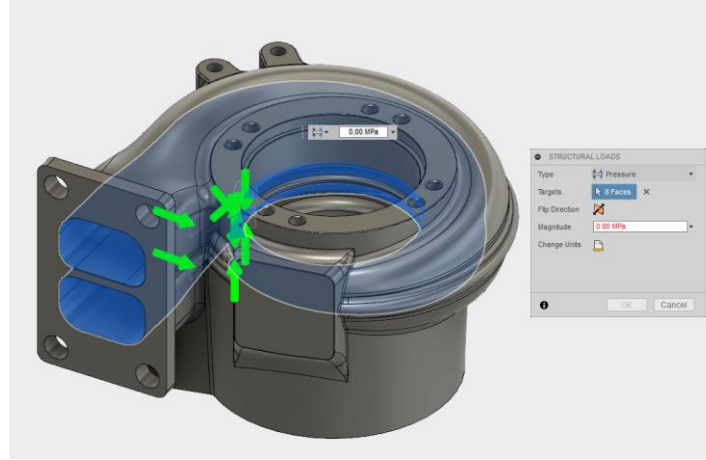
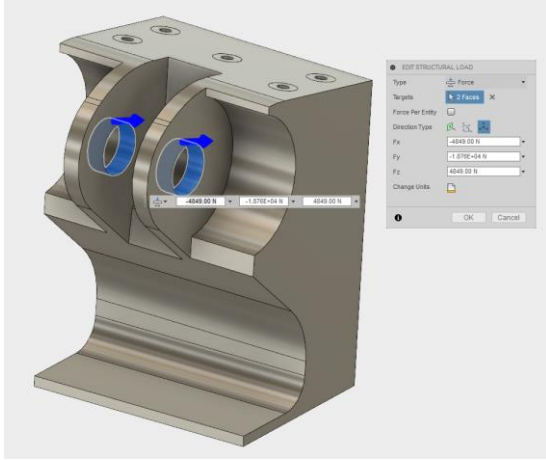
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# Constraints



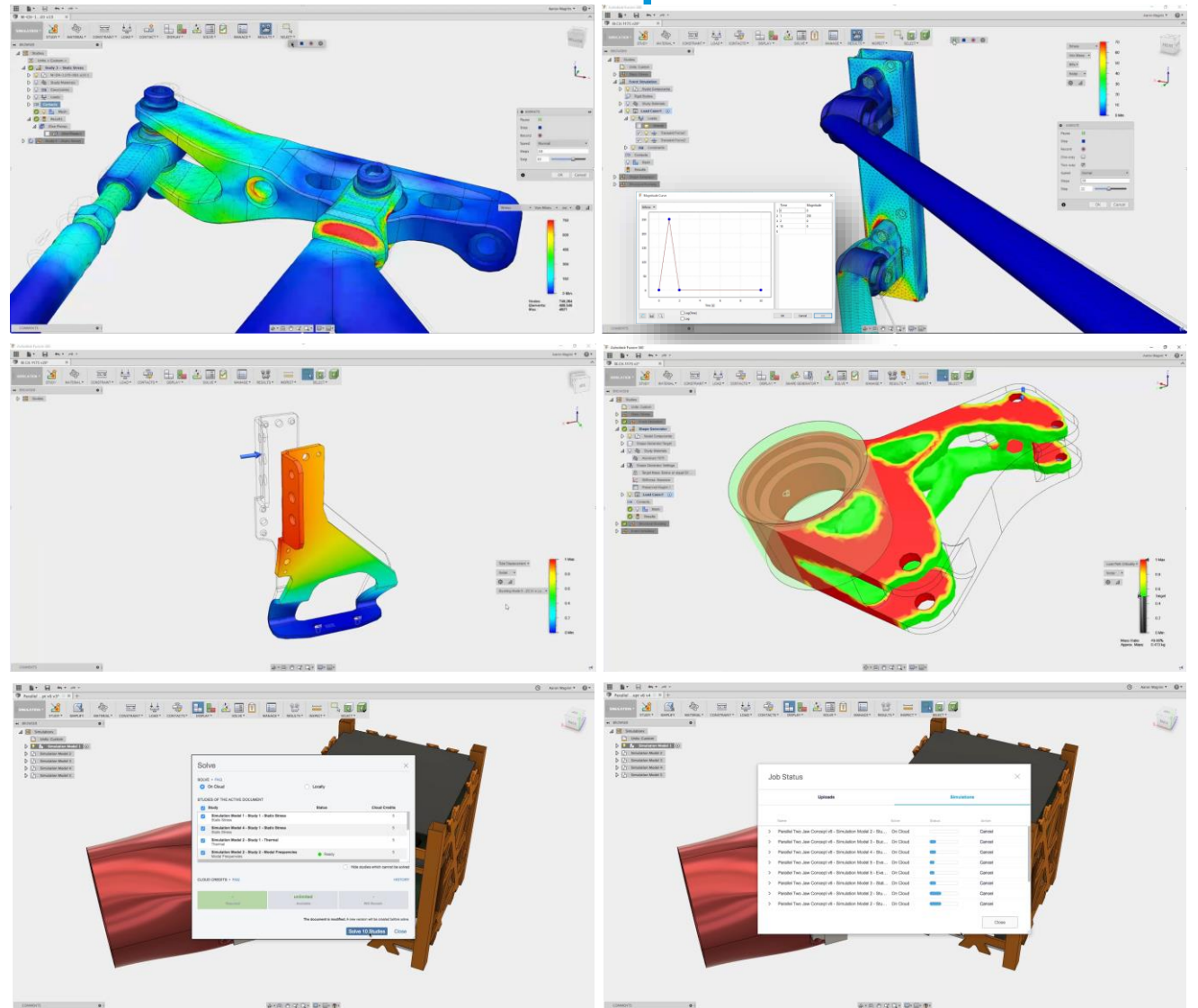


# Loads



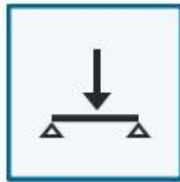
# Fusion 360 – Simulation Workspace

- Powered by Autodesk Nastran Solver
  - Linear Static Stress
  - Modal (Frequency)
  - Thermal
  - Thermal Stress
  - Structural Buckling
  - Shape Optimization
  - Linear Structural Buckling
  - Non-linear Static Stress
  - Event Simulation
- Cloud Solve
- Simplify Workspace
- Compare Workspace



# Simulation Types

New Study



Static Stress



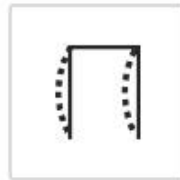
Modal Frequencies



Thermal



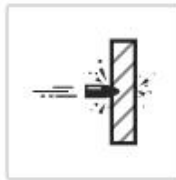
Thermal Stress



Structural Buckling



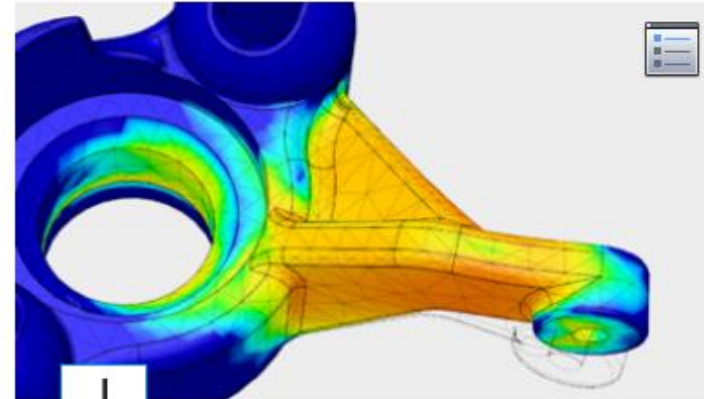
Nonlinear Static Stress  
(Preview)



Event Simulation  
(Preview)



Shape Optimization



Static Stress

Analyze the deformation and stress into the model from structural loads and constraints. From the results, you can investigate displacement, stresses, and common failure criteria. The results are calculated based on assumption of linear response to the stress.

OK

Cancel

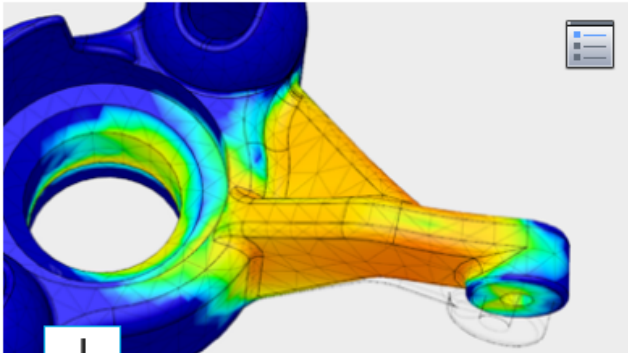
[Help me choose a study type.](#)

# Questions to ask

## New Study ×

I want to

- see if my design will deform excessively or fail from the physical loads applied to it. (Linear)
- see if my design will deform excessively or fail from the physical loads applied to it. (Linear)
- find the natural frequency and shape of my design as it vibrates. (Modal)
- see the temperature distribution throughout my design when it is heated or cooled. (Steady Thermal)
- see if my design will deform excessively or fail when heated or cooled in combination with physical loads applied to it. (Thermal Stress)
- see if my long, thin design will collapse under applied physical loads. (Buckling)
- see how my design behaves when the load is high enough to permanently deform the shape. (Nonlinear Static)
- see how my design reacts to motion, large deformation, and impact (such as when it is dropped onto a hard floor). (Event Simulation)
- minimize the weight of my design by removing non-critical material while maintaining the stiffness required to support physical loads. (Shape Optimization)



**Static Stress**

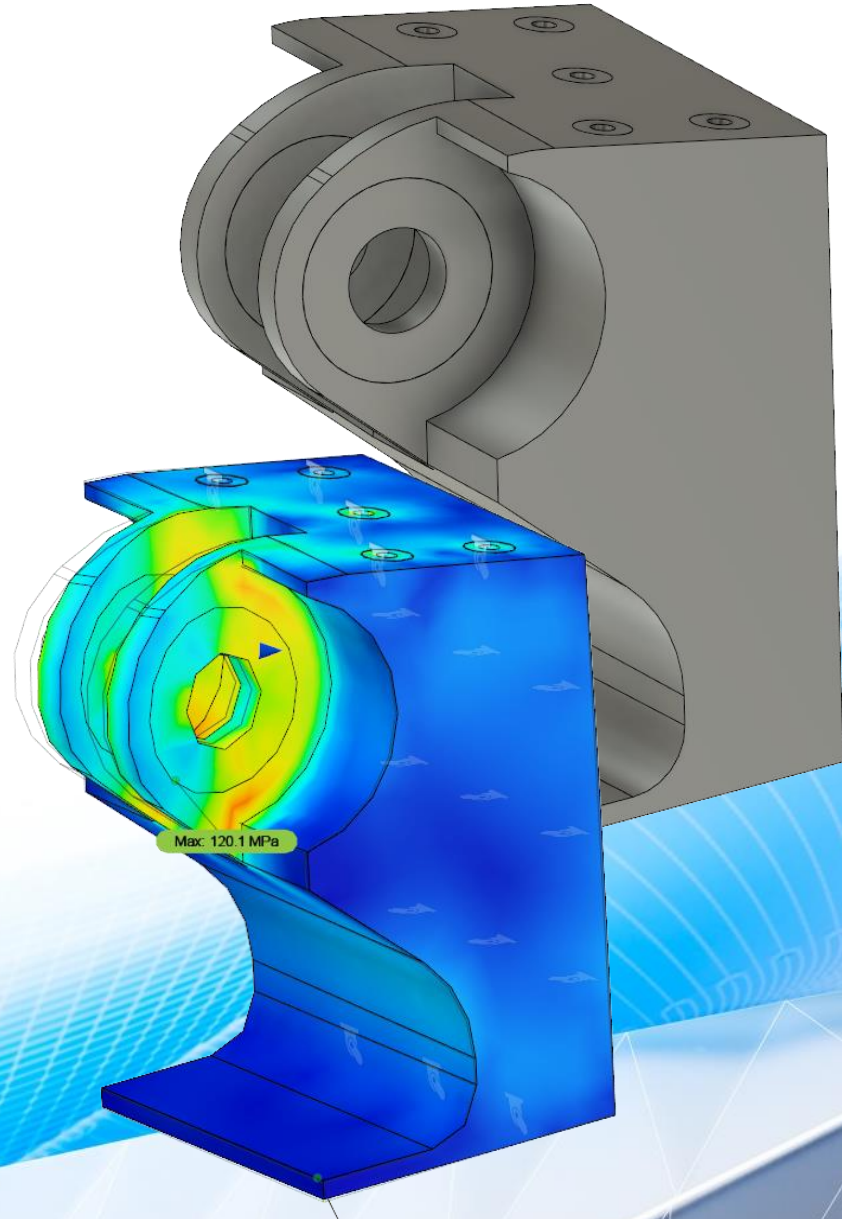
Analyze the deformation and stress into the model from structural loads and constraints. From the results, you can investigate displacement, stresses, and common failure criteria. The results are calculated based on assumption of linear response to the stress.

