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2021 ALTAIR STUDENT WEBINAR SERIES – SIMLAB

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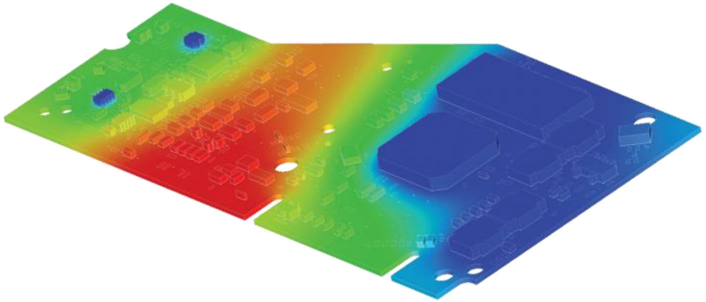
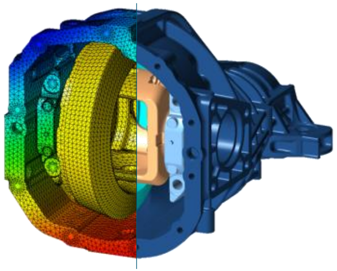
Multiphysics Workflows with CAD Associativity

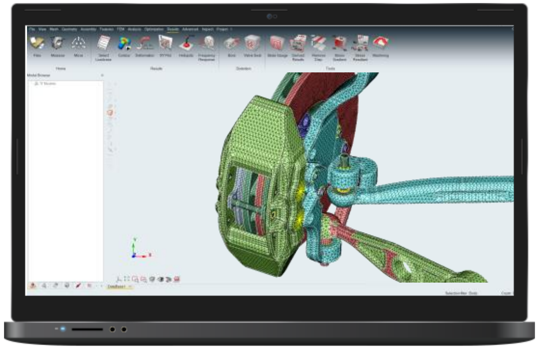
Altair SimLab

SimLab is a process-oriented multidisciplinary simulation environment to accurately analyse the performance of complex assemblies. Multiple physics including structural, thermal, e-mag, and fluid dynamics can be easily setup using highly automated modelling tasks, helping to drastically reduce the time spent creating finite element models and interpreting results.

- Highly efficient, feature-based modelling approach
- Create templates to enable CAE automation
- Multiphysics analyses locally or in the cloud







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SYSTEM IDEALIZATION

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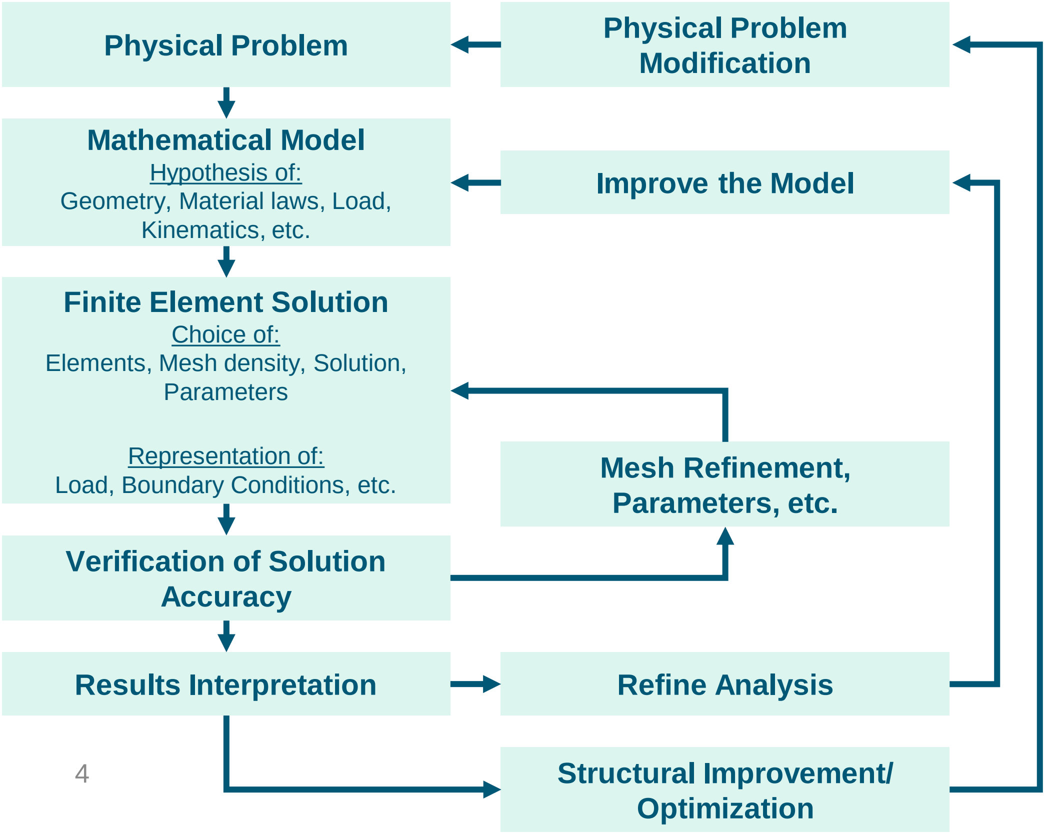
System Idealization

Workflow



Pre-Processing

- Idealization of physical problem and its representation proposing a mathematical model

Processing

- Solution of mathematical model

Post-Processing

- Verification and interpretation of the results

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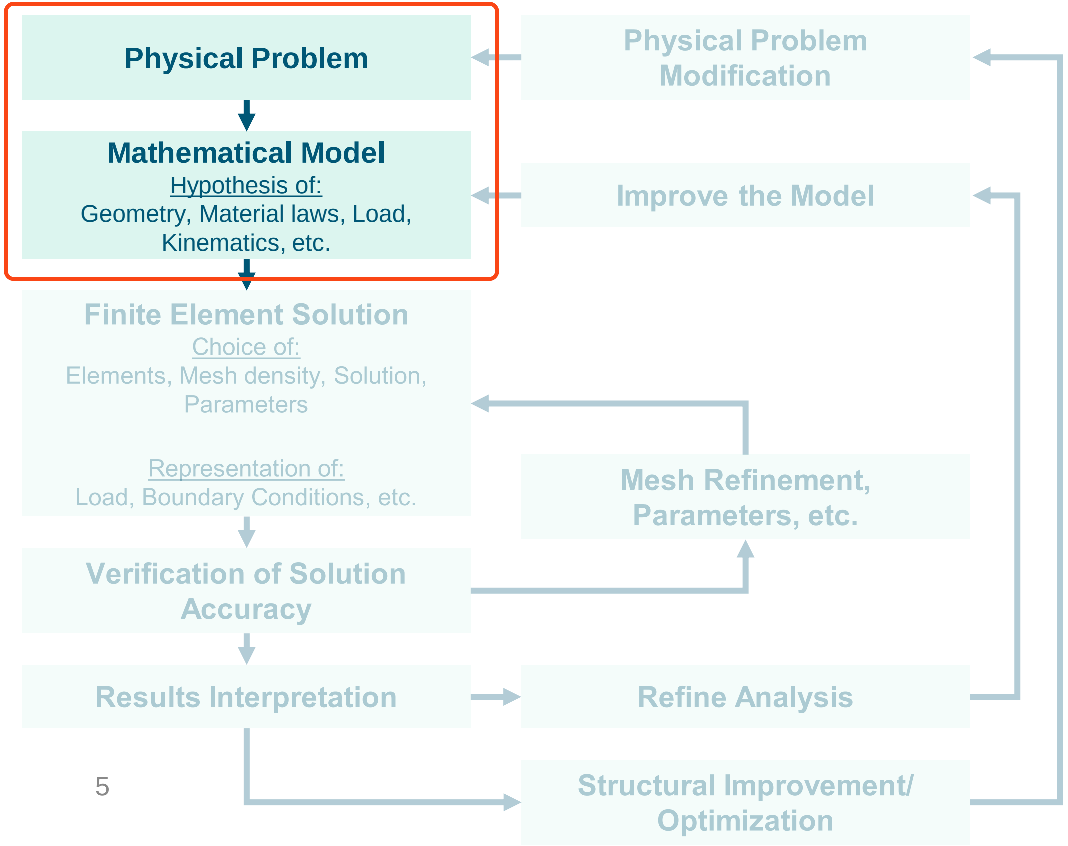
Structural Analysis

System Idealization



- System Idealization

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$

- Linear x Nonlinear Analyses
- Static x Dynamic Analyses
- Consistent Unit System

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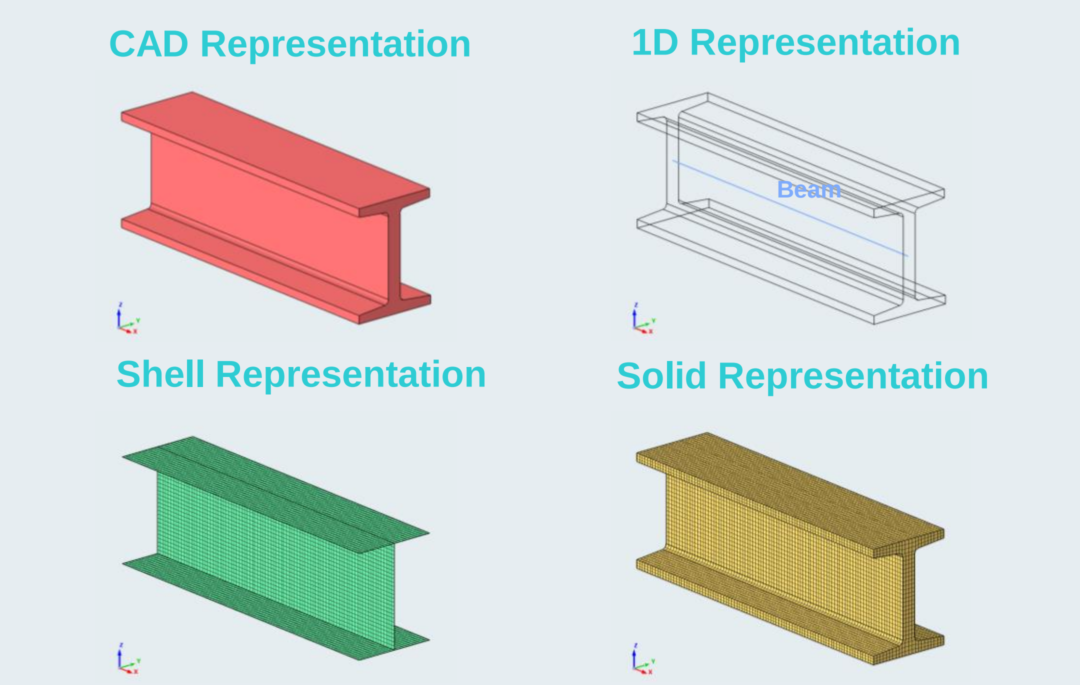
Structural Analysis

System Idealization

- The physical problem complexity is infinite and its model must represent it just within the required precision, with the lower cost possible.



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Structural Analysis

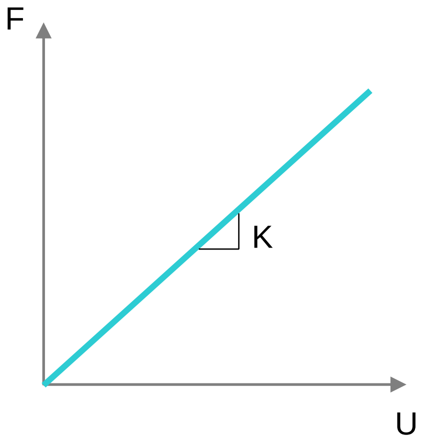
Linear vs Nonlinear Analysis

Linear

Fundamental condition: Stiffness $[K]$ constant

$$\mathbf{F} = [K] \times \{U\}$$

Proportionality between causes and effects

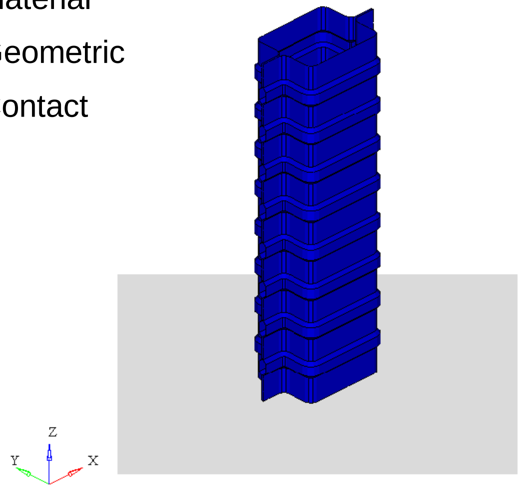


Nonlinear

Stiffness $[K]$ varying along the analysis

3 sources of non-linearity:

- Material
- Geometric
- Contact



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Structural Analysis

Static vs Dynamic Analysis

Static

Inertial effects neglected

Time period does not affect the result

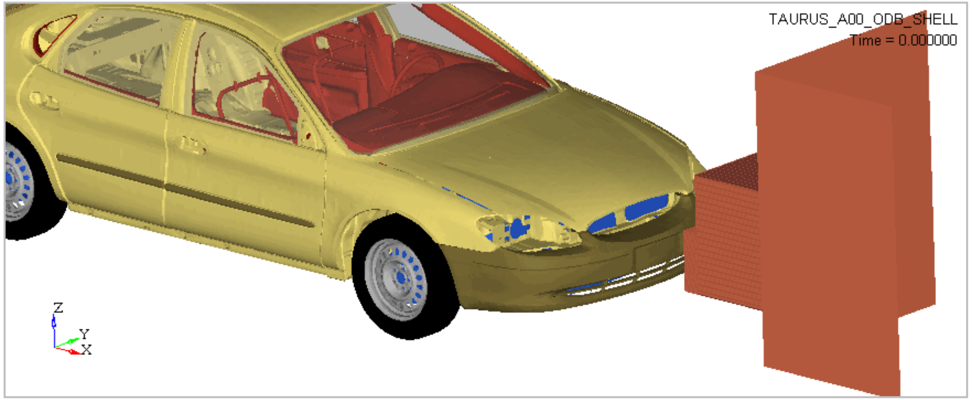
$$Kx = f$$

Dynamic

Inertia effects are important

Time period does affect the result

$$M\ddot{x} + C\dot{x} + Kx = f(t)$$



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ENGINEERING APPLICATIONS

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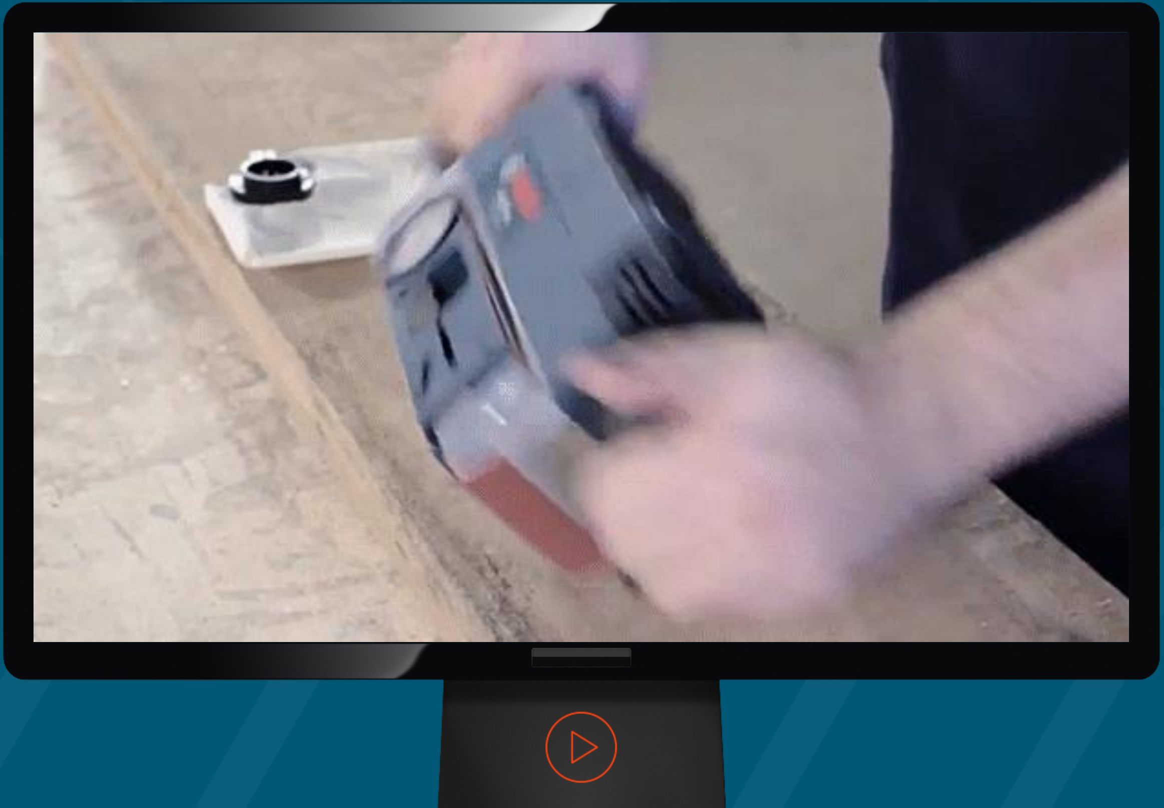
Product Engineering of Belt Sander



