

Stressing Out: Simulation Workspace in Fusion 360

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About me

Elizabeth Bishop

- 2012 – 2017 MEng Mechanical Engineering
- 2016 – 2017 UAV Group Project
- 2017 – 2021 PhD in Large-Scale Additive Manufacturing (3D Printing)
- Maker in Residence at Warwick Engineering Build Space

 @LizBish94

 @WEDesignMake

 Elizabeth Bishop

Learning Objectives

OBJECTIVE 1

Learn about the basics of setting up a simulation in Fusion 360

OBJECTIVE 2

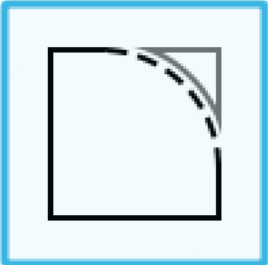
Learn how to understand which simulation study type to choose

OBJECTIVE 3

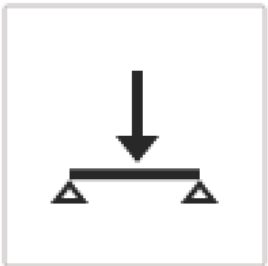
Explore simulation outputs and how to use them in iterative design methods

Simulation Workspace


New Study



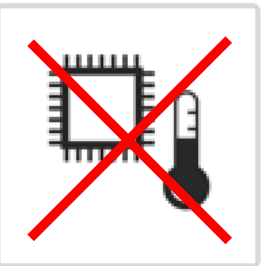
Simplify geometry for use in Simulation



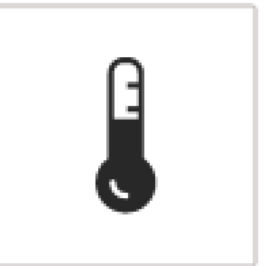
Static Stress



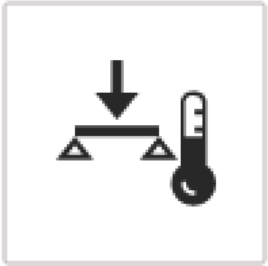
Modal Frequencies



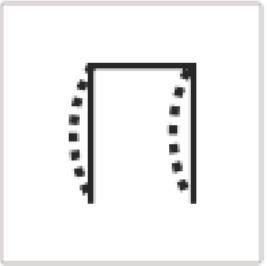
Electronics Cooling (Preview)




Thermal



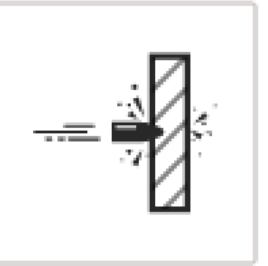
Thermal Stress




Structural Buckling



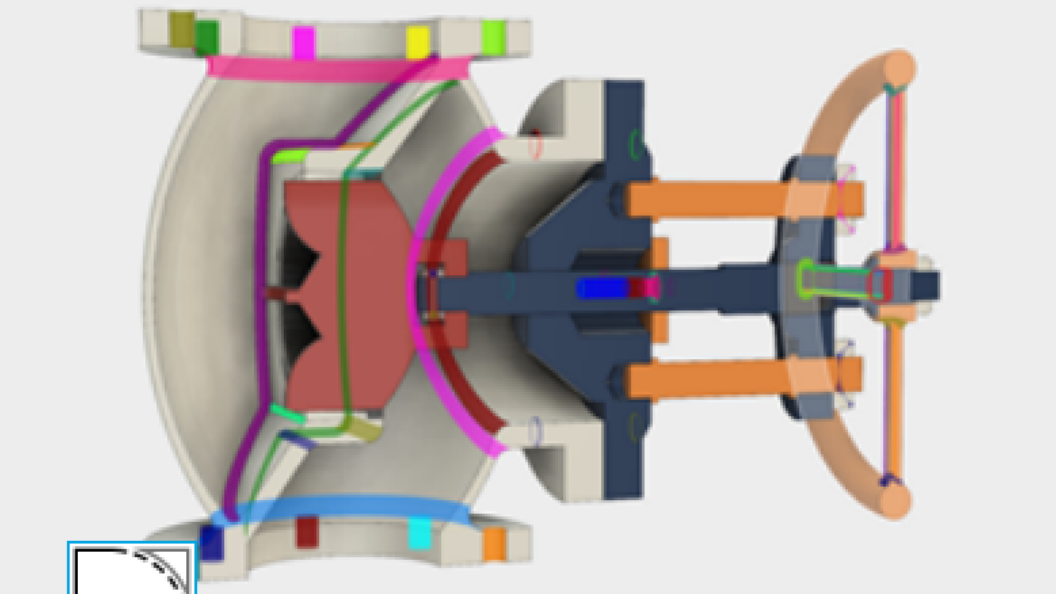
Nonlinear Static Stress




Event Simulation



Shape Optimization





Simplify

Choose "Simplify..." to clean up your CAD model for simulation, or select a study type from the left and "Create Study". You can also choose to simplify your model after you've created a study.

Help me choose a study type.

