Become a simulation expert within 60 minutes

Wasim Younis

Simulation Manager @ Symetri

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AUTODESK UNIVERSITY

About the speaker

Wasim Younis – Symetri

Very passionate about Simulation and a strong believer that simulation is easy and is for all designers out there in the world making great innovative products. I have been teaching simulation for many years, lost count. I know I don’t look that old. Any how here are my contact details in case you would like to reach out to me.

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LinkedIn: https://www.linkedin.com/in/wasimyounis/

So we all want to become Stress Experts

…. So we can effectively reduce stress
in our day-to-day workplace 🙂……

Well actually to make great products

…. Need something more than just hand calculations and guess work (I mean to say intuition) ……….

Which are also not over-designed

…. As we can explore more digitally as physical testing takes to much time and costs £££££ ………

Simulation – Digital Testing

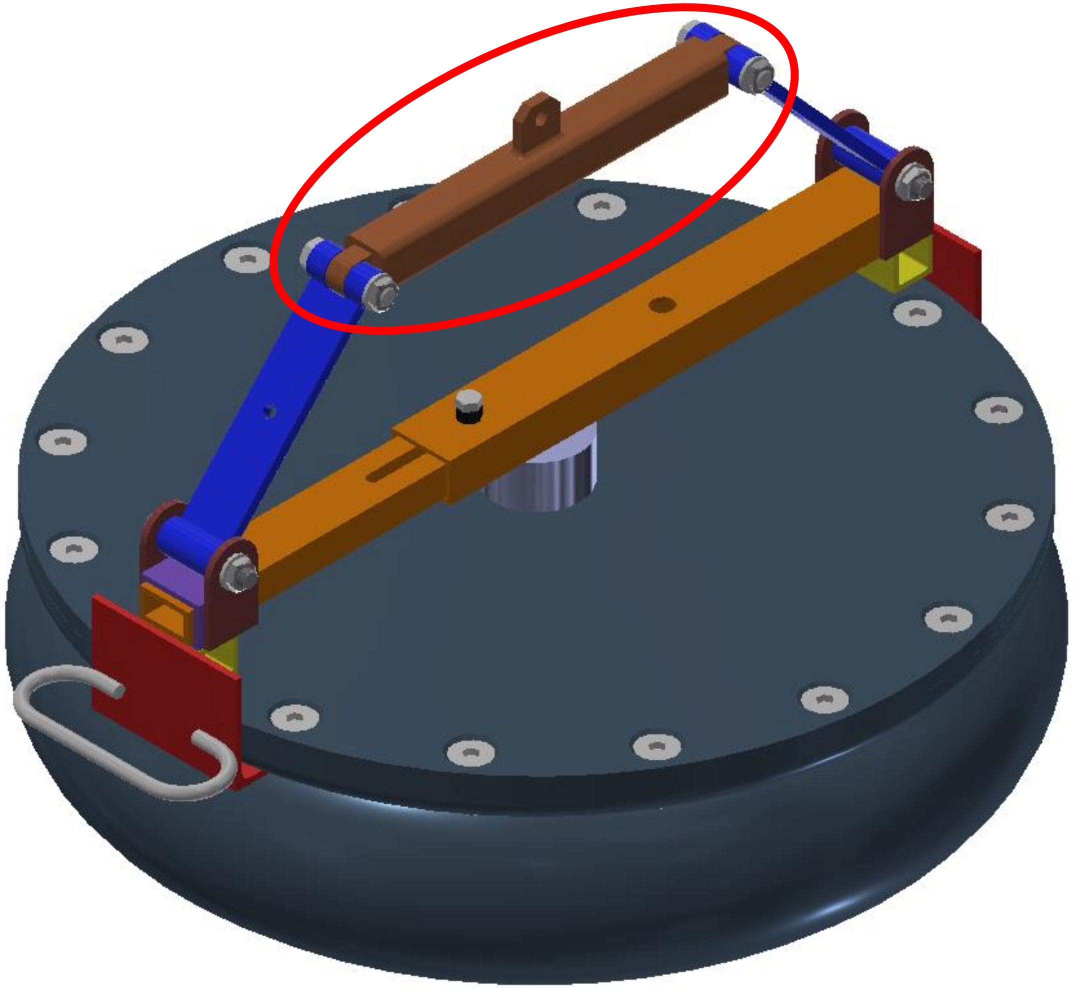
To explore – what if?

1. Do I need a thicker plate?
2. Can I remove more material?
3. Do I need to add more stiffening rings?
4. Can I increase load?
5. And more…..?

Lets take a simple example

…. To see benefits of simulation ……

Benefits of Simulation– Lets take a simple example



Tools Available

Benefits of Simulation– Lets take a simple example

$$\sigma = M x \frac{y}{I}$$

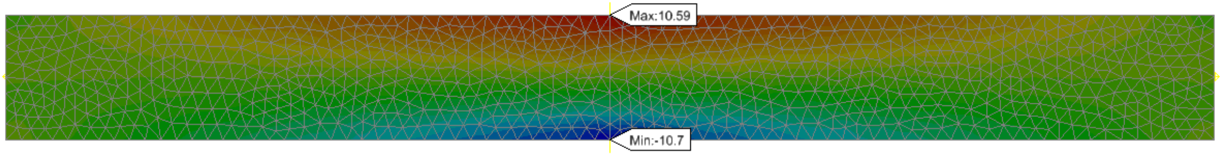
Load is applied centrally on the beam, therefore to find the maximum bending moment, we can use:

M = P x L / 4
= 780N * 390mm / 4
= 76050 Nmm

y = Distance to neutral axis
= Section height / 2
= 40mm / 2 = 20 mm

I = 2nd Moment of Area (for box section)
= Outer 2nd Moment of Area - Inner 2nd Moment of Area
= $(BD^3 / 12) - (bd^3 / 12)$
= $(40 \times 40^3 / 12) - (30 \times 30^3 / 12)$
= 2560000- 675000
= 145833 mm^4

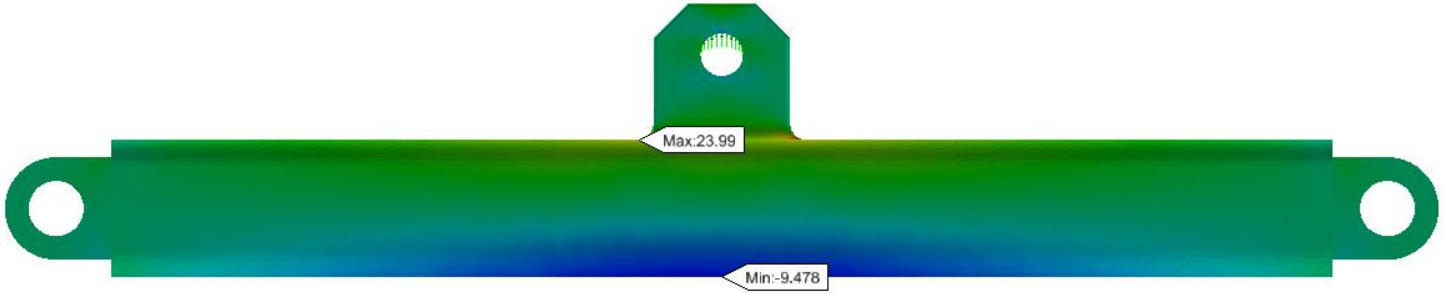
Therefore, Max Tensile or Compressive Stress due to bending is:
σ = 76050 x 20 / 145833
= 10.43N/mm^2 = 10.43×10^6 N/m^2 = **10.43 MPa**

