

Become a simulation expert within 60 minutes

Wasim Younis

Simulation Manager @ Symetri

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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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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 too much
time and costs £££££

Simulation – Digital Testing



To explore – what if?

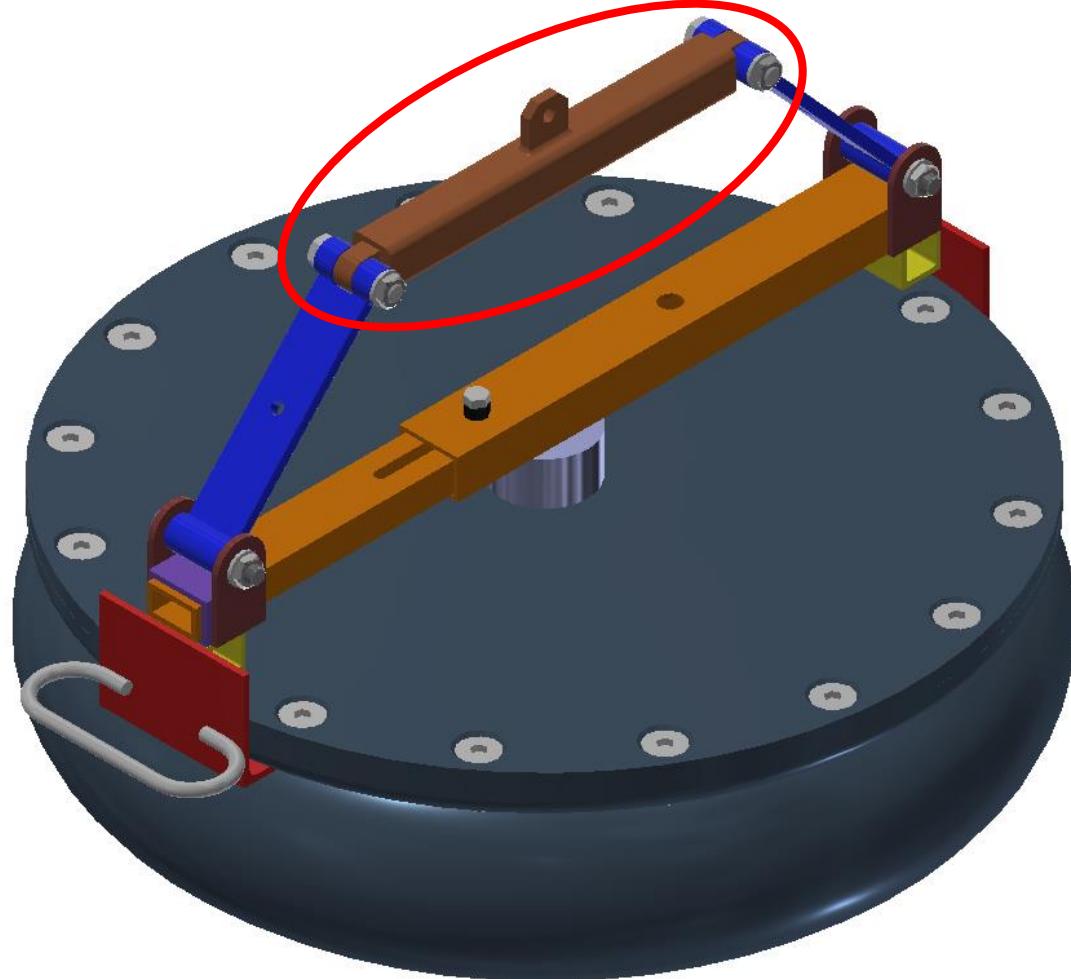
1. Do I need a thicker plate?
2. Can I remove more material?
3. Do I need to add more stiffening rings?
4. Can I increase load?
5. And more.....?

Lets take a simple example

.... To see benefits of simulation



Benefits of Simulation–
Lets take a simple example



Tools Available

Benefits of Simulation– Let's take a simple example

$$\sigma = Mx \frac{y}{I}$$

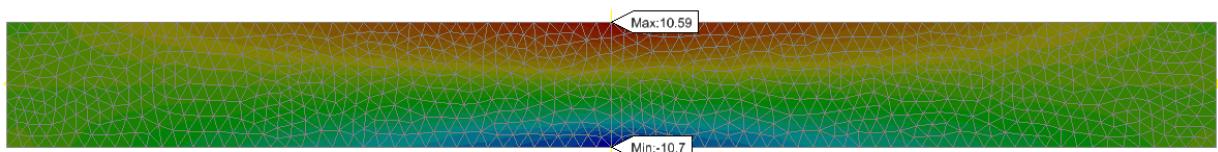
Load is applied centrally on the beam, therefore to find the maximum bending moment, we can use:

$$\begin{aligned} M &= P \times L / 4 \\ &= 780N * 390mm / 4 \\ &= 76050 \text{ Nmm} \end{aligned}$$

$$\begin{aligned} y &= \text{Distance to neutral axis} \\ &= \text{Section height} / 2 \\ &= 40mm / 2 = 20 \text{ mm} \end{aligned}$$

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

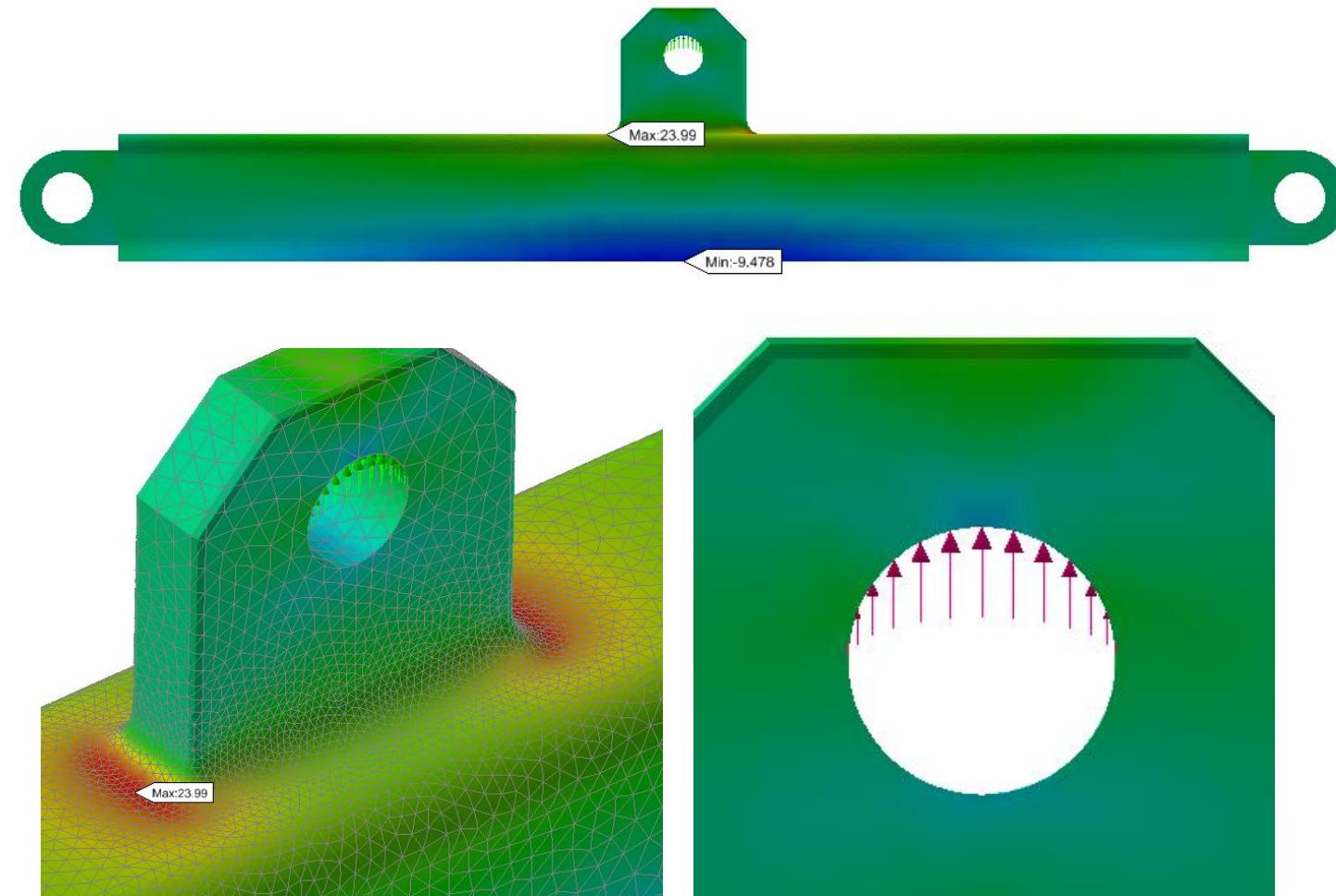
Therefore, Max Tensile or Compressive Stress due to bending is:
 $\sigma = 76050 \times 20 / 145833$
 $= 10.43 \text{ N/mm}^2 = 10.43 \times 10^6 \text{ N/m}^2 = 10.43 \text{ MPa}$