Simplify Model

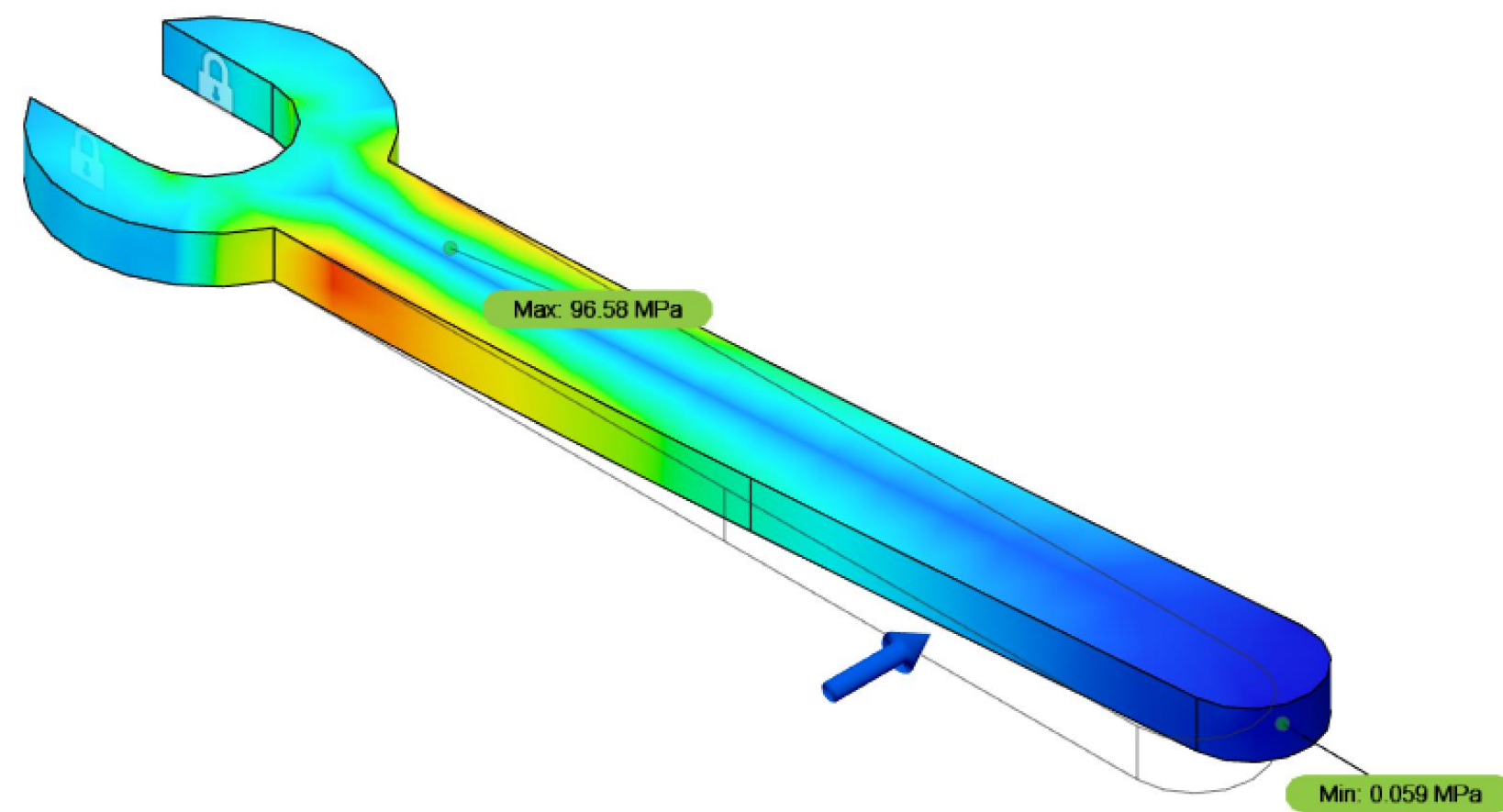
Cancel

Static Stress



Static Stress

SPANNER



SPICE SHELF BRACKET





Spice Shelf Loading



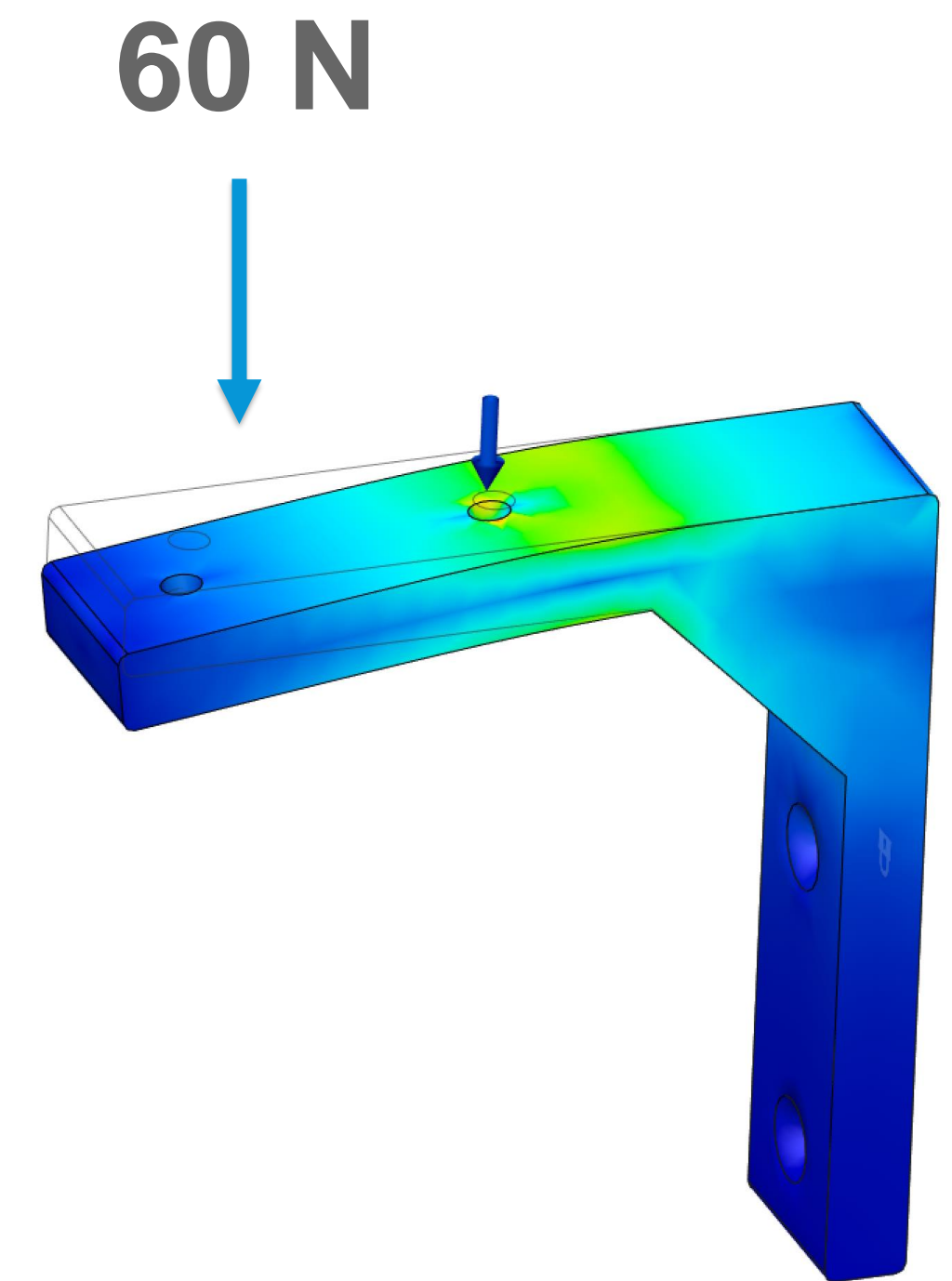
bishs_kitchen

Spice Shelf Loading

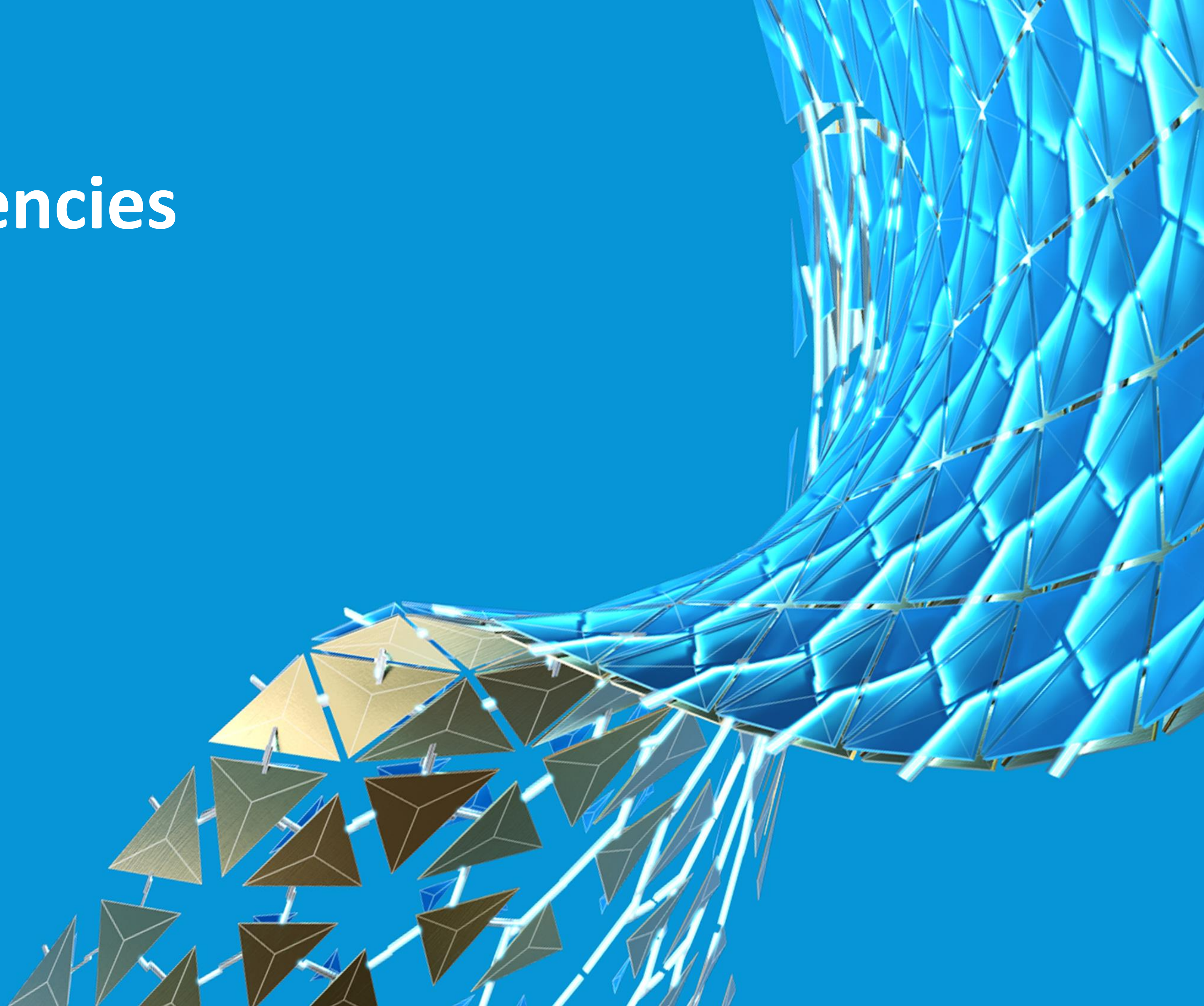


$$150 \text{ g} \times 35 = 5250 \text{ g} = 5.25 \text{ kg} \sim 6 \text{ kg}$$

$$6 \text{ kg} \times \text{gravity} = 60 \text{ Newtons}$$



Modal Frequencies

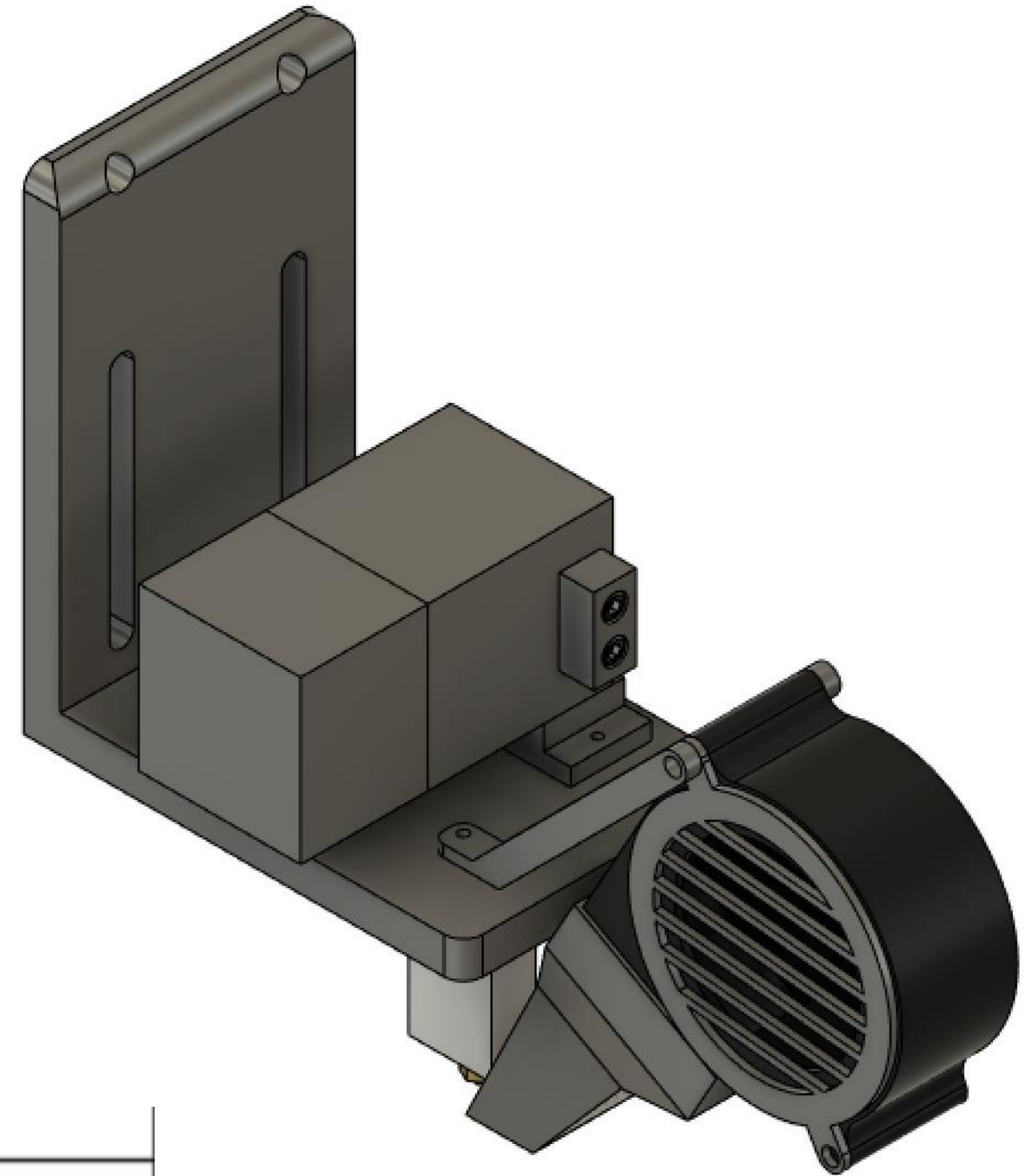


Modal Frequencies

- Don't want driven speed/frequency to be close to the part's natural or resonate frequency
- Fan spins at 3000 rpm = $3000 / 60 = 50$ rev per second = 50 Hz
- Avoid 50 Hz