OK Cancel

# Hands On

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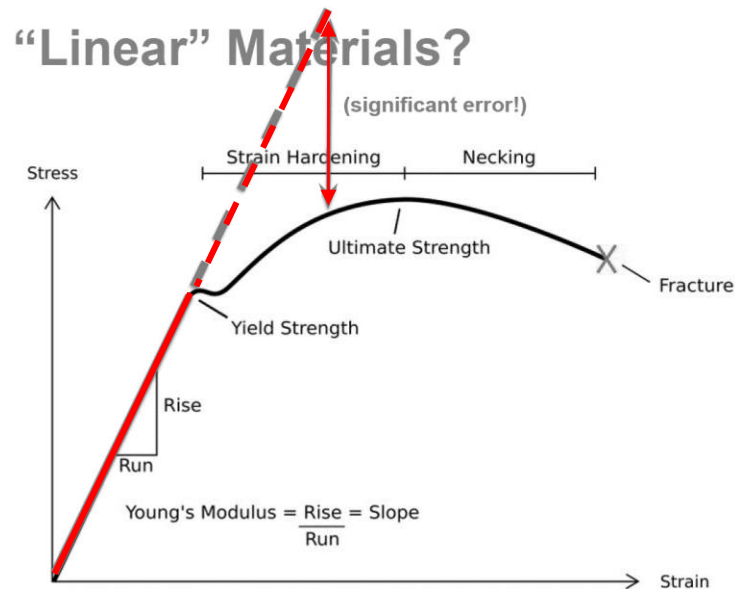
# Static Stress



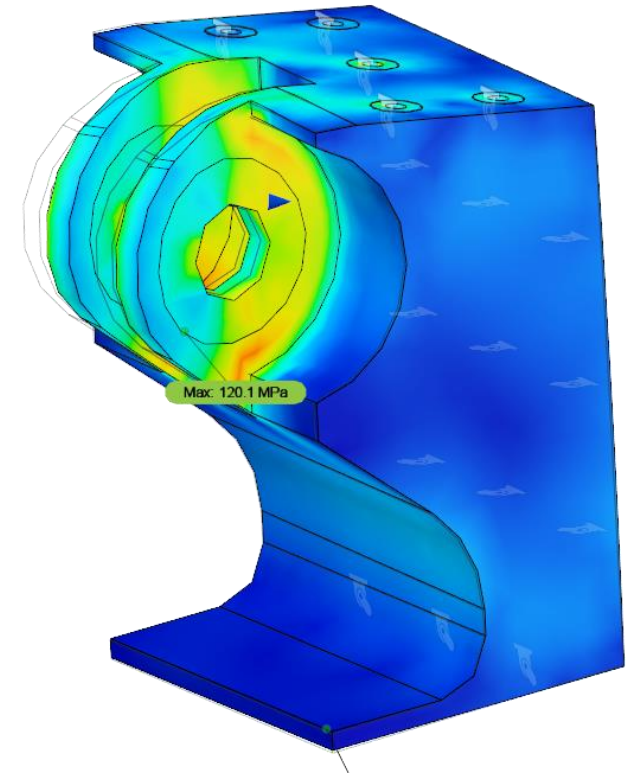
# Simulation Types

## Static Stress

- Material is “Linear”
- Loads are applied slowly and steadily
- Structural deformations are small



$$\text{Stress} = \sigma = \frac{F}{A}$$
$$\text{strain} = \frac{\Delta L}{L}$$

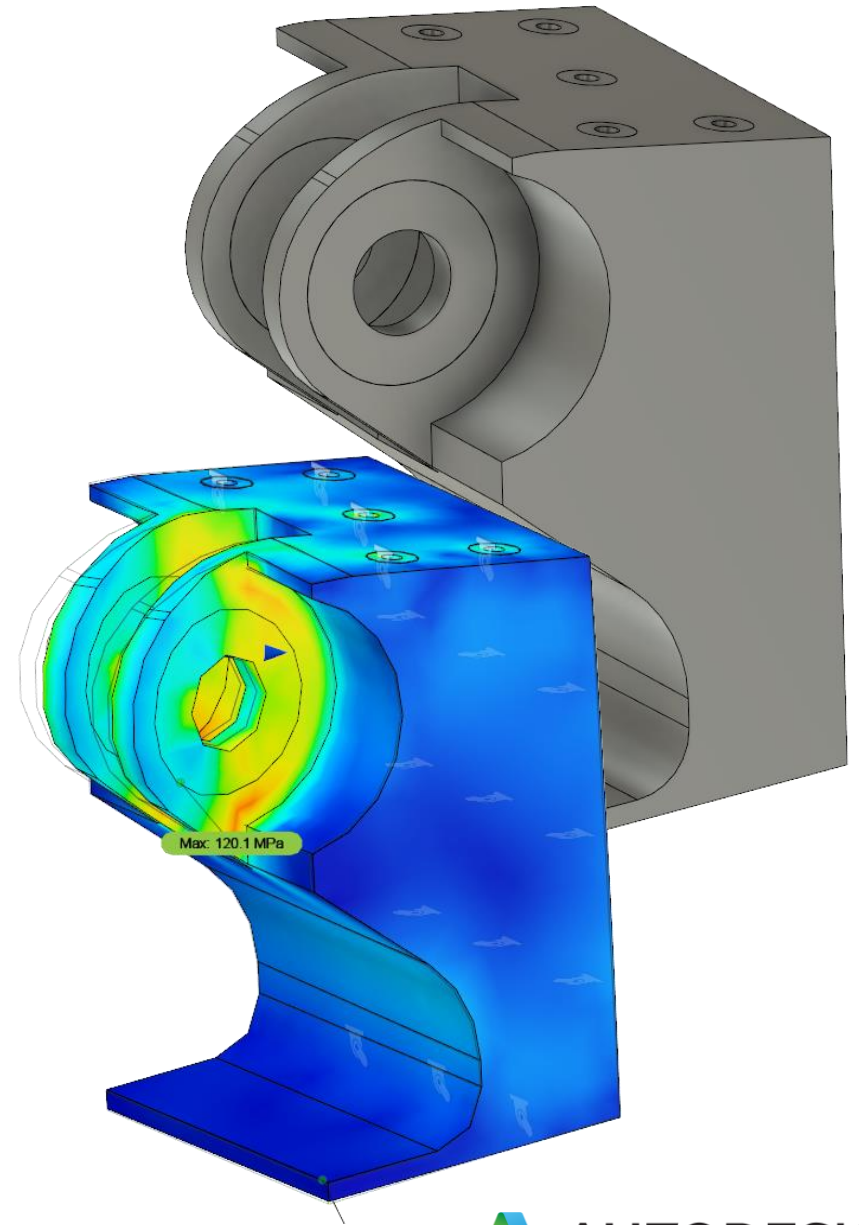


# Static Stress

GKN Bracket

Aircraft Elevator Bracket

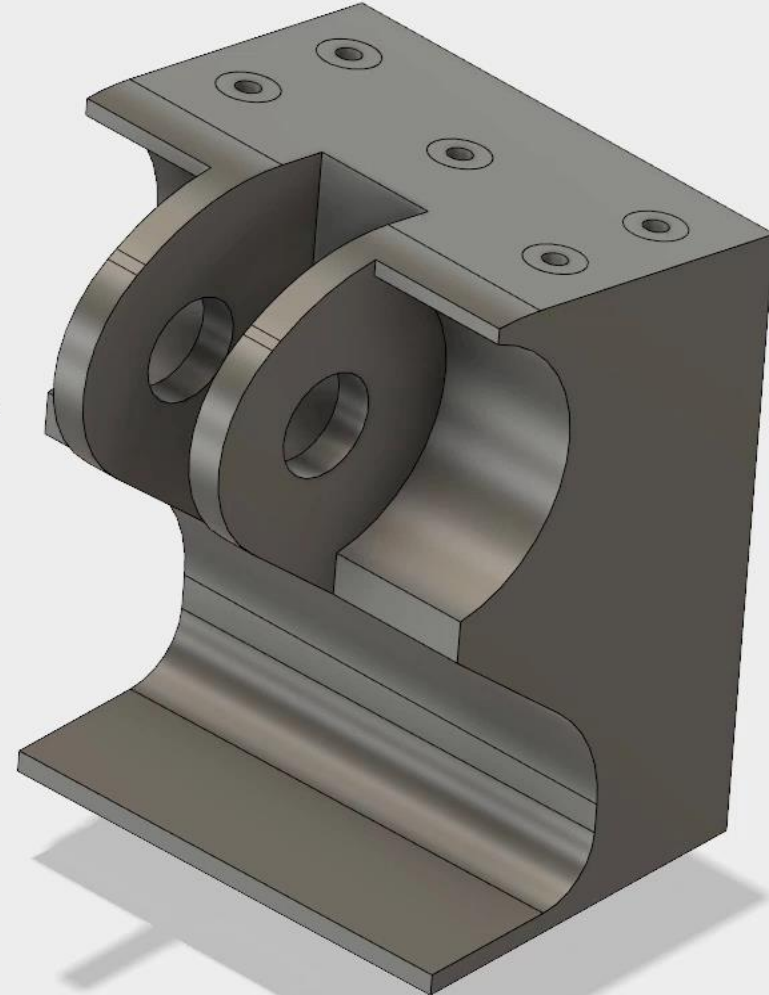
- Material – Ti 6Al 4V
- Minimum FOS – 1.2
- Maximum Displacement – 0.55mm