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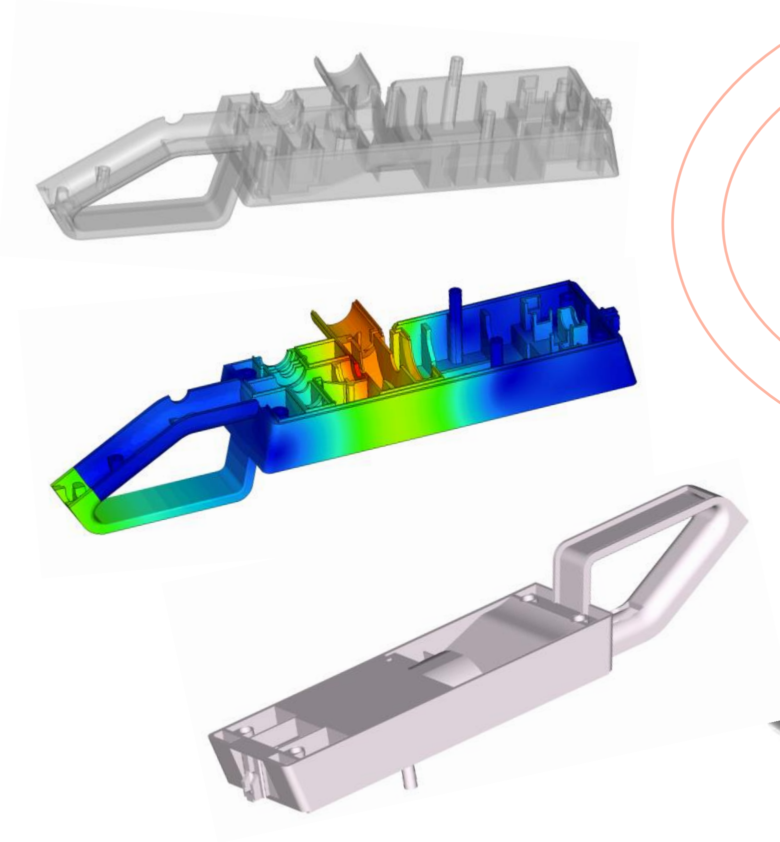
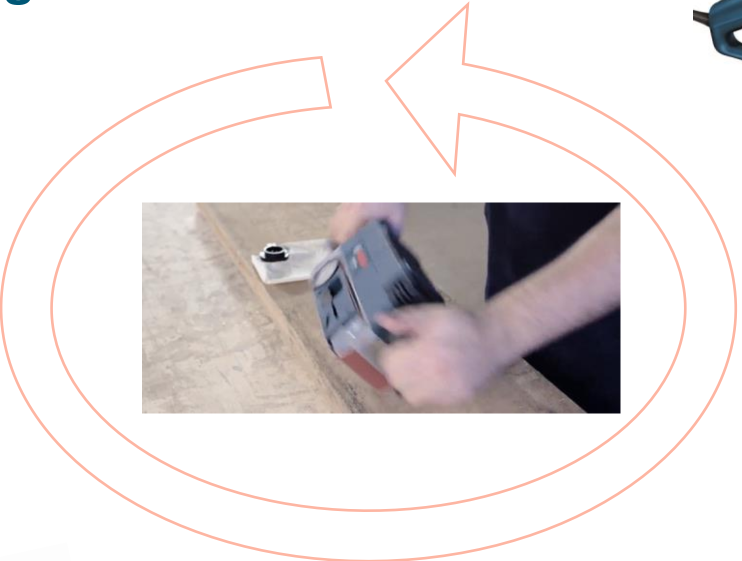
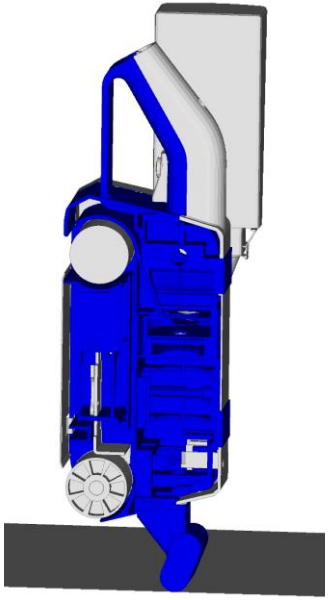
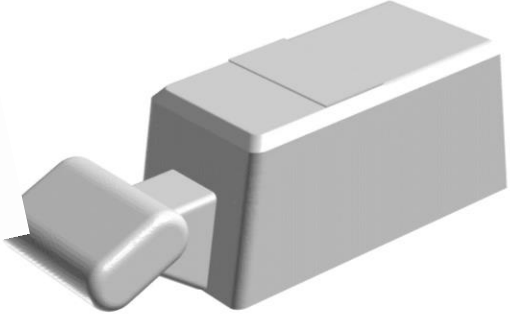
Single GUI Multiple Physics

Belt Sander









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1.2

HOT & HEAVY

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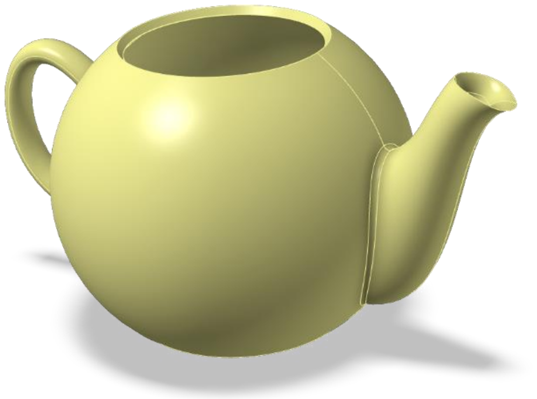
1.2 Hot & Heavy

"How big is the stress in the porcelain due to the weight of the tea and to the hot temperature?

Task: Solve a Linear Static Analysis with overlaid temperature results.

In this level you will learn how to:

- Use *Body*- and *Volume Layer* ***Mesh Controls***
- Create **loads and constraints**
- Run a simple **linear static** structural solution
- Run a simple **heat transfer** solution
- **Couple** the thermal and the structural solution.



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1.2
MESH: VOLUME LAYERS


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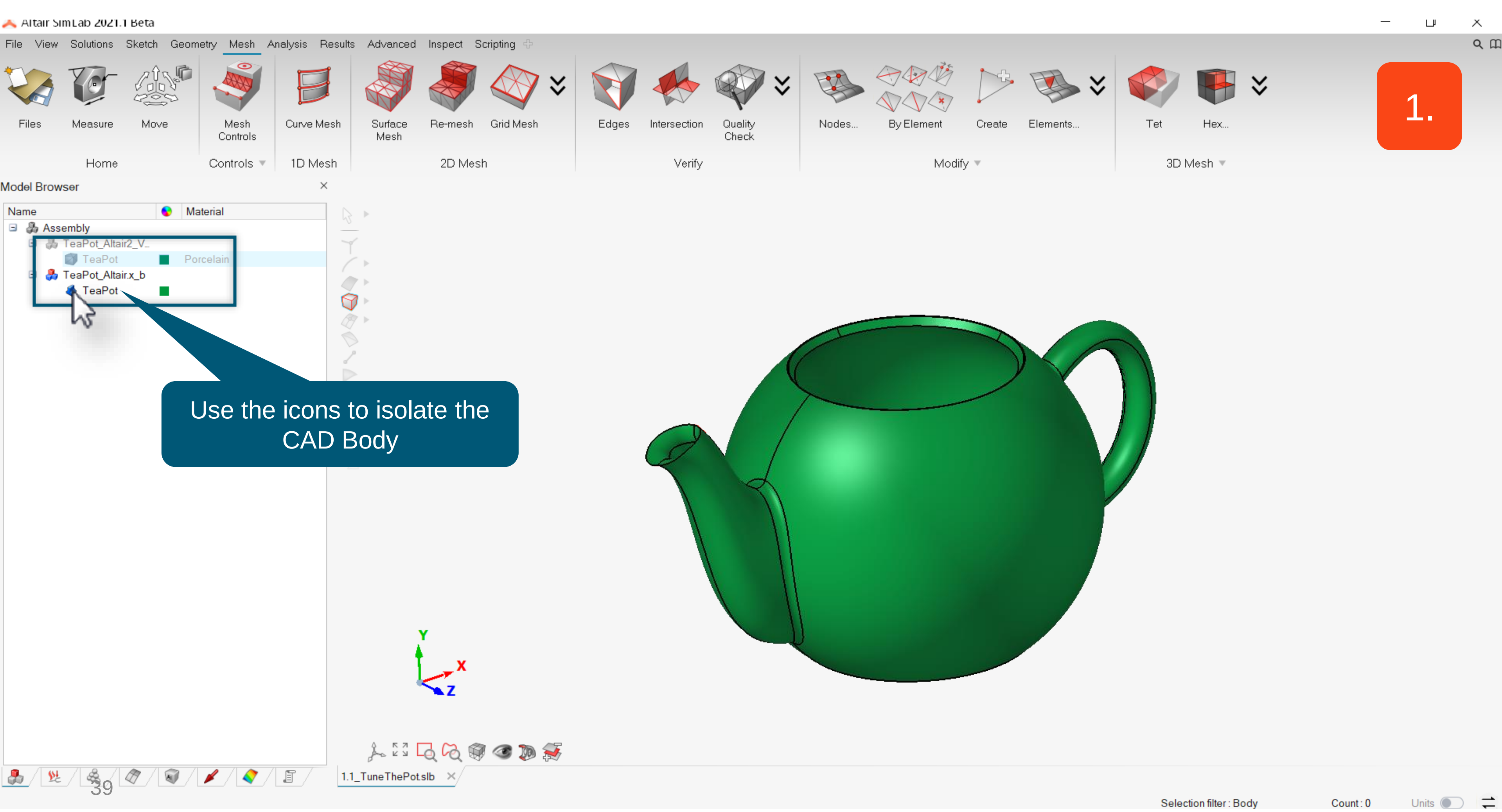
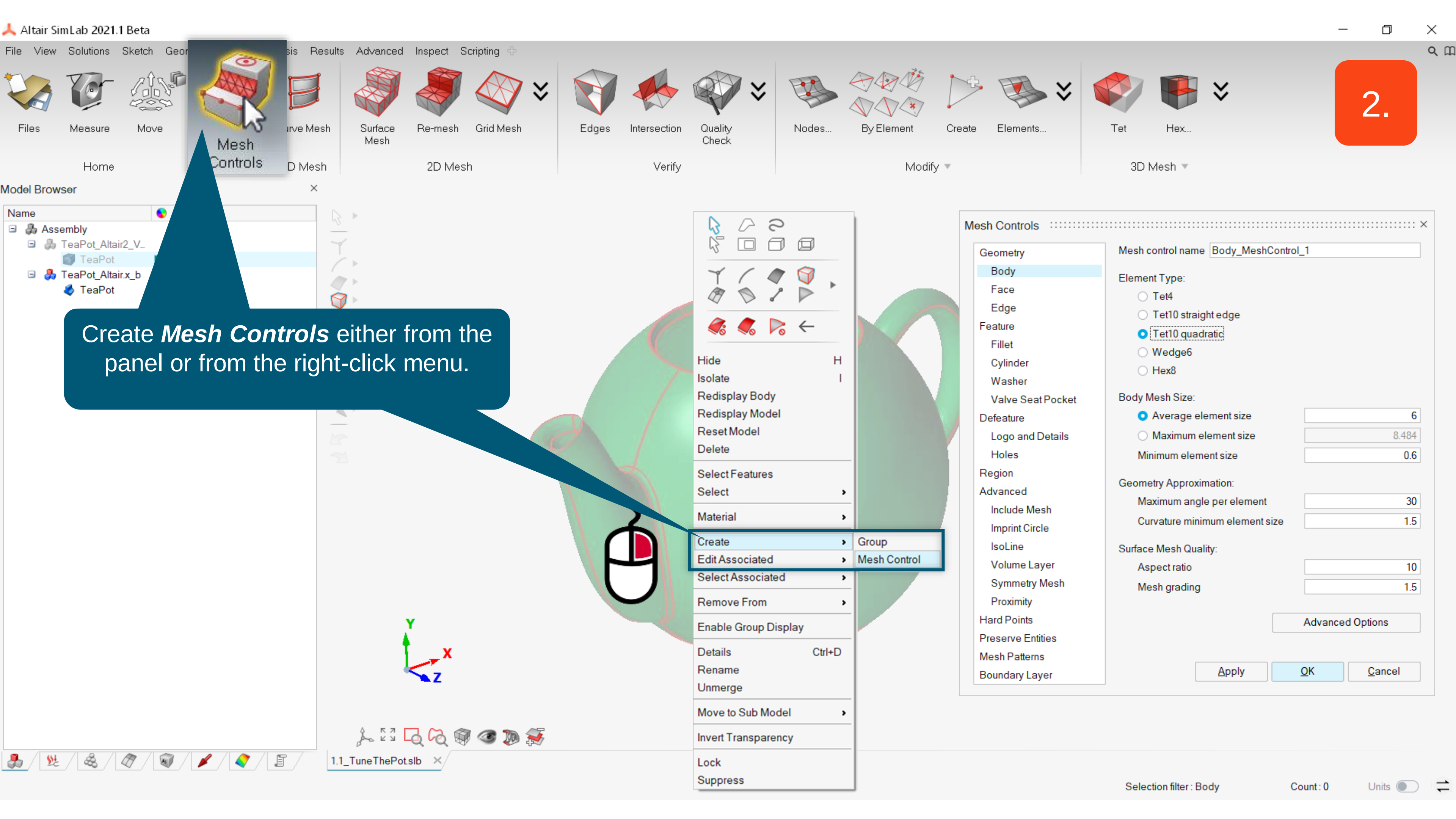
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Mesh Controls
Surface Mesh Re-mesh Grid Mesh
Edges Intersection Quality Check
Nodes... By Element Create Elements...
Hex...
Home Controls 2D Mesh Verify Modify 3D Mesh
Body Mesh Control
Model Browser
Name Material
Assembly
TeaPot_Altair2_V...
TeaPot Porcelain
TeaPot_Altair.x_b
TeaPot
1. Hide results, then isolate CAD to start new.
2. Create ***Body Mesh Control***:
Element size: 6mm
Curvature refinement: 30°
Curvature min size 1.5
3. Create ***Volume Layer Mesh Control*** for 2 Element Layers through the thickness.
4. **Tet Mesh** using the advanced option ***Create Mesh in New Model***
Y
X
Z
1.1_TuneThePot.slb
Reveal…
Selection filter : Body
Count : 0
Units


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Mesh Controls
Controls
Curve Mesh
1D Mesh
Surface Mesh Re-mesh Grid Mesh
2D Mesh
Edges Intersection Quality Check
Verify
Nodes... By Element Create Elements...
Modify
Tet Hex...
3D Mesh
1.
Model Browser
Name Material
Assembly
TeaPot_Altair2_V..
TeaPot Porcelain
TeaPot_Altair.x_b
TeaPot
Use the icons to isolate the CAD Body
Y
X
Z
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units



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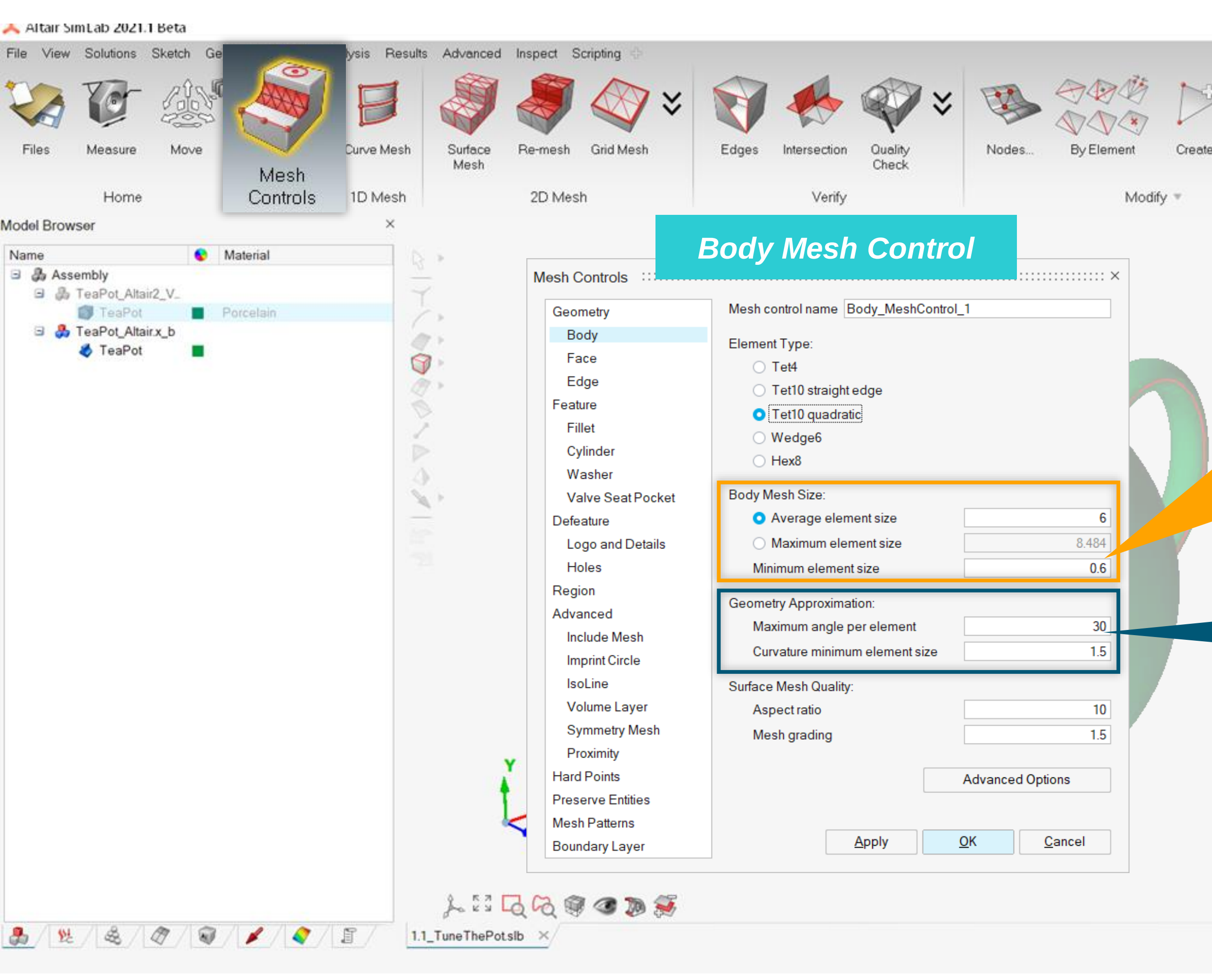
File
View
Solutions
Sketch
Results
Advanced
Inspect
Scripting
Files
Measure
Move
Mesh Controls
Surface Mesh
Re-mesh
Grid Mesh
Edges
Intersection
Quality Check
Nodes...
By Element
Create
Elements...
Tet
Hex...
Home
2D Mesh
Verify
Modify
3D Mesh
2.
Model Browser
Name
Assembly
TeaPot_Altair2_V...
TeaPot
TeaPot_Altair.x_b
TeaPot
Create Mesh Controls either from the panel or from the right-click menu.
Hide H
Isolate I
Redisplay Body
Redisplay Model
Reset Model
Delete
Select Features
Select
Material
Create
Edit Associated
Select Associated
Remove From
Enable Group Display
Details Ctrl+D
Rename
Unmerge
Move to Sub Model
Invert Transparency
Lock
Suppress
Group
Mesh Control
Mesh Controls
Geometry
Body
Face
Edge
Feature
Fillet
Cylinder
Washer
Valve Seat Pocket
Defeature
Logo and Details
Holes
Region
Advanced
Include Mesh
Imprint Circle
IsoLine
Volume Layer
Symmetry Mesh
Proximity
Hard Points
Preserve Entities
Mesh Patterns
Boundary Layer
Mesh control name Body_MeshControl_1
Element Type:
Tet4
Tet10 straight edge
Tet10 quadratic
Wedge6
Hex8
Body Mesh Size:
Average element size 6
Maximum element size 8.484
Minimum element size 0.6
Geometry Approximation:
Maximum angle per element 30
Curvature minimum element size 1.5
Surface Mesh Quality:
Aspect ratio 10
Mesh grading 1.5
Advanced Options
Apply
OK
Cancel
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units

Body Mesh Control



General Mesh size parameters.