Input Power	2.88 W
Rated Speed (RPM)	3000
Airflow (CFM)	10

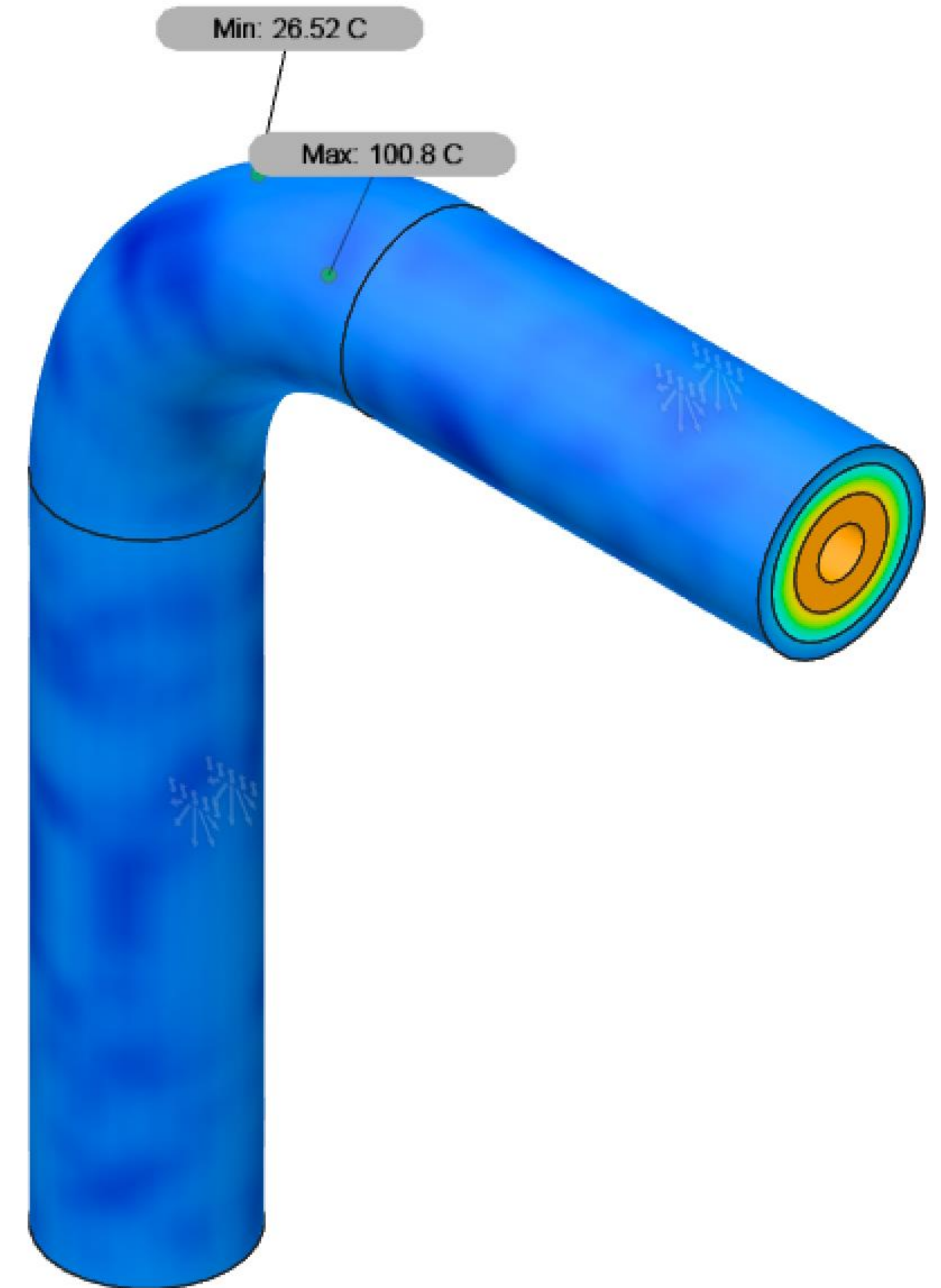


Thermal

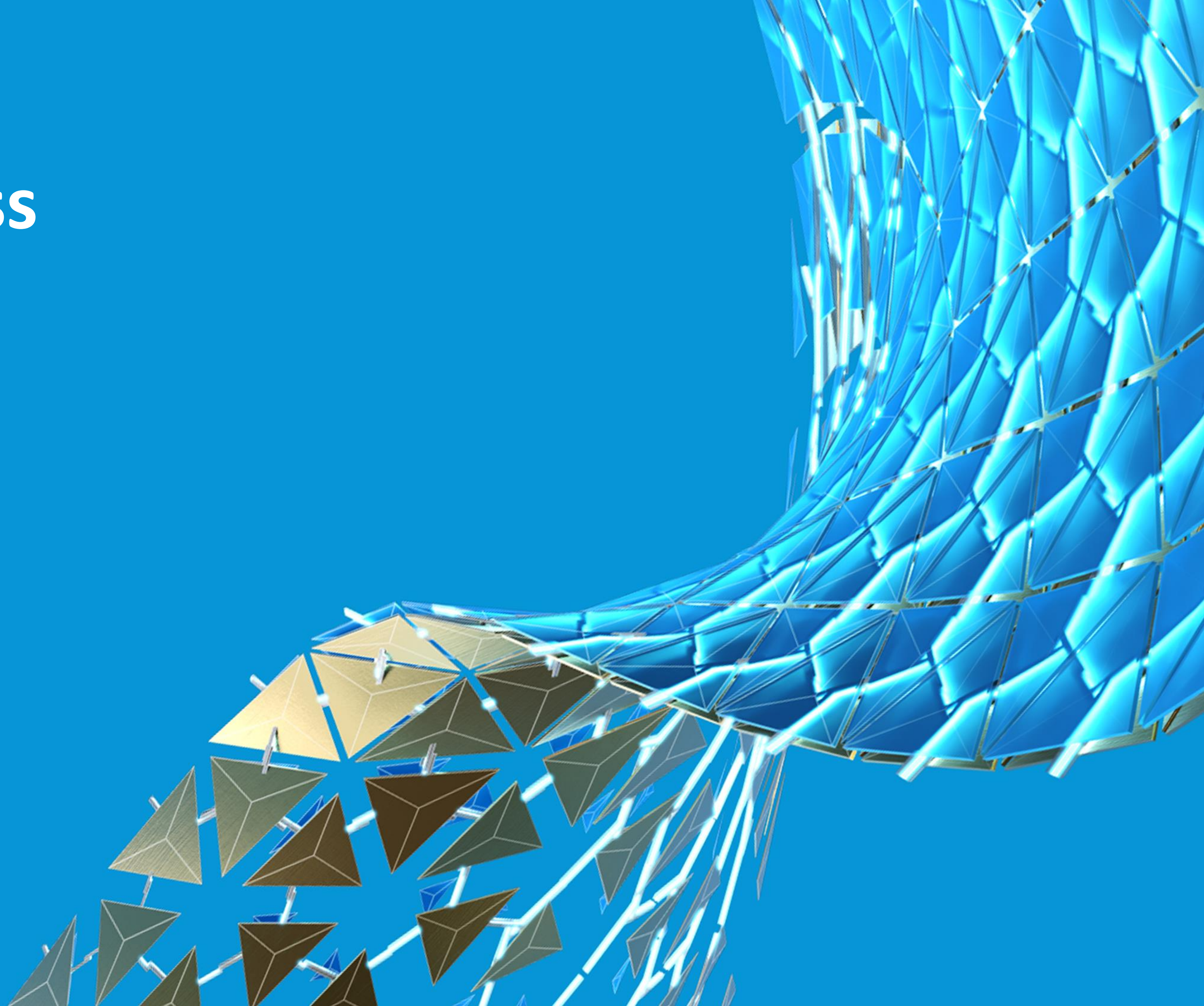


Thermal Analysis

- **Used to model thermal problems e.g.**
 - Cooling Fins
 - Insulations
- **Insulating a Pipe**
 - Explore different insulation materials
 - Explore different insulation thicknesses