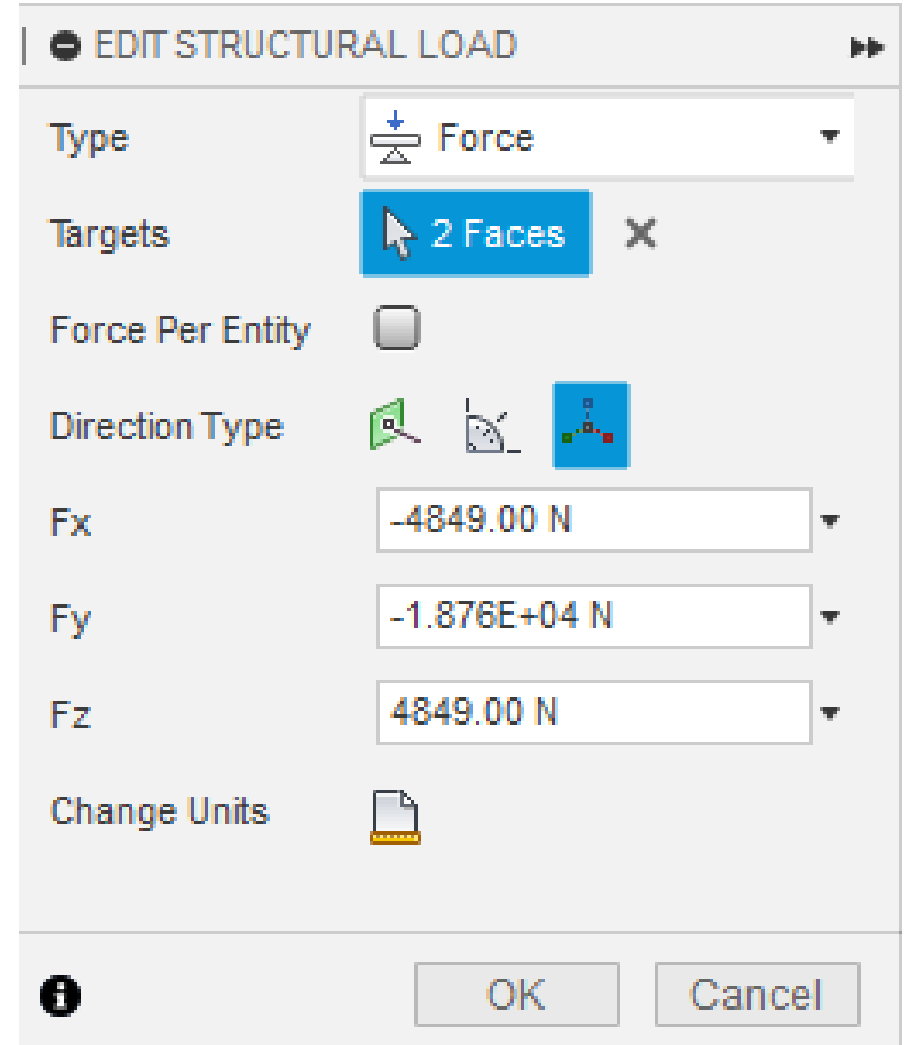
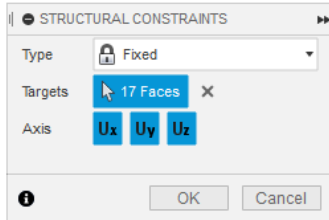
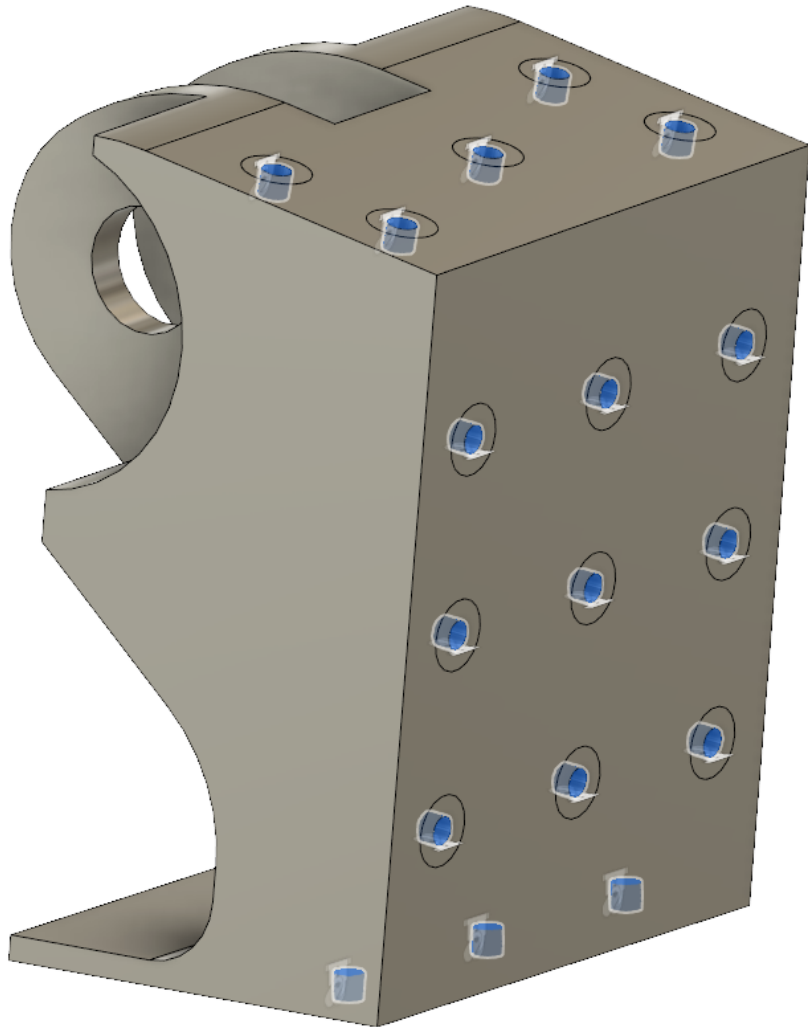


- 2-GKN Static Stress v5
  - Document Settings
  - Named Views
  - Origin
  - Sketches
  - DS2:1

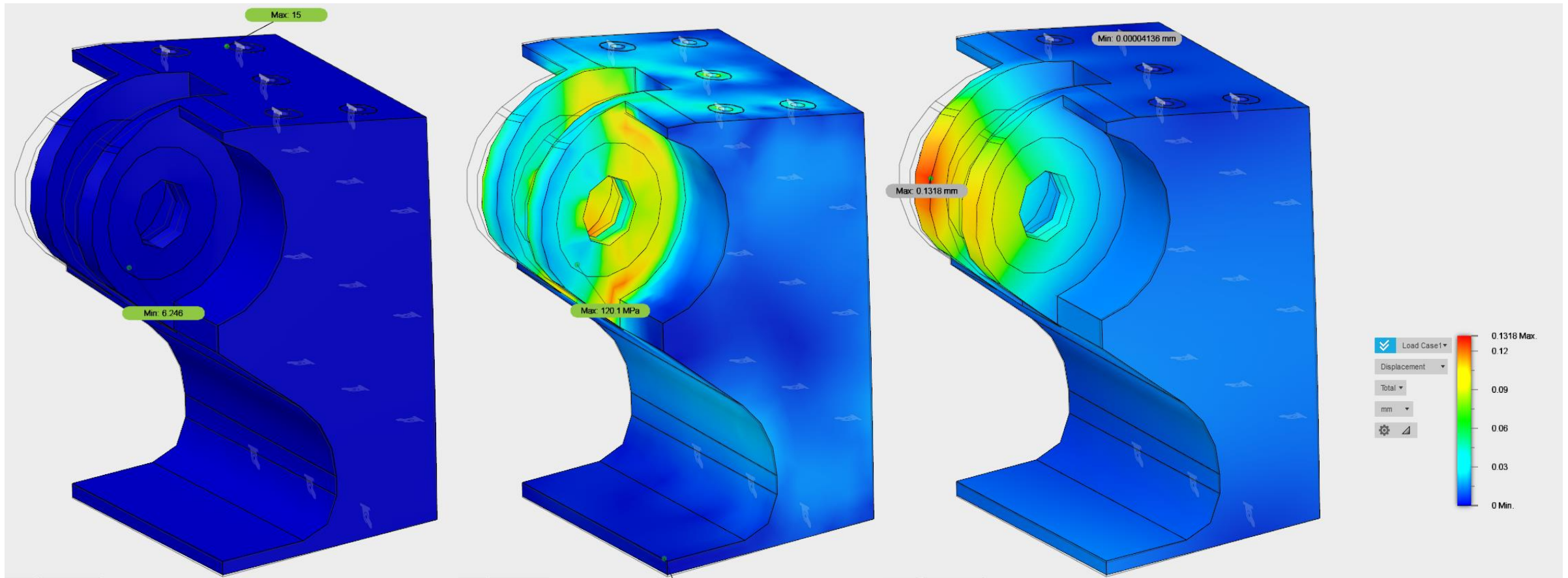
# Static Stress



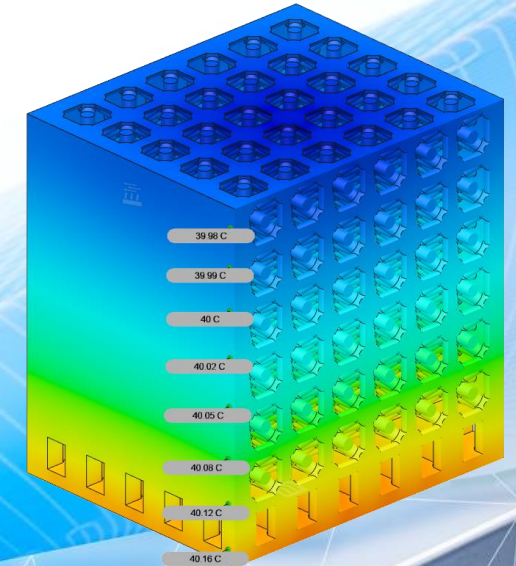
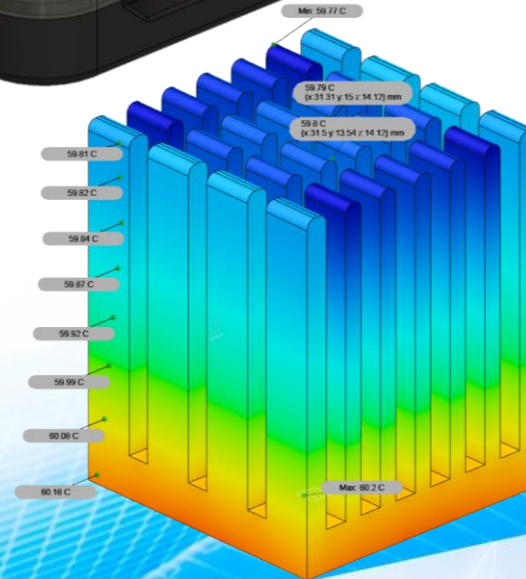
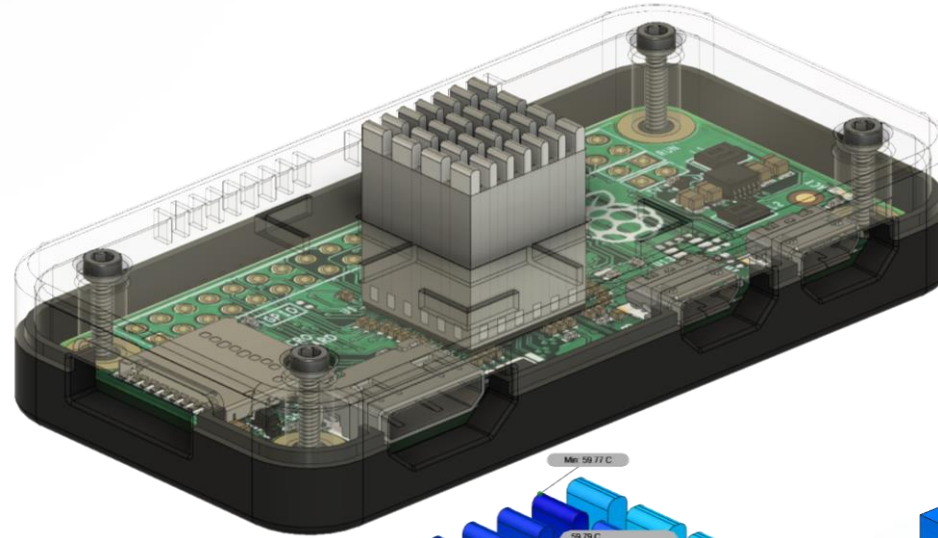
# Constraints & Loads



# Static Stress



# Thermal



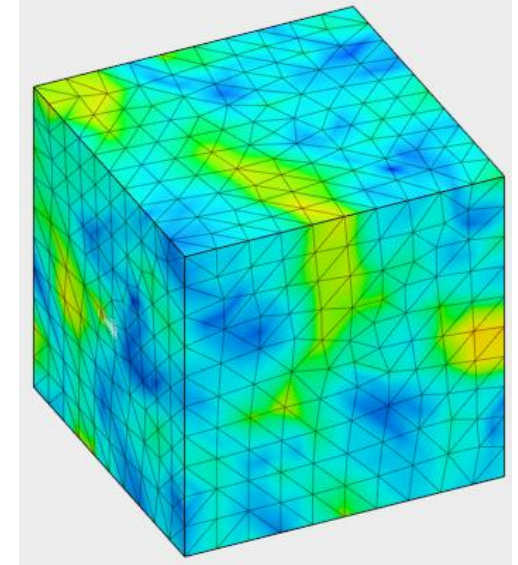
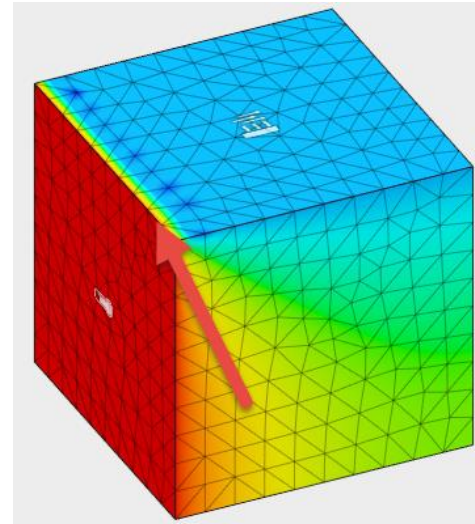
# Simulation Types