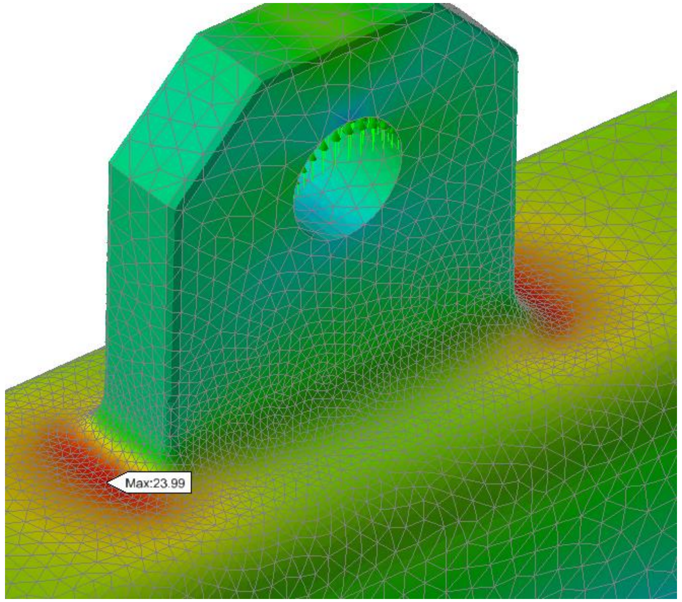


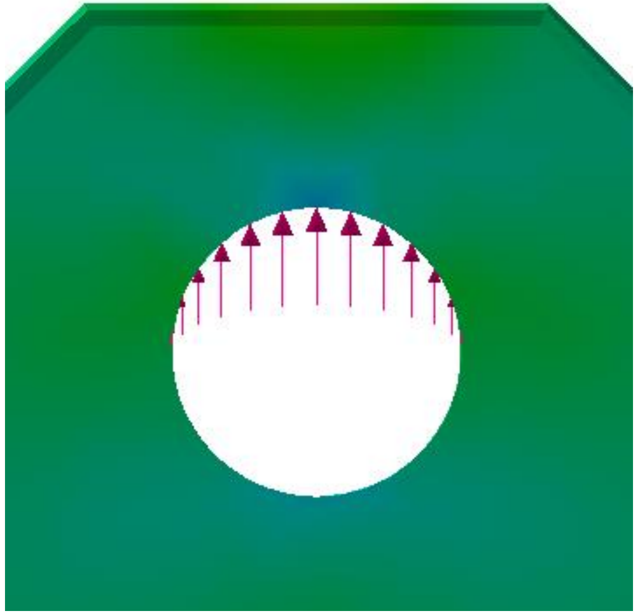
Tools Available

1. Hand Calculations

Benefits of Simulation– Lets take a simple example



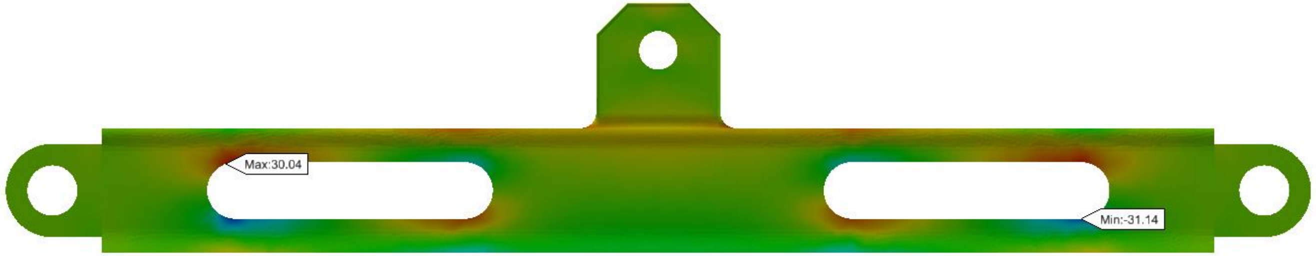


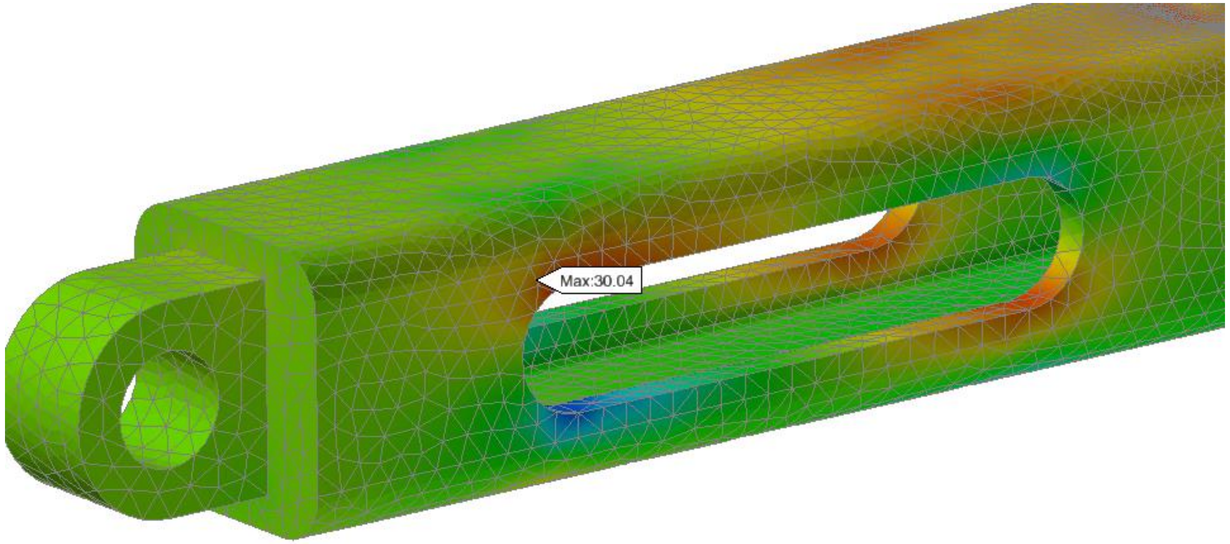


Tools Available

1. Hand Calculations
2. Upfront Simulation

Benefits of Simulation– Lets take a simple example





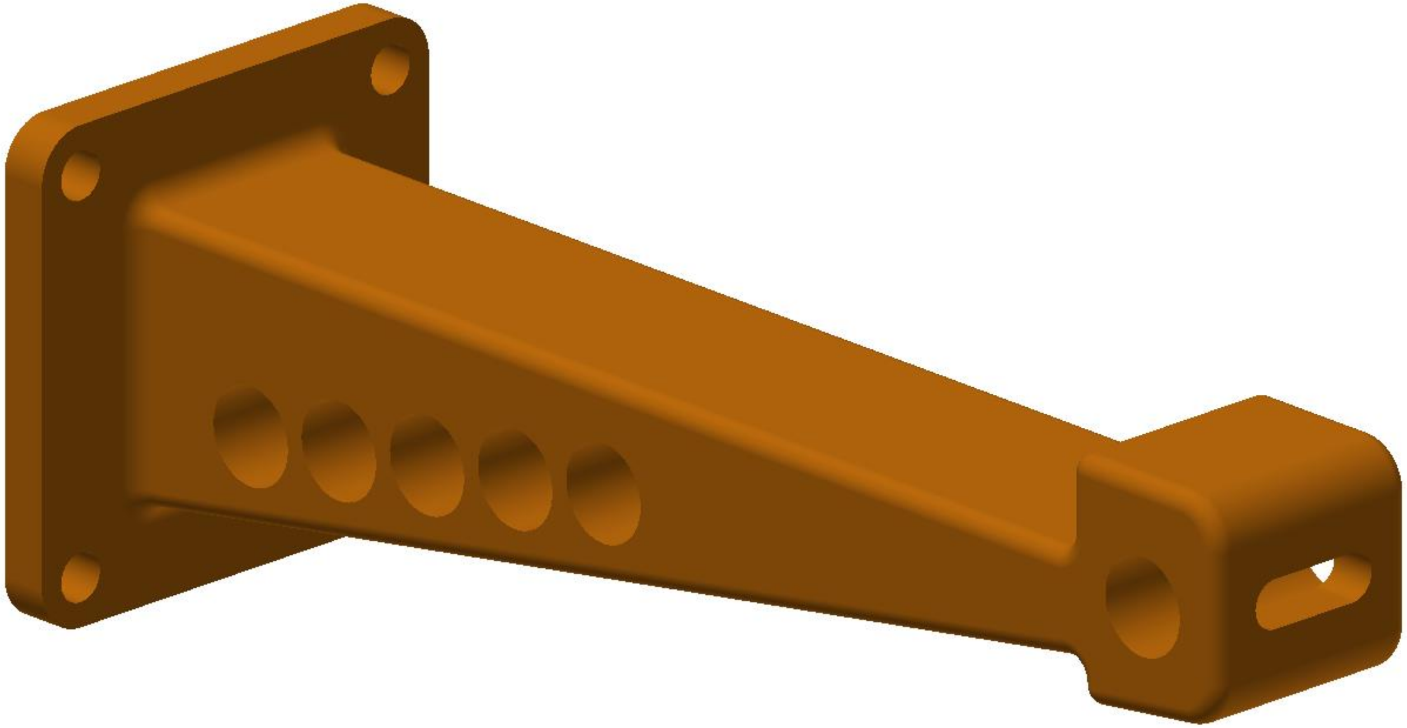
Tools Available

1. Hand Calculations
2. Upfront Simulation
3. Optimisation

We got 45 mins lefts

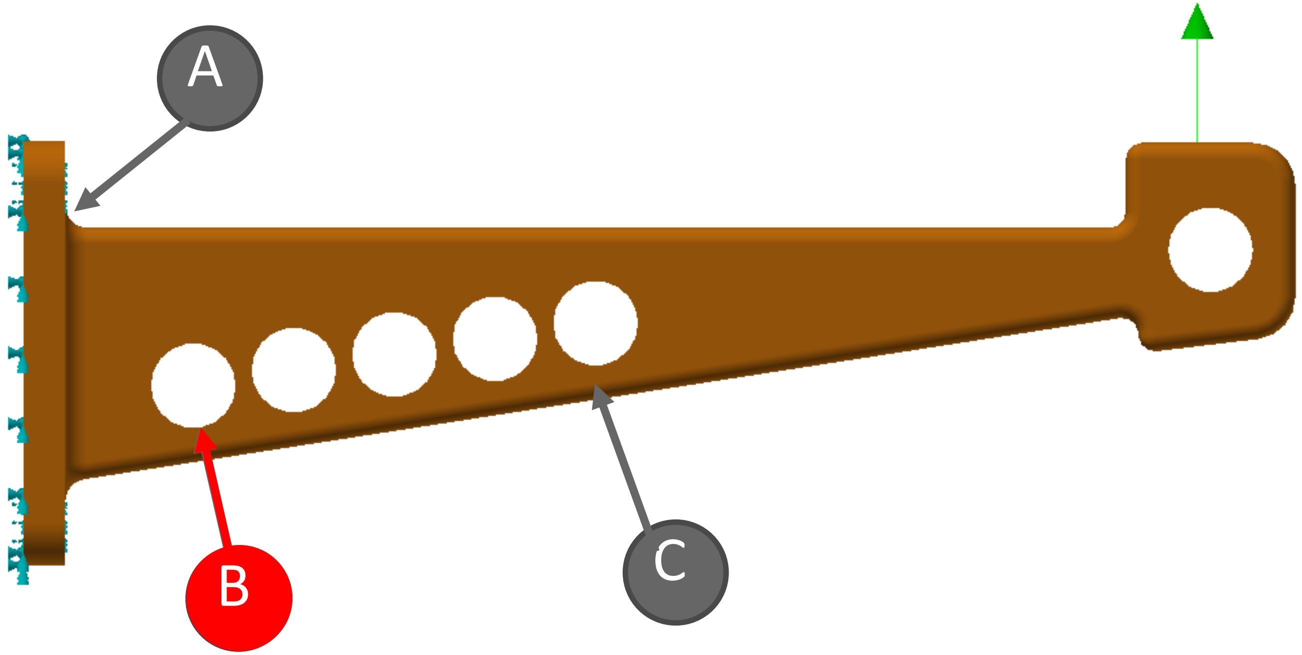
.... Can we really master Simulation in that time????..