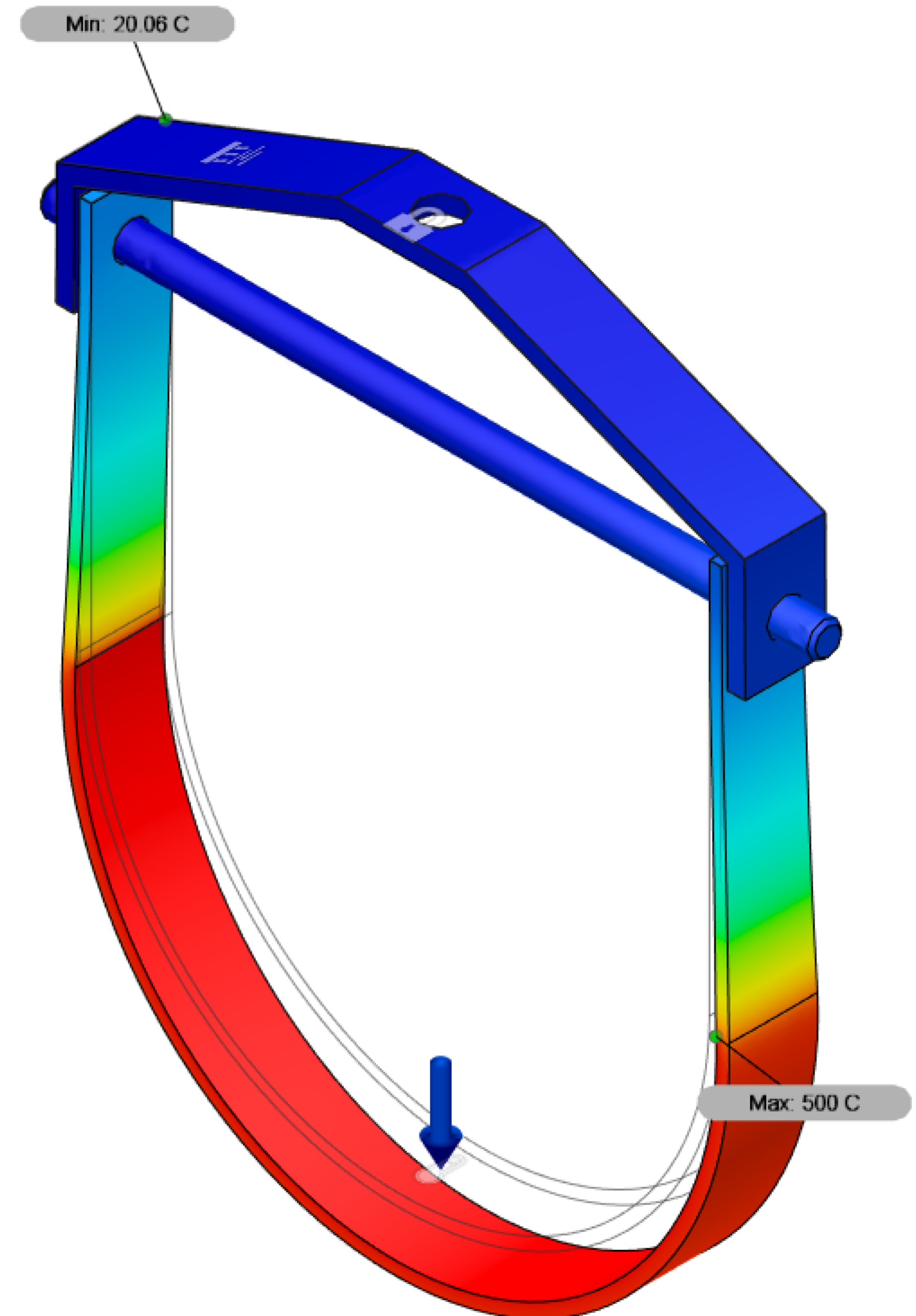


Thermal Stress

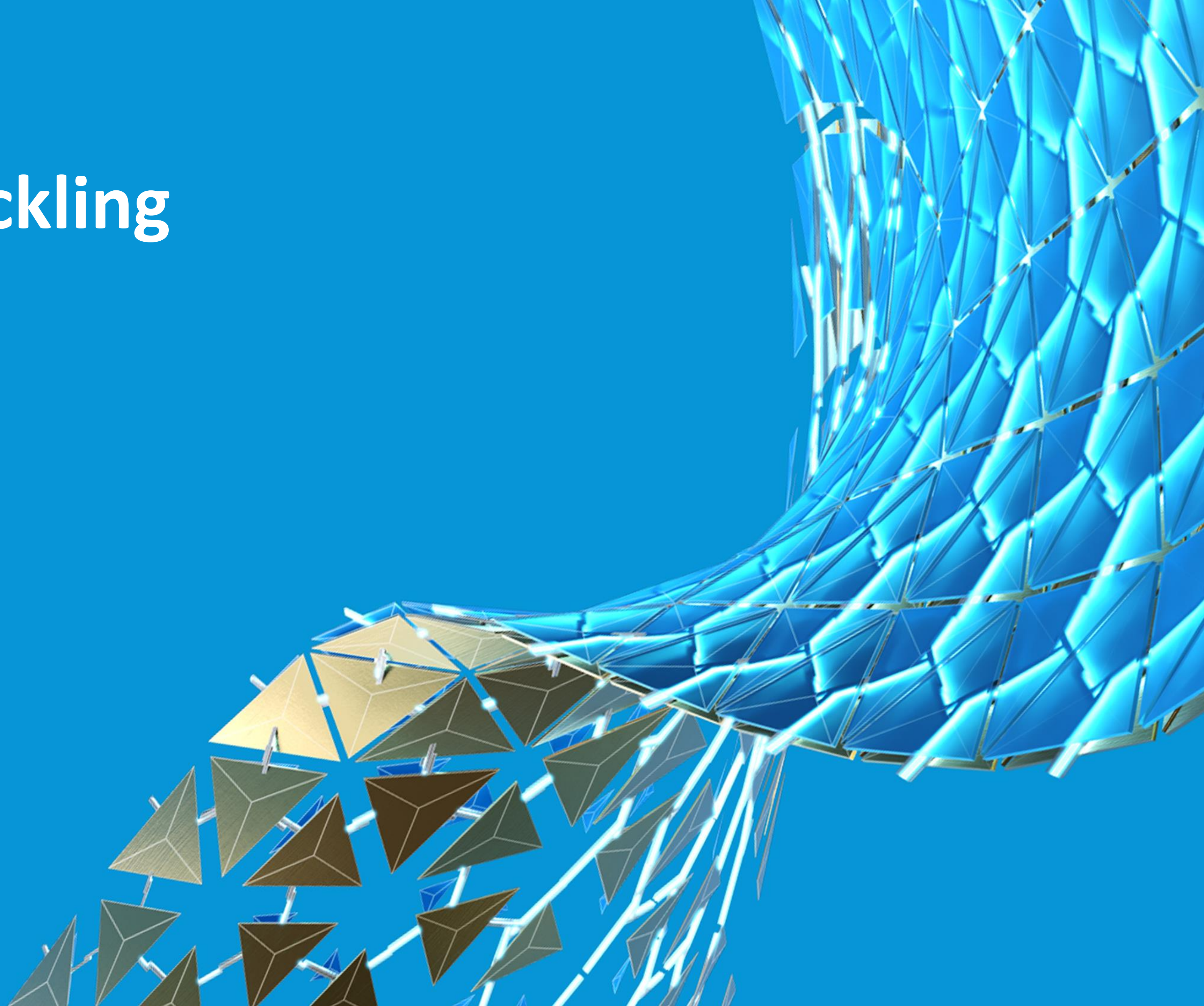


Thermal Stress

- Simulate both static stress and thermal in the same set up
 - Consider the thermal stress on a high temperature steam pipe hanger

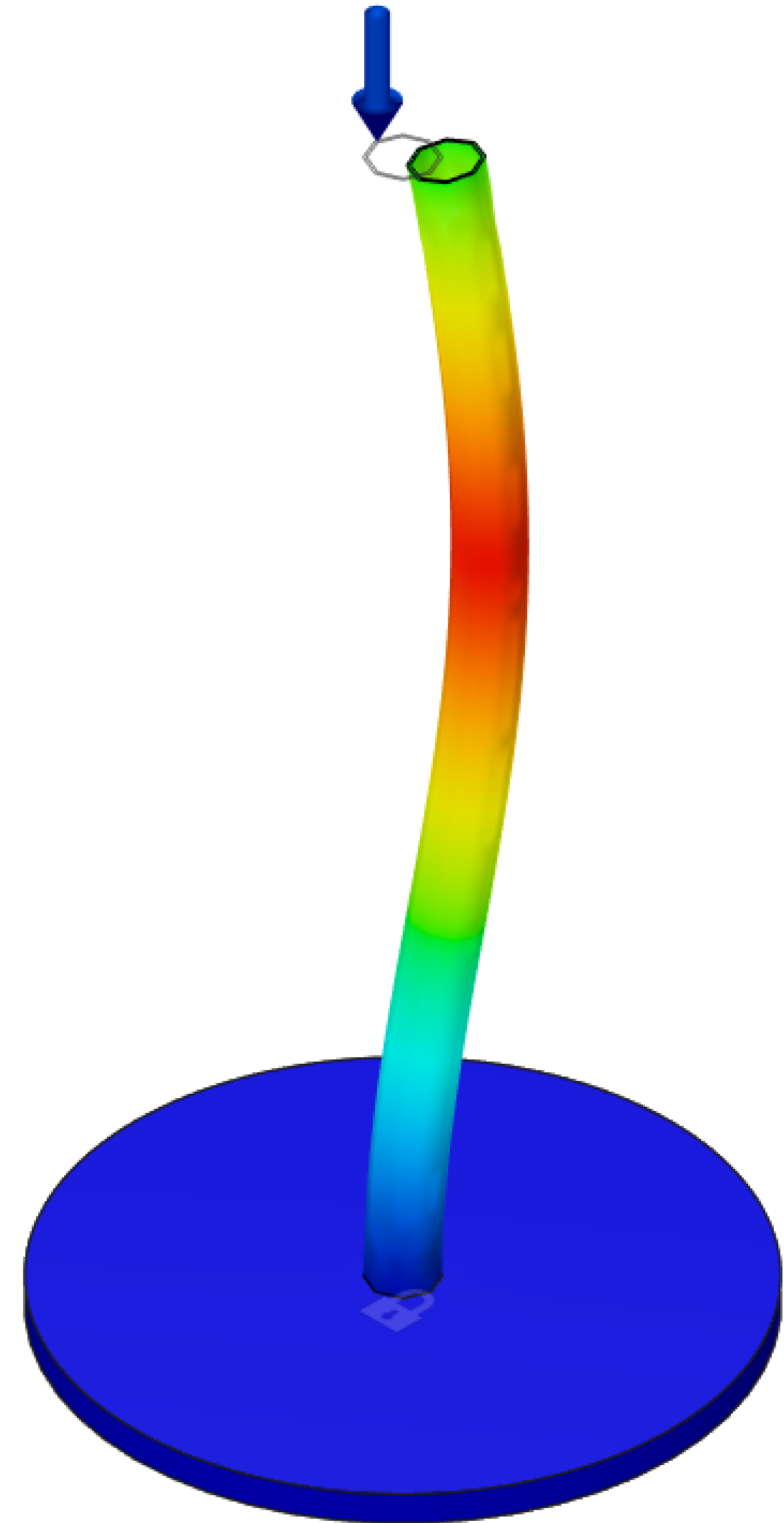


Structural Buckling



Structural Buckling

- Buckling is a sudden change in shape of an object when subjected to compressive forces
- Usually happens when the length is long compared to the cross sectional area of the object
- Very different response compared to standard compression