Tools Available

1. Hand Calculations

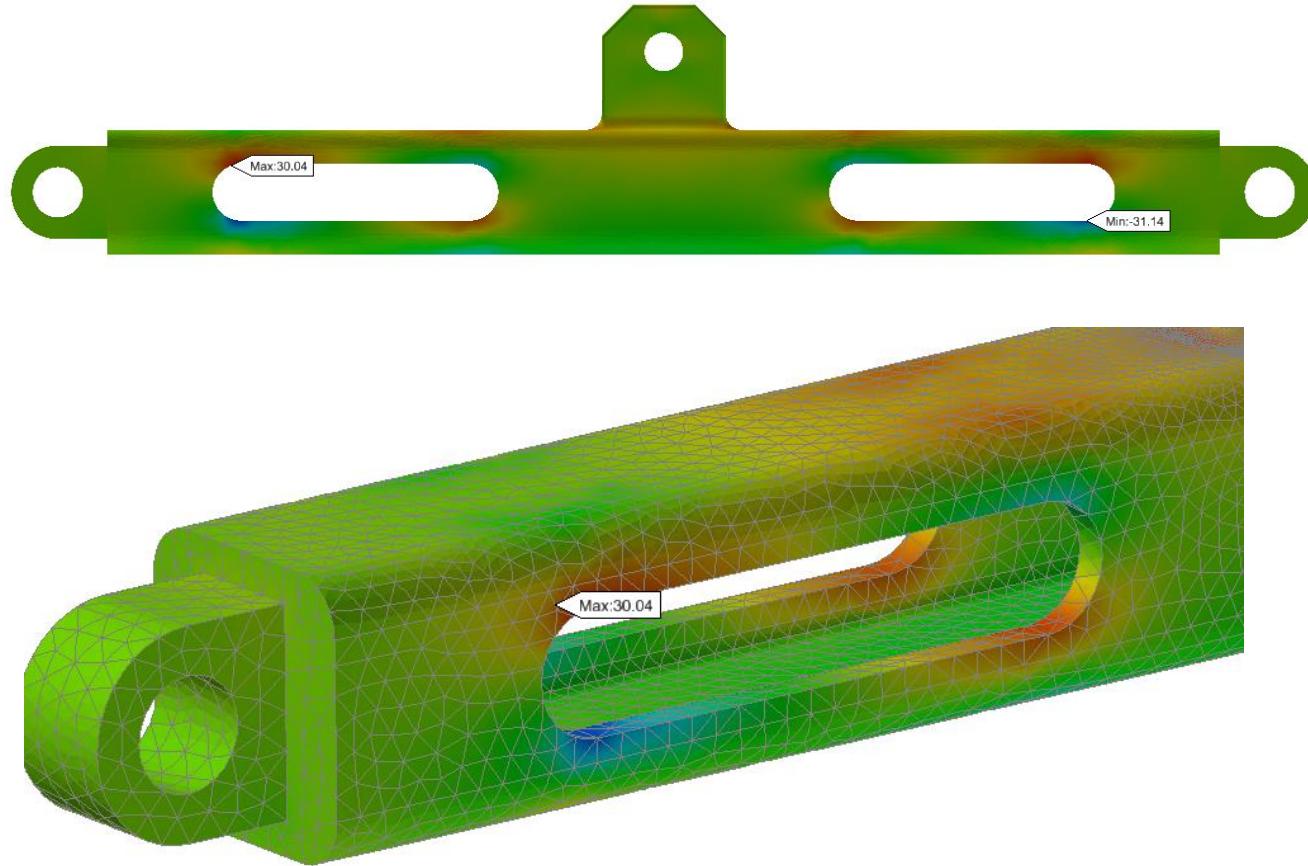
Benefits of Simulation– Let's take a simple example



Tools Available

1. Hand Calculations
2. Upfront Simulation

Benefits of Simulation– Lets take a simple example

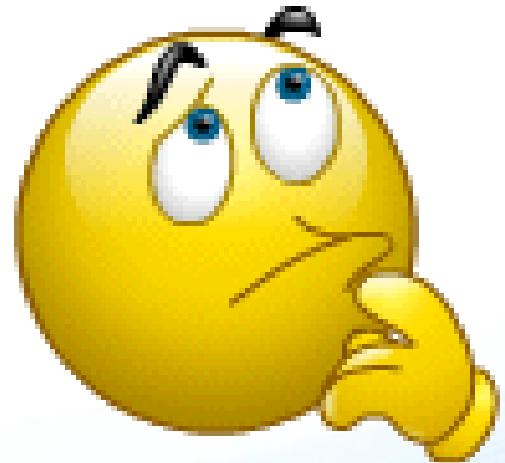


Tools Available

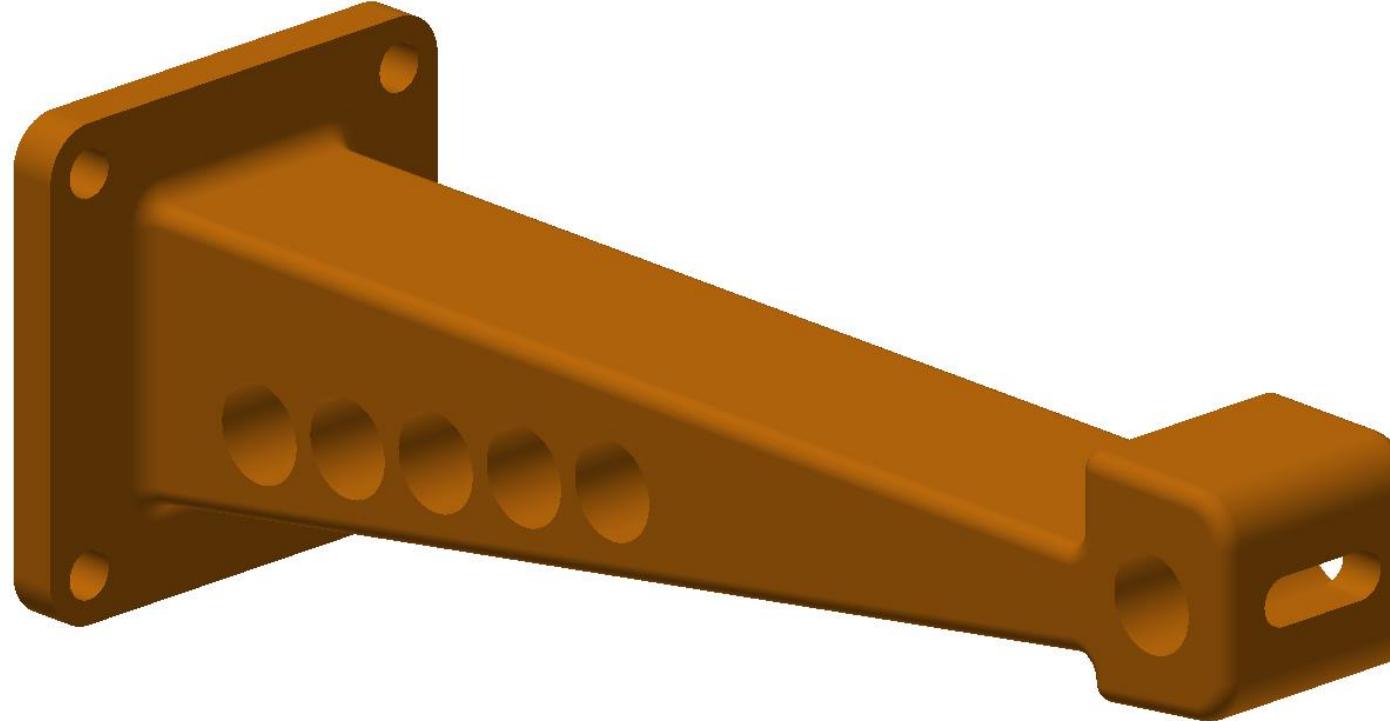
1. Hand Calculations
2. Upfront Simulation
3. Optimisation