## Thermal

Convection of heat

Measure Heat Flux and gradient

Understand how thermal distribution will effect components

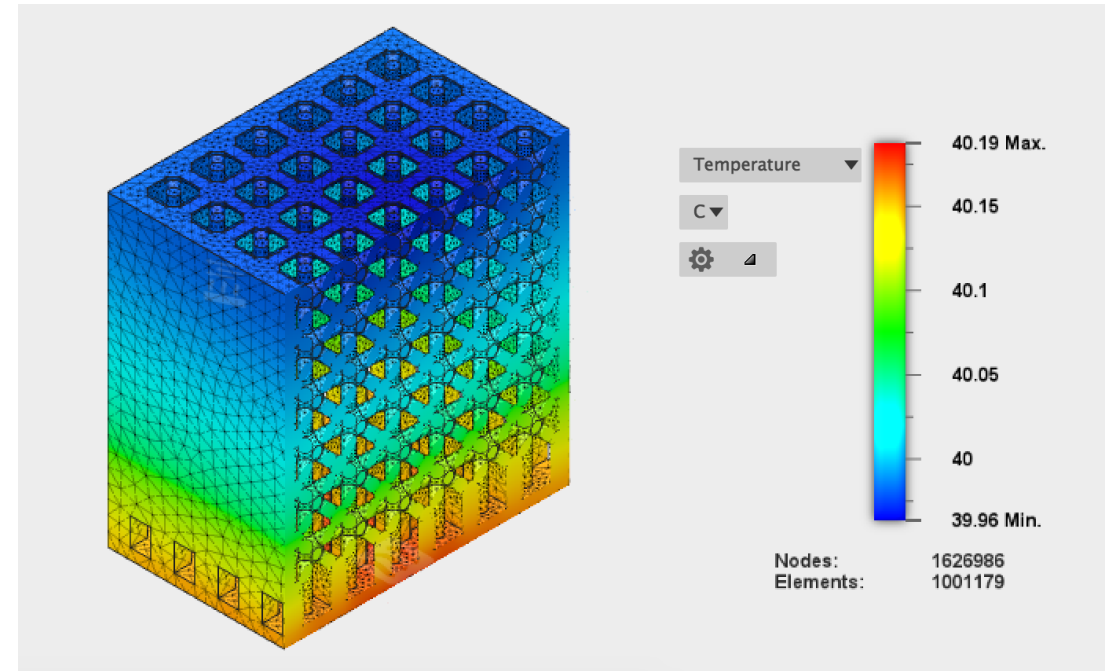


# Thermal

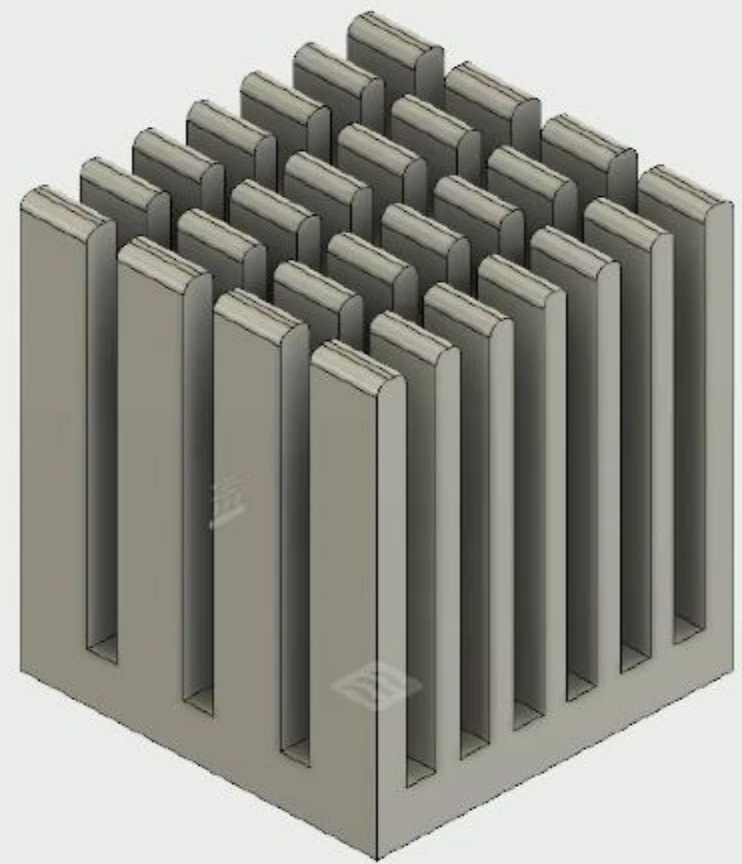
## Raspberry Pi PCB

### Heat Sink

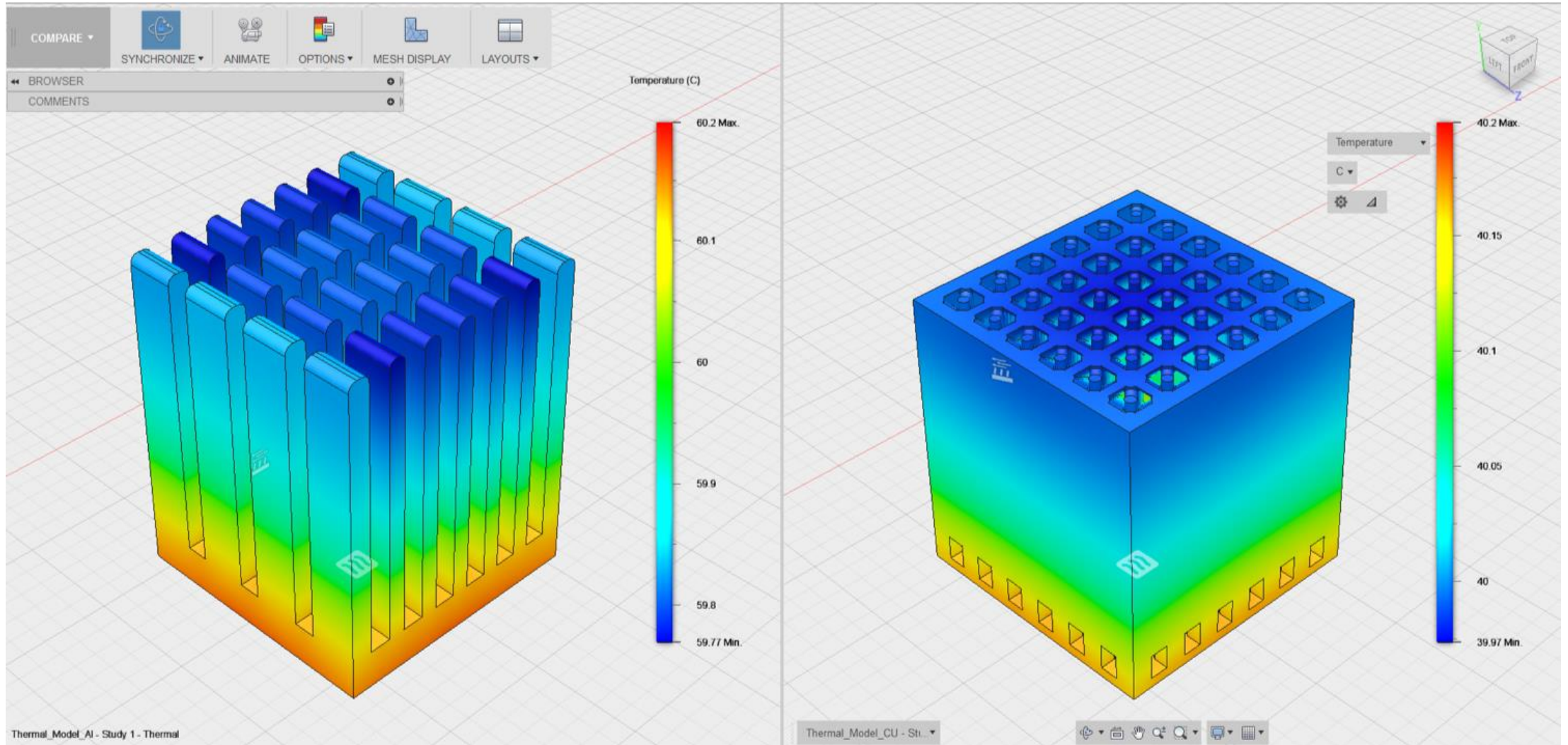
- Material – Aluminum
- Internal Heat – 0.7W
- Convection –  $7.00 \text{ W} / (\text{m}^2 \text{ K})$  |  $20^\circ\text{C}$
- Reduce maximum temperature



# Thermal



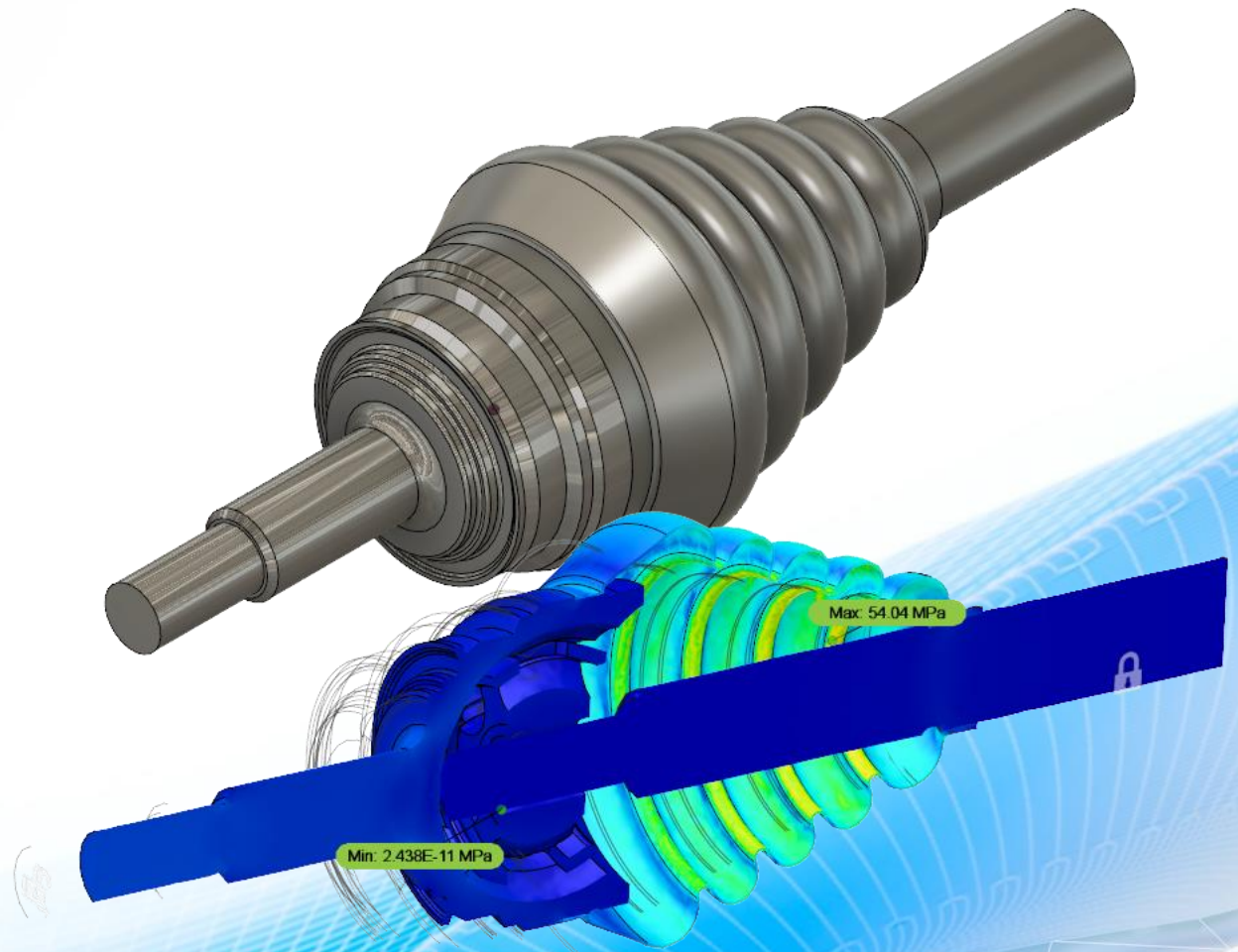
# Thermal



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# Non Linear



# Simulation Types

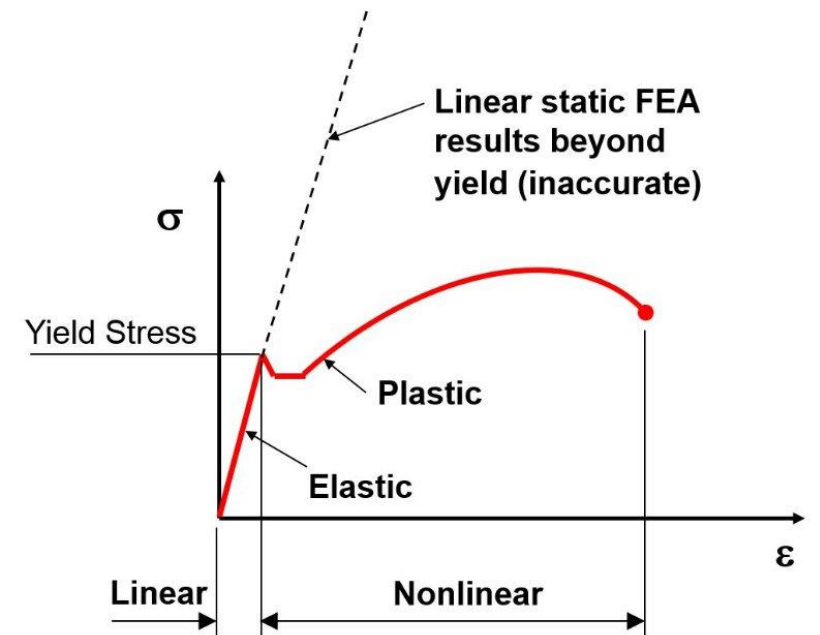
## Non Linear

Material is not “Linear”