Bar Stool Example



Tested for: 110 kg

Width: 38 cm

Depth: 36 cm

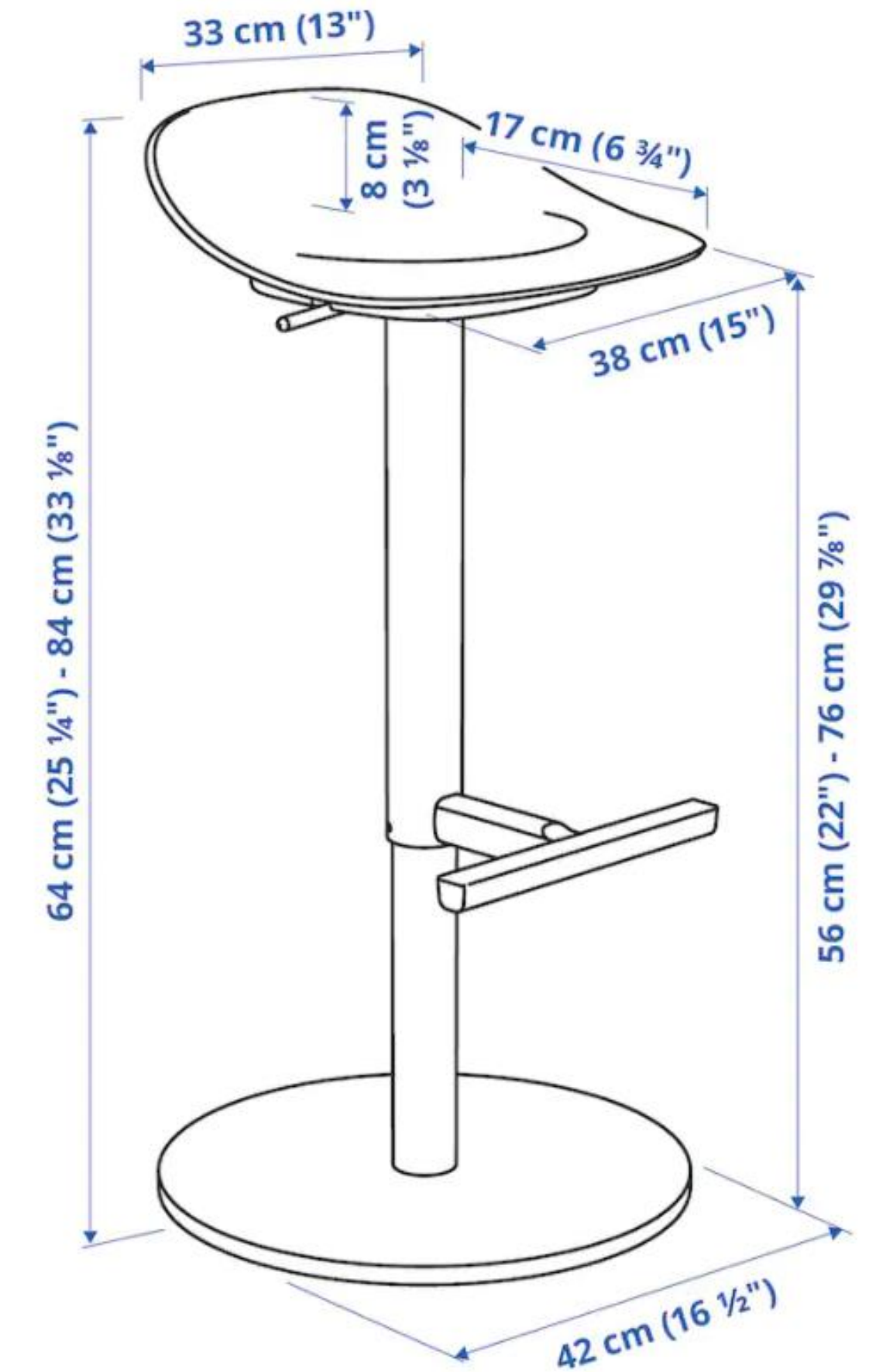
Height: 84 cm

Diameter: 42 cm

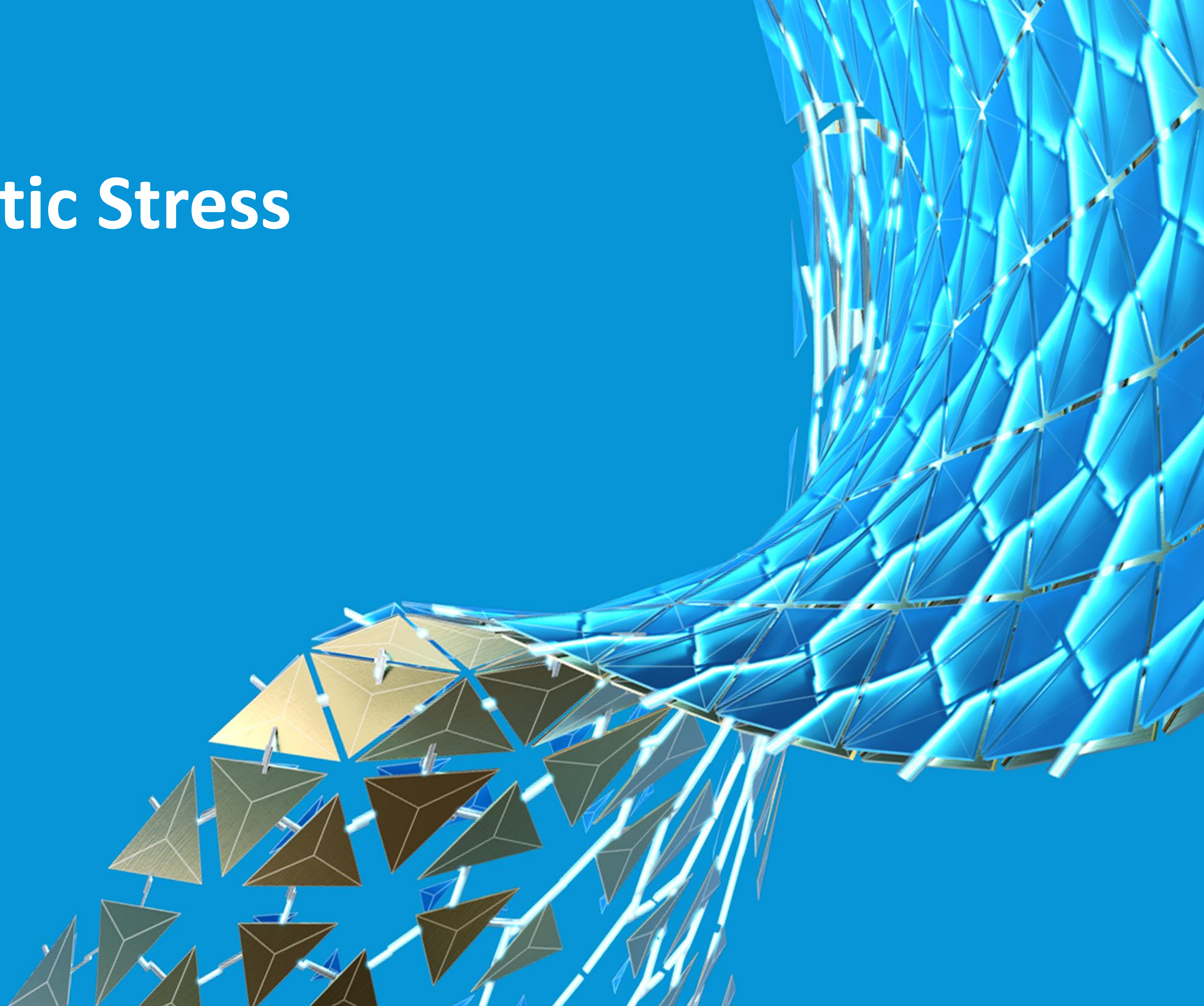
Seat height: 76 cm

Min. seat height: 56 cm

Max. seat height: 76 cm

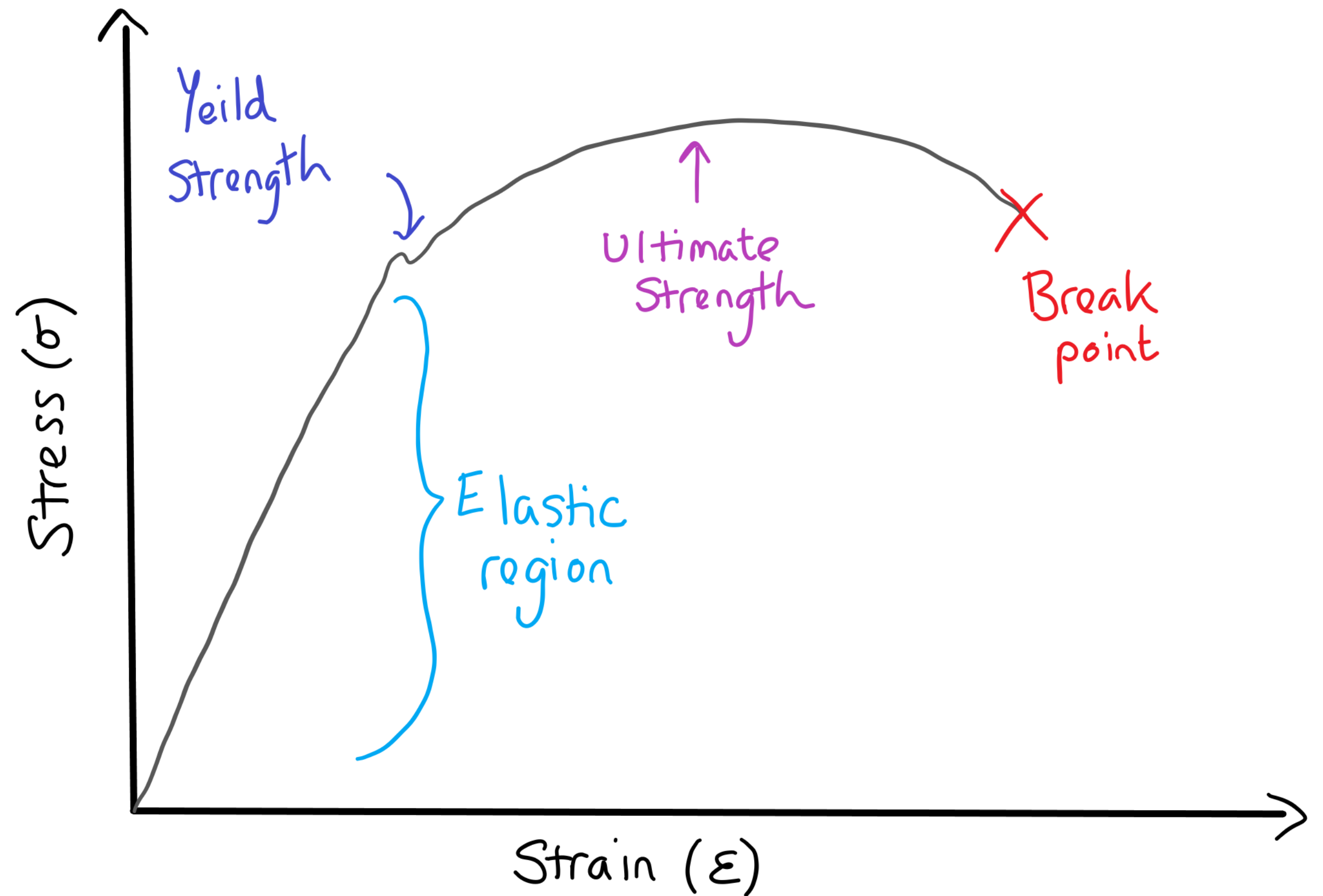