We got 45 mins lefts

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

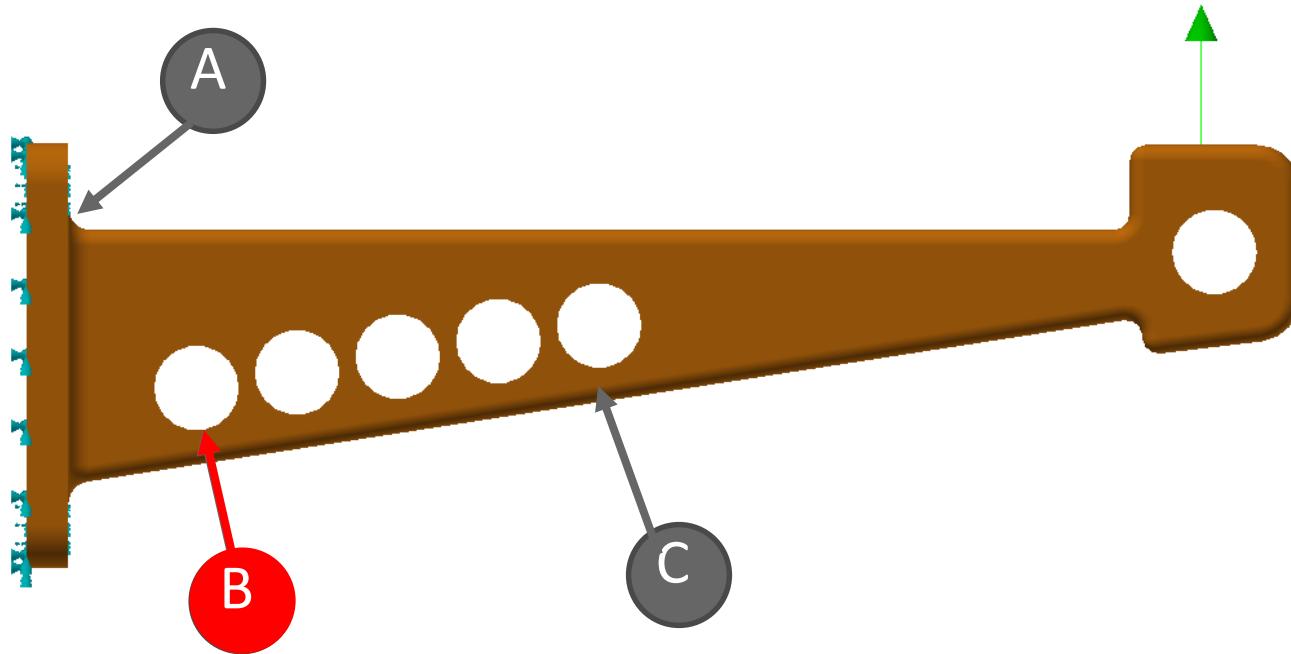


The big Myth – Stopping widespread adoption of Upfront Simulation



Are my results correct?

The big Myth – Stopping widespread adoption of Upfront Simulation



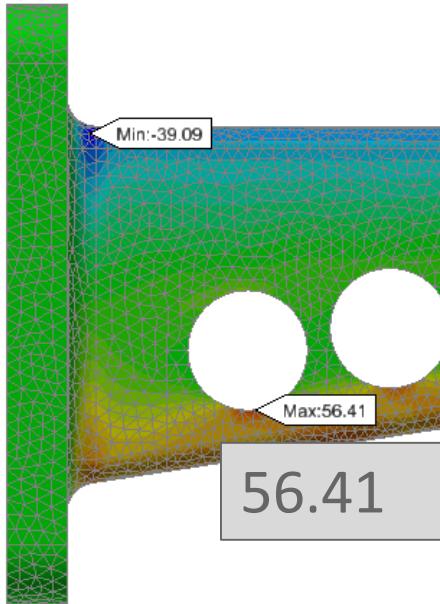
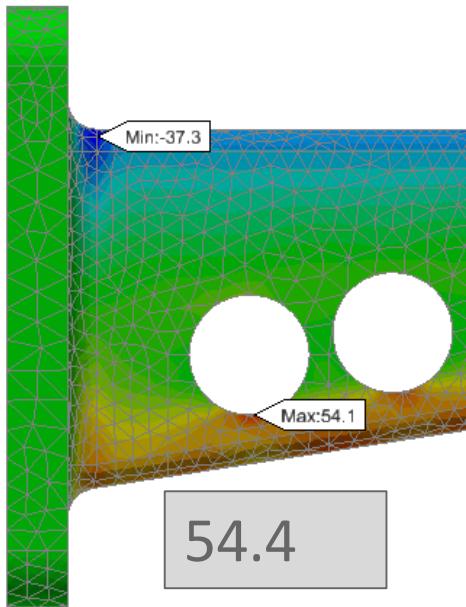
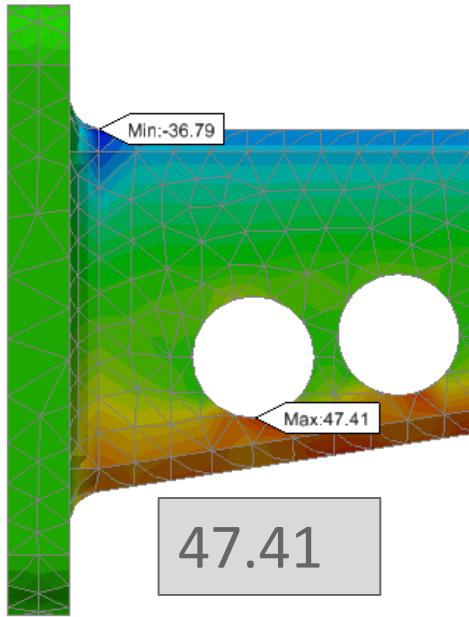
Are my results correct?



1. Max-Stress – You have an idea

The big Myth – Stopping widespread adoption of Upfront

~ ~ ~ ~ ~



Are my results correct?