Minimum Element Size will defeature small geometry edges.

Mesh refinement by Curvature

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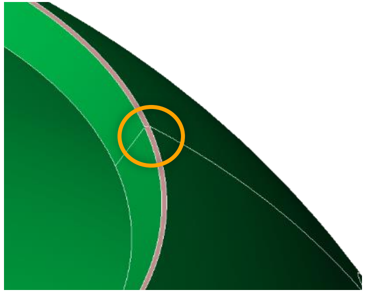
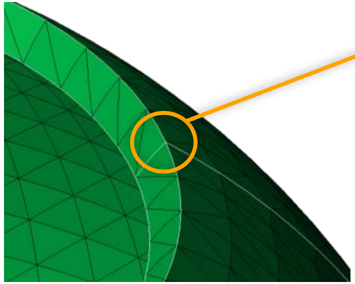
Body Mesh Control

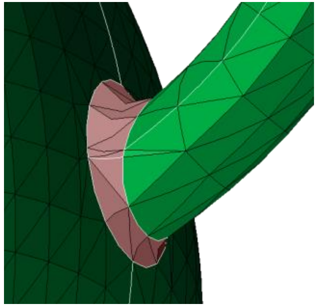
- ***Minimum element size*** = 0.6mm
will suppress all geometry features <0.6mm

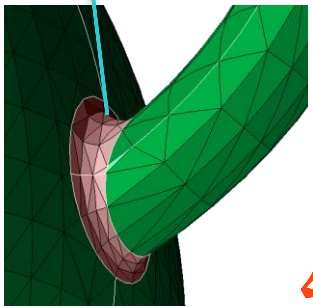




Body Mesh Size:	
Average element size	6
Maximum element size	8.484
Minimum element size	0.6
Geometry Approximation:	
Maximum angle per element	30
Curvature minimum element size	1.5
Surface Mesh Quality:	
Aspect ratio	10
Mesh grading	1.5

- ***Geometry Approximation*** =30°/ 1.5mm
improves mesh resolution on curved faces





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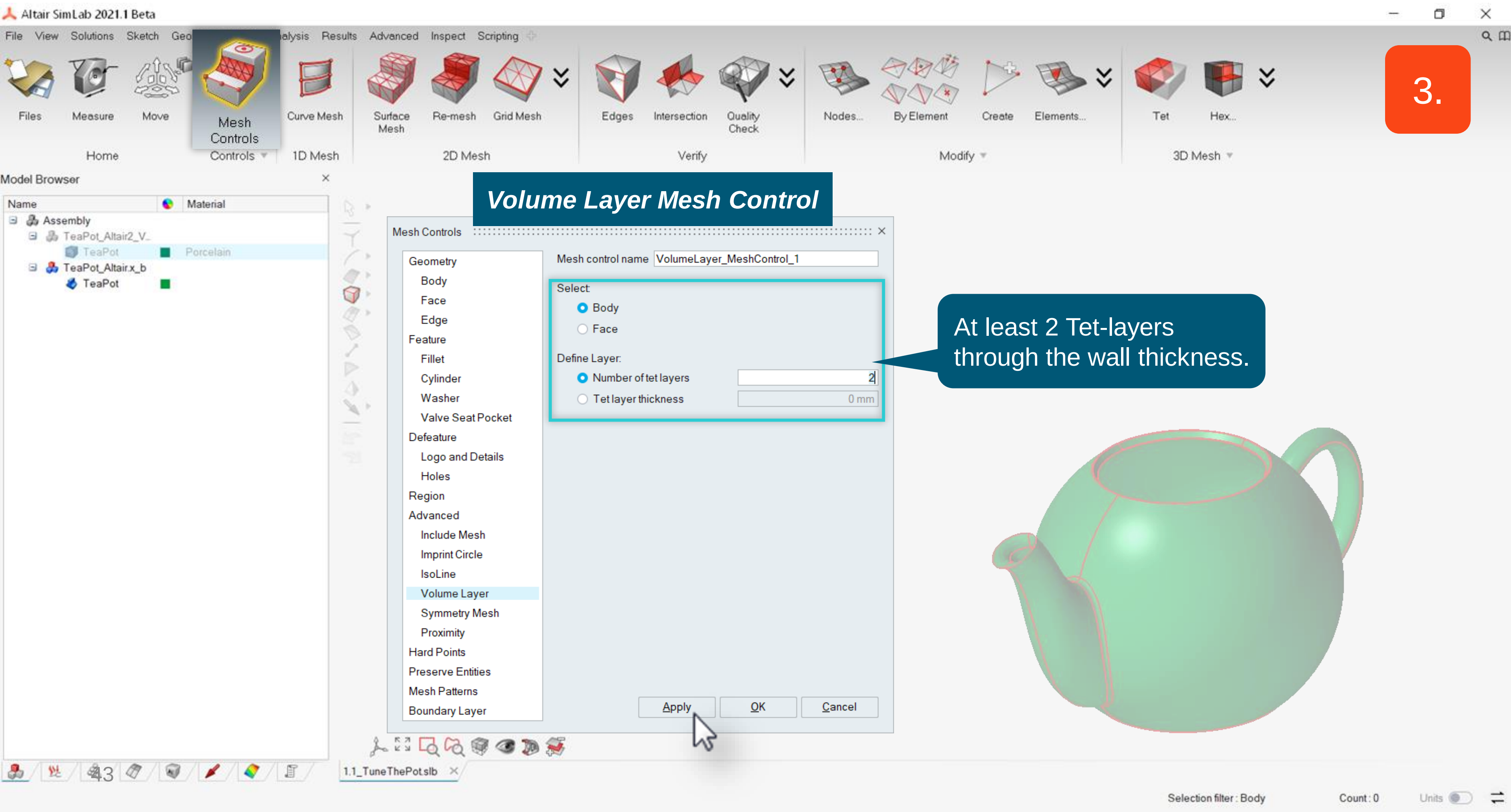
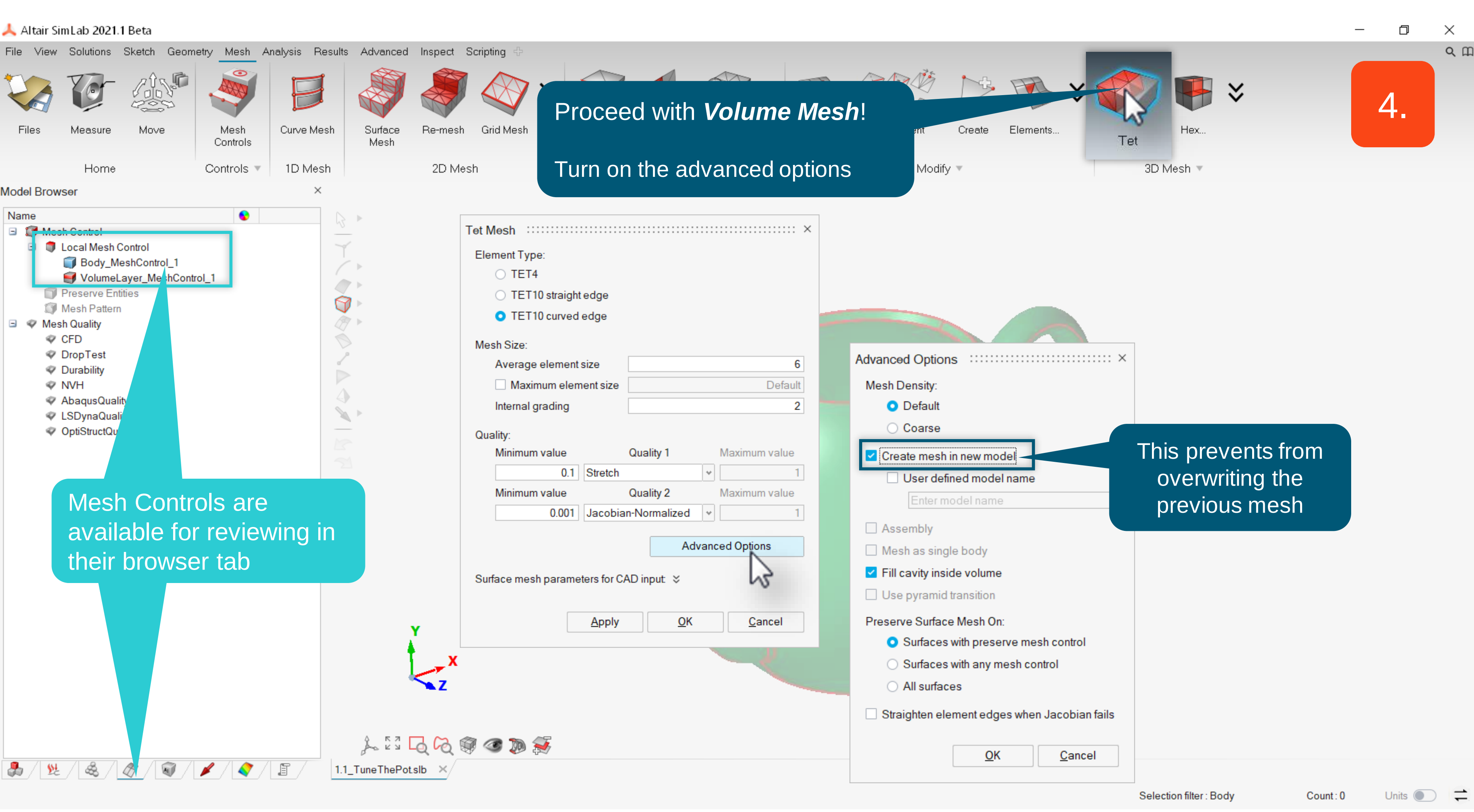

3.
Volume Layer Mesh Control
At least 2 Tet-layers through the wall thickness.
Altair SimLab 2021.1 Beta
Mesh Controls
Mesh control name VolumeLayer_MeshControl_1
Select:
Body
Face
Define Layer:
Number of tet layers
2
Tet layer thickness
0 mm
Geometry
Body
Face
Edge
Feature
Fillet
Cylinder
Washer
Valve Seat Pocket
Defeature
Logo and Details
Holes
Region
Advanced
Include Mesh
Imprint Circle
IsoLine
Volume Layer
Symmetry Mesh
Proximity
Hard Points
Preserve Entities
Mesh Patterns
Boundary Layer
Apply
OK
Cancel
Model Browser
Assembly
TeaPot_Altair2_V...
TeaPot
Porcelain
TeaPot_Altair.x_b
TeaPot
1.1_TuneThePot.slb
Selection filter : Body
Count : 0



4.
Proceed with ***Volume Mesh***!
Turn on the advanced options
Mesh Controls are available for reviewing in their browser tab
This prevents from overwriting the previous mesh
Altair SimLab 2021.1 Beta
Tet Mesh
Advanced Options
Create mesh in new model
Model Browser

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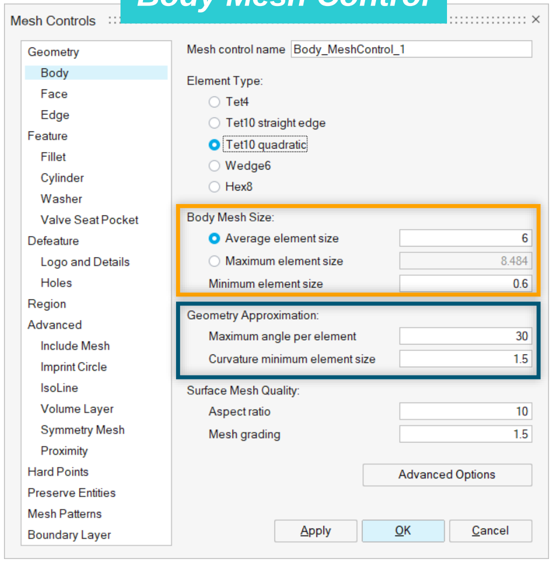
Mesh Parameters

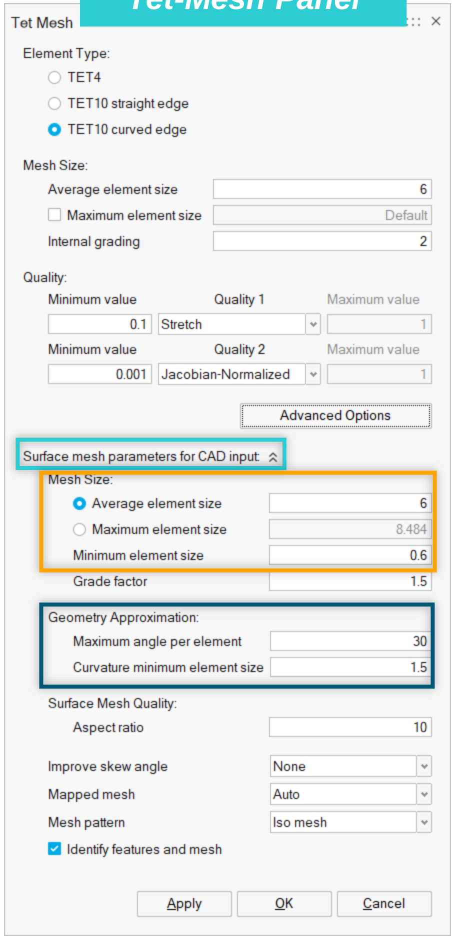
- Instead of creating a Mesh Control it is possible to enter the same mesh parameters directly in the Tet Mesh panel, under ***Surface mesh parameters for CAD input***.