Nonlinear Static Stress

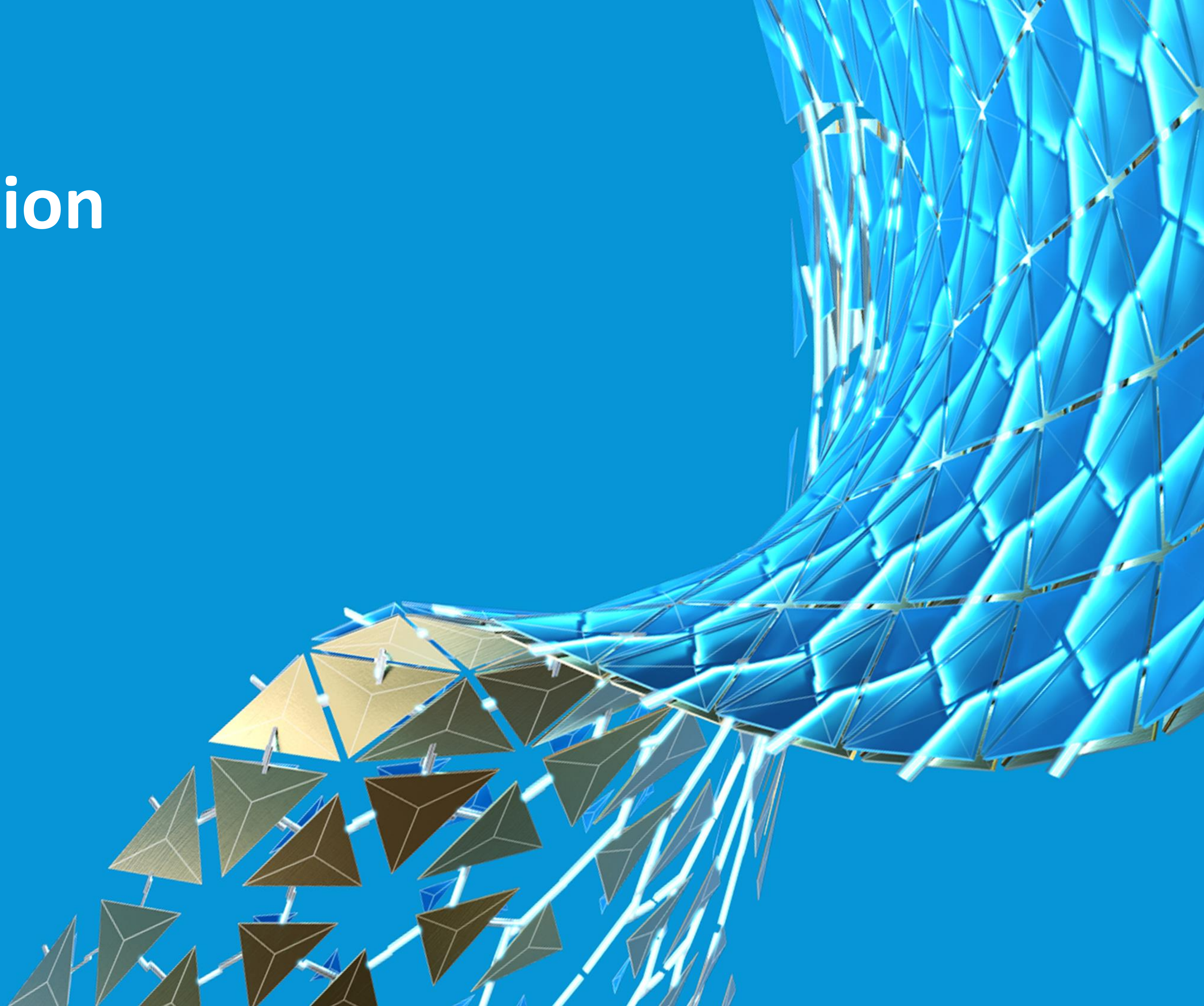


Nonlinear Static Stress

- Take into account the non-linear properties of materials

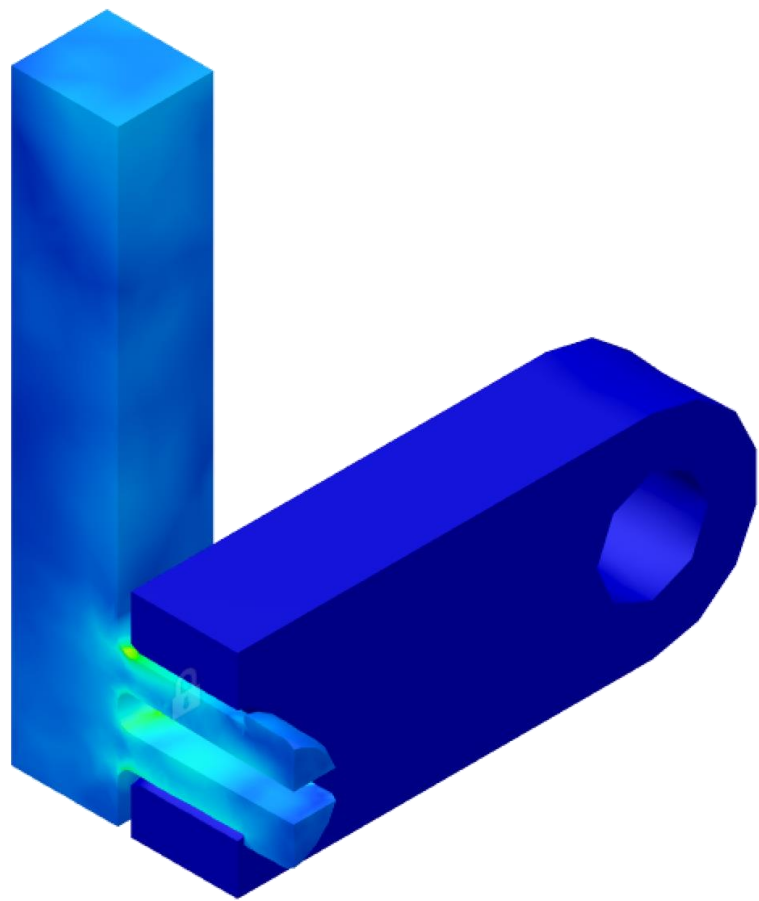


Event Simulation

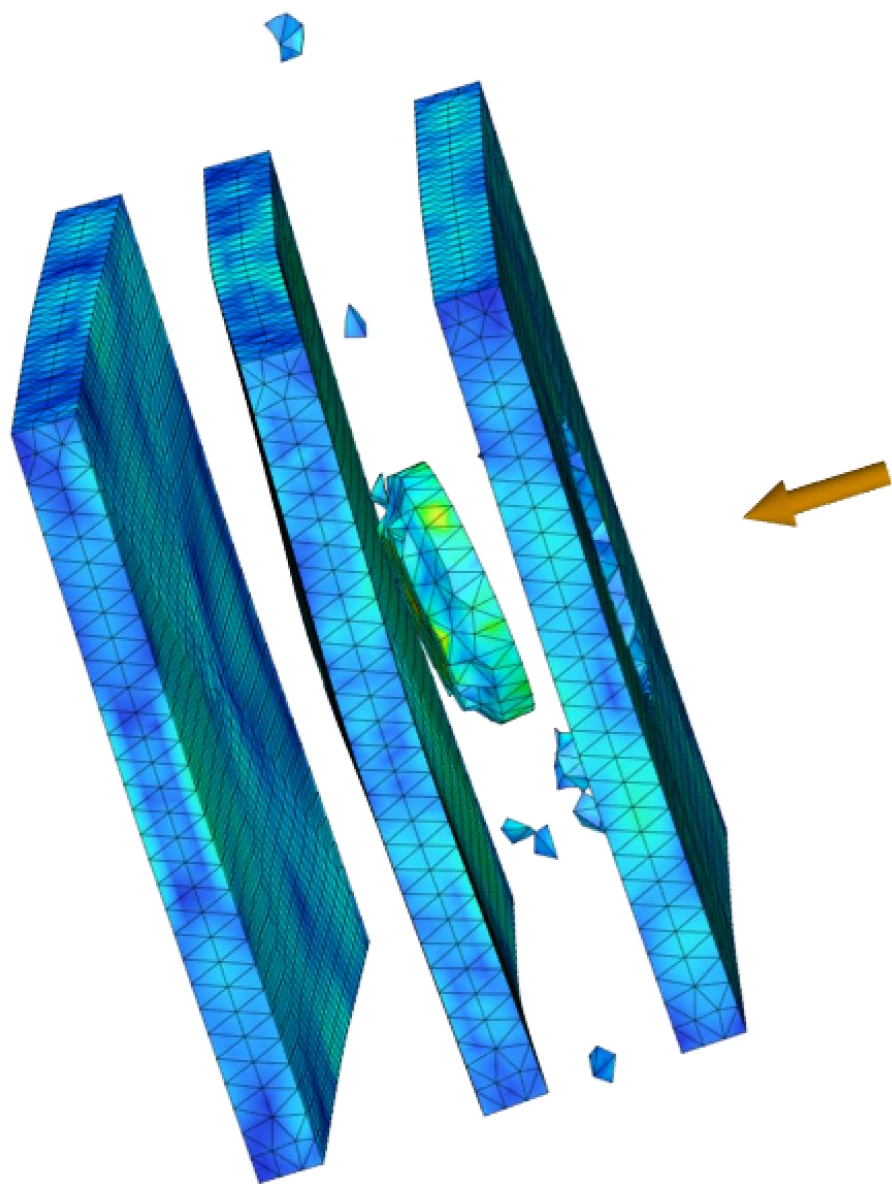