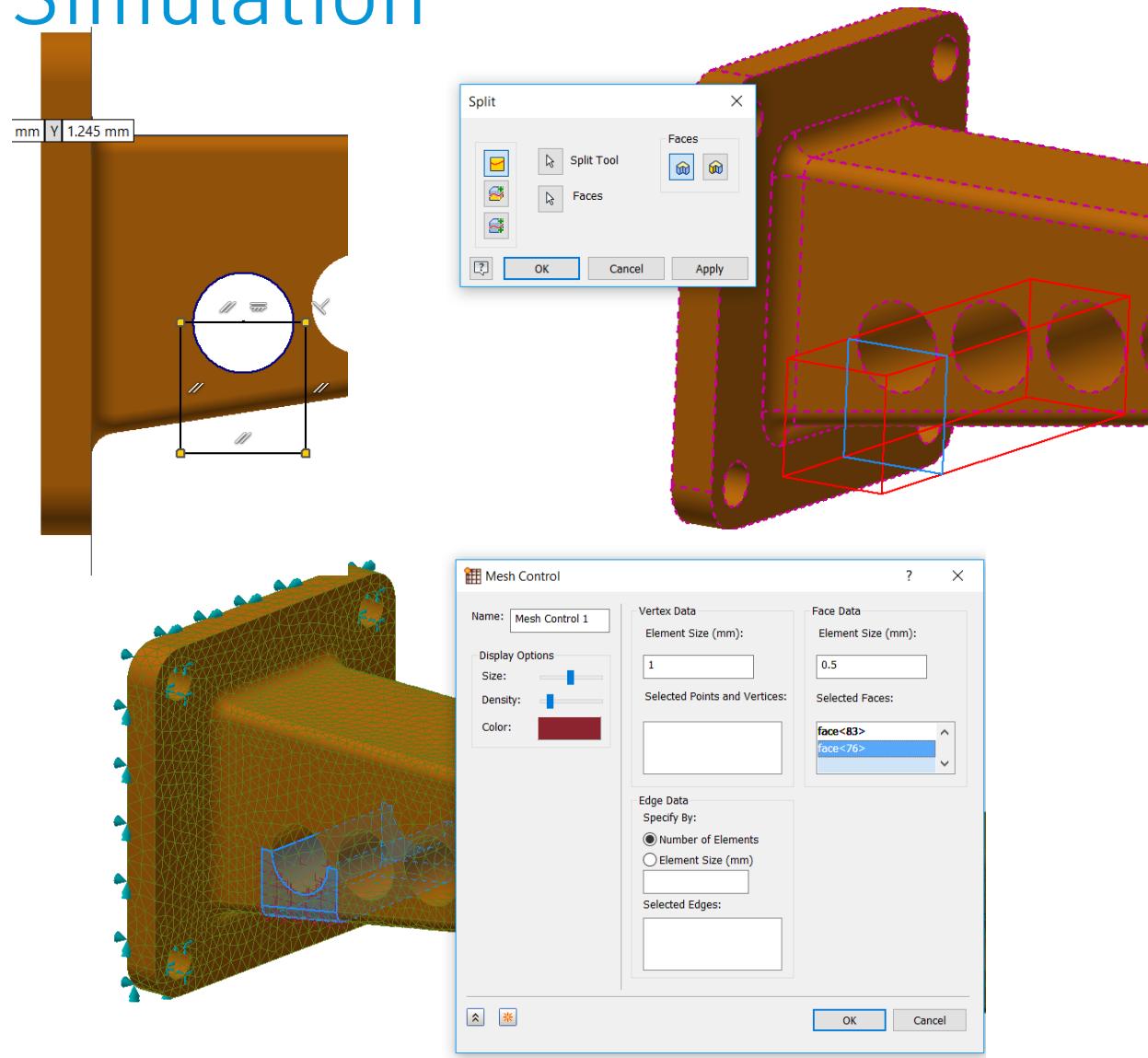


Max-Stress – You have an idea



Analyse with 3 mesh sizes

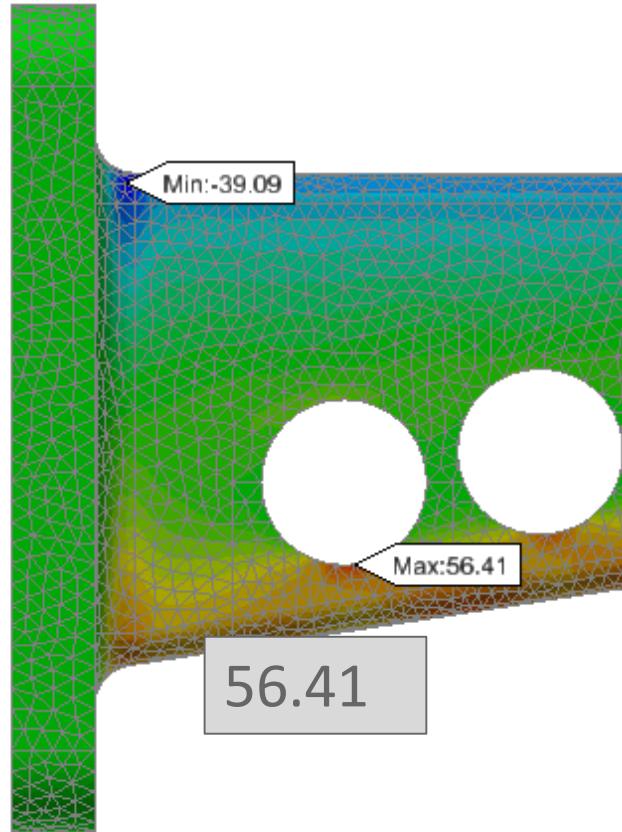
The big Myth – Stopping widespread adoption of Upfront Simulation



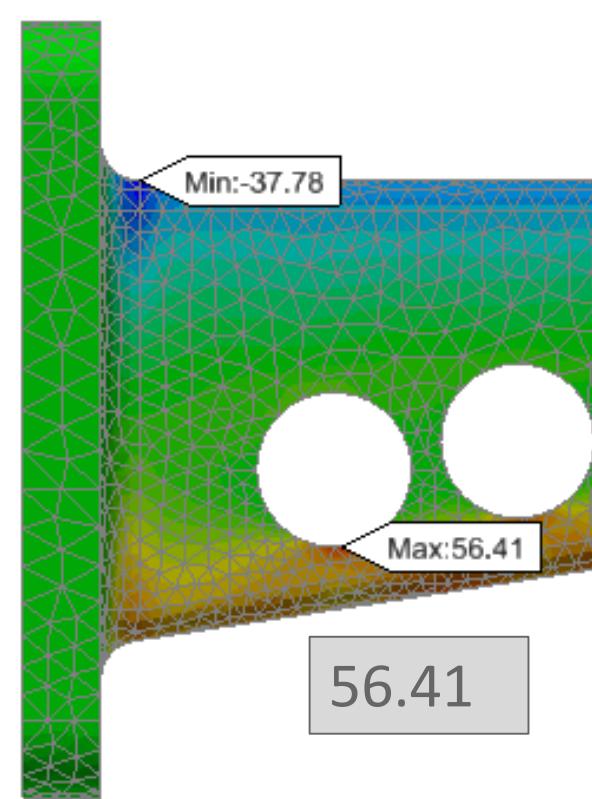
Are my results correct?