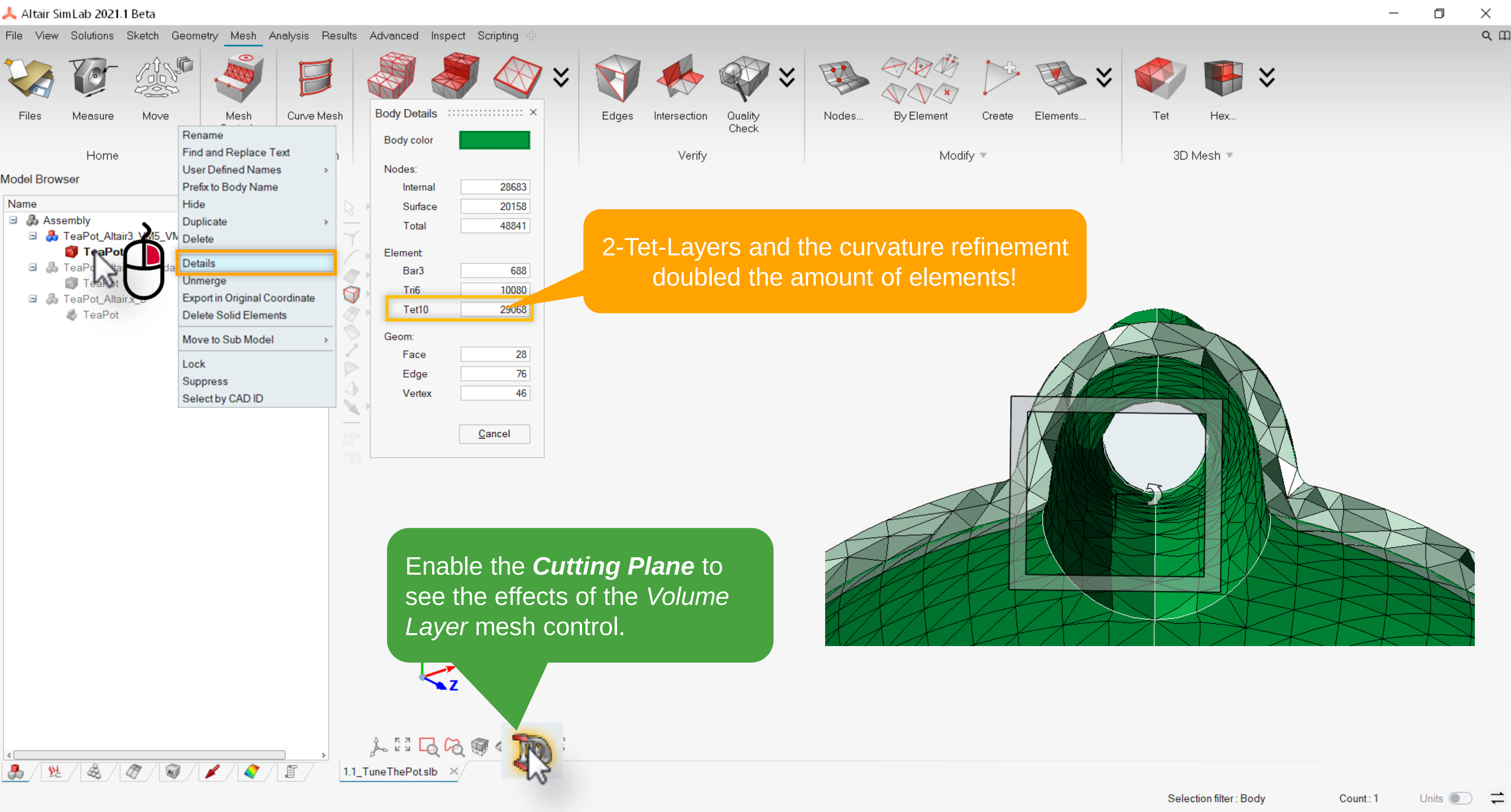
- Anyway, parameters entered in the mesh control have higher priority and will always be used.

Body Mesh Control



Tet-Mesh Panel





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File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move Mesh Curve Mesh
Home
Edges Intersection Quality Check
Verify
Nodes... By Element Create Elements...
Modify
Tet Hex...
3D Mesh
Model Browser
Name
Assembly
TeaPot_Altair3
TeaPot
TeaPot_Altair
TeaPot
Rename
Find and Replace Text
User Defined Names
Prefix to Body Name
Hide
Duplicate
Delete
Details
Unmerge
Export in Original Coordinate
Delete Solid Elements
Move to Sub Model
Lock
Suppress
Select by CAD ID
Body Details
Body color
Nodes:
Internal 28683
Surface 20158
Total 48841
Element:
Bar3 688
Tri6 10080
Tet10 29068
Geom:
Face 28
Edge 76
Vertex 46
Cancel
2-Tet-Layers and the curvature refinement doubled the amount of elements!
Enable the Cutting Plane to see the effects of the Volume Layer mesh control.
1.1_TuneThePot.slb
Selection filter : Body
Count : 1
Units


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Surface Mesh Re-mesh Grid Mesh
2D Mesh
Edges Intersection Quality Check
Verify
Nodes... By Element Create Elements...
Modify
Tet Hex...
3D Mesh
Model Browser
Name Material
Assembly
TeaPot_Altair3_VM5_VM.gda
TeaPot
Porcelain
Both versions of the mesh are now available as independent FE models.
You don’t need to delete the old one, but ensure you display only one when selecting entities!
Rename
Unmerge
Delete Solid Elements
Move to Sub Model
Invert Transparency
Lock
Suppress
If you want to avoid confusion between different versions, you can use the options ***Lock (***or ***Suppress)*** to isolate (or hide) permanently the bodies.
Model Browser
Name Material
Assembly
TeaPot_Altair3_VM5_VM.gda [1/1]
TeaPot
TeaPot_Altair2_VM.gda [0/1]
TeaPot_Altair.x_b [0/1]
Y
X
Z
1.1_TuneThePot.slb
Selection filter : Body
Count : 1
Units

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1.2

SOLUTION SETUP - STRUCTURAL

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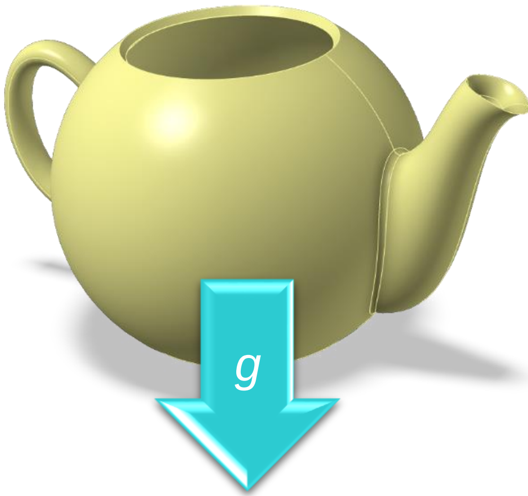
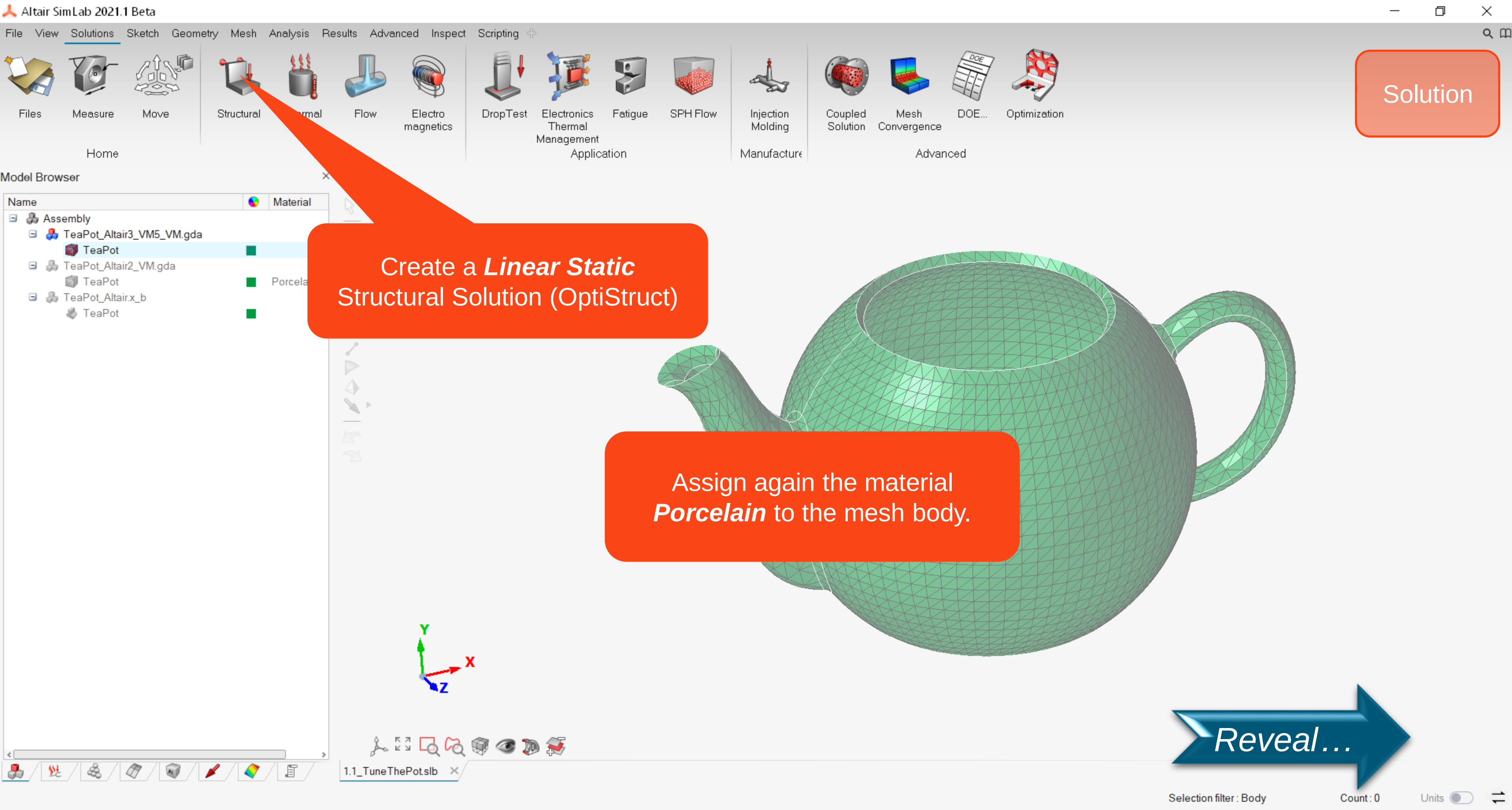
Linear Static Solution

First, we want to compute the stresses in the material due to the weight (and pressure) of the tea in it.

We will simply lock some nodes in order to simulate the hand holding the handle and apply a hydrostatic pressure on the inside faces.

Note: our Porcelain material can afford stresses of 15 MPa for tension, 30 MPa for shear and 240 MPa for compression.



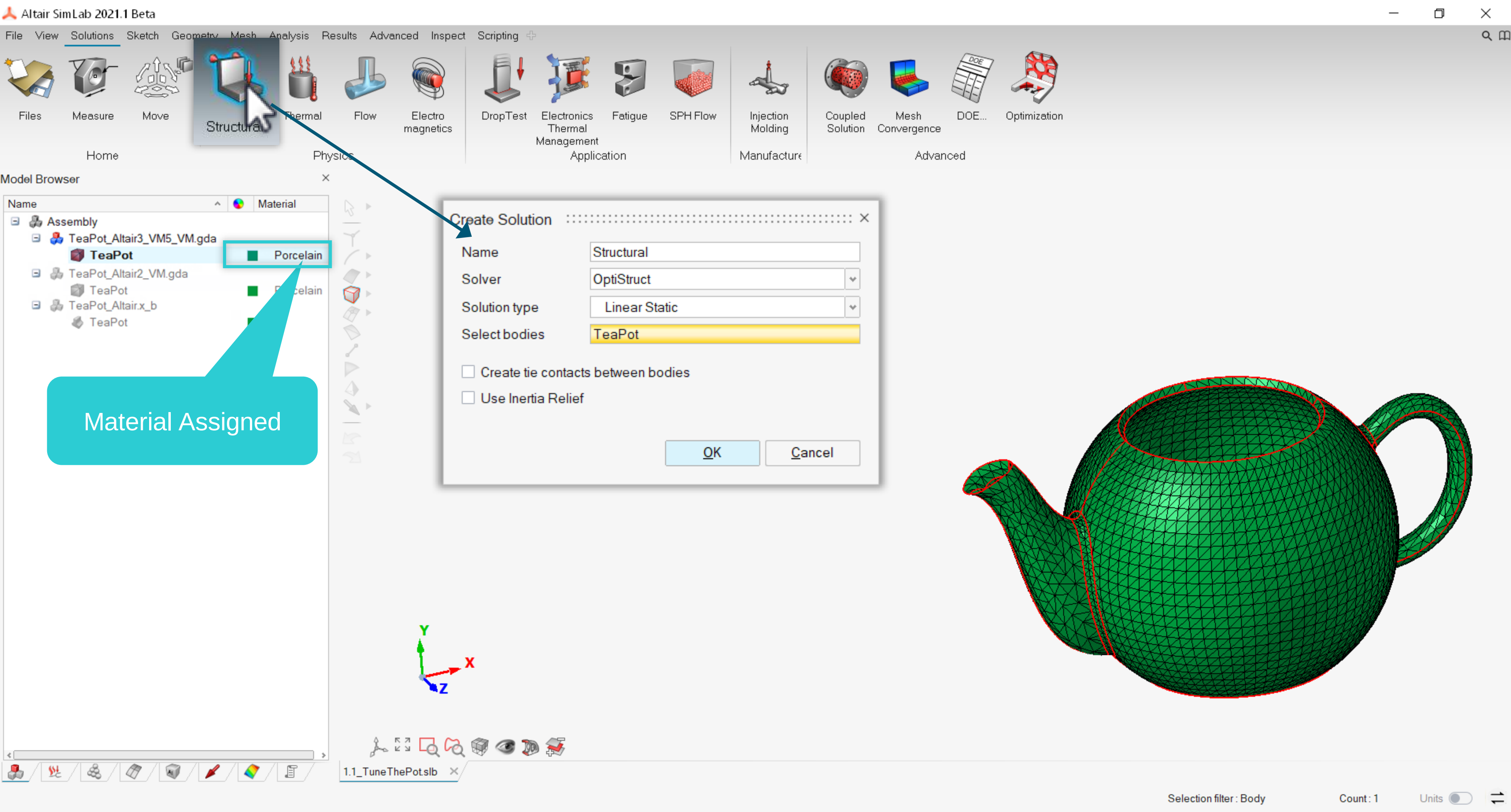


Solution

Create a ***Linear Static*** Structural Solution (OptiStruct)

Assign again the material ***Porcelain*** to the mesh body.

Reveal…



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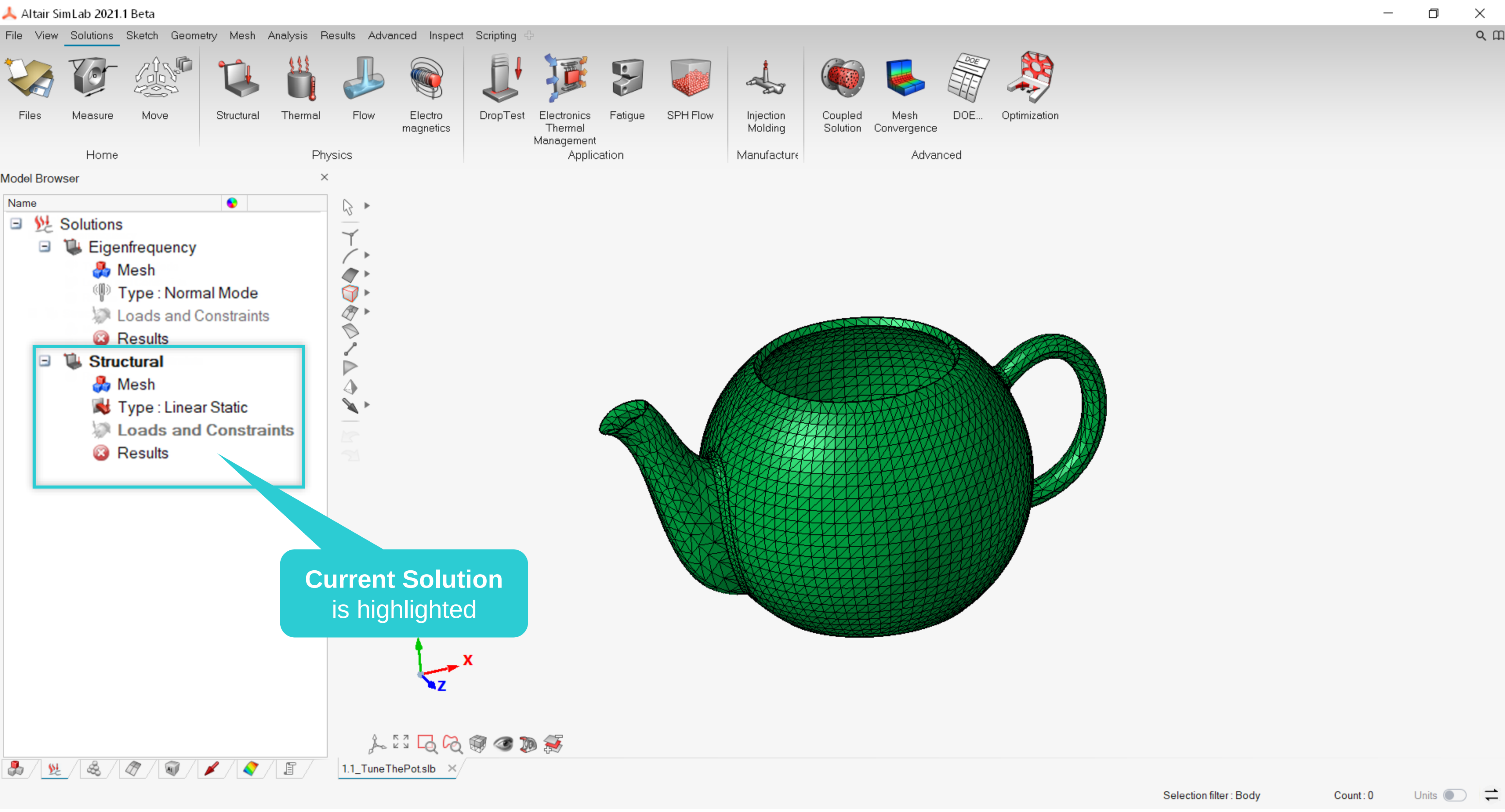
Structural
Thermal
Flow
Electro magnetics
DropTest
Electronics Thermal Management
Fatigue
SPH Flow
Injection Molding
Coupled Solution
Mesh Convergence
DOE...
Optimization
Home
Physics
Application
Manufacture
Advanced
Model Browser
Name
Material
Assembly
TeaPot_Altair3_VM5_VM.gda
TeaPot
Porcelain
TeaPot_Altair2_VM.gda
TeaPot
TeaPot_Altair.x_b
TeaPot
Material Assigned
Create Solution
Name
Structural
Solver
OptiStruct
Solution type
Linear Static
Select bodies
TeaPot
Create tie contacts between bodies
Use Inertia Relief
OK
Cancel
Y
X
Z
1.1_TuneThePot.slb
Selection filter : Body
Count : 1
Units