Event Simulation

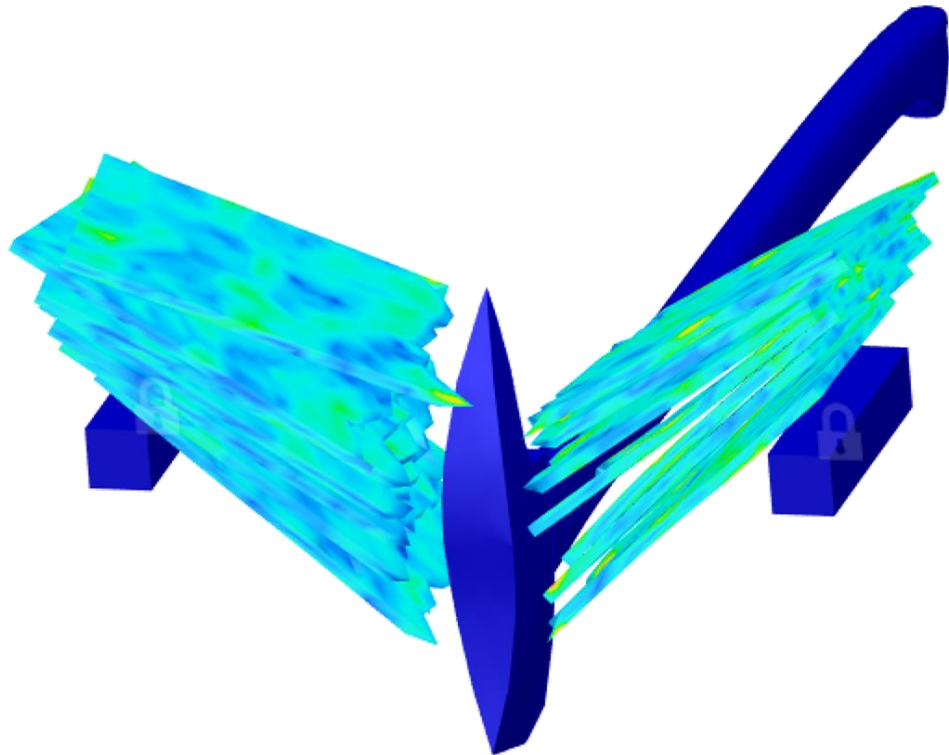
SNAP FIT CONNECTOR



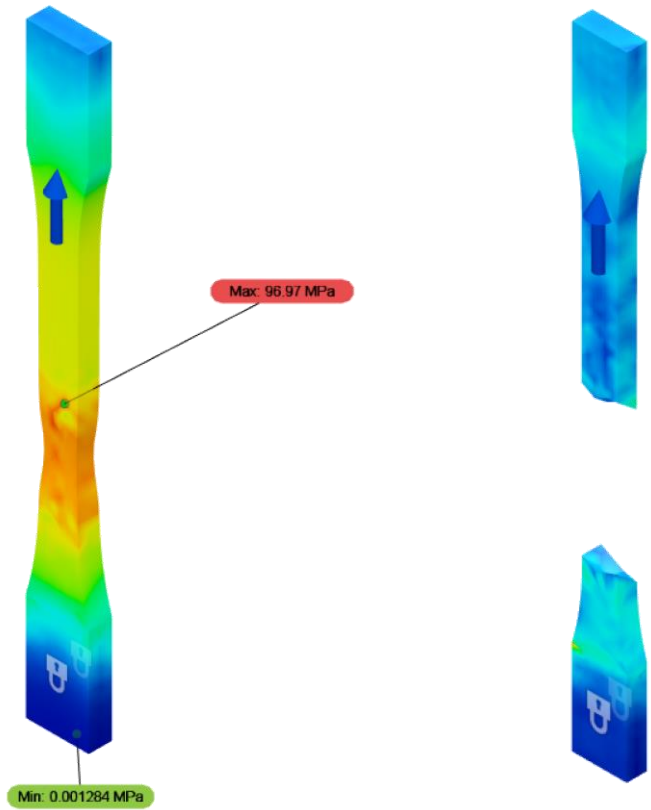
WALL IMPACT



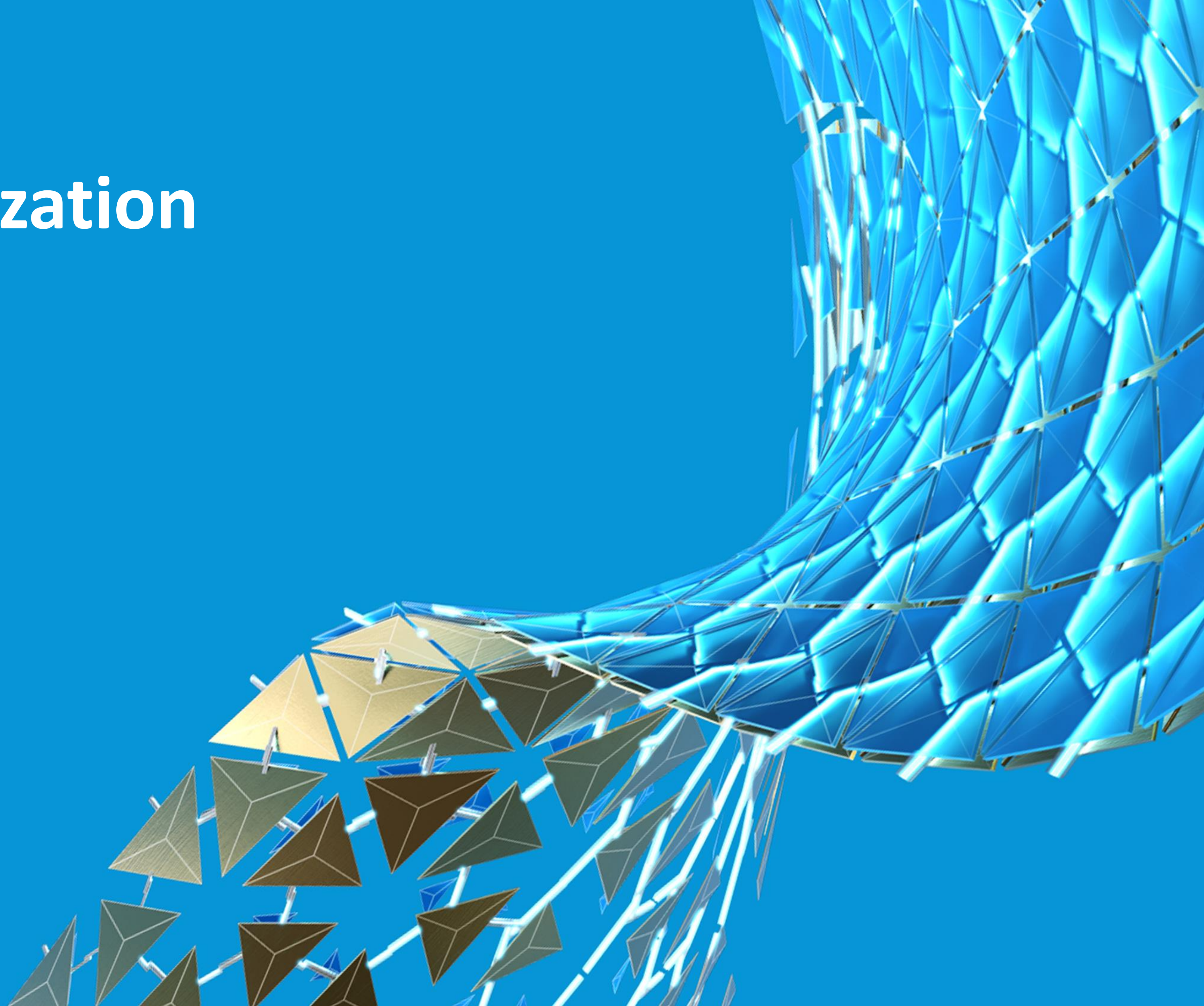
AXE CHOP



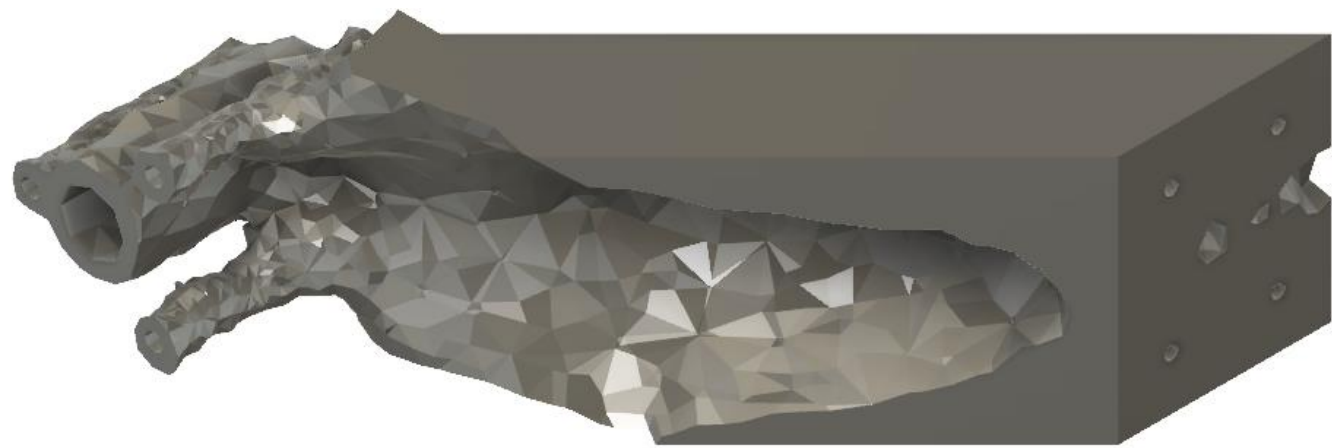
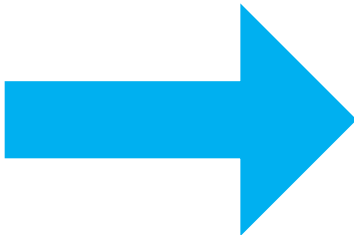
TENSILE TEST