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

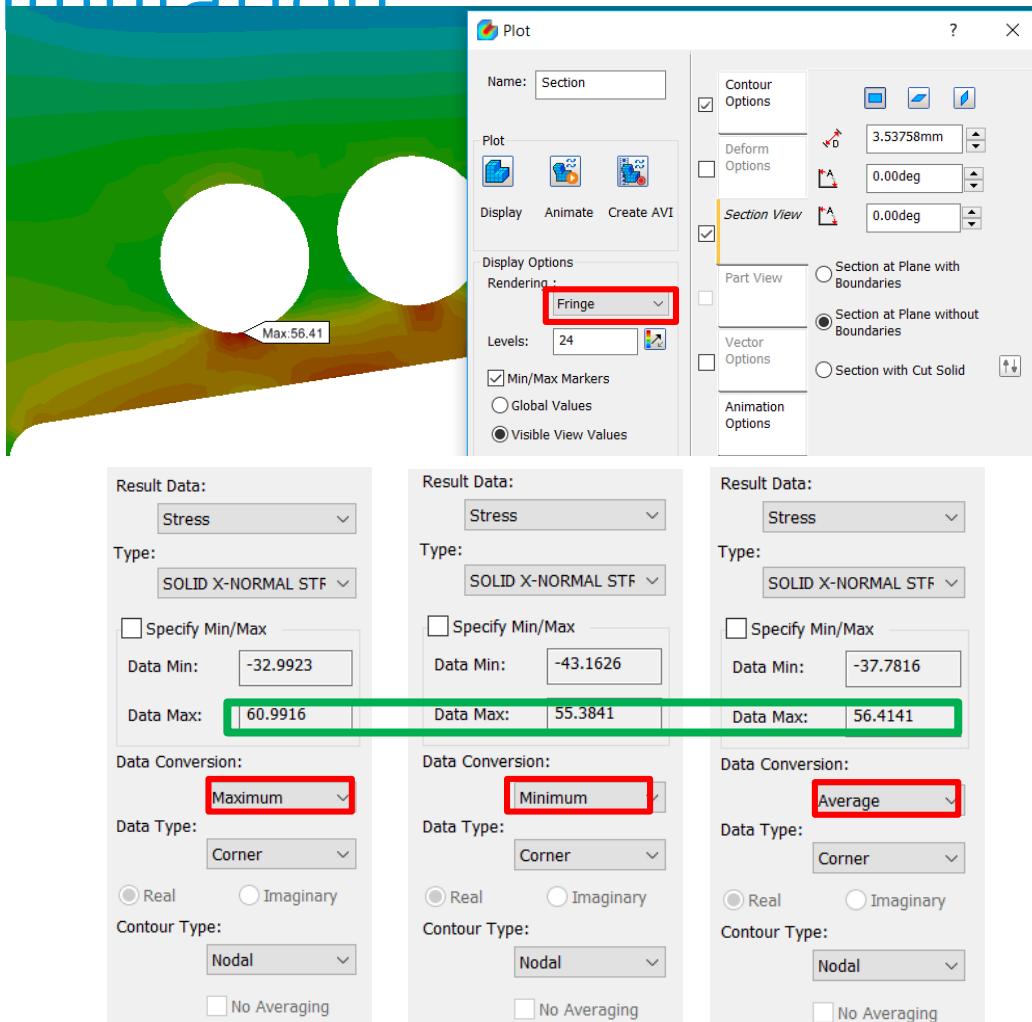


Local Mesh Control

Are my results correct?

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

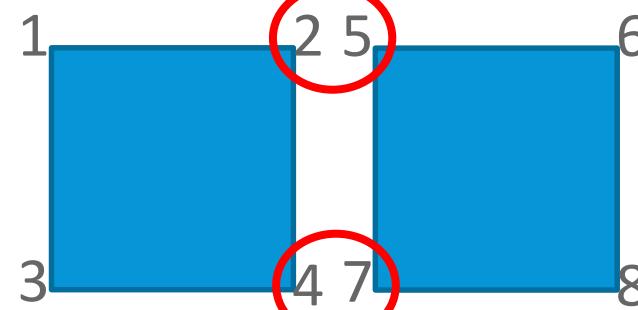
The big Myth – Stopping widespread adoption of Upfront Simulation



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



Result Data: Stress

Type: SOLID X-NORMAL STF

Specify Min/Max

Data Min: -37.7816

Data Max: 56.4141

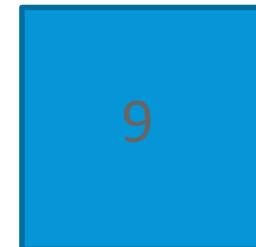
Data Conversion: Average

Data Type: Corner

Real Imaginary

Contour Type: Nodal

No Averaging



Result Data: Stress

Type: SOLID X-NORMAL STF

Specify Min/Max

Data Min: -30.3809

Data Max: 47.605

Data Conversion: Average

Data Type: Centroidal

Real Imaginary

Contour Type: Nodal

No Averaging

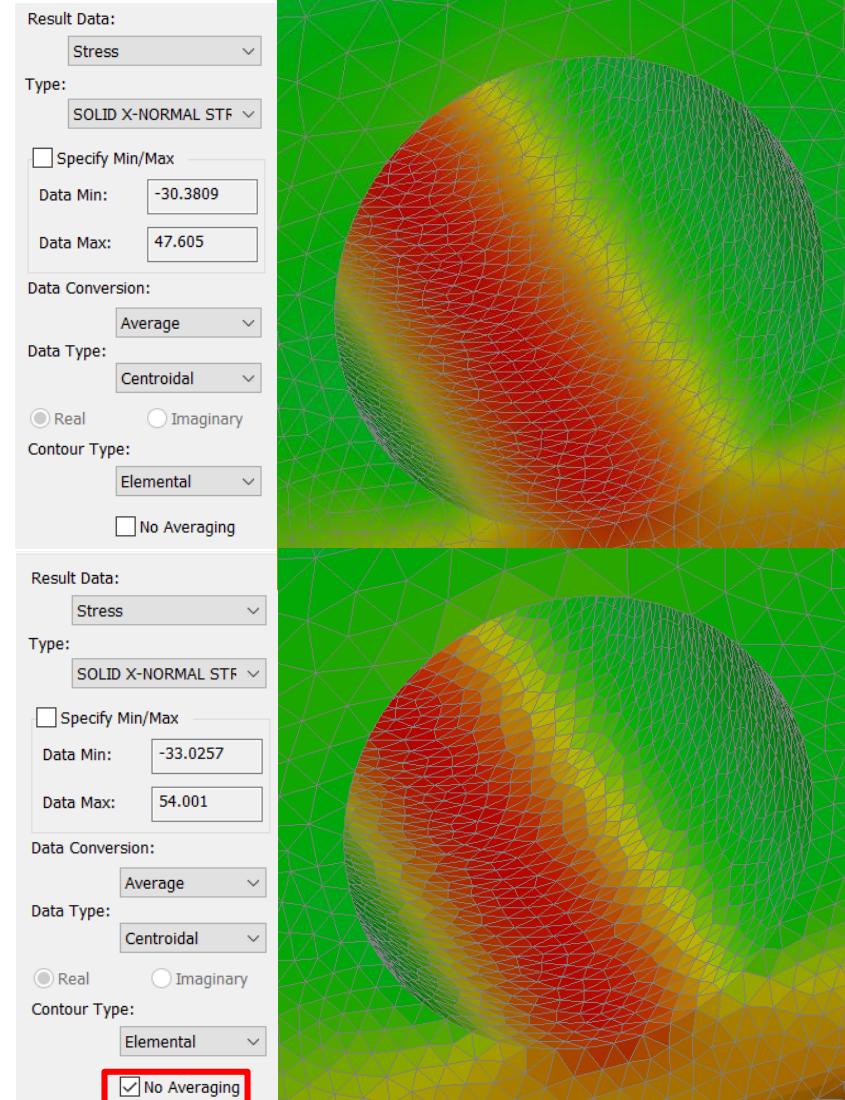
Are my results correct?