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
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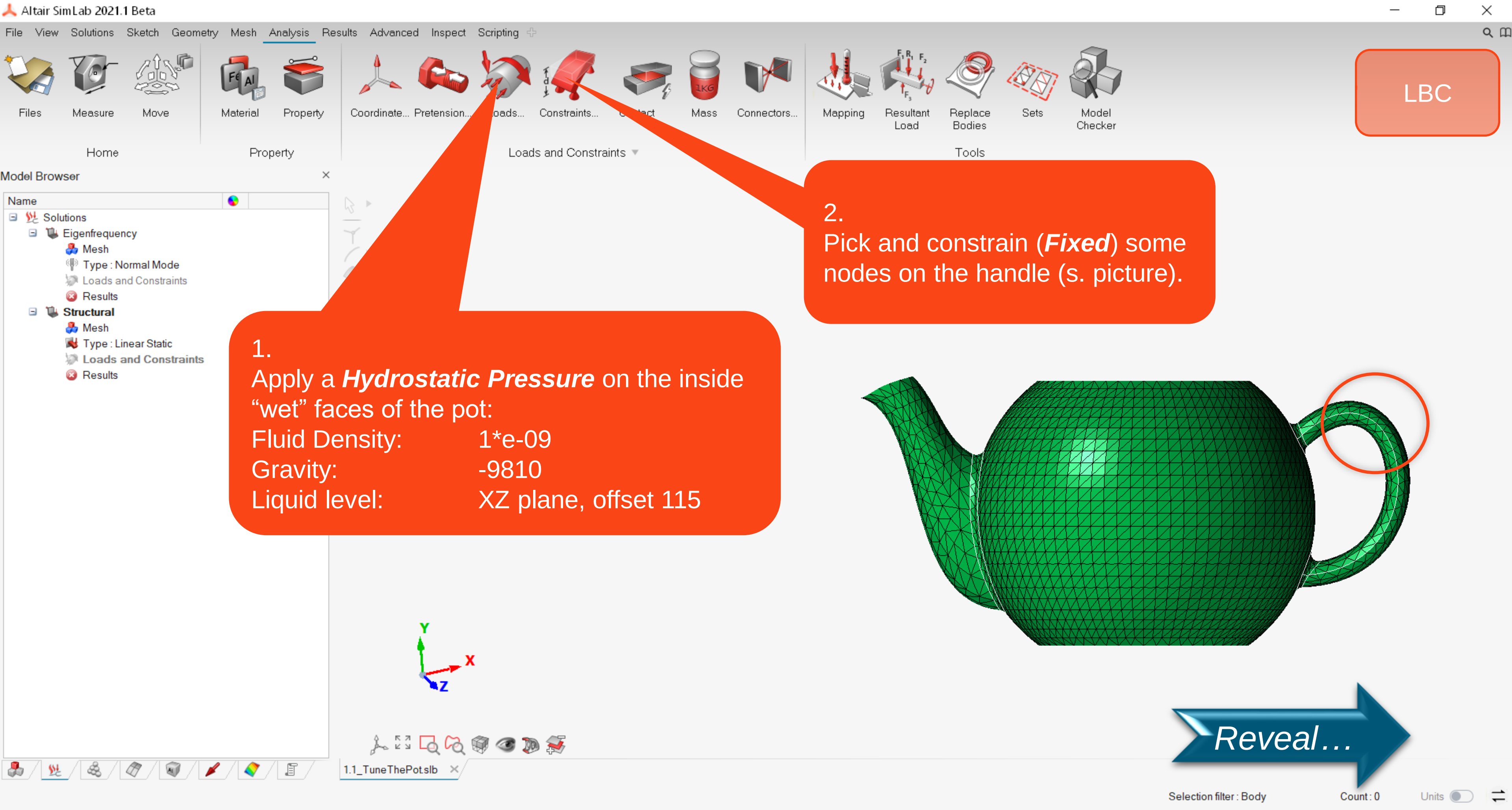
Thermal
Flow
Electro magnetics
Physics
DropTest
Electronics Thermal Management
Fatigue
SPH Flow
Application
Injection Molding
Manufacture
Coupled Solution
Mesh Convergence
DOE...
Optimization
Advanced
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
Results
Current Solution is highlighted
X
Z
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units



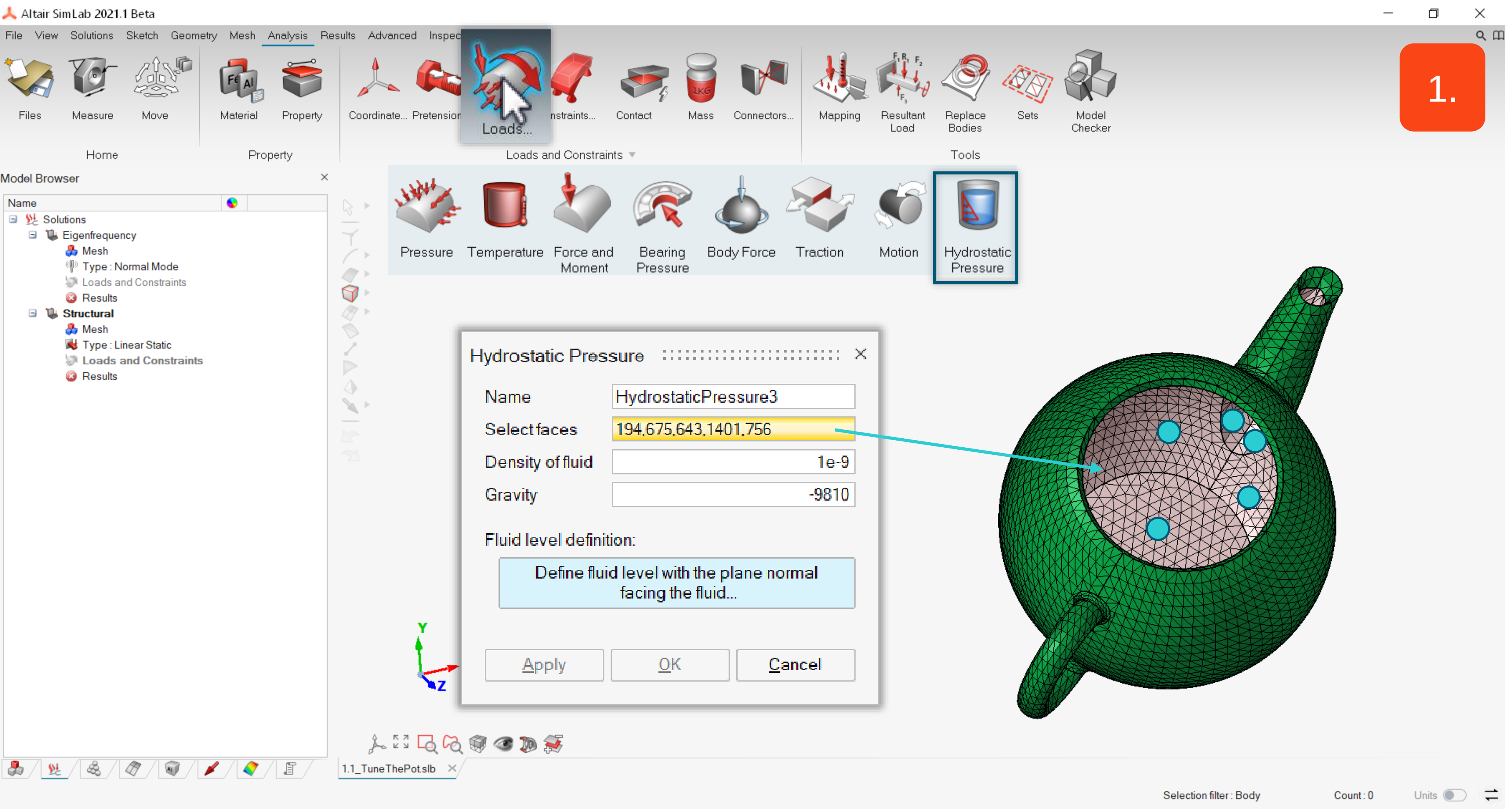
LBC

1.
Apply a ***Hydrostatic Pressure*** on the inside "wet" faces of the pot:

Fluid Density:	1*e-09
Gravity:	-9810
Liquid level:	XZ plane, offset 115

2.
Pick and constrain (***Fixed***) some nodes on the handle (s. picture).

Reveal…



1.
Altair SimLab 2021.1 Beta
File
View
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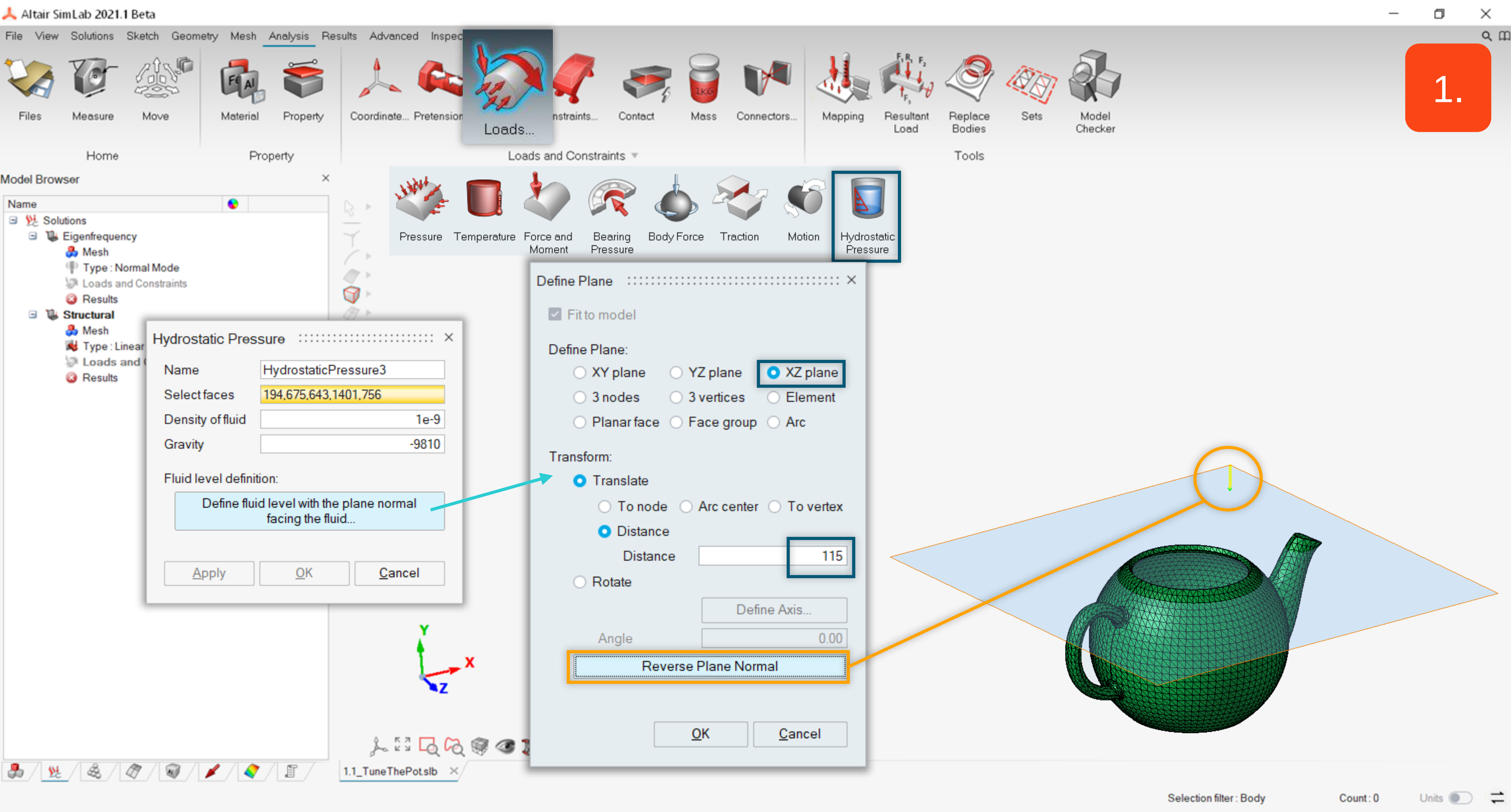
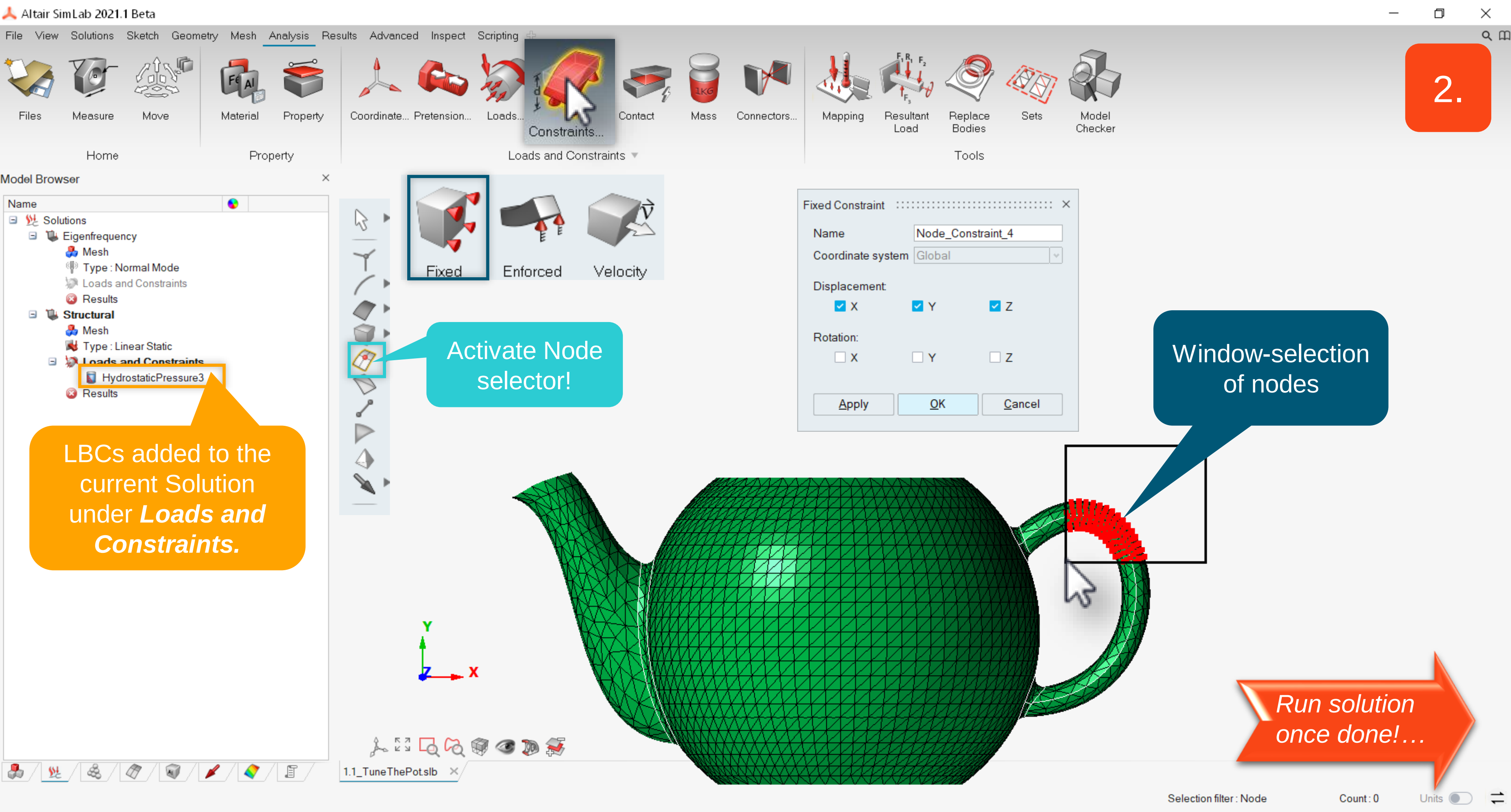
Measure
Move
Material
Property
Coordinate...
Pretension
Loads...
Contact
Mass
Connectors...
Mapping
Resultant Load
Replace Bodies
Sets
Model Checker
Home
Property
Loads and Constraints
Tools
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
Results
Pressure
Temperature
Force and Moment
Bearing Pressure
Body Force
Traction
Motion
Hydrostatic Pressure
Hydrostatic Pressure
Name
HydrostaticPressure3
Select faces
194,675,643,1401,756
Density of fluid
1e-9
Gravity
-9810
Fluid level definition:
Define fluid level with the plane normal facing the fluid...
Apply
OK
Cancel
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units



Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspec
Files Measure Move Material Property Coordinate... Pretension Loads... nstraints... Contact Mass Connectors... Mapping Resultant Load Replace Bodies Sets Model Checker
Home Property Loads and Constraints Tools
1.
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear
Loads and
Results
Pressure Temperature Force and Moment Bearing Pressure Body Force Traction Motion Hydrostatic Pressure
Hydrostatic Pressure
Name HydrostaticPressure3
Select faces 194,675,643,1401,756
Density of fluid 1e-9
Gravity -9810
Fluid level definition:
Define fluid level with the plane normal facing the fluid...
Apply OK Cancel
Define Plane
Fit to model
Define Plane:
XY plane YZ plane XZ plane
3 nodes 3 vertices Element
Planar face Face group Arc
Transform:
Translate
To node Arc center To vertex
Distance
Distance 115
Rotate
Define Axis...
Angle 0.00
Reverse Plane Normal
OK Cancel
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Material Property
Property
Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors...
Loads and Constraints
Mapping Resultant Load Replace Bodies Sets Model Checker
Tools
2.
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
HydrostaticPressure3
Results
LBCs added to the current Solution under ***Loads and Constraints.***
Fixed Enforced Velocity
Activate Node selector!
Fixed Constraint
Name Node_Constraint_4
Coordinate system Global
Displacement
X Y Z
Rotation:
X Y Z
Apply OK Cancel
Window-selection of nodes
Y
X
Run solution once done!…
1.1_TuneThePot.slb
Selection filter : Node
Count : 0
Units