The big Myth – Stopping widespread adoption of Upfront Simulation



Are my results correct?

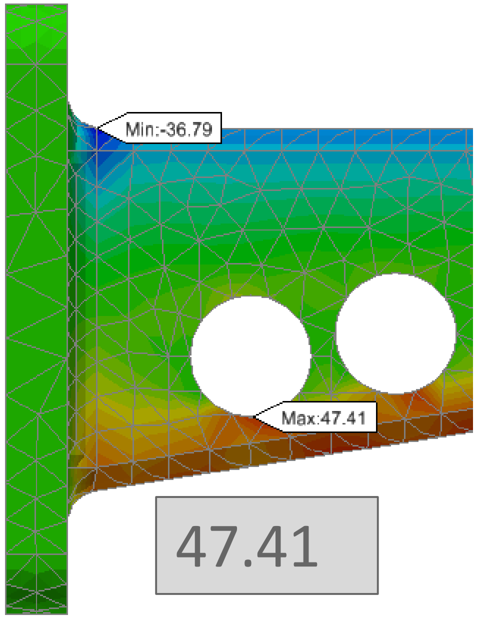
The big Myth – Stopping widespread adoption of Upfront Simulation

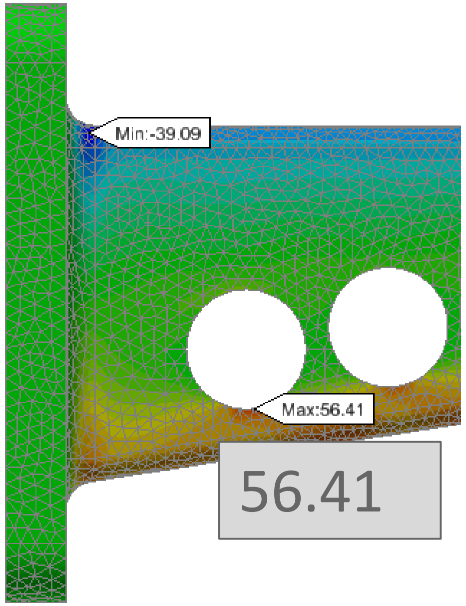


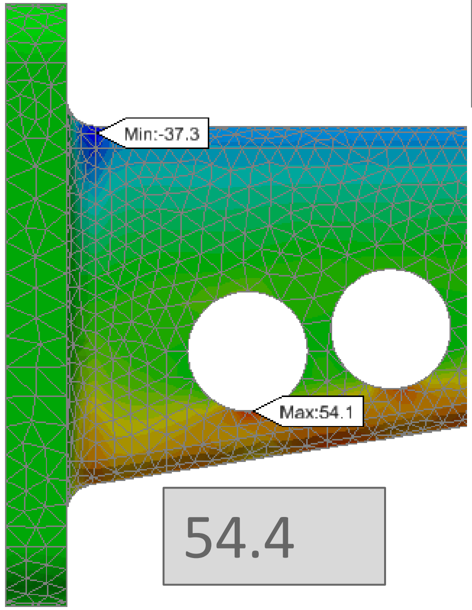
Are my results correct?

1. Max-Stress – You have an idea

The big Myth – Stopping widespread adoption of Upfront



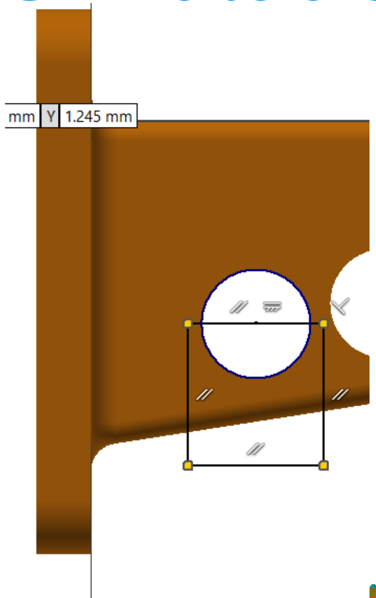


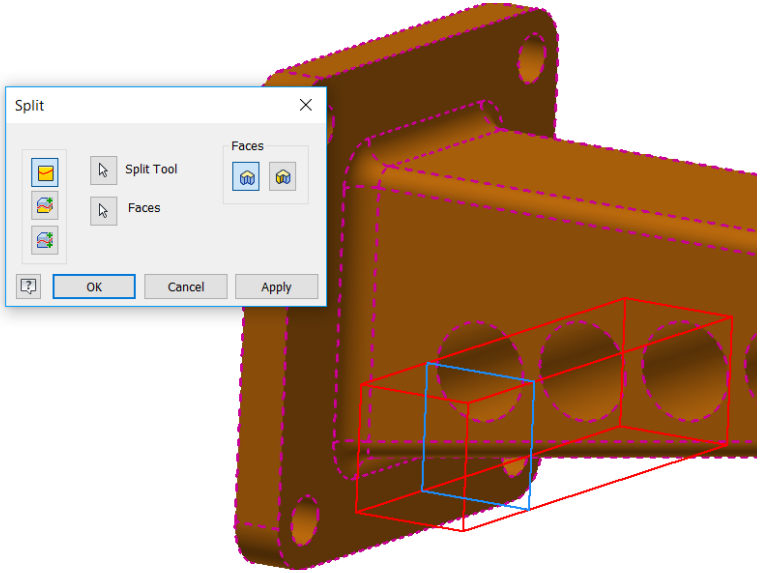


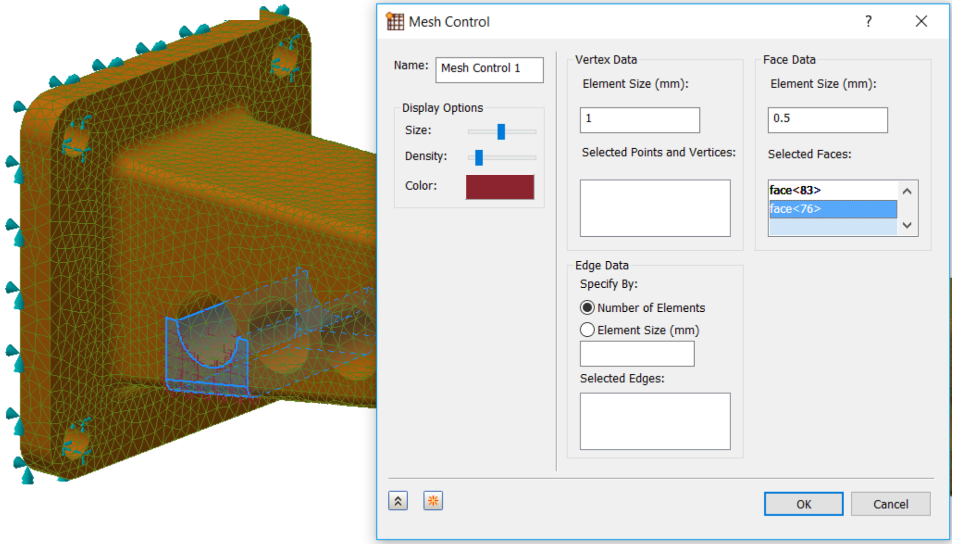
Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes

The big Myth – Stopping widespread adoption of Upfront Simulation



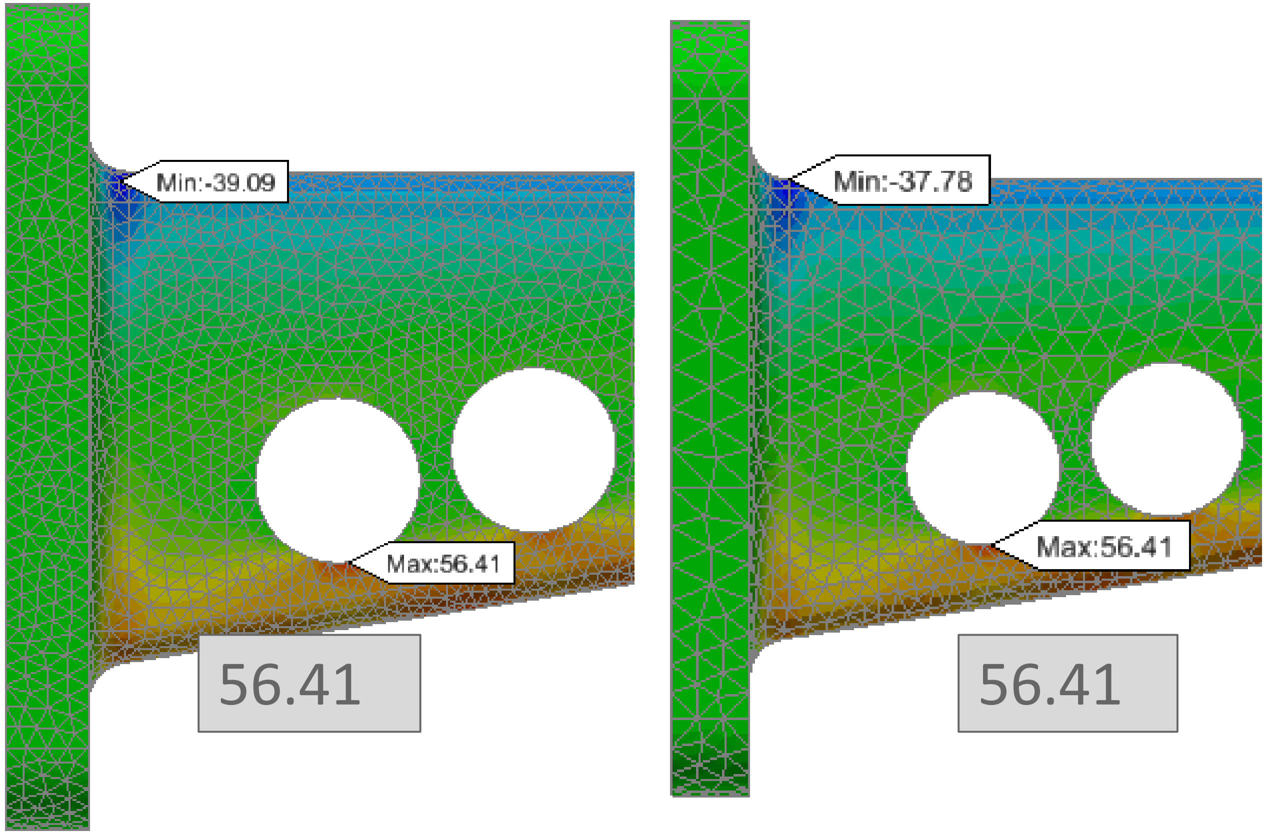




Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Split faces to define local mesh

The big Myth – Stopping widespread adoption of Upfront Simulation



Global Mesh Control

Local Mesh Control

Are my results correct?

1. Max-Stress – You have an idea
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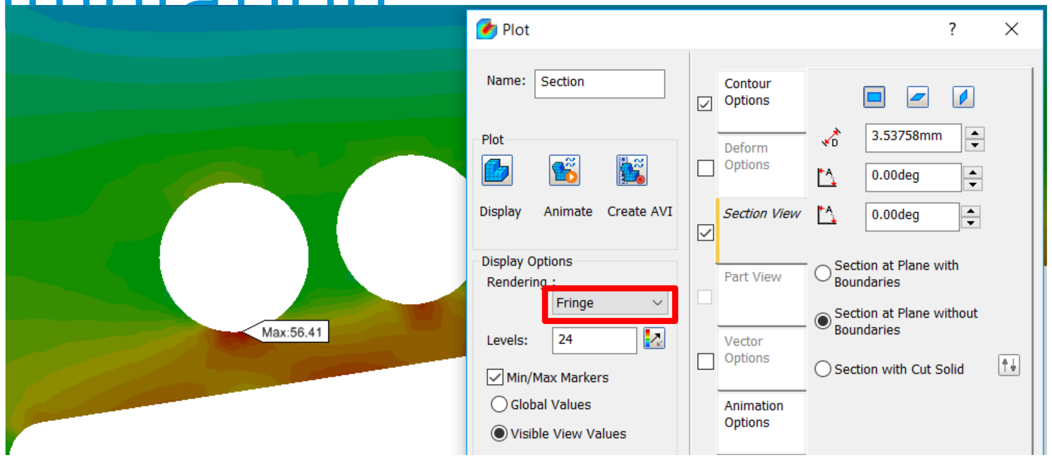
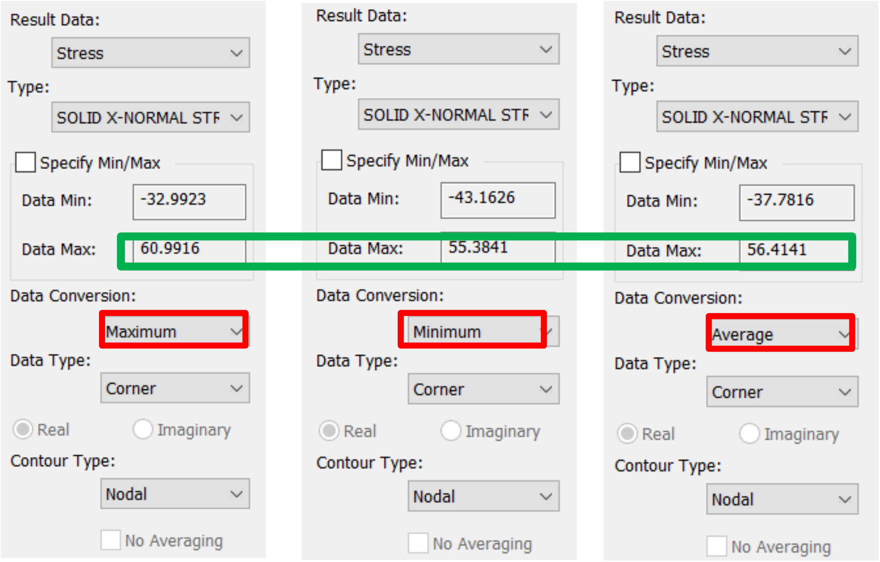
The big Myth – Stopping widespread adoption of Upfront Simulation

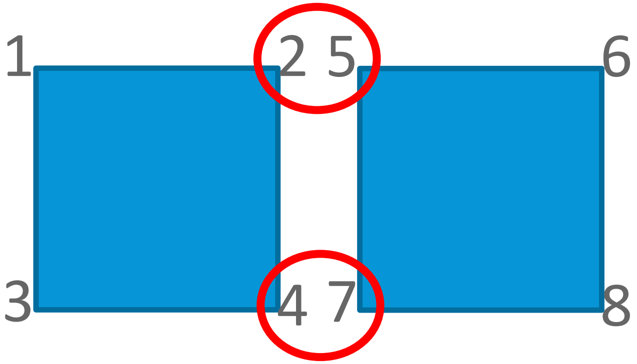


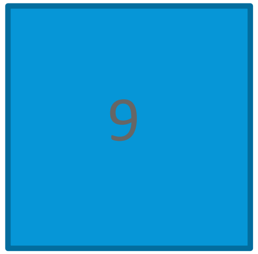


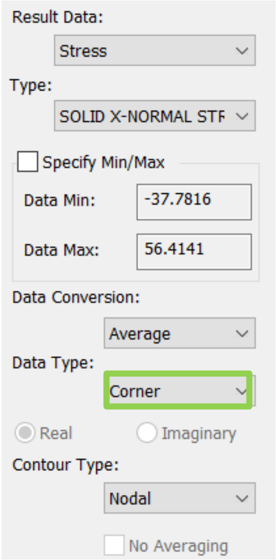
Are my results correct?