Direction of load changes as the model deforms

Displacement is large

Stress strain curves deviates from a straight line

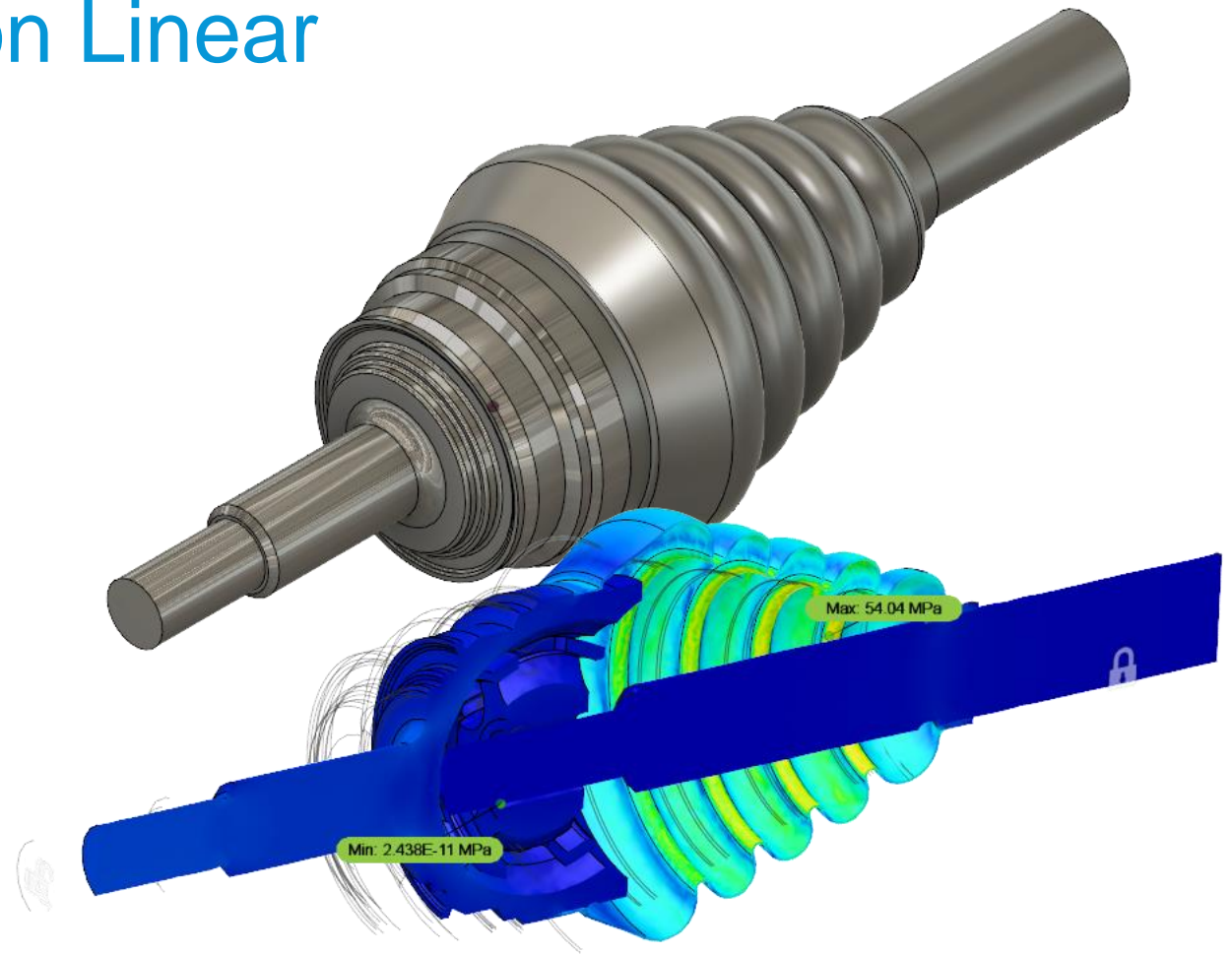


# Non Linear

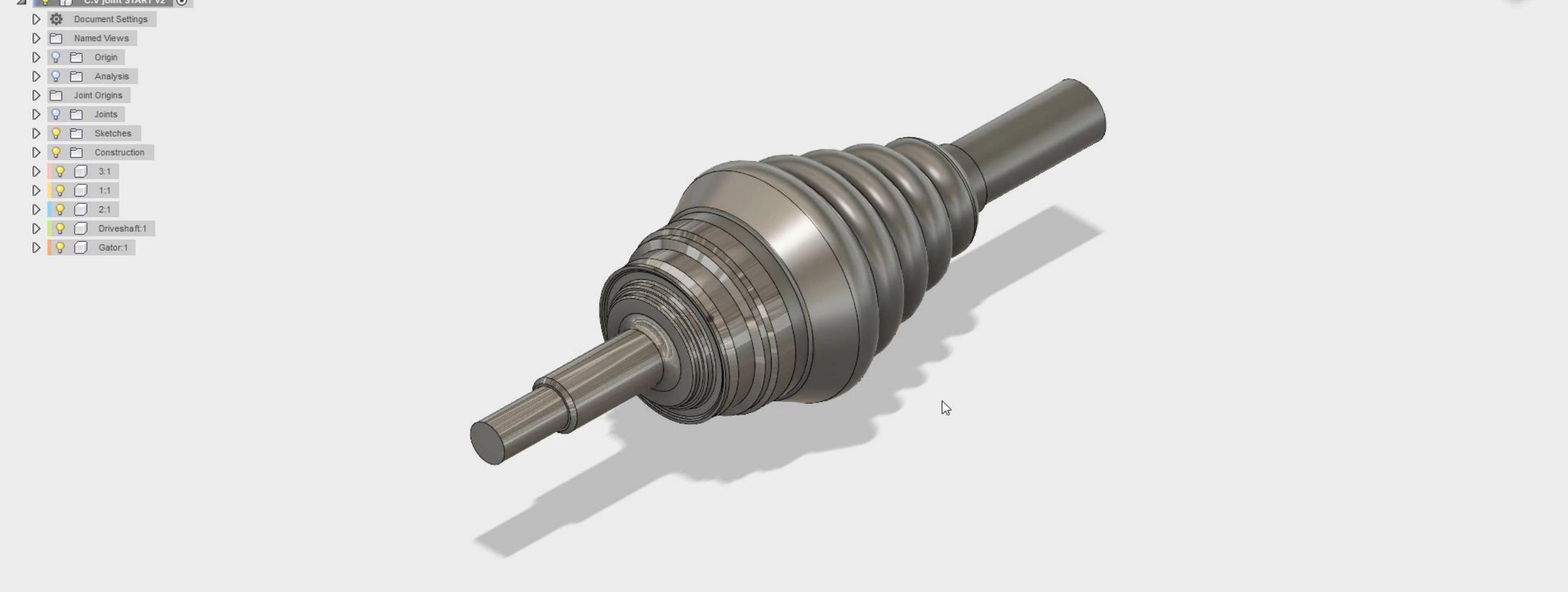
## Constant Velocity Joint

### CV Joint Gator

- Materials
  - Stainless Steel
  - Rubber (Non Linear)
- FOS > 1.5
- Stress < 75 MPa

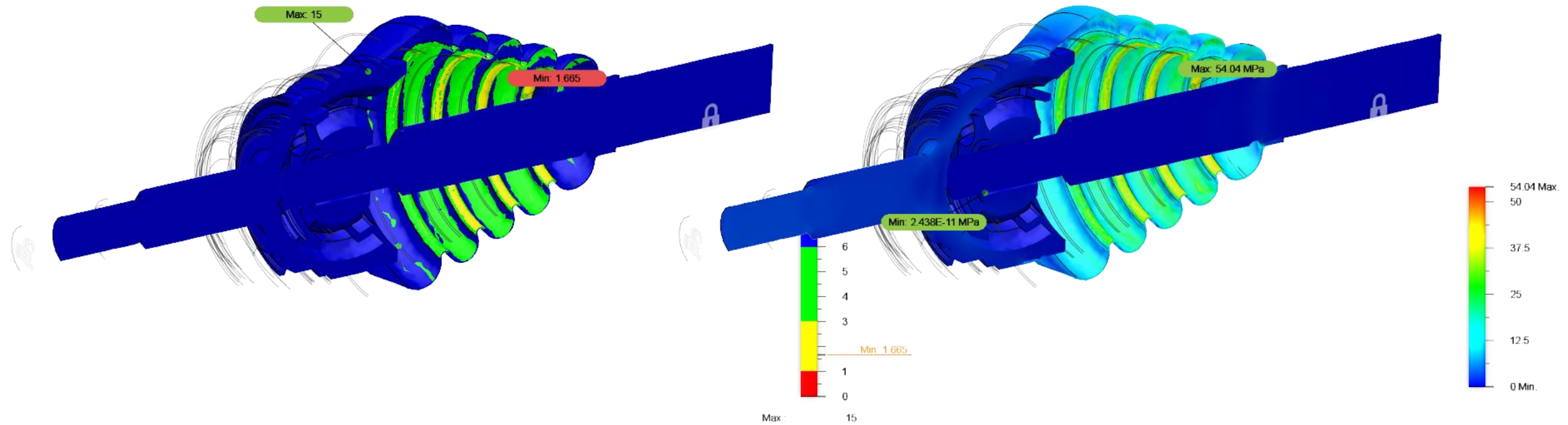


# Non Linear

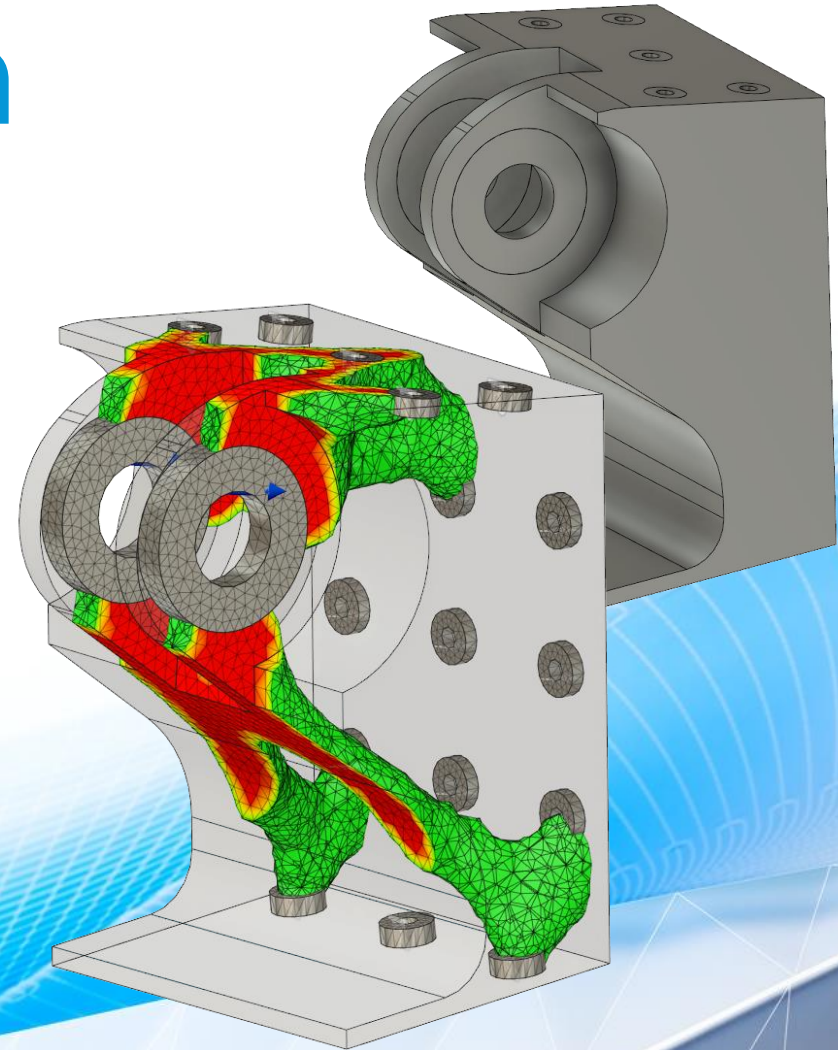


# Non Linear

## Results



# Shape Optimisation



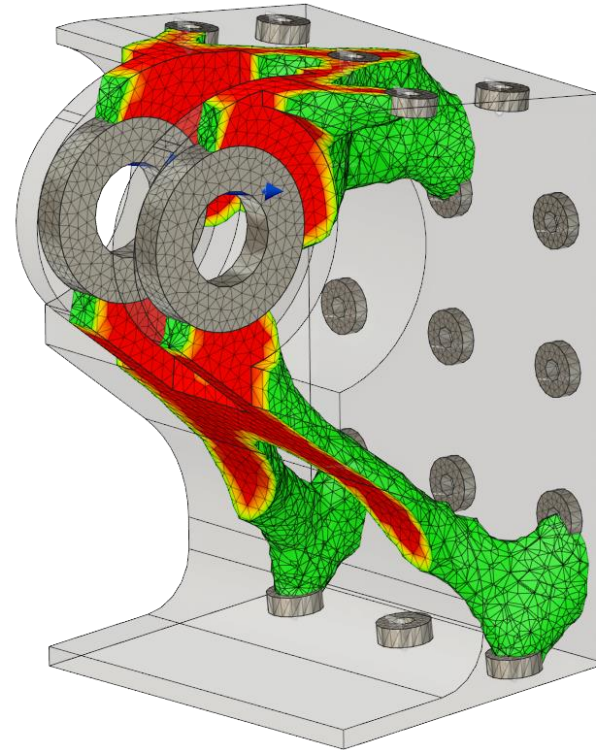
# Simulation Types

## Shape Optimisation

A Shape Optimization study should be used if you are interested in designing lightweight, structurally efficient parts