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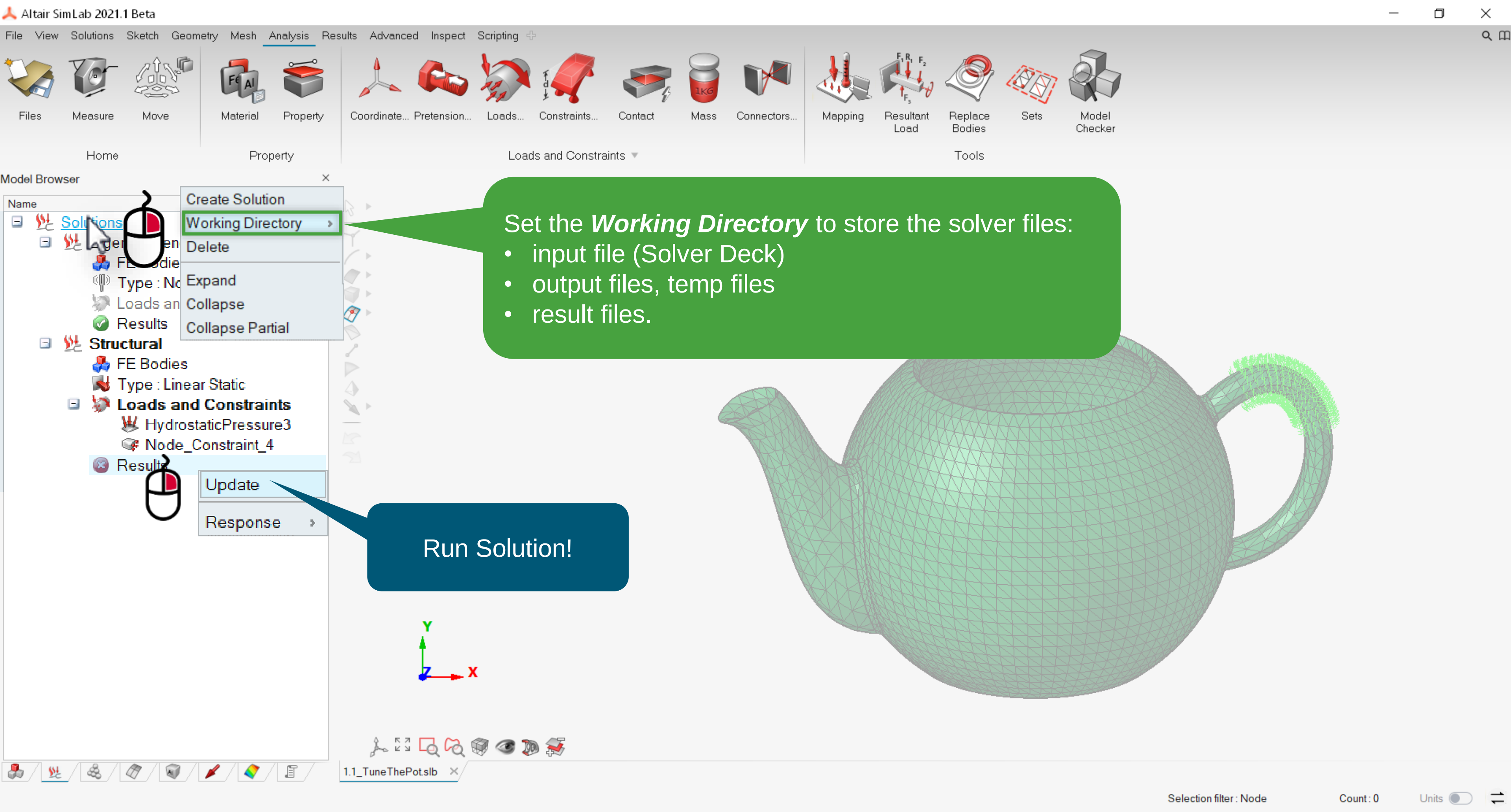
1.2

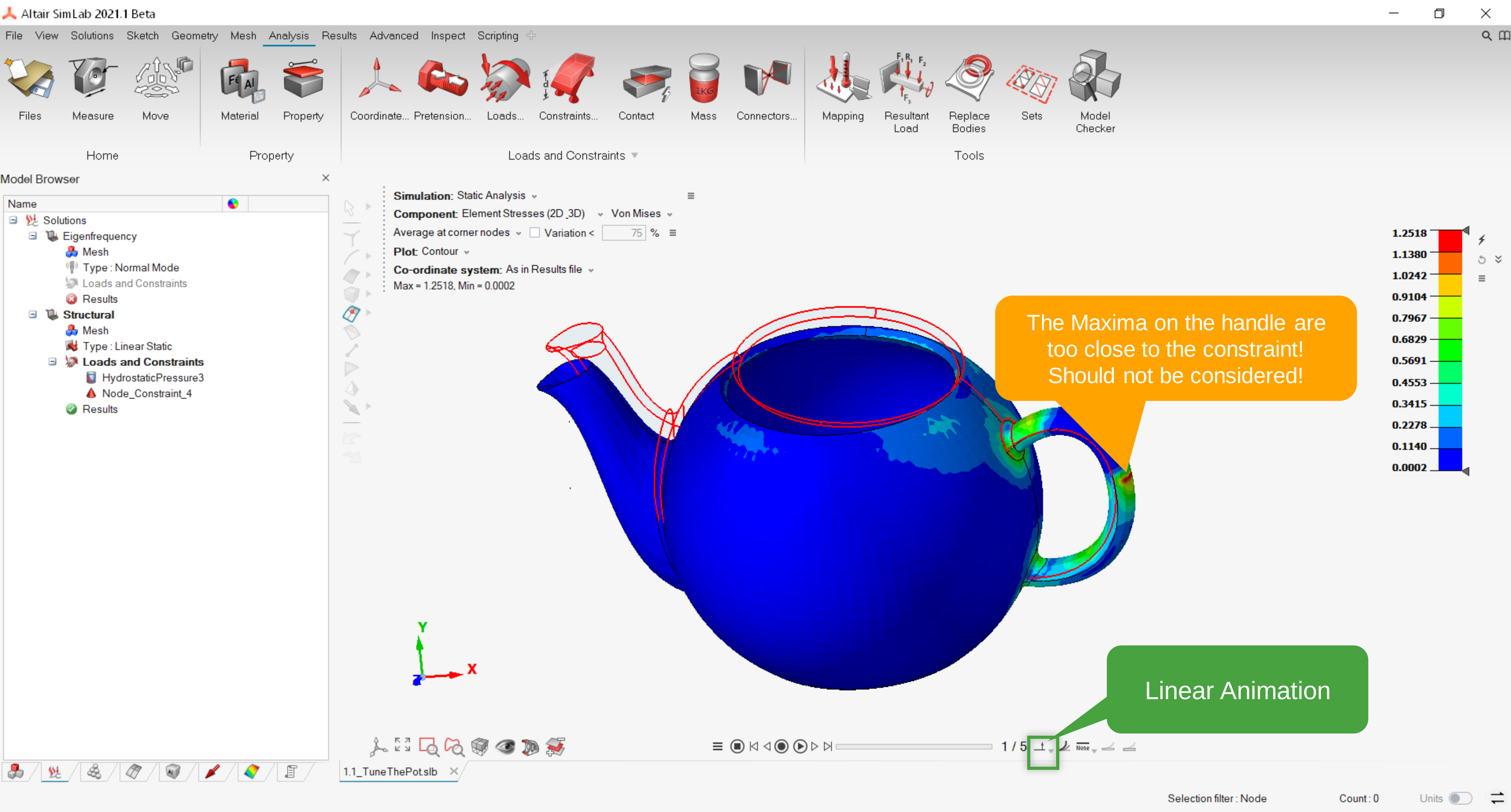
SOLUTION RESULTS - STRUCTURAL



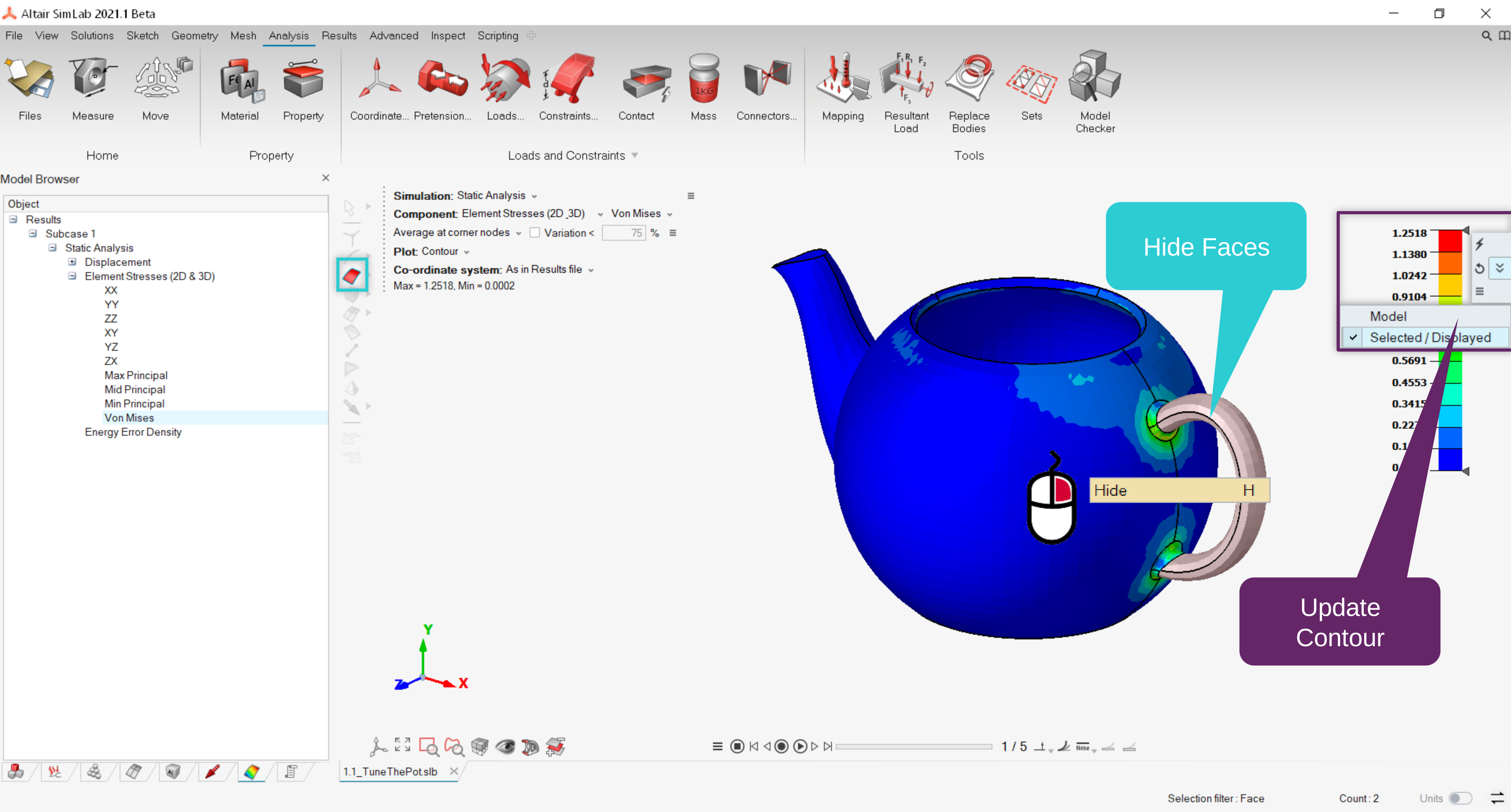
Set the ***Working Directory*** to store the solver files:

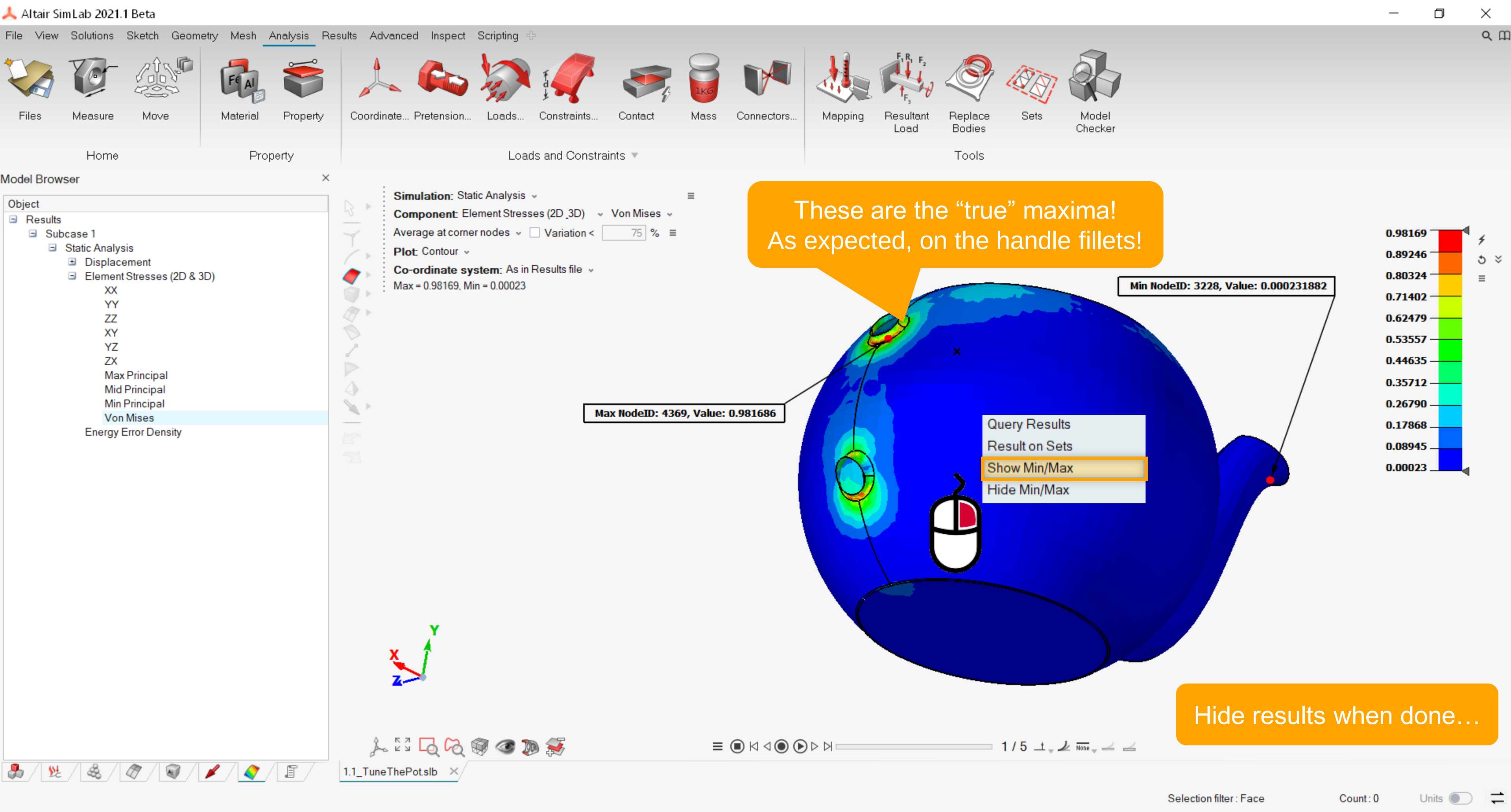
- input file (Solver Deck)
- output files, temp files
- result files.

Run Solution!



Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move Material Property Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors... Mapping Resultant Load Replace Bodies Sets Model Checker
Home Property Loads and Constraints Tools
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
HydrostaticPressure3
Node_Constraint_4
Results
Simulation: Static Analysis
Component: Element Stresses (2D ,3D) Von Mises
Average at corner nodes Variation < 75 %
Plot: Contour
Co-ordinate system: As in Results file
Max = 1.2518, Min = 0.0002
1.2518
1.1380
1.0242
0.9104
0.7967
0.6829
0.5691
0.4553
0.3415
0.2278
0.1140
0.0002
The Maxima on the handle are too close to the constraint! Should not be considered!
Linear Animation
1 / 5
1.1_TuneThePot.slb
Selection filter : Node
Count : 0
Units


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Material Property
Property
Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors...
Loads and Constraints
Mapping Resultant Load Replace Bodies Sets Model Checker
Tools
Model Browser
Object
Results
Subcase 1
Static Analysis
Displacement
Element Stresses (2D & 3D)
XX
YY
ZZ
XY
YZ
ZX
Max Principal
Mid Principal
Min Principal
Von Mises
Energy Error Density
Simulation: Static Analysis
Component: Element Stresses (2D 3D) Von Mises
Average at corner nodes Variation < 75 %
Plot: Contour
Co-ordinate system: As in Results file
Max = 1.2518, Min = 0.0002
Hide Faces
1.2518
1.1380
1.0242
0.9104
Model
Selected / Displayed
0.5691
0.4553
Hide H
Update Contour
1 / 5
1.1_TuneThePot.slb
Selection filter : Face
Count : 2
Units



Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Material Property
Property
Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors...
Loads and Constraints
Mapping Resultant Load Replace Bodies Sets Model Checker
Tools
Model Browser
Object
Results
Subcase 1
Static Analysis
Displacement
Element Stresses (2D & 3D)
XX
YY
ZZ
XY
YZ
ZX
Max Principal
Mid Principal
Min Principal
Von Mises
Energy Error Density
Simulation: Static Analysis
Component: Element Stresses (2D ,3D) Von Mises
Average at corner nodes Variation < 75 %
Plot: Contour
Co-ordinate system: As in Results file
Max = 0.98169, Min = 0.00023
These are the “true” maxima!
As expected, on the handle fillets!
Min NodeID: 3228, Value: 0.000231882
Max NodeID: 4369, Value: 0.981686
Query Results
Result on Sets
Show Min/Max
Hide Min/Max
0.98169
0.89246
0.80324
0.71402
0.62479
0.53557
0.44635
0.35712
0.26790
0.17868
0.08945
0.00023
Hide results when done…
1 / 5
1.1_TuneThePot.slb
Selection filter : Face
Count : 0
Units

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The highest value of stress (Von Mises) is about 1 to 1.5 MPa.

Even considering the tensile stress of Porcelain (15 MPa), we get a safety factor of about 10-15.

As expected, the pot will not break if I simply carry some tea in it...

But let’s see what happens if we add some fire!

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1.2

SOLUTION – HEAT TRANSFER

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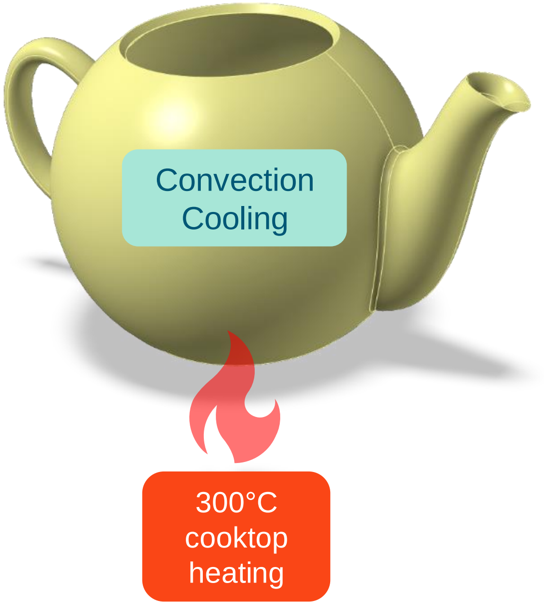
Heat Transfer Solution

Everyday science: the big danger for pots, dishes and tableware is the very quick heating or cooling. It is more likely to break a pot putting it on the fire, than when carrying tea in it!

We will first compute the **temperature distribution** due to a heat source (cooktop, 300°) and to the cooling convection (air outside, water inside).

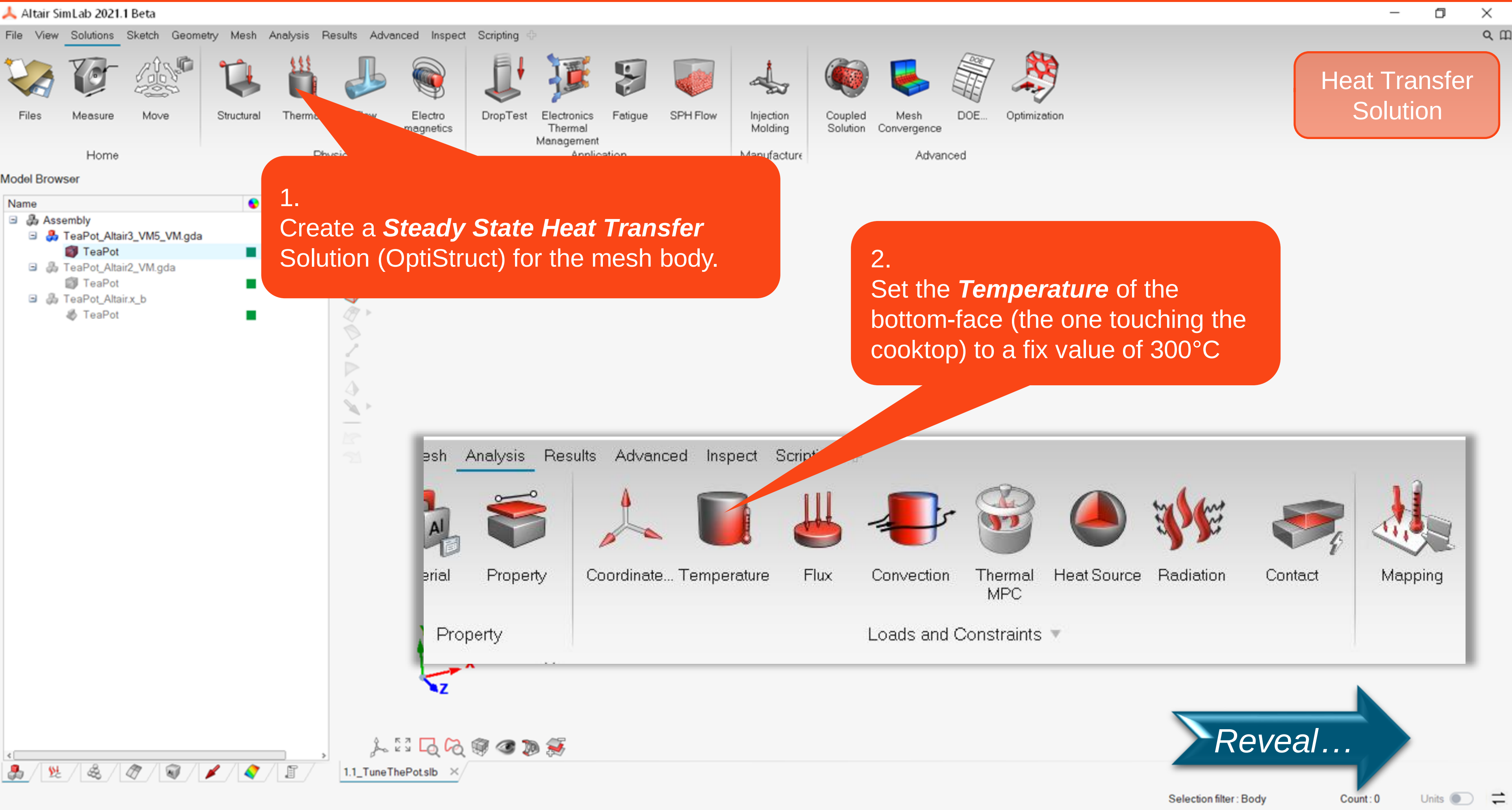
After this, we will map the computed temperature distribution on the structural solution to verify the cumulated mechanical stresses.



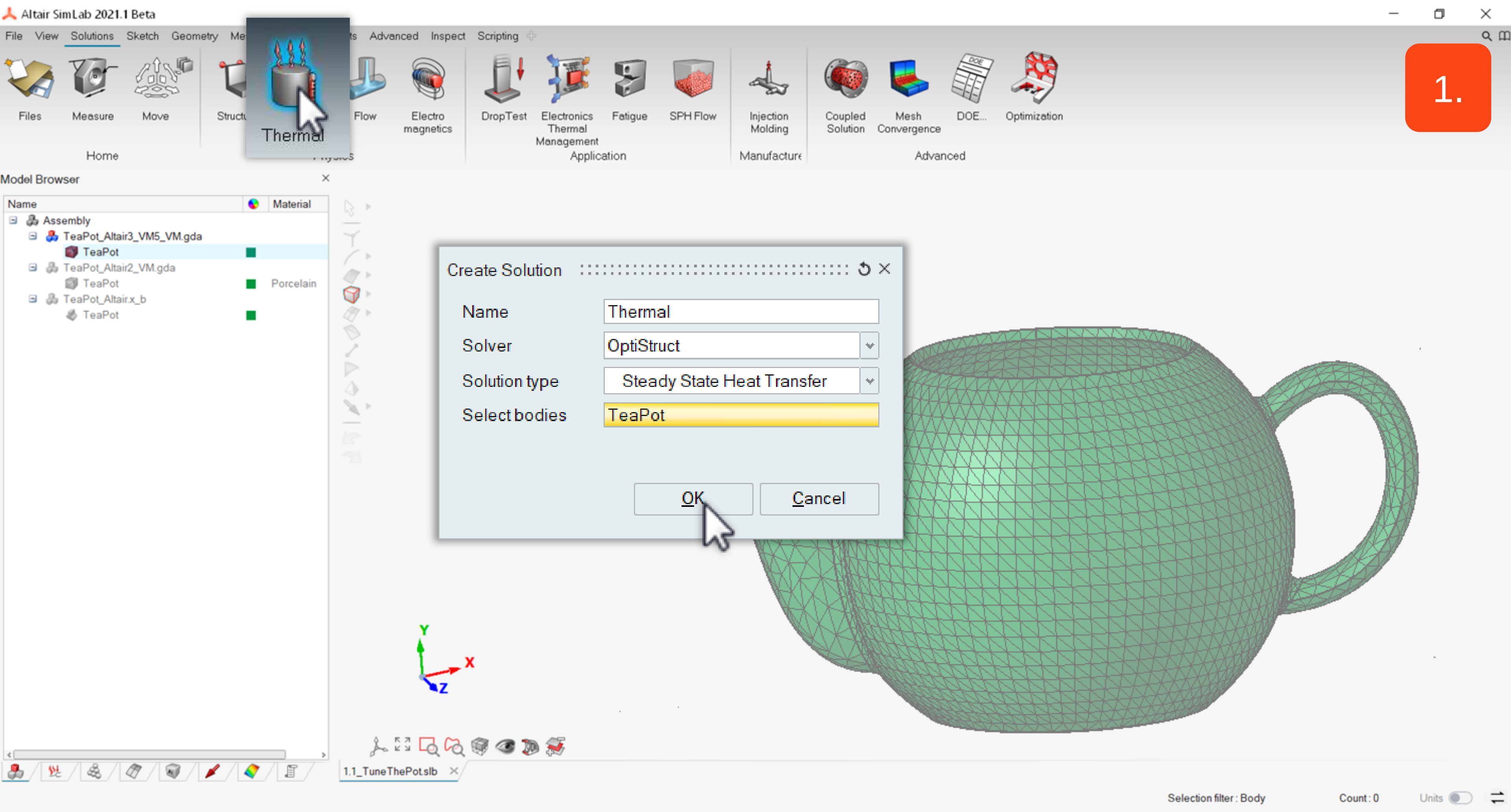
Heat Transfer Solution

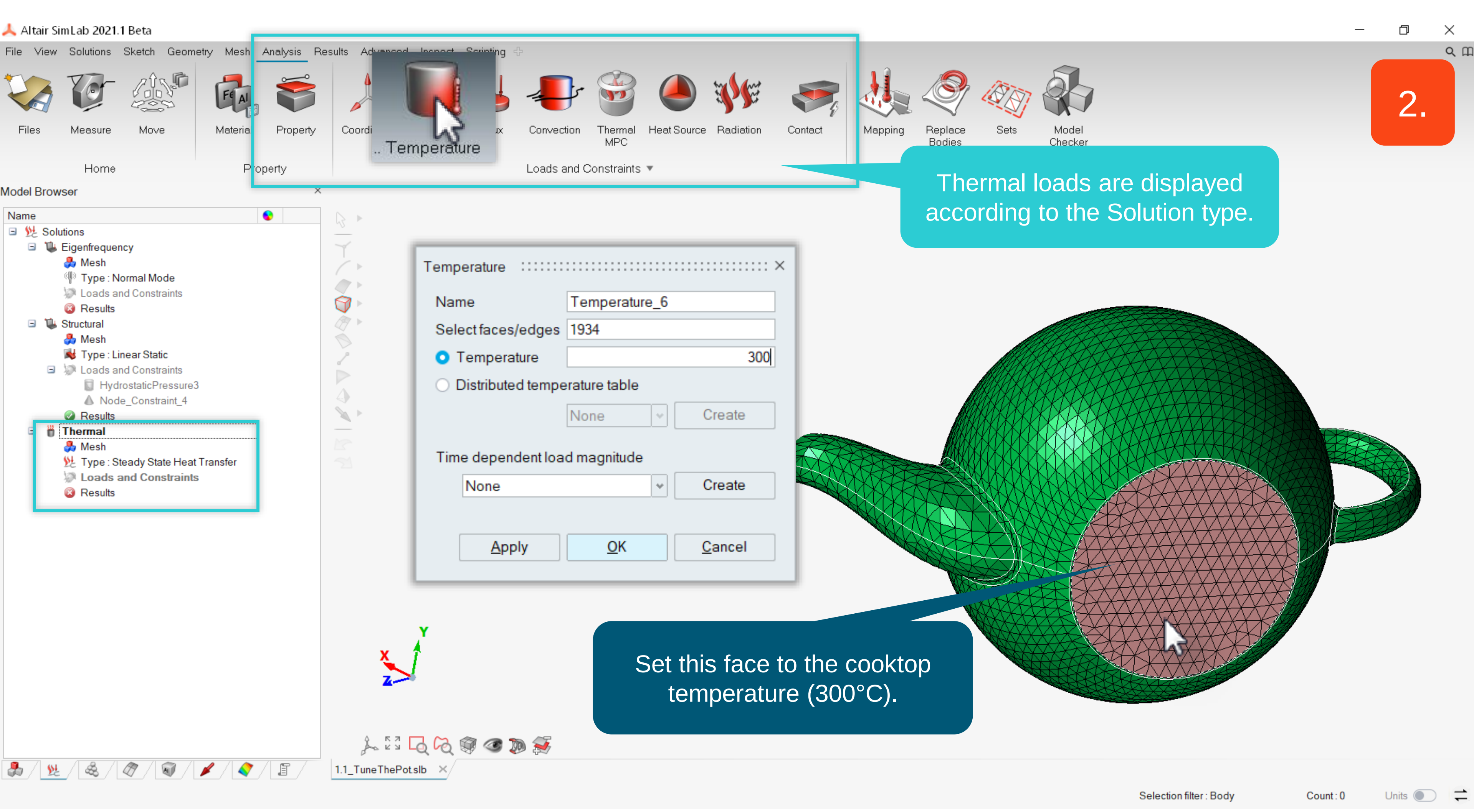
1.
Create a ***Steady State Heat Transfer*** Solution (OptiStruct) for the mesh body.

2.
Set the ***Temperature*** of the bottom-face (the one touching the cooktop) to a fix value of 300°C



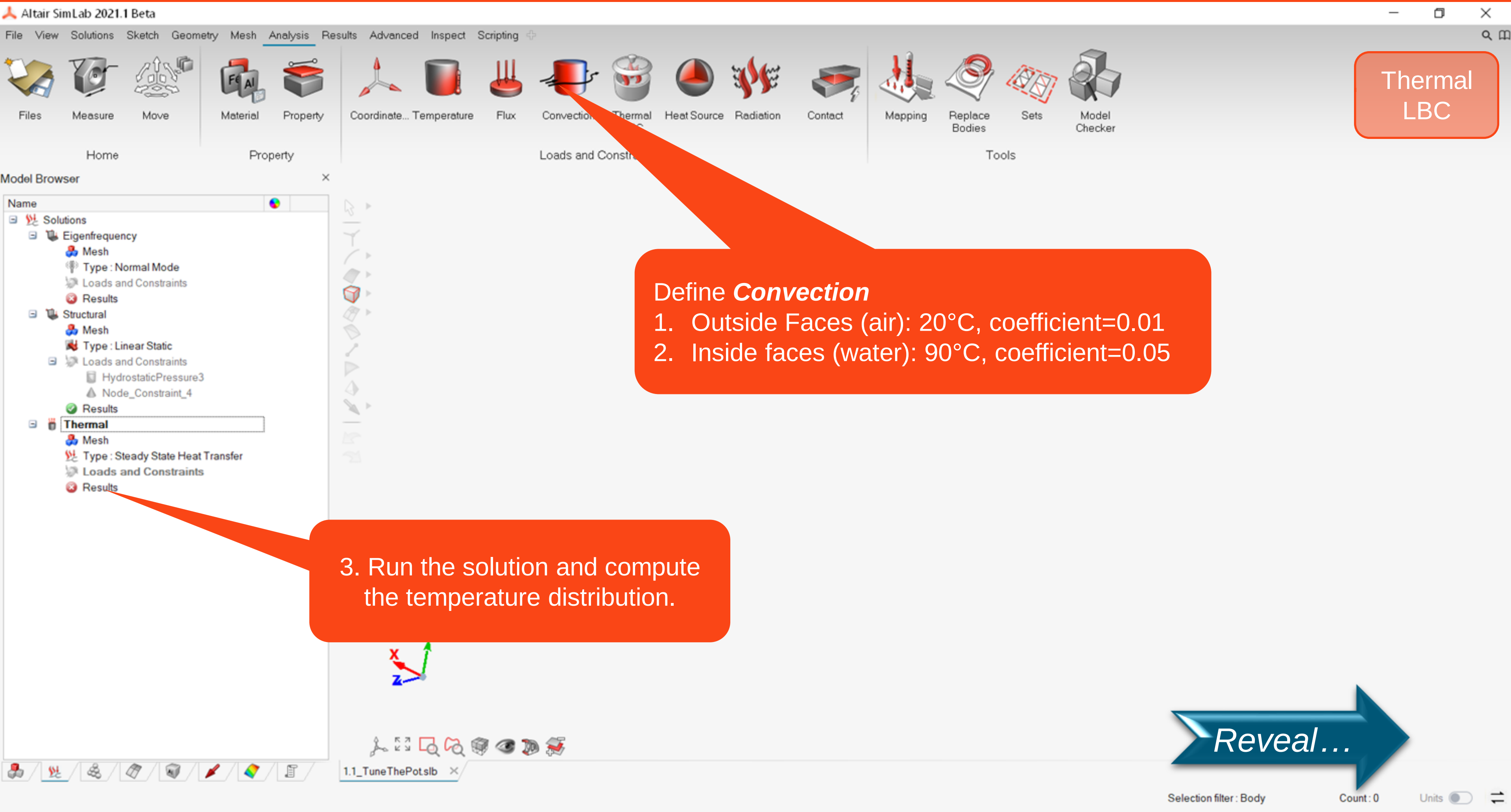
Reveal…


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Me
Advanced Inspect Scripting
Files Measure Move Struct
Thermal
Flow
Electro magnetics
DropTest
Electronics Thermal Management
Fatigue
SPH Flow
Injection Molding
Coupled Solution
Mesh Convergence
DOE...
Optimization
Home
Application
Manufacture
Advanced
1.
Model Browser
Name
Material
Assembly
TeaPot_Altair3_VM5_VM.gda
TeaPot
TeaPot_Altair2_VM.gda
TeaPot
Porcelain
TeaPot_Altair.x_b
TeaPot
Create Solution
Name
Thermal
Solver
OptiStruct
Solution type
Steady State Heat Transfer
Select bodies
TeaPot
OK
Cancel
Y
X
Z
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units



Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move Material Property Coordi .. Temperature Convection Thermal MPC Heat Source Radiation Contact Mapping Replace Bodies Sets Model Checker
Home Property Loads and Constraints
2.
Thermal loads are displayed according to the Solution type.
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
HydrostaticPressure3
Node_Constraint_4
Results
Thermal
Mesh
Type : Steady State Heat Transfer
Loads and Constraints
Results
Temperature
Name Temperature_6
Select faces/edges 1934
Temperature 300
Distributed temperature table
None Create
Time dependent load magnitude
None Create
Apply OK Cancel
Set this face to the cooktop temperature (300°C).
1.1_TuneThePot.slb
Selection filter : Body
Count : 0
Units

Thermal LBC

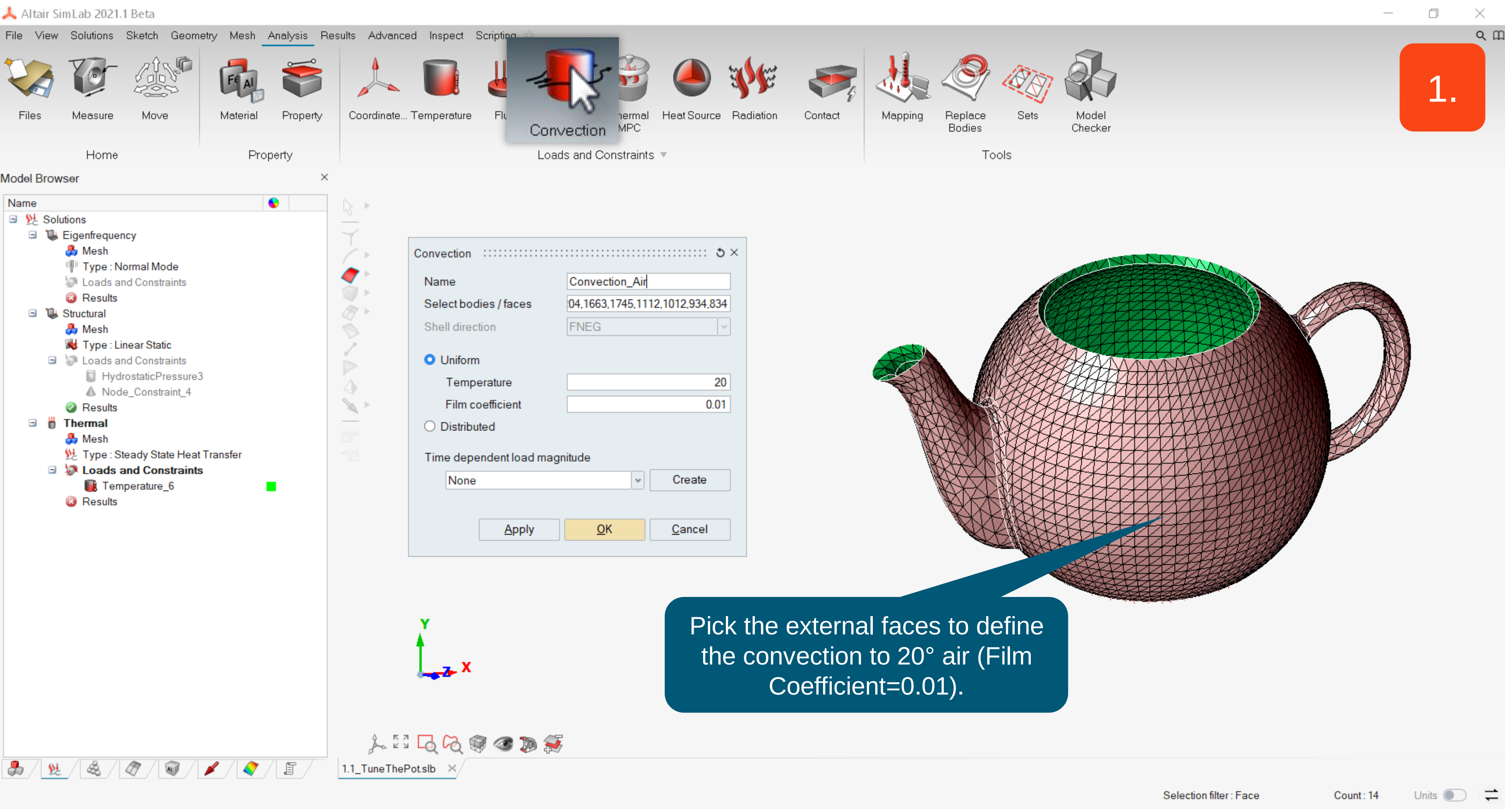


Define ***Convection***

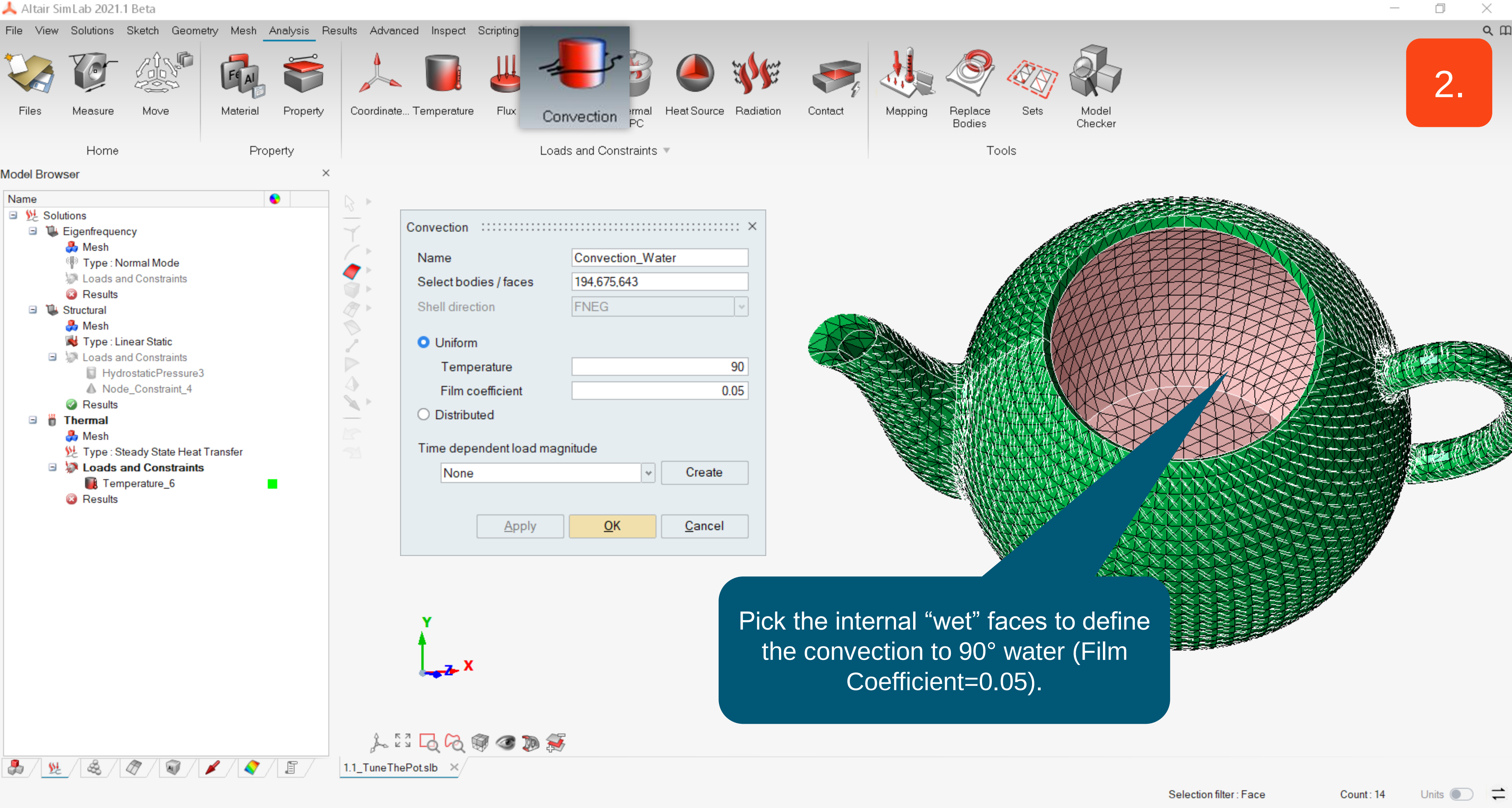
1. Outside Faces (air): 20°C, coefficient=0.01
2. Inside faces (water): 90°C, coefficient=0.05

3. Run the solution and compute the temperature distribution.

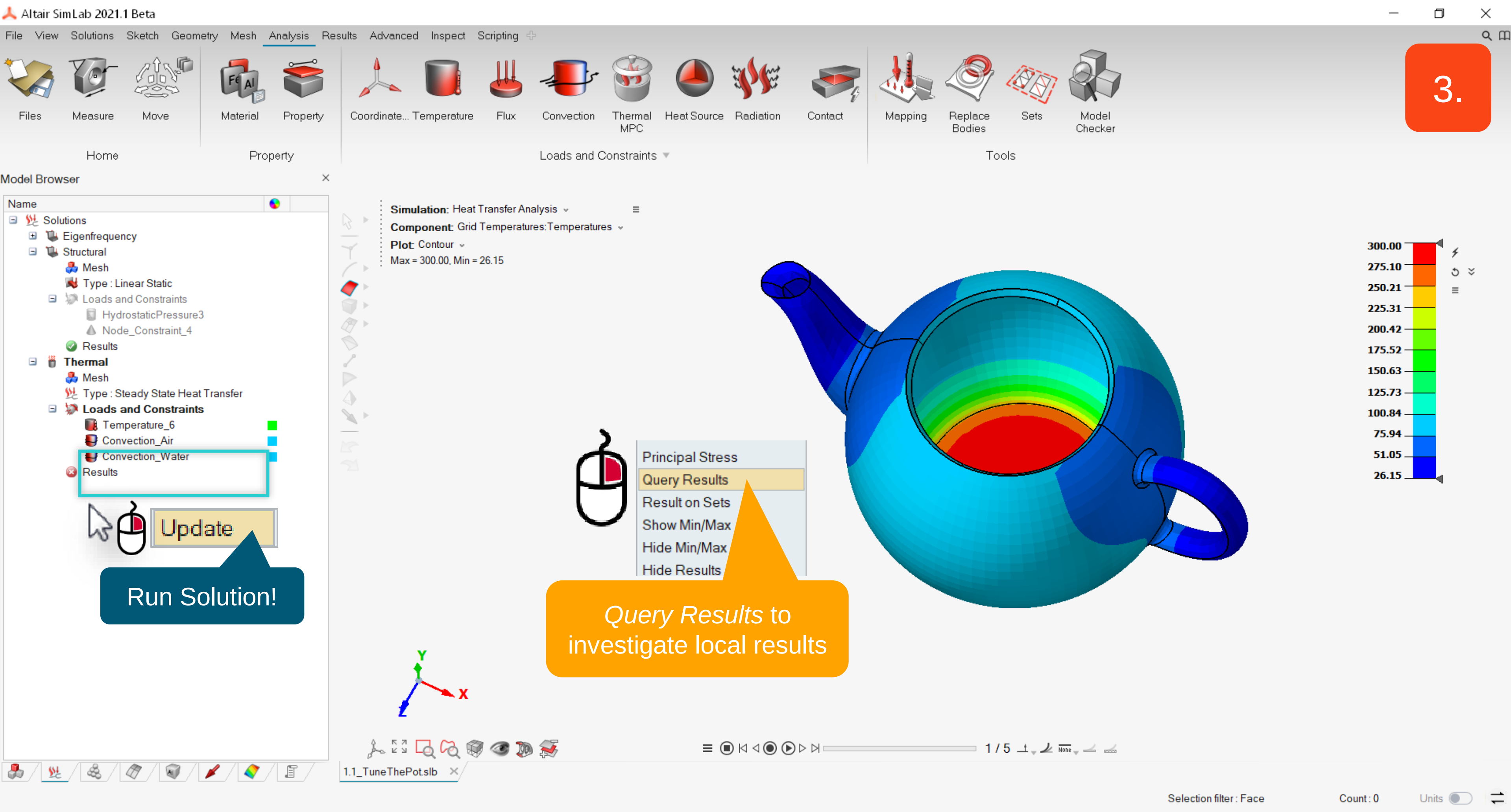
Reveal…


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Material Property
Property
Coordinate... Temperature Convection Heat Source Radiation Contact
Loads and Constraints
Mapping Replace Bodies Sets Model Checker
Tools
1.
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
HydrostaticPressure3
Node_Constraint_4
Results
Thermal
Mesh
Type : Steady State Heat Transfer
Loads and Constraints
Temperature_6
Results
Convection
Name
Convection_Air
Select bodies / faces
04,1663,1745,1112,1012,934,834
Shell direction
FNEG
Uniform
Temperature
20
Film coefficient
0.01
Distributed
Time dependent load magnitude
None
Create
Apply
OK
Cancel
Y
Z
X
Pick the external faces to define the convection to 20° air (Film Coefficient=0.01).
1.1_TuneThePot.slb
Selection filter : Face
Count : 14
Units

2.



Pick the internal “wet” faces to define the convection to 90° water (Film Coefficient=0.05).


Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Material Property
Property
Coordinate... Temperature Flux Convection Thermal MPC Heat Source Radiation Contact
Loads and Constraints
Mapping Replace Bodies Sets Model Checker
Tools
3.
Model Browser
Name
Solutions
Eigenfrequency
Structural
Mesh
Type : Linear Static
Loads and Constraints
HydrostaticPressure3
Node_Constraint_4
Results
Thermal
Mesh
Type : Steady State Heat Transfer
Loads and Constraints
Temperature_6
Convection_Air
Convection_Water
Results
Update
Run Solution!
Simulation: Heat Transfer Analysis
Component: Grid Temperatures:Temperatures
Plot: Contour
Max = 300.00, Min = 26.15
Principal Stress
Query Results
Result on Sets
Show Min/Max
Hide Min/Max
Hide Results
Query Results to investigate local results
300.00
275.10
250.21
225.31
200.42
175.52
150.63
125.73
100.84
75.94
51.05
26.15
Y
X
Z
1 / 5
1.1_TuneThePot.slb
Selection filter : Face
Count : 0
Units

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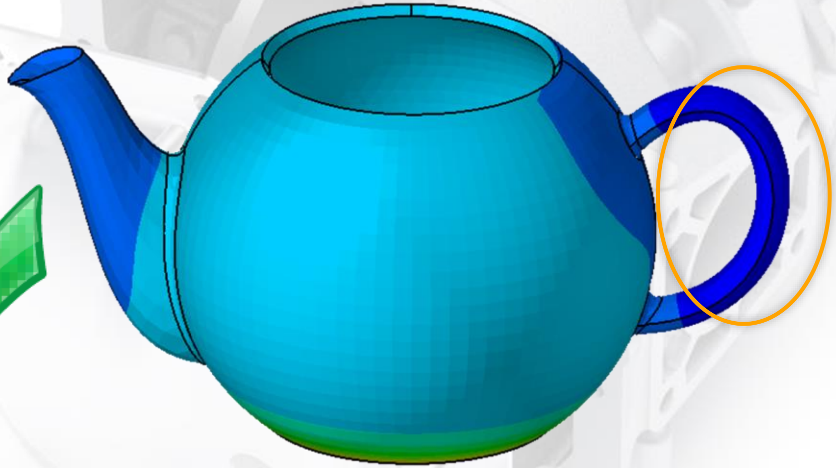
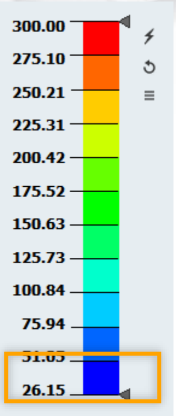
First result: the isolation given by porcelain is not so bad! The temperature of the handle remains at about 40°C so that we will not burn our hand when taking the pot from the cooktop!