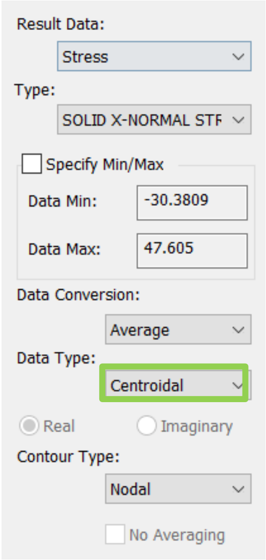
1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Split faces to define local mesh
4. More post-processing tools

The big Myth – Stopping widespread adoption of Upfront Simulation







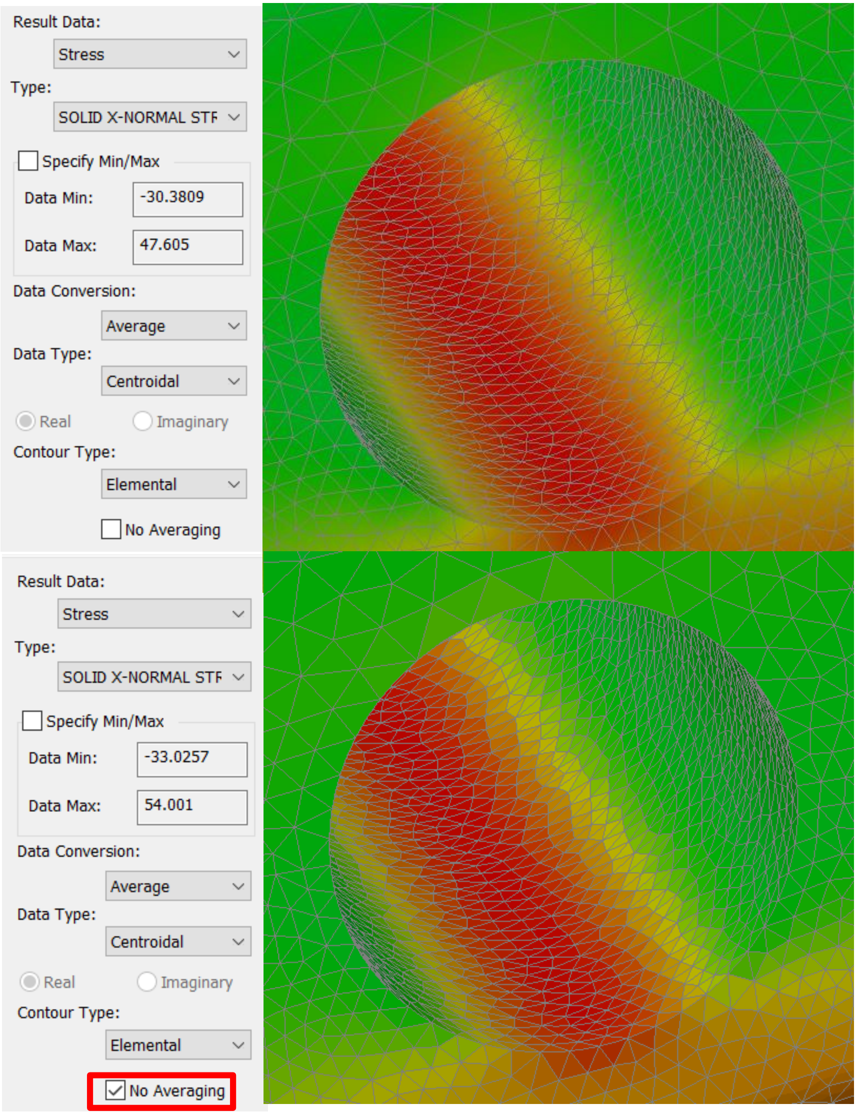


Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Split faces to define local mesh
4. More post-processing tools

.... That was toooo much information ...
To much information can't hurt I suppose...

The big Myth – Stopping widespread adoption of Upfront Simulation



Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Split faces to define local mesh
4. More post-processing tools

…. That was more like it…………

What if my results don’t converge?

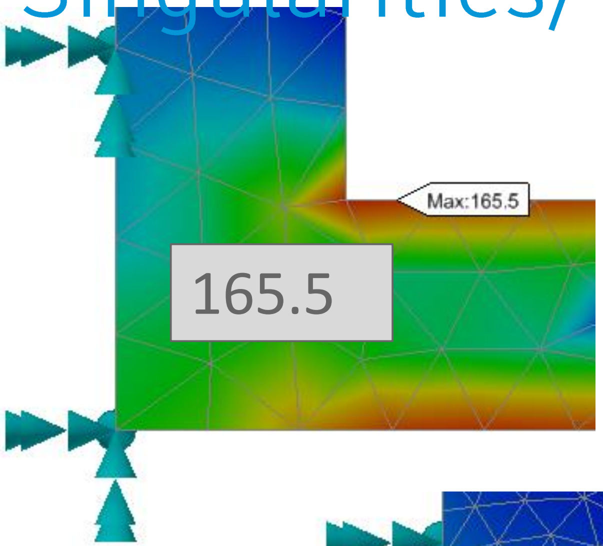
…. Whaaaaat can it happen?
Now I am really confused!
I thought you said the simulation was easy………

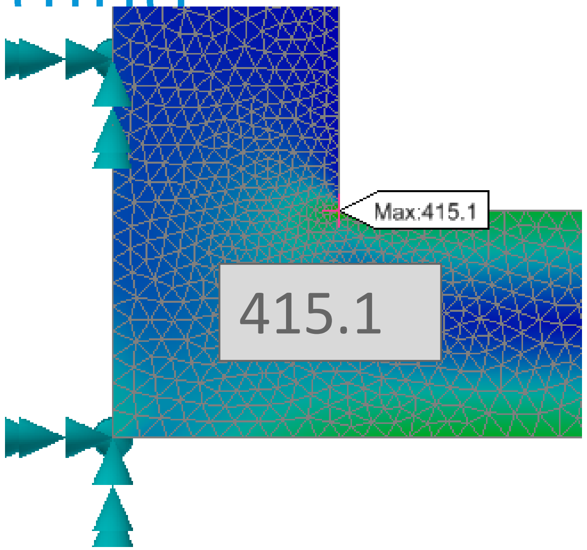
What if my results don't converge?
A simple L-shape bracket

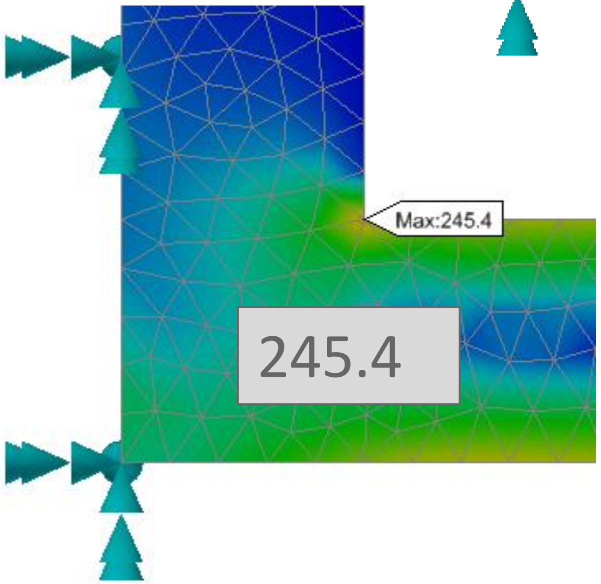
Are my results correct?