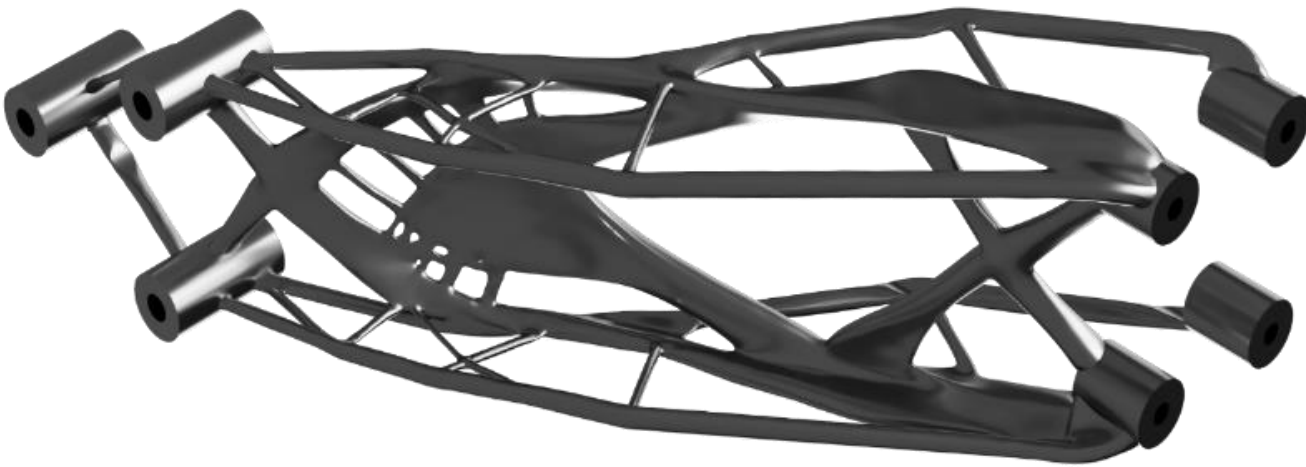
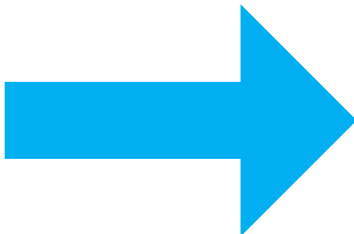
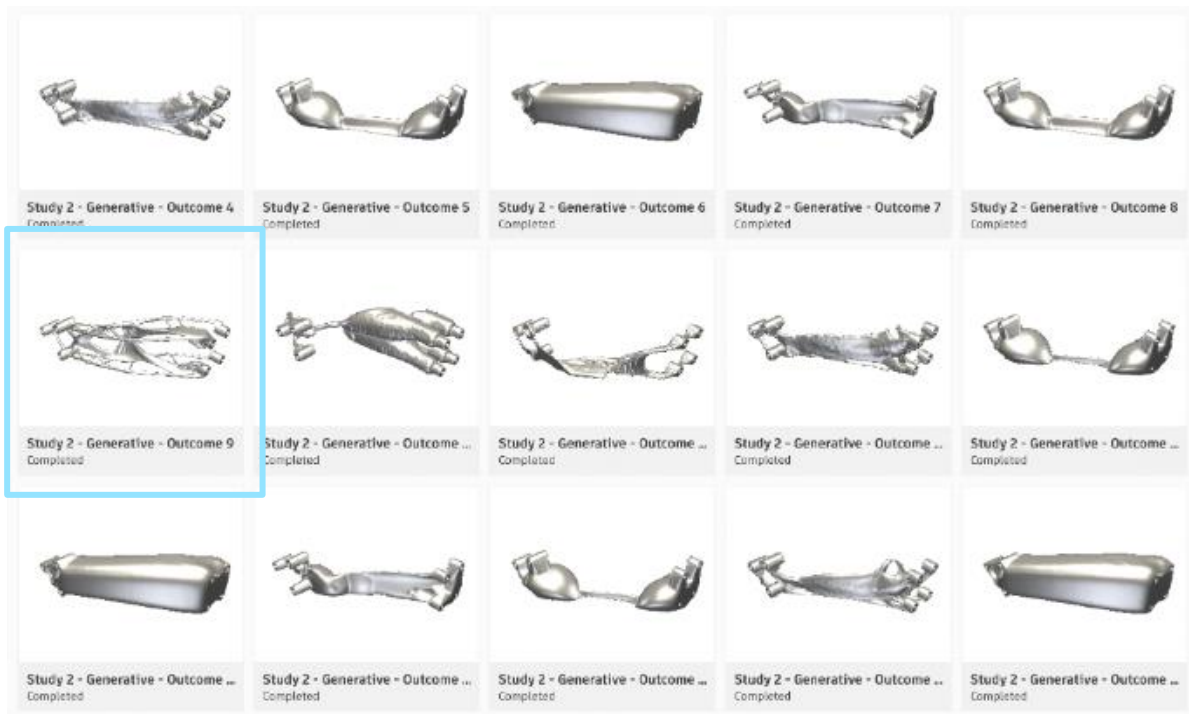
Shape Optimization



SHAPE OPTIMISATION

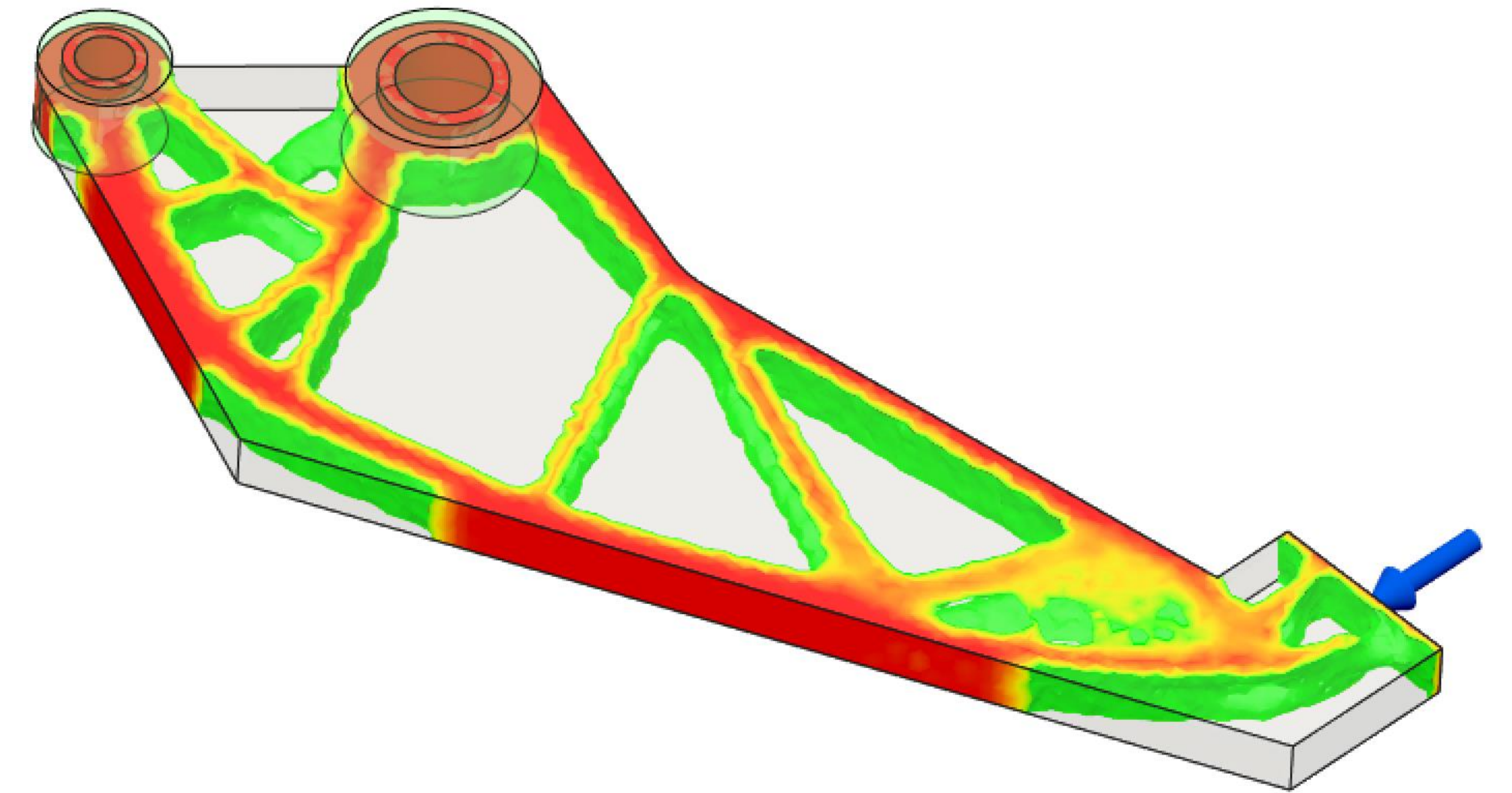
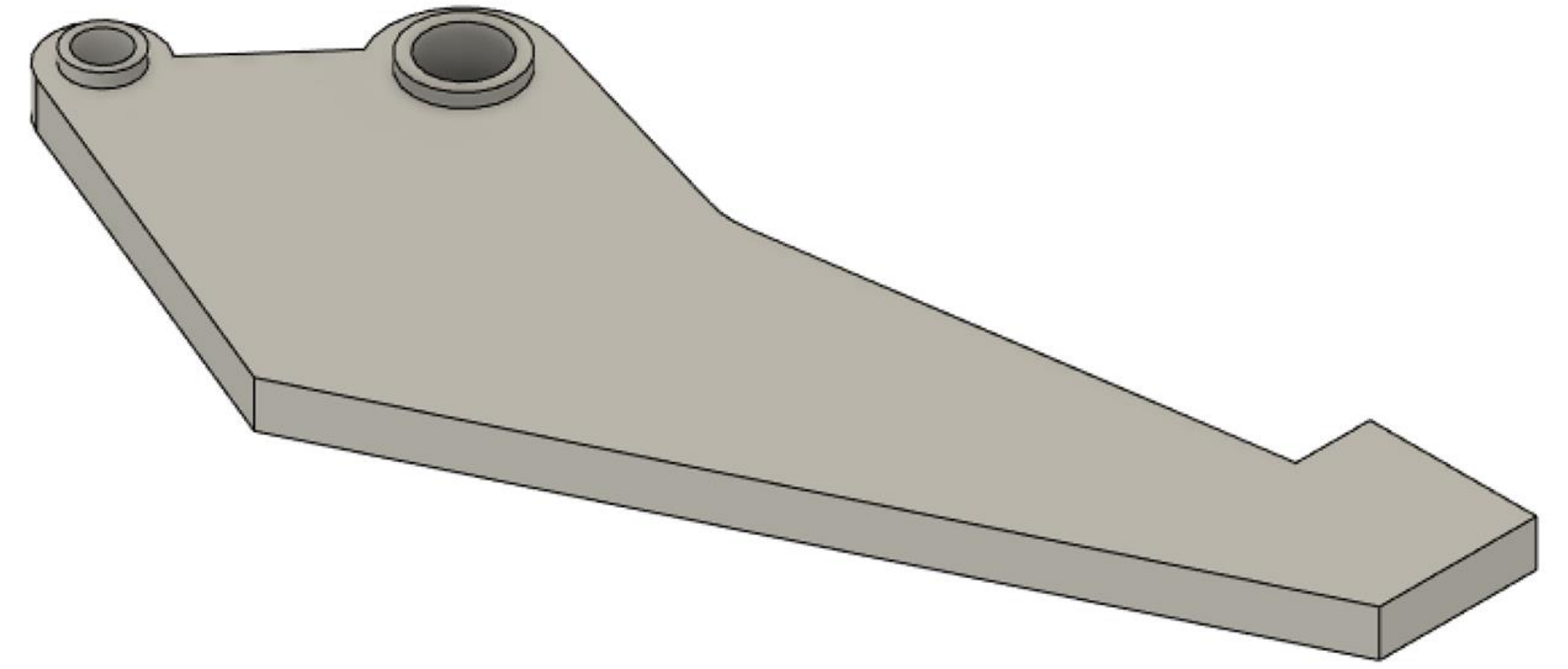


GENERATIVE DESIGN



Shape Optimization

- Mass target
- Remove material along non-critical paths
- Iterative design influence



Conclusions



Summary

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3D Printing PPE: A Three Minute Face Shield Solution



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