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

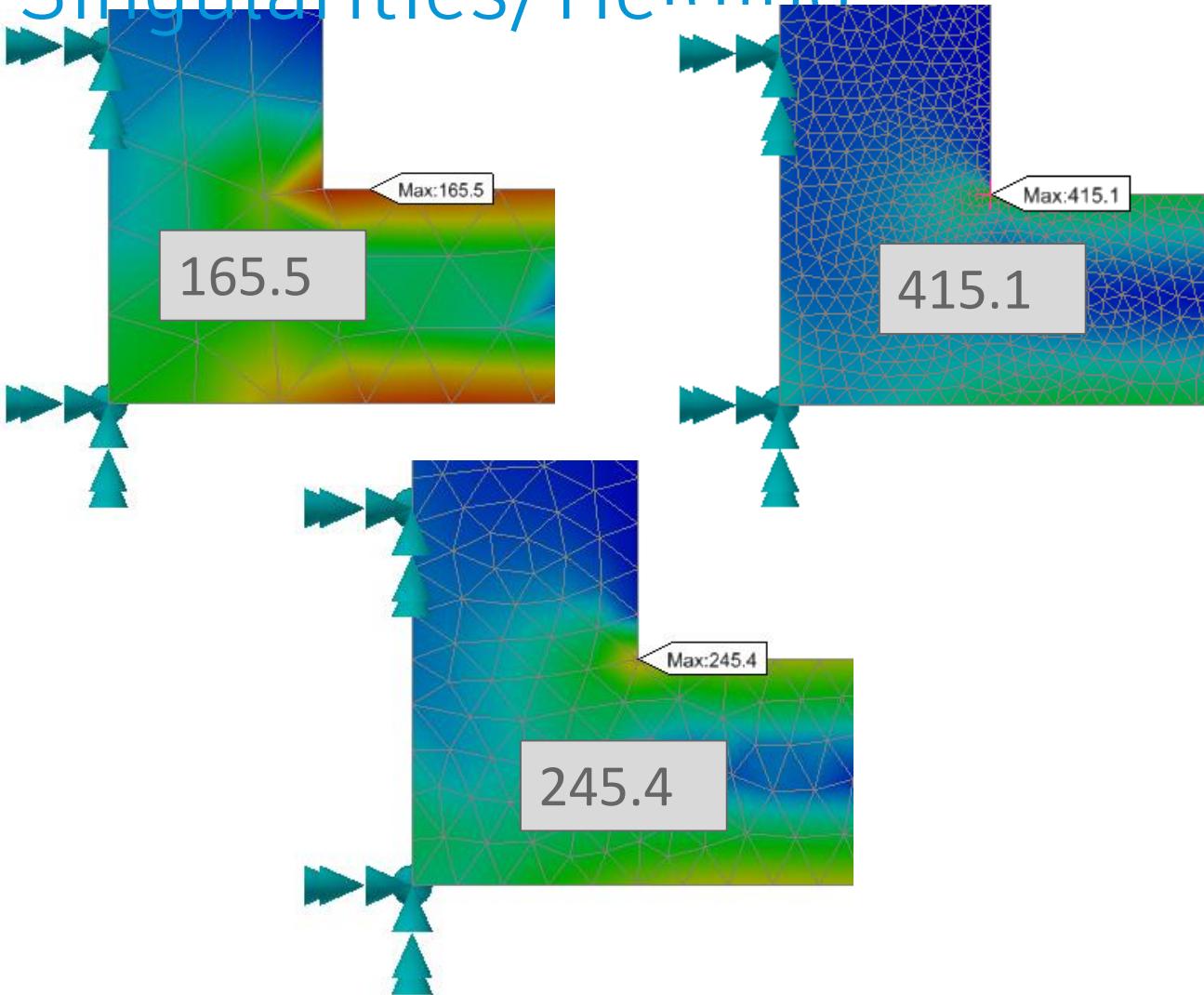


Are my results correct?



1. Max-Stress – You have an idea

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

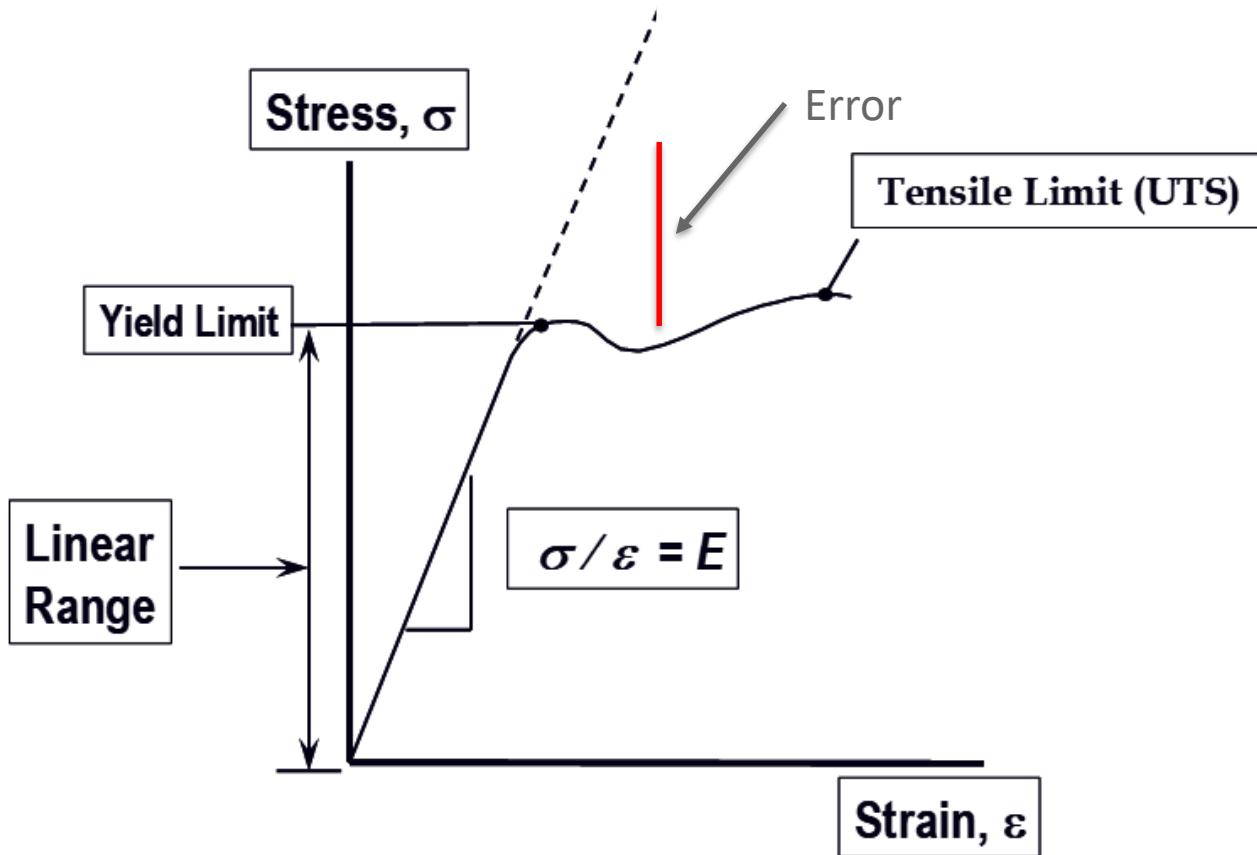


Are my results correct?

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

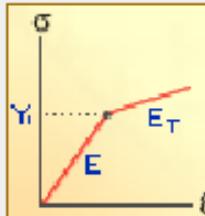
What if my results don't converge?

Non-Linear Analysis

Nonlinear Material Data

Type

- None
- Nonlinear Elastic
- Elasto-Plastic (Bi-Linear)
- Plastic



Properties

Tangent Modulus, E_t (MPa):

Hardening Rule:

Yield Function

Yield Criterion:

Initial Yield Stress (MPa):

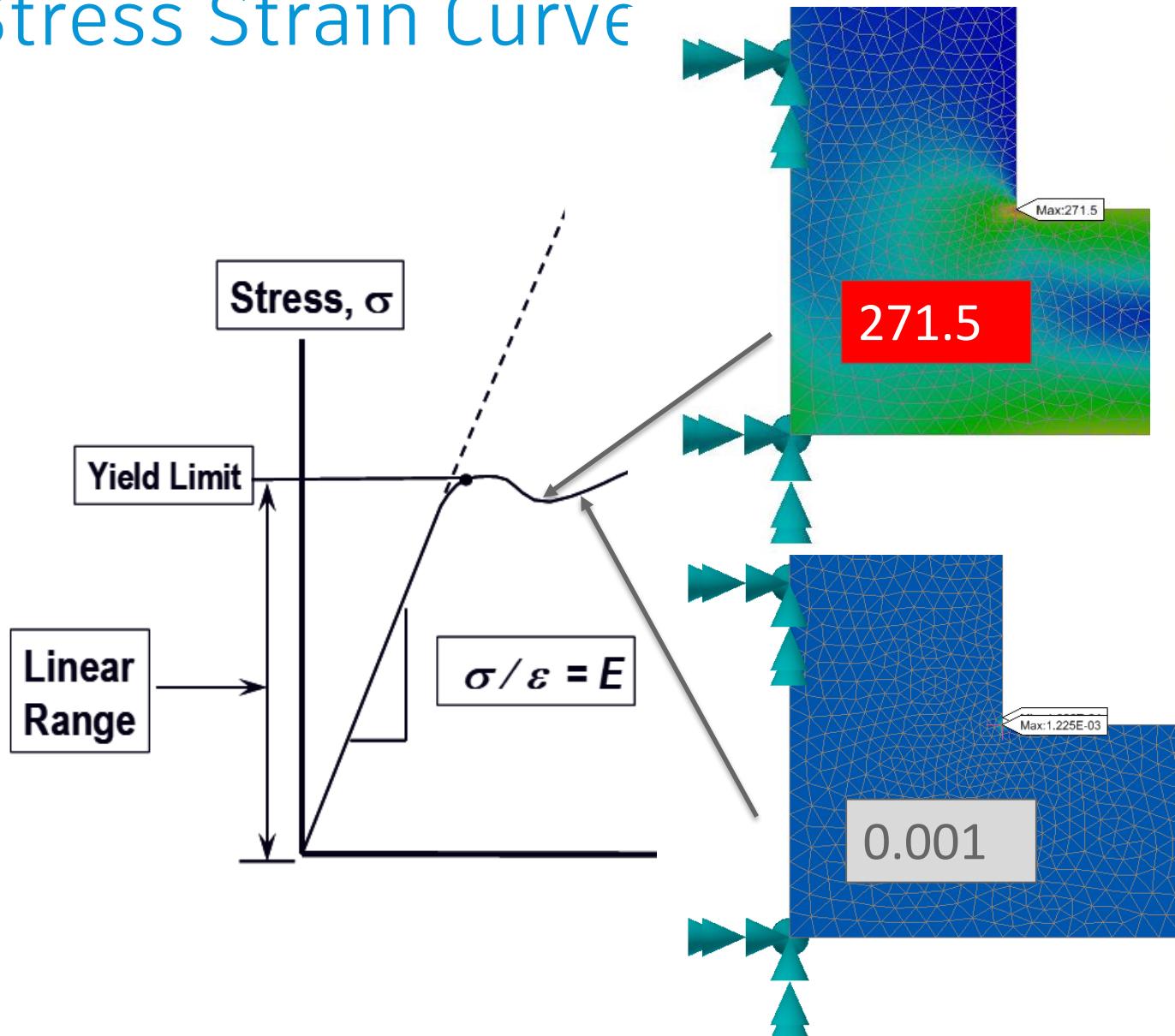
Friction Angle: (deg):