### Scenarios to use Shape Optimisation

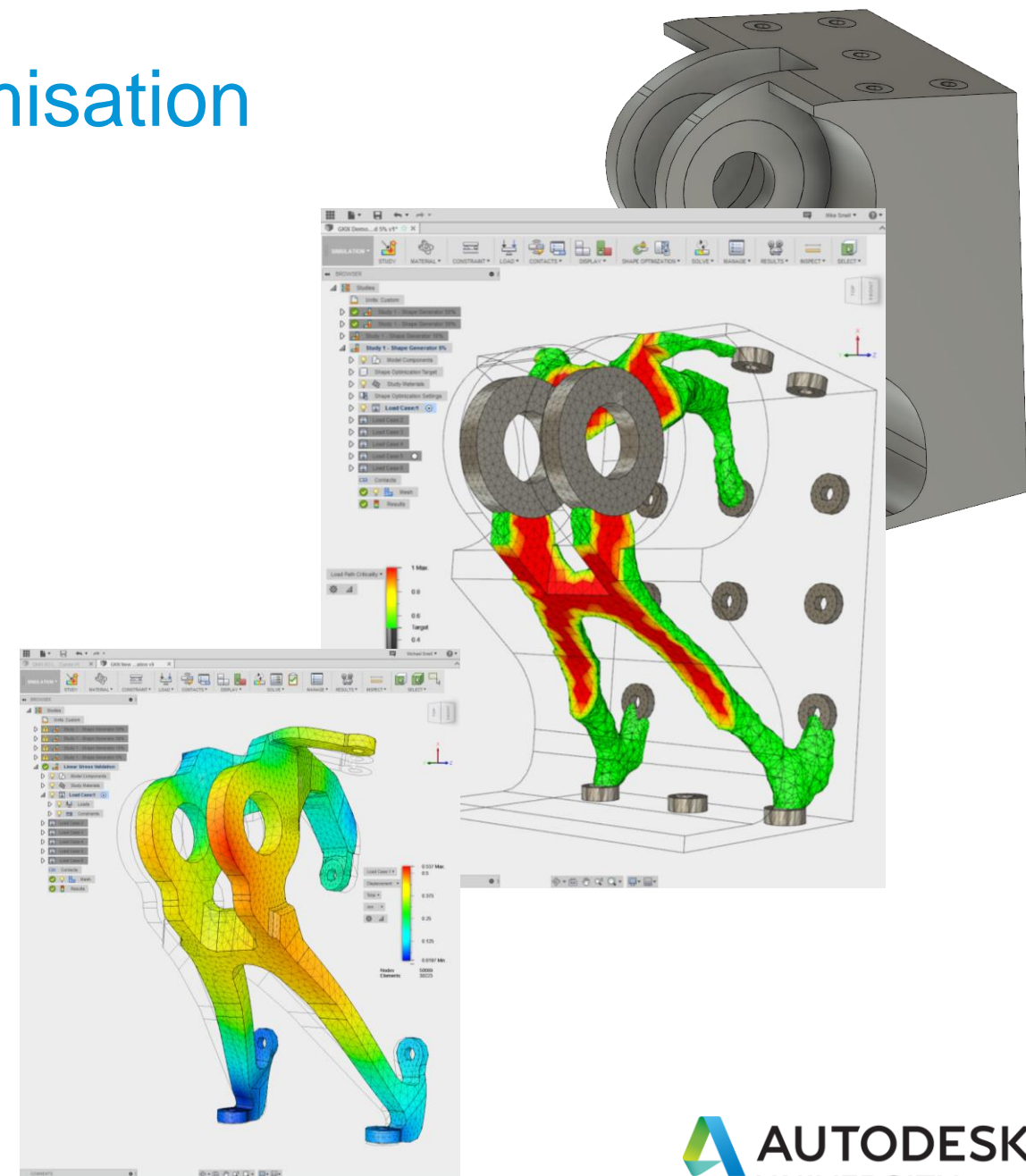
- Design Exploration
- Lightweighting of parts
- Determine where to safely remove material



# Shape Optimisation

## Aircraft Elevator Bracket GKN Bracket

- Material – Ti 6Al 4V
- Minimum FOS – 1.2
- Maximum Displacement – 0.55mm
- 6 multi-directional load cases @ 1.5x operating loads



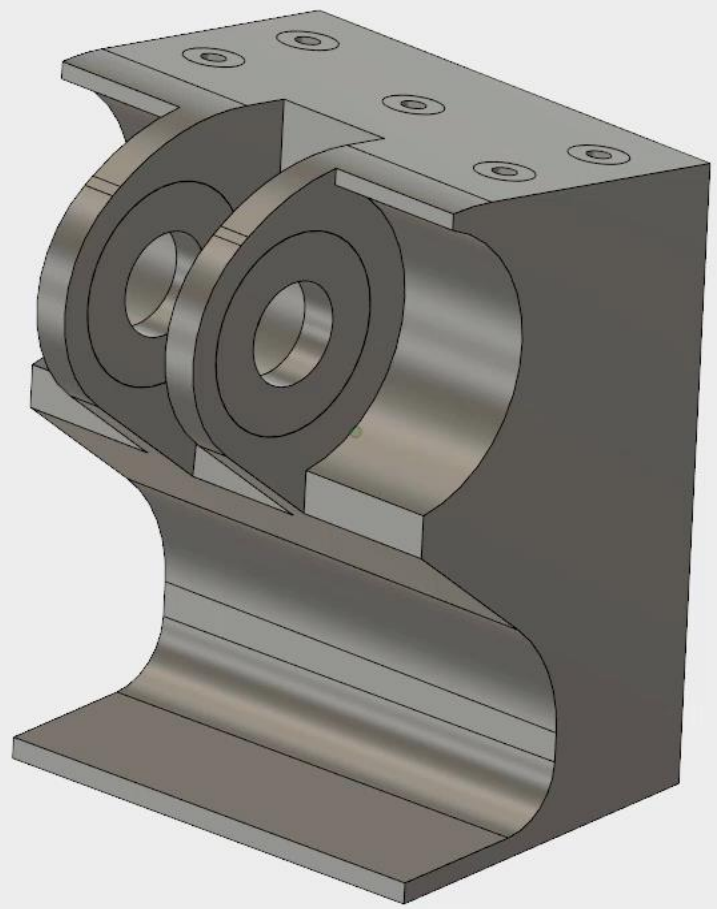




# Shape Optimisation

BROWSER

- GKN Shape Op Start v2
  - Document Settings
  - Named Views
  - Origin
  - Sketches
  - DS2:1
  - Component7:1
  - Component8:1
  - Component9:1
  - Component10:1
  - Component11:1
  - Component12:1
  - Component13:1
  - Component14:1
  - Component15:1
  - Component16:1
  - Component17:1
  - Component18:1
  - Component19:1
  - Component20:1
  - Component21:1
  - Component22:1
  - Component23:1