1. Max-Stress – You have an idea

What if my results don't converge? Hotspots/Stress Singularities/Yielding



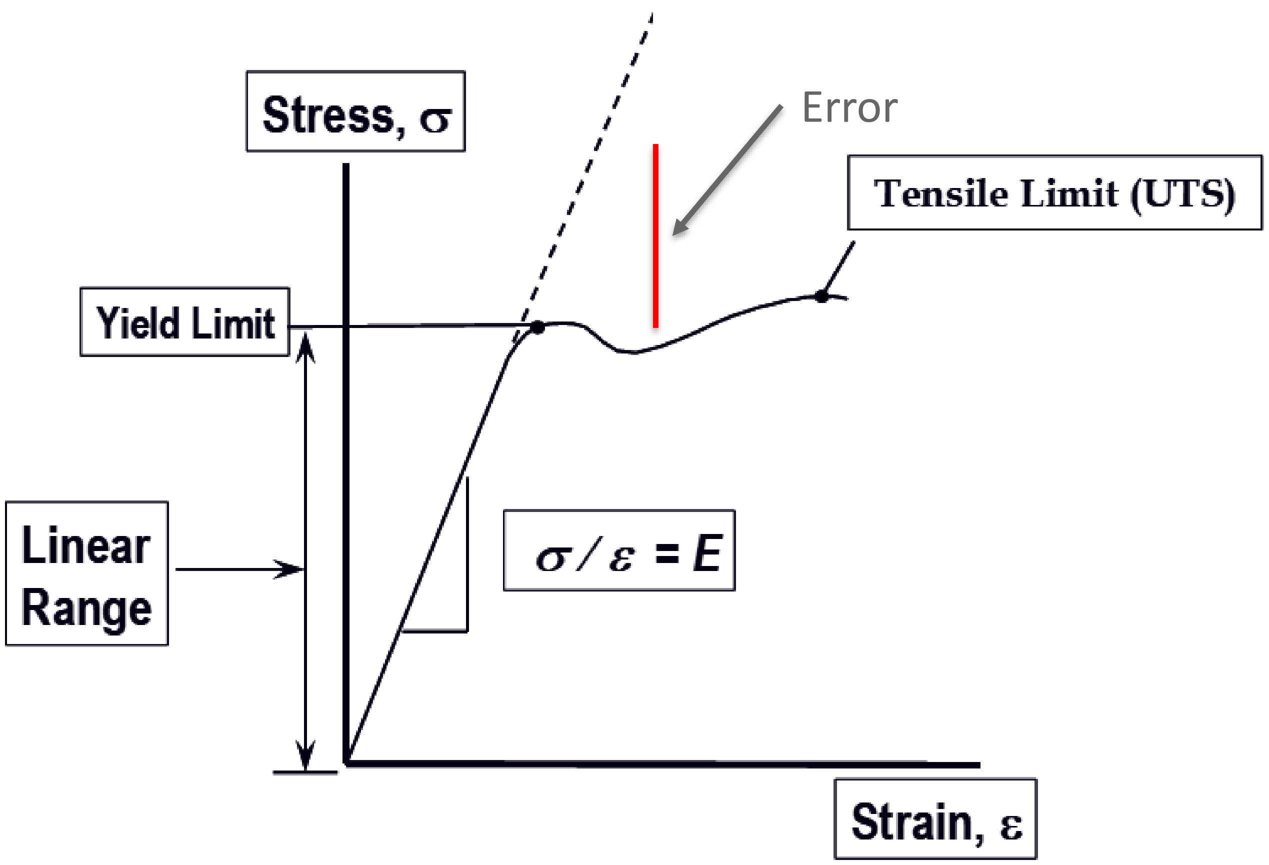




Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes

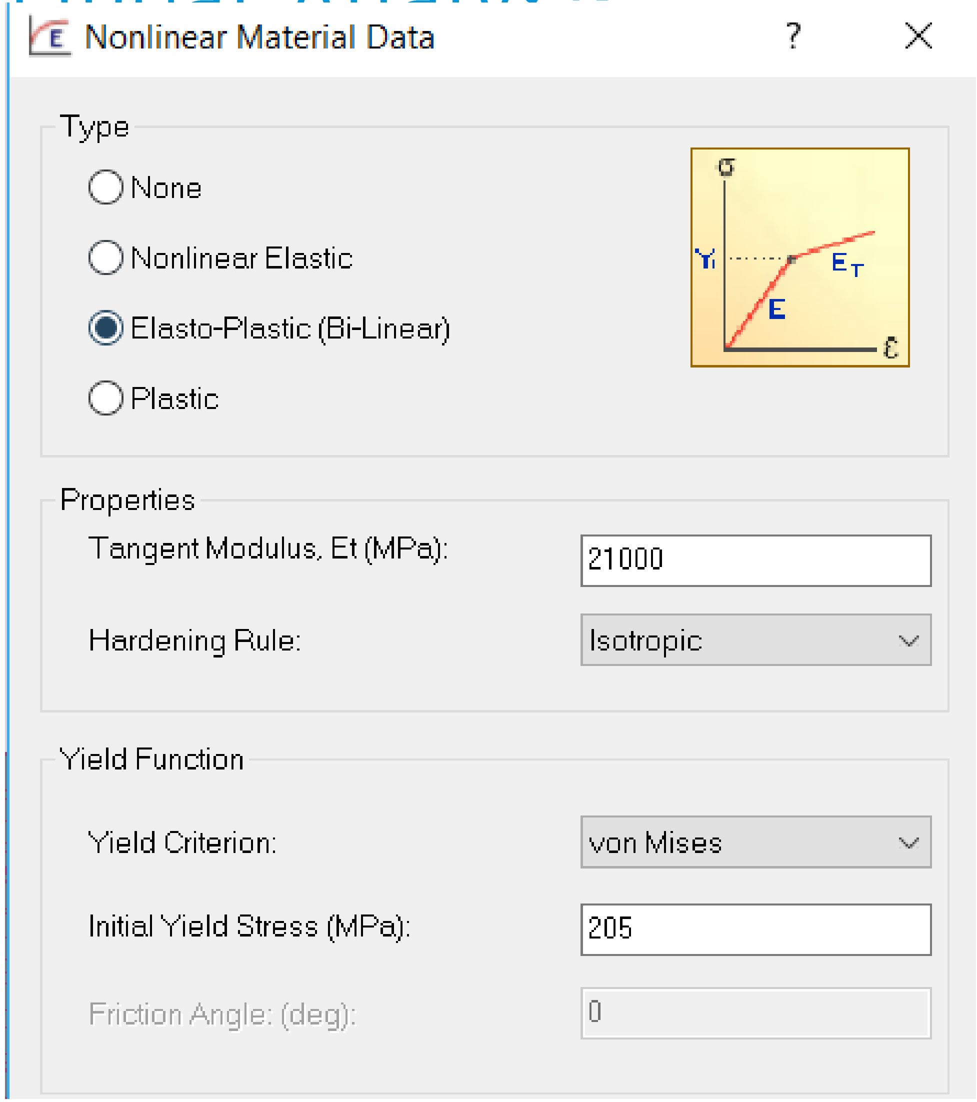
What if results don't converge?
Stress Strain Curve



Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Non-Linear Analysis

What if my results don't converge?
Non-Linear Analysis



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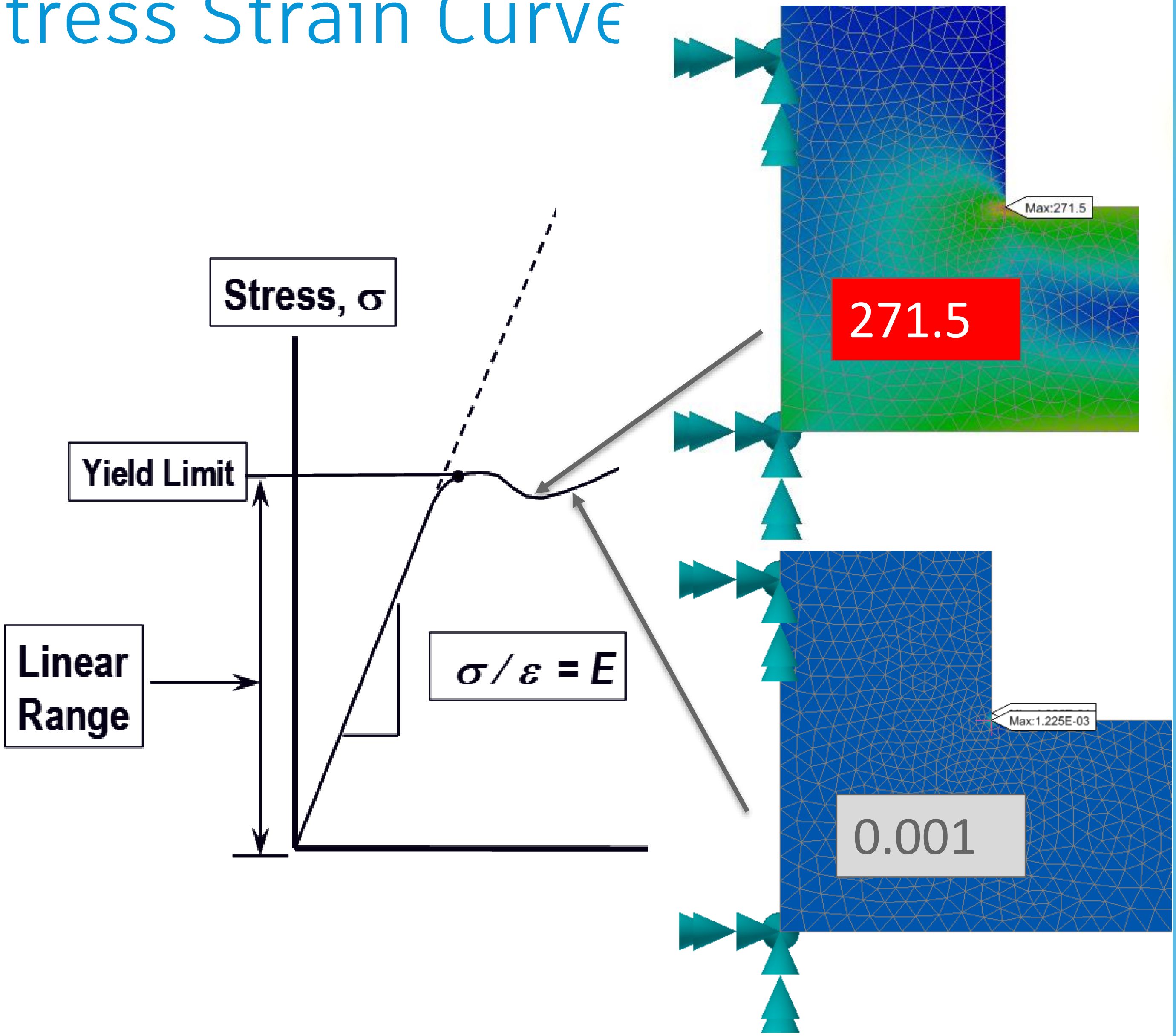
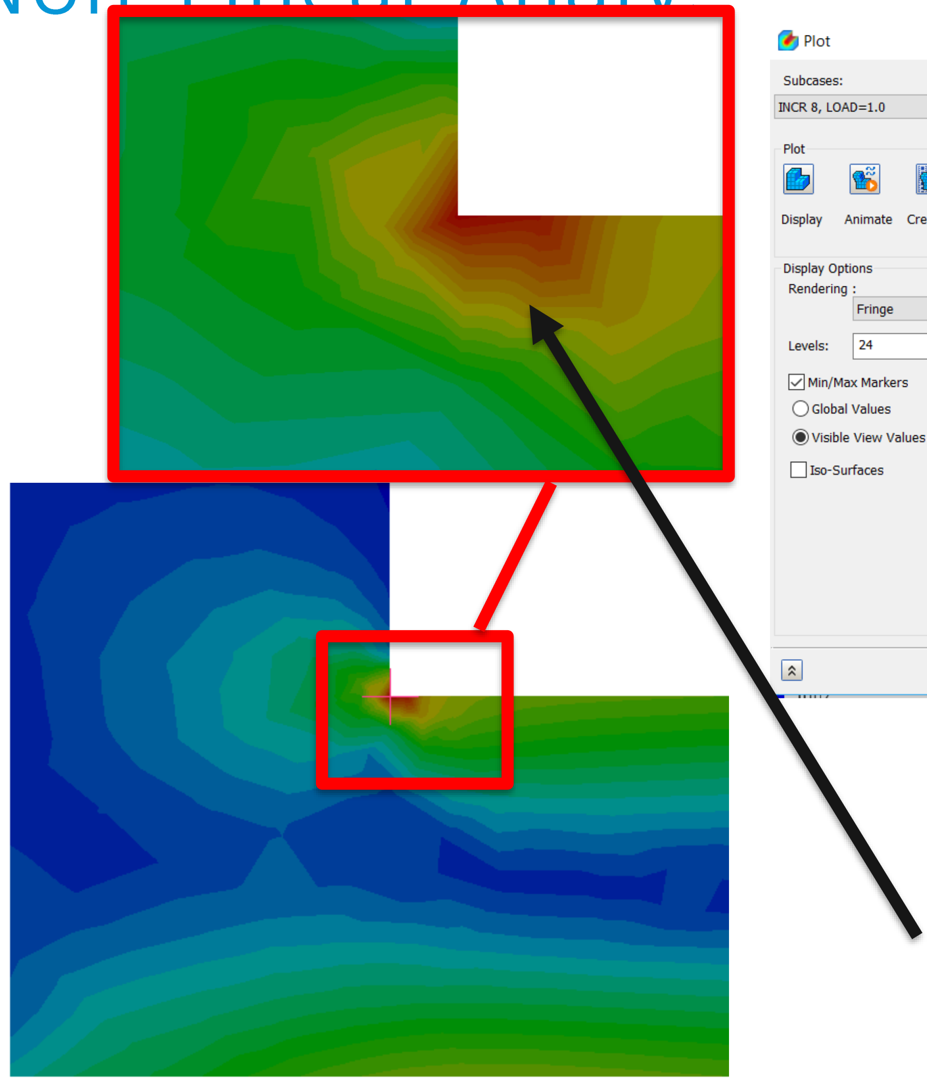
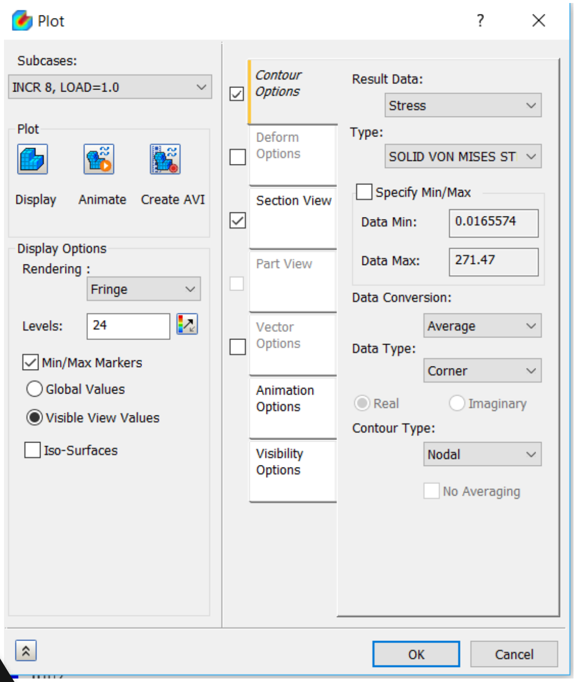


Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Non-Linear Analysis

What if my results don’t converge?
Non-Linear Analysis





Stress penetration across thickness

Are my results correct?

1. Max-Stress – You have an idea
2. Analyse with 3 mesh sizes
3. Non-Linear Analysis
4. Section View

…. That made absolute sense…………
Now I consider myself an expert……

Finally can I trust Nastran results?

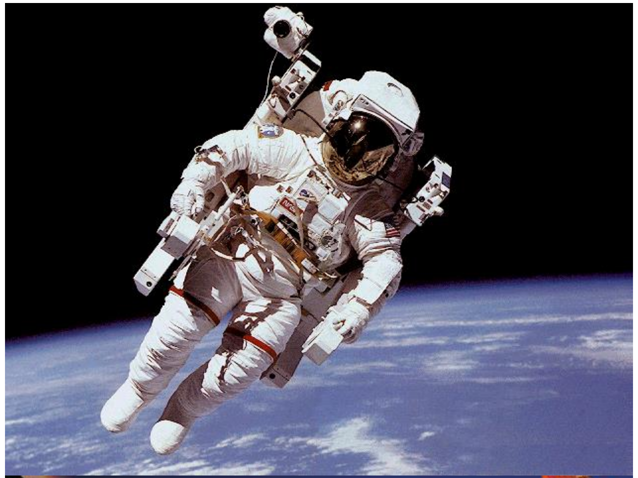
…. Of course who wouldn't…………

Can I trust Nastran results


Autodesk® Nastran® In-CAD 2019

Verification Manual

AUTODESK.