Are my results correct?

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

What if results don't converge?

Stress Strain Curve

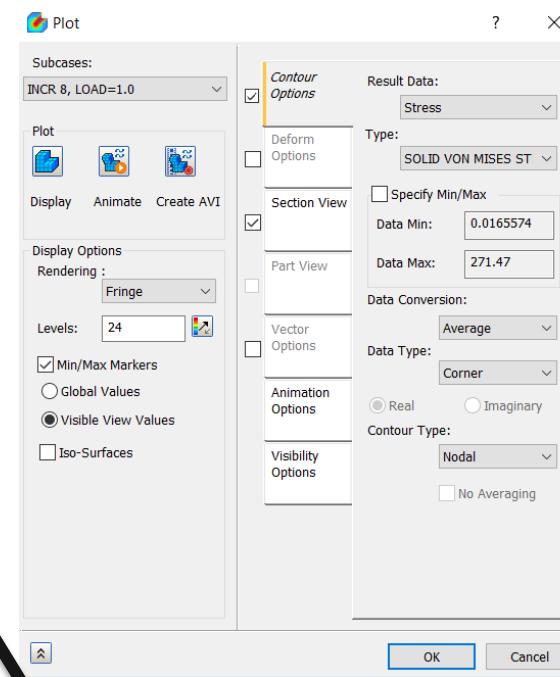
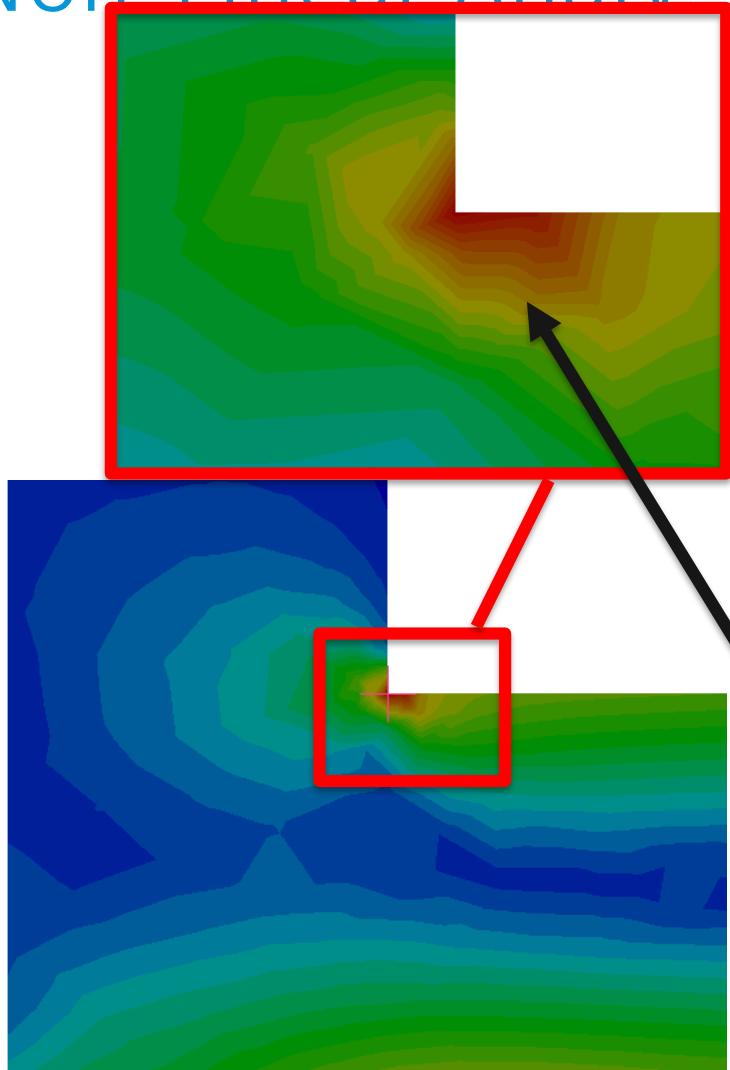


Are my results correct?

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



**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?

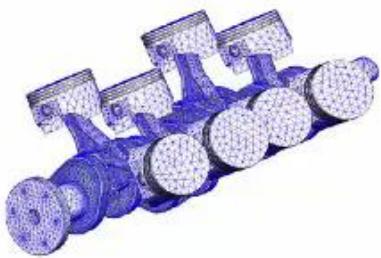
.... Of course who wouldn't.....