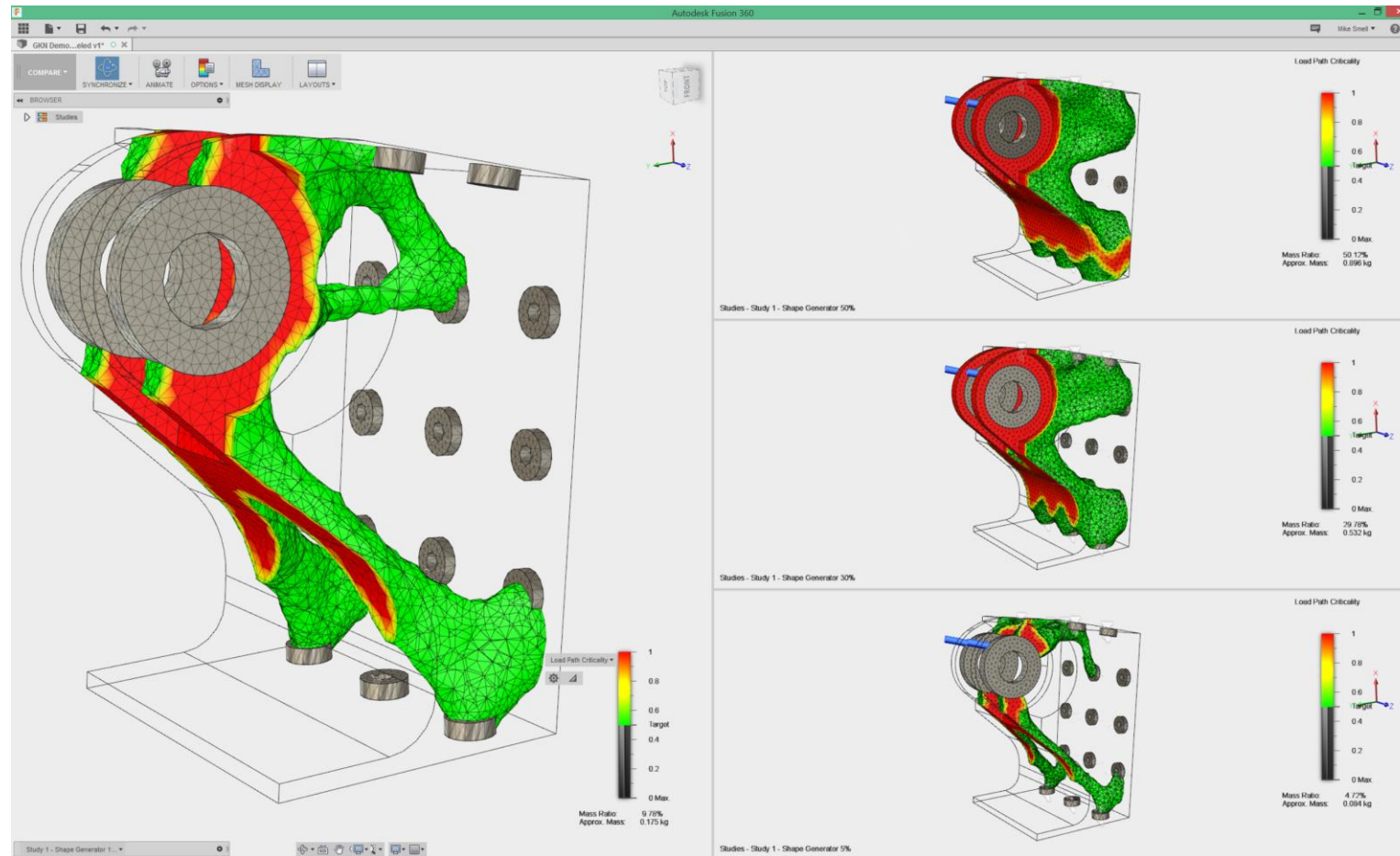
COMMENTS



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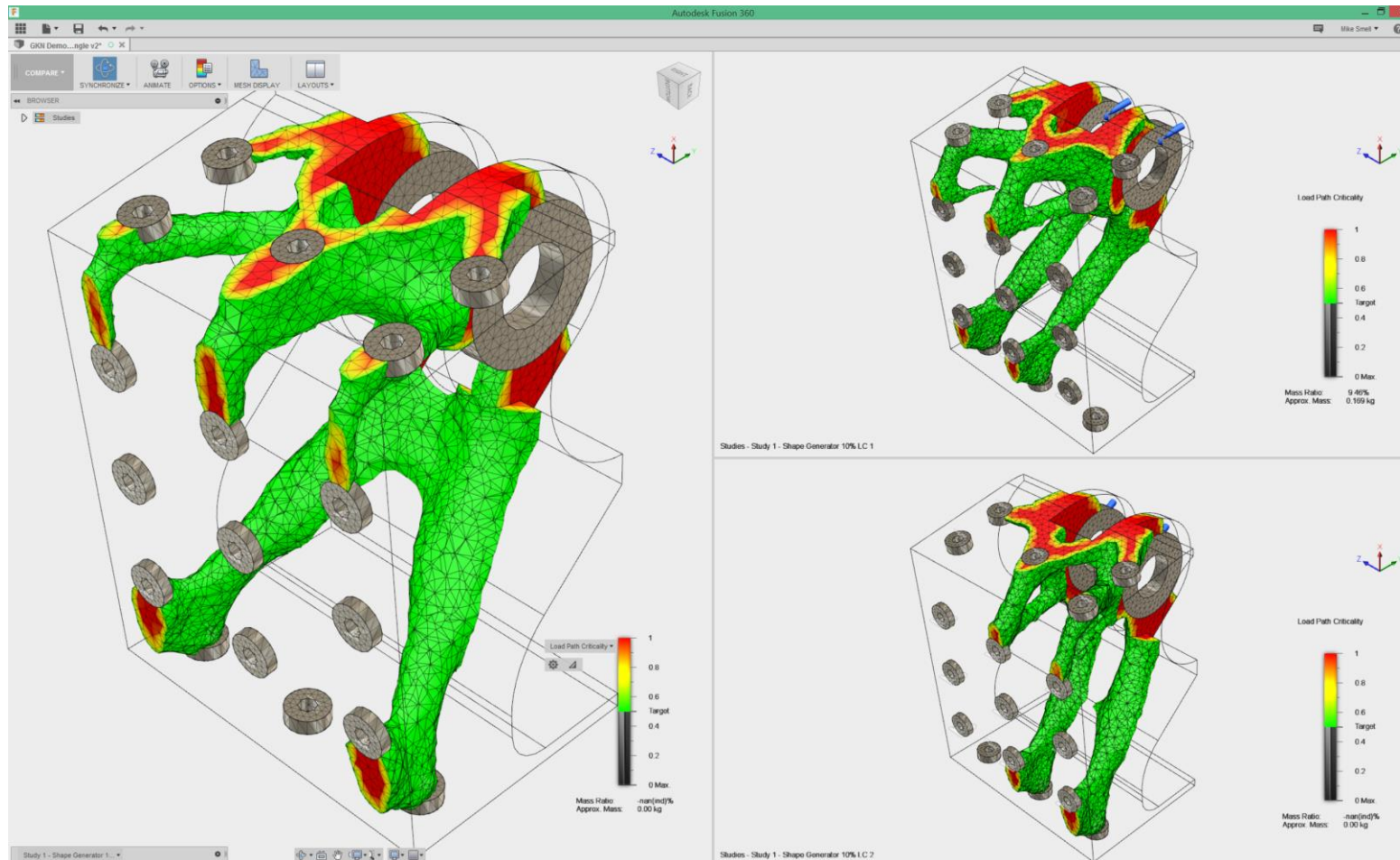
# Shape Optimisation

## Results – Multiple Mass Targets



# Shape Optimisation

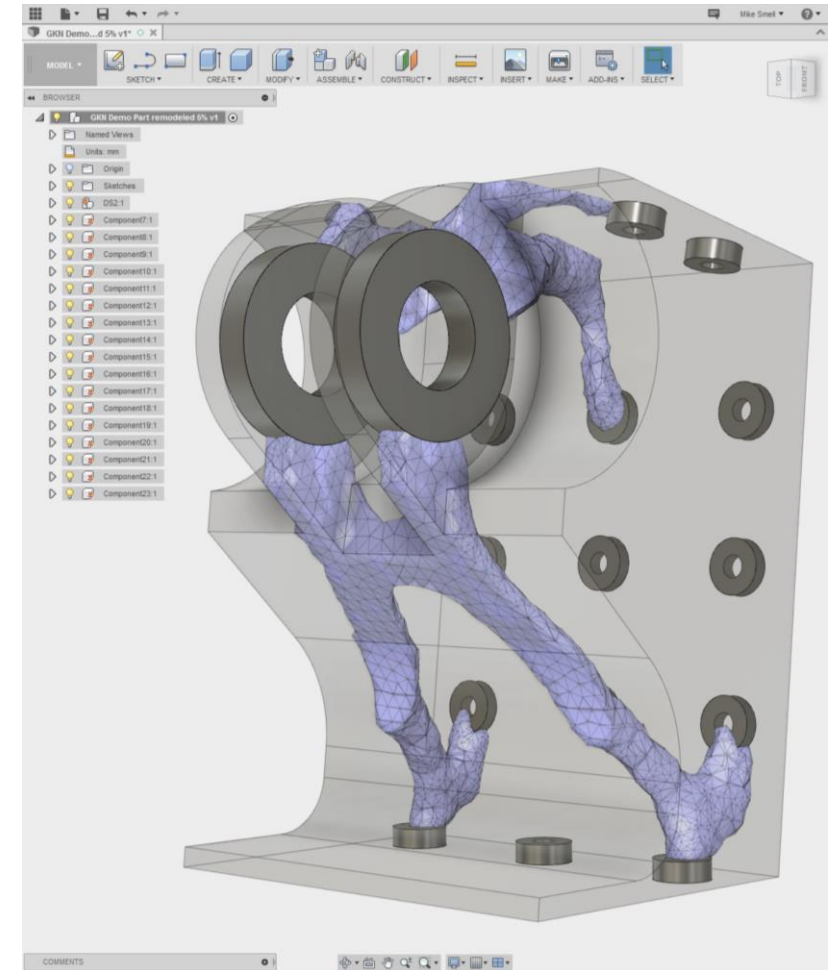
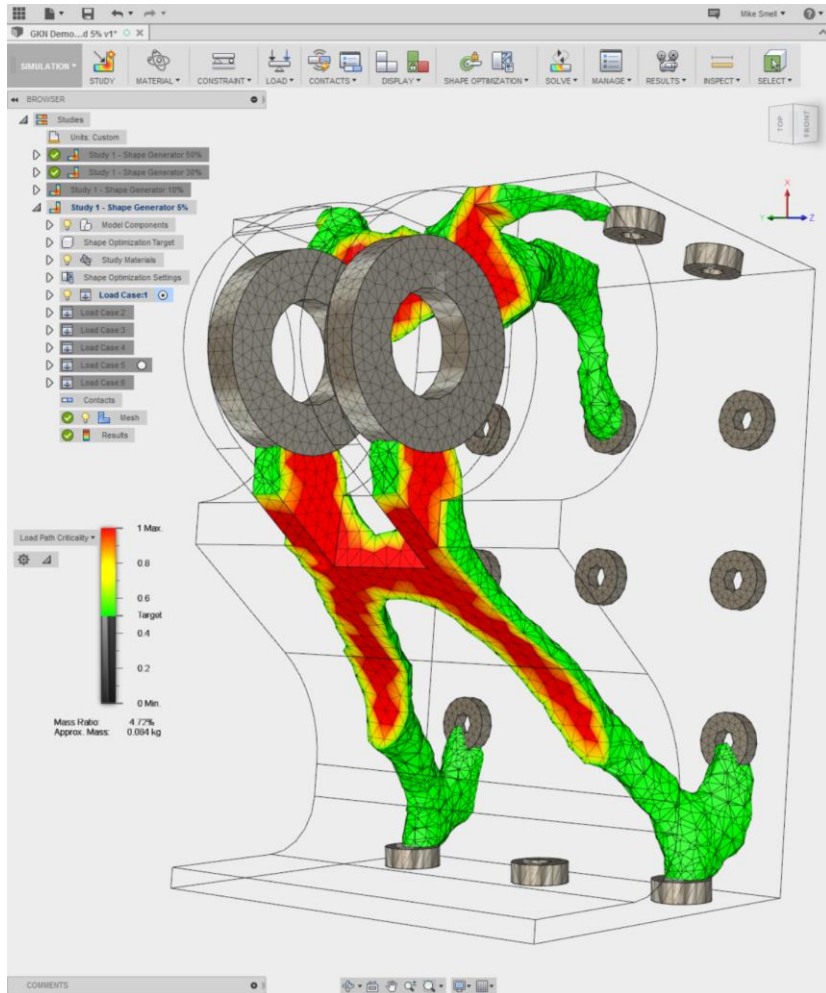
## Results – Multiple Load Cases



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# Shape Optimisation

Promote to Model workspace



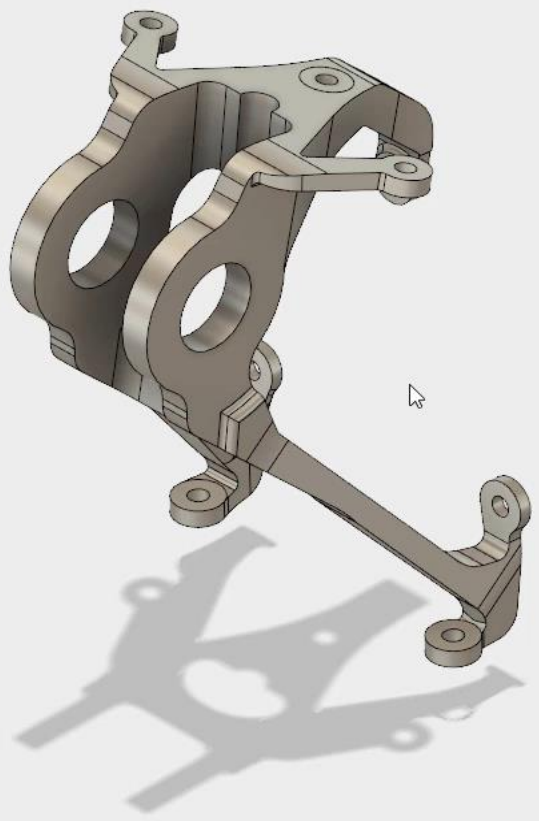
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# Shape Optimisation

BROWSER

- GKN Validation Start v2
  - Document Settings
  - Named Views
  - Origin
  - Sketches
  - Construction
  - DS2:1
  - Component7:1
  - Component8:1
  - Component9:1
  - Component10:1
  - Component11:1
  - Component12:1
  - Component13:1
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  - Component23:1

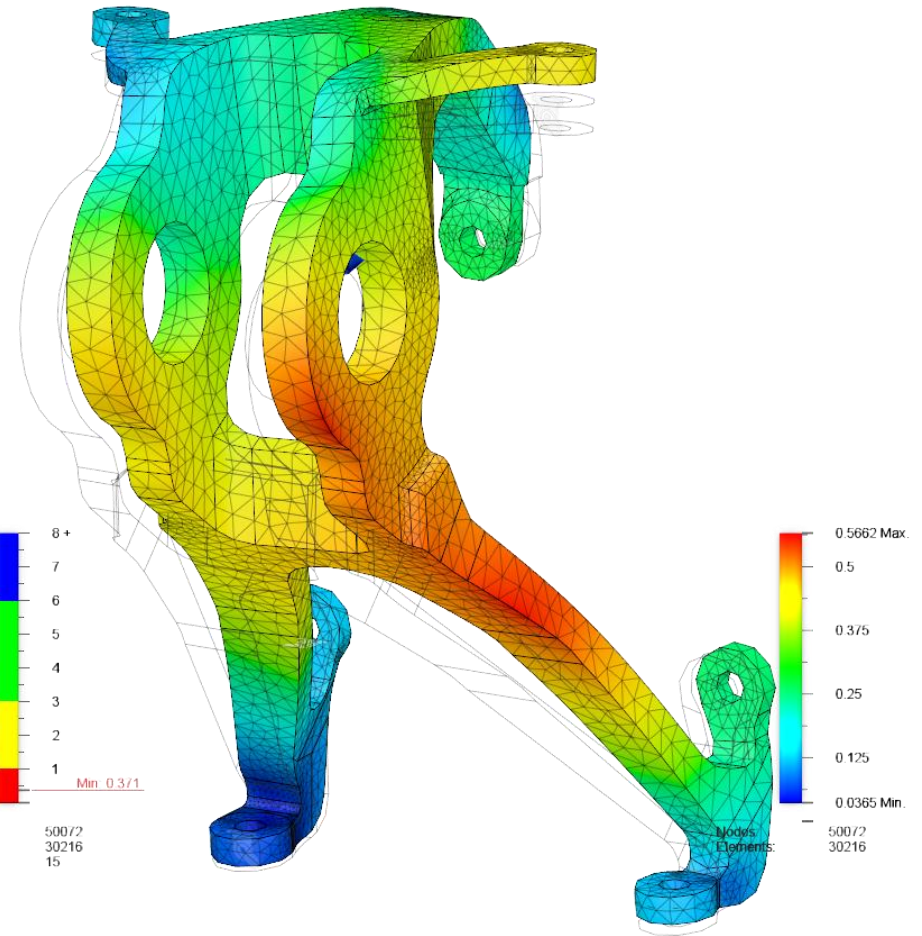
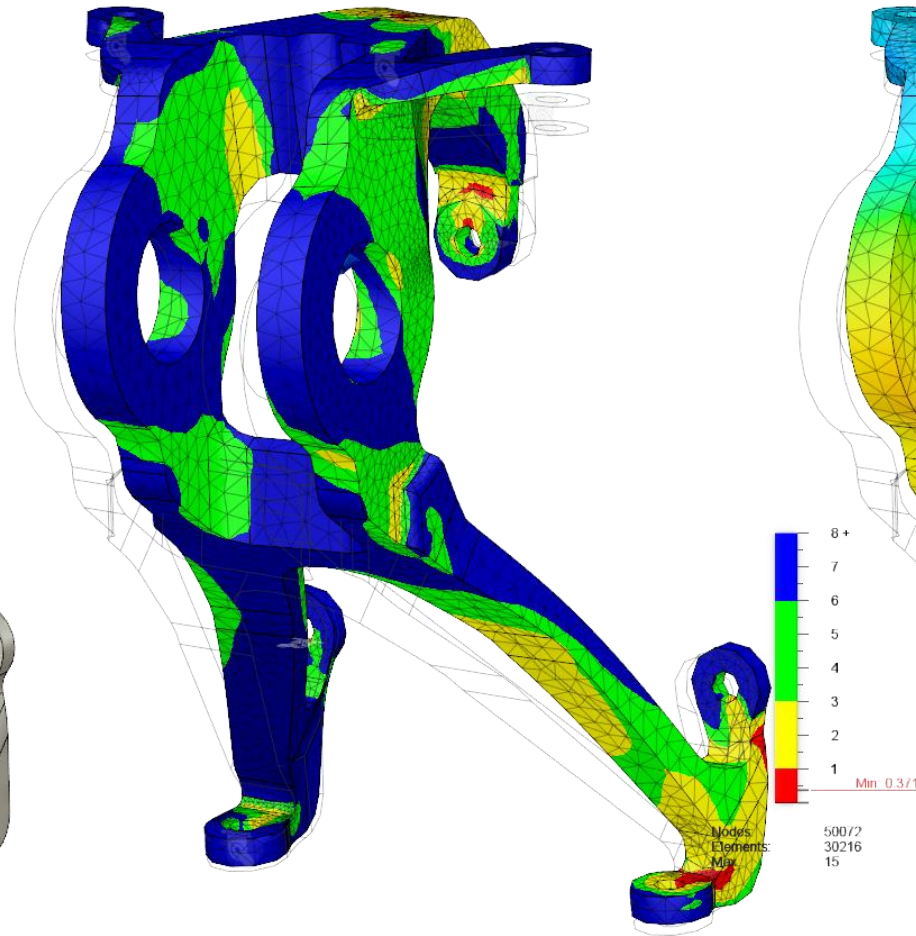
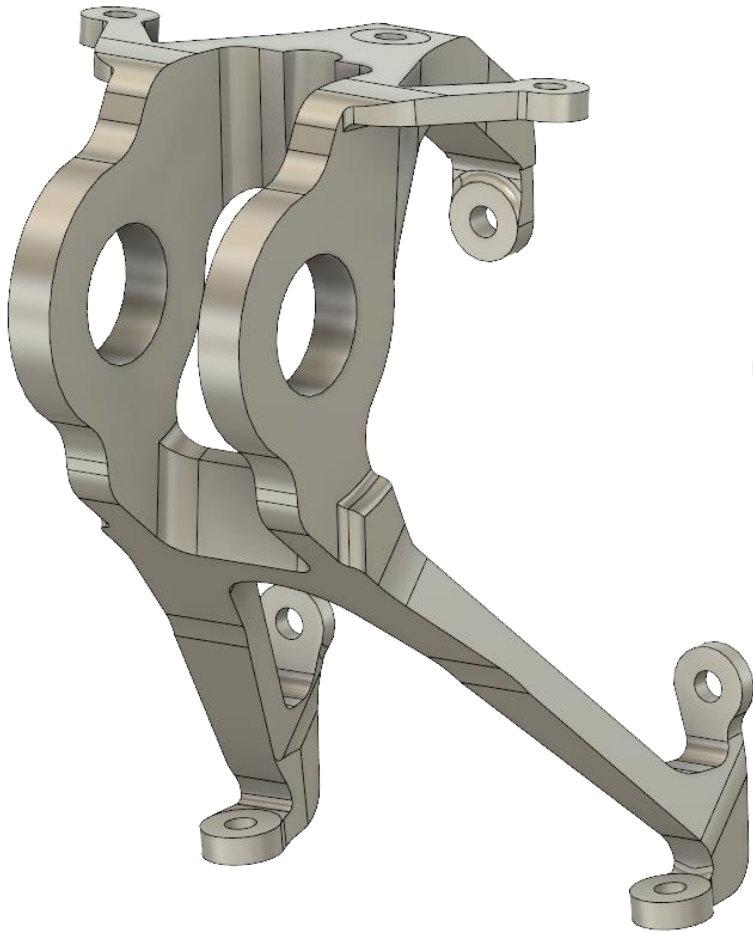


COMMENTS



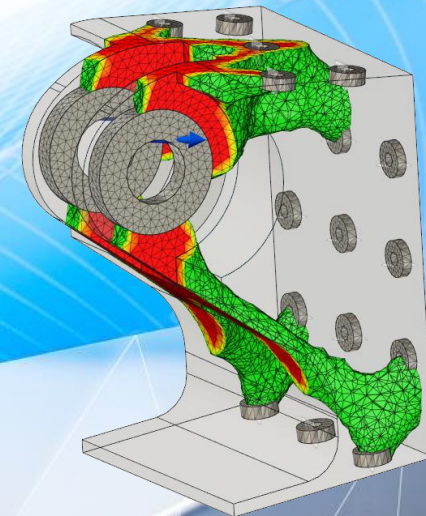
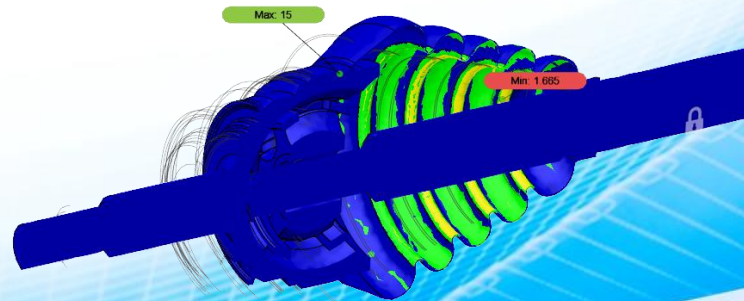
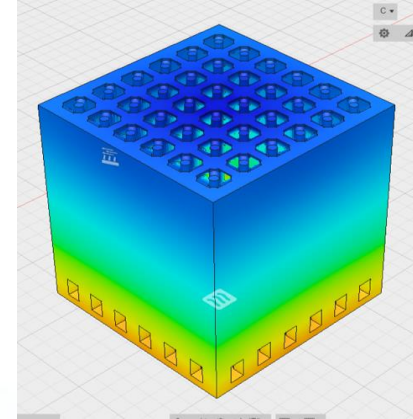
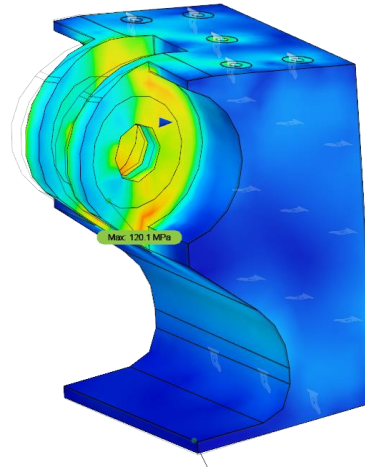
# Shape Optimisation

## Redesign & Validation



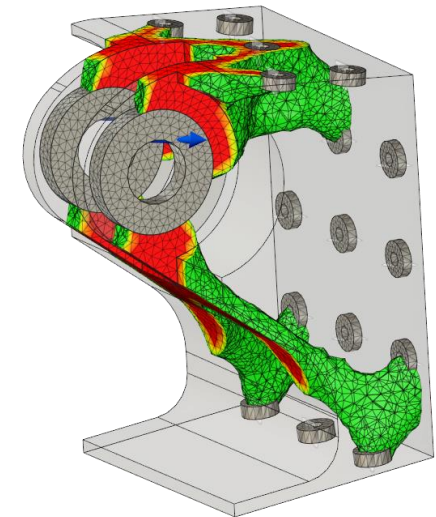
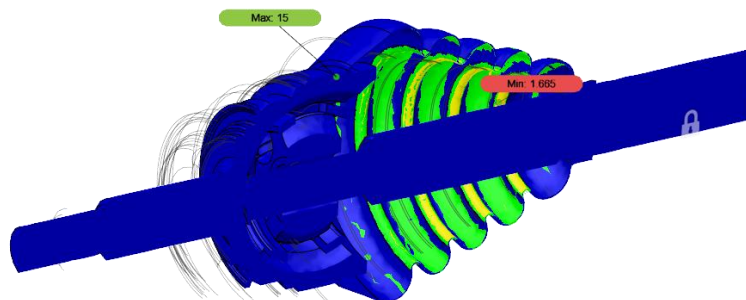
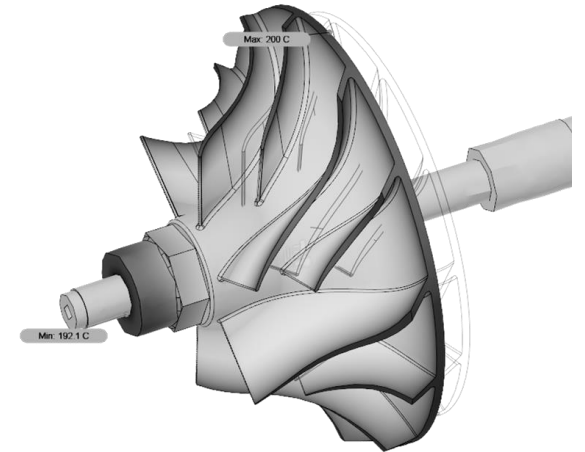
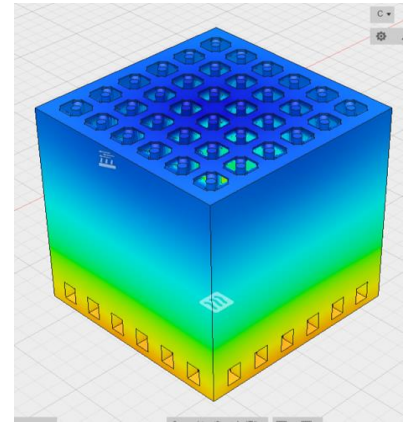
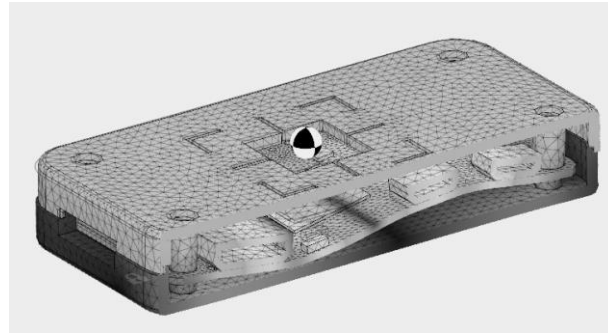
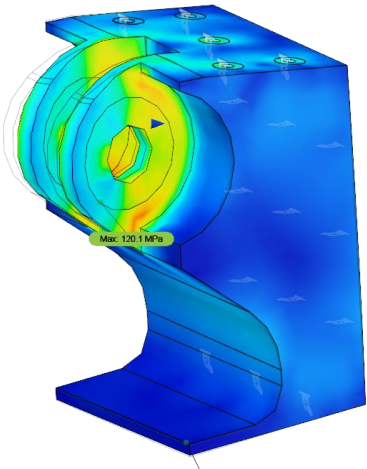
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# Summary



# Summary

## Fusion 360 Simulation Use cases







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