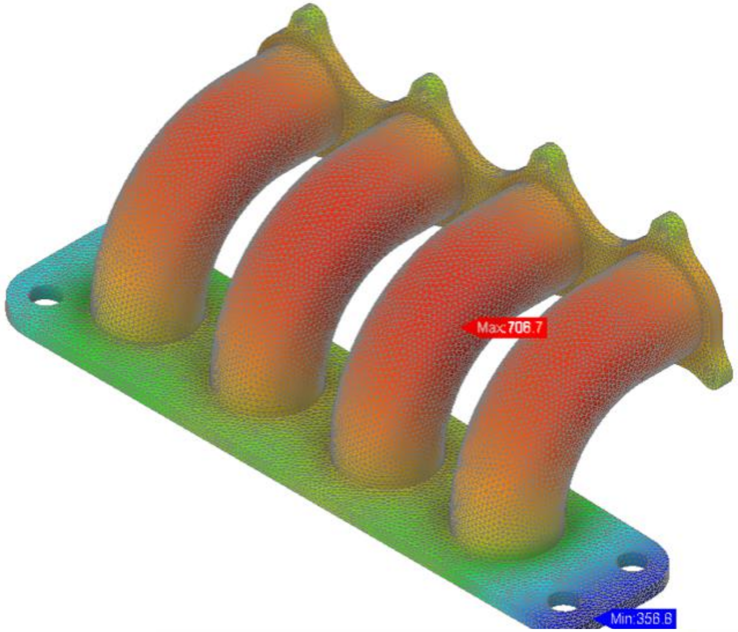


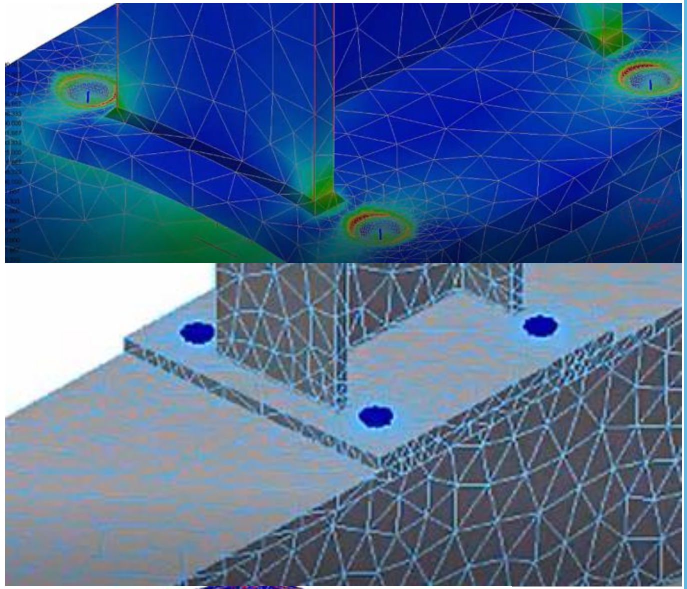
Absolutely

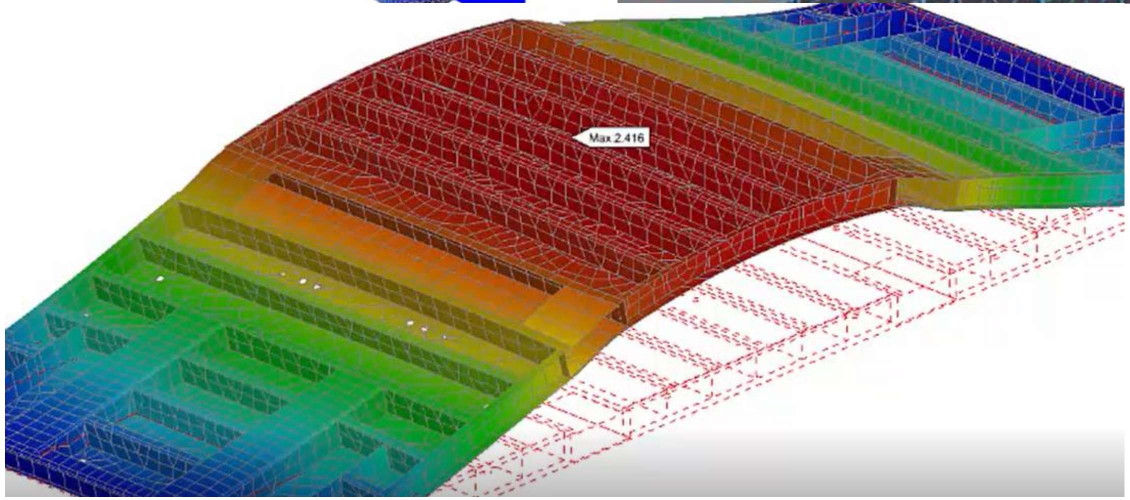
1. Verification Document
2. NASA
3. Most planes verified with Nastran if not all.
4. Industry Standard Solver

Nastran In-CAD in action

Nastran In-CAD in action







Typical Examples

Above and Beyond Inventor FEA

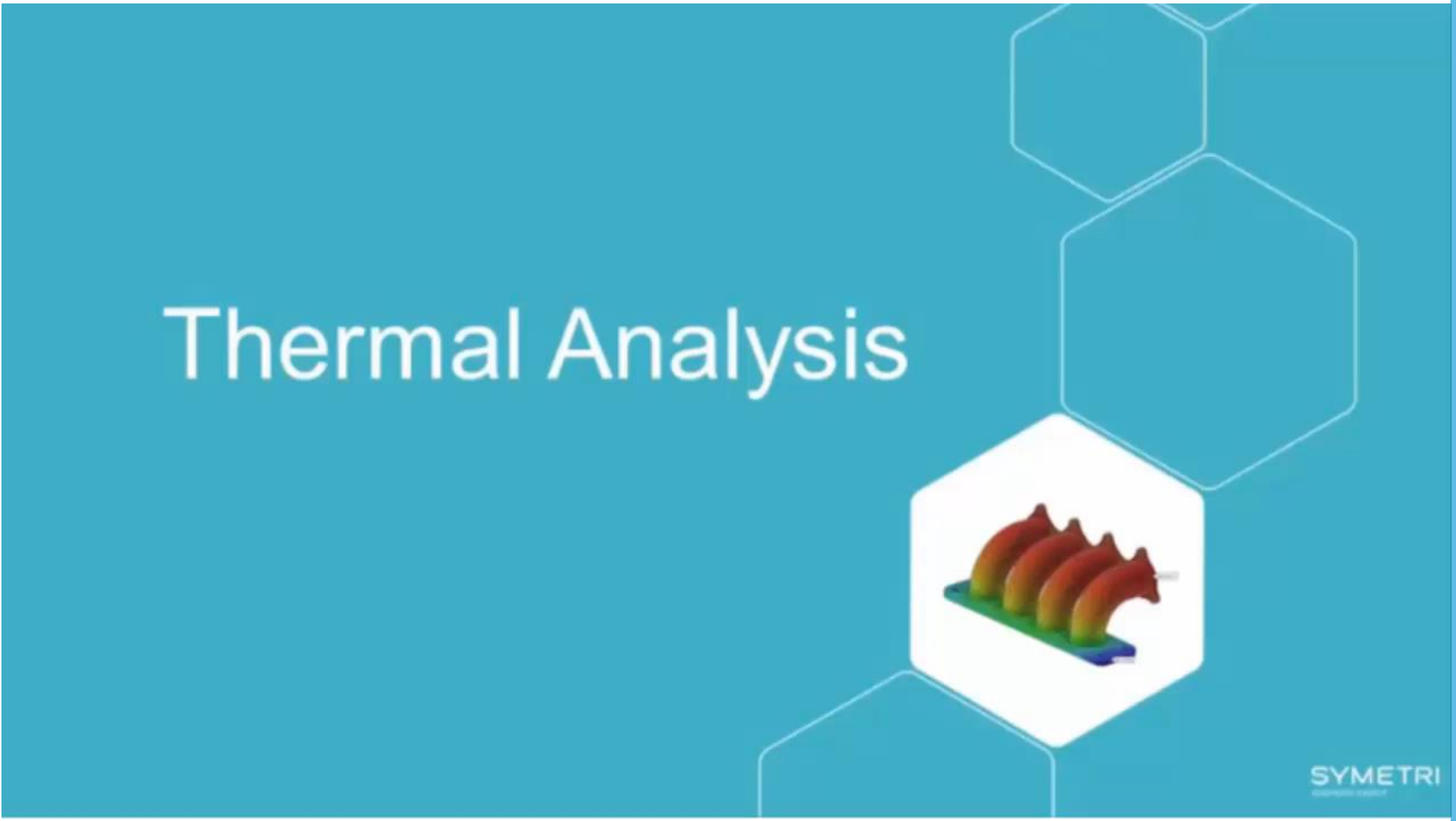
1. Bolted Connections
2. Thermal Analysis
3. Fabrications

Nastran In-CAD in action Complete workflow - Setup to results

Typical Applications

1. Bolted Connections
   - Local Mesh Control
   - Surface Contact with Friction
   - Bolt Stress

Nastran In-CAD in action
Manifold



Typical Applications

1. Bolted Connections
2. Thermal Analysis
   - Start Thermal Analysis
   - Determine temperatures
   - Start New Static Analysis
   - Use temperatures as load
   - Determine stresses

Nastran In-CAD in action
Shell Analysis – 3 different ways

Fabrication Analysis

1. Mid Surface extraction of thin parts
2. Is to create surfaces to represent thin parts/structures
3. Is to select external faces of parts/structures

SYMETRI
ADDNODE GROUP

Typical Applications

1. Bolted Connections
2. Thermal Analysis
3. Fabrications

…. Well that didn’t seem difficult I think!

……. Are you all ready to use simulation…..

….. And start innovating………..

…. Or perhaps you have some questions?

……. So fire away …..

AUTODESK®

Make anything.