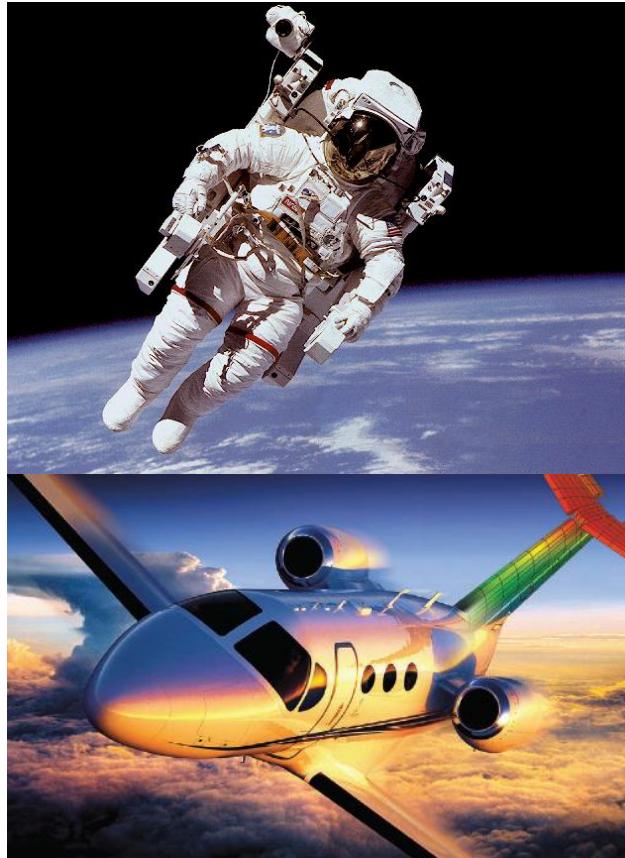
Can I trust Nastran results

Autodesk® Nastran® In-CAD 2019

Verification Manual



 AUTODESK®



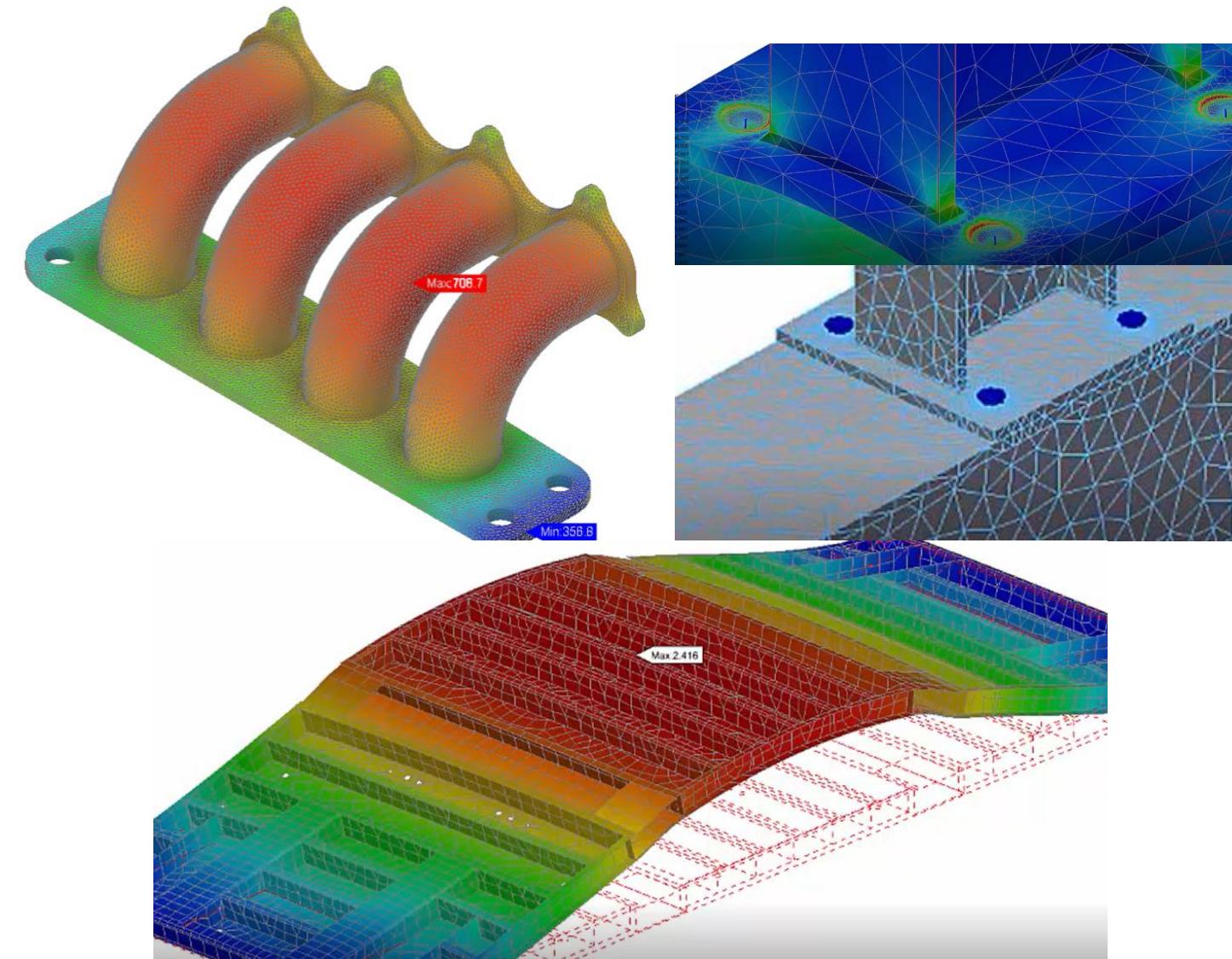
Absolutely

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

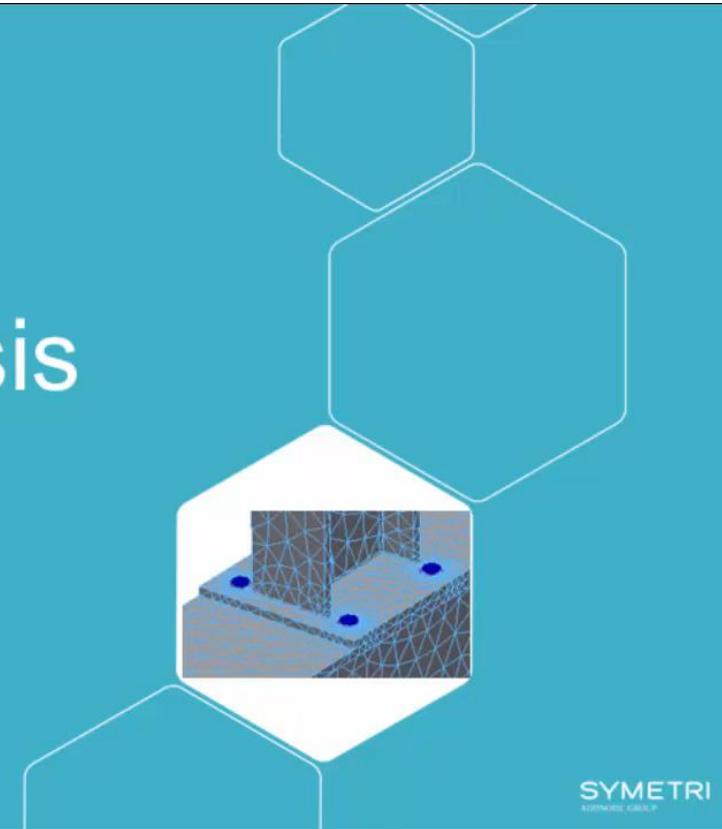
Above and Beyond Inventor FEA

1. Bolted Connections
2. Thermal Analysis
3. Fabrications

Nastran In-CAD in action

Complete workflow - Setup to results

Bolt Analysis



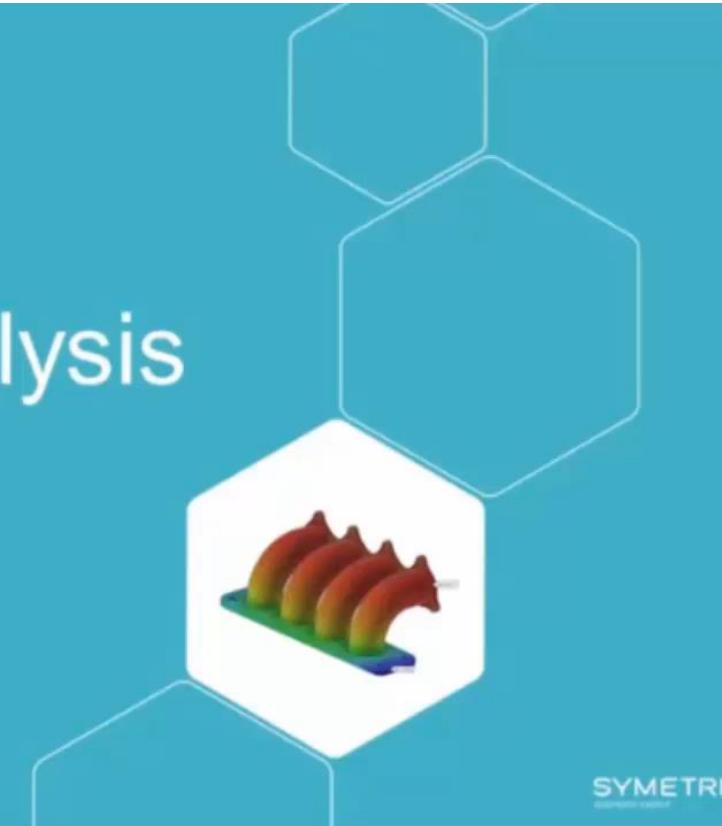
Typical Applications

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

Nastran In-CAD in action

Manifold

Thermal Analysis



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

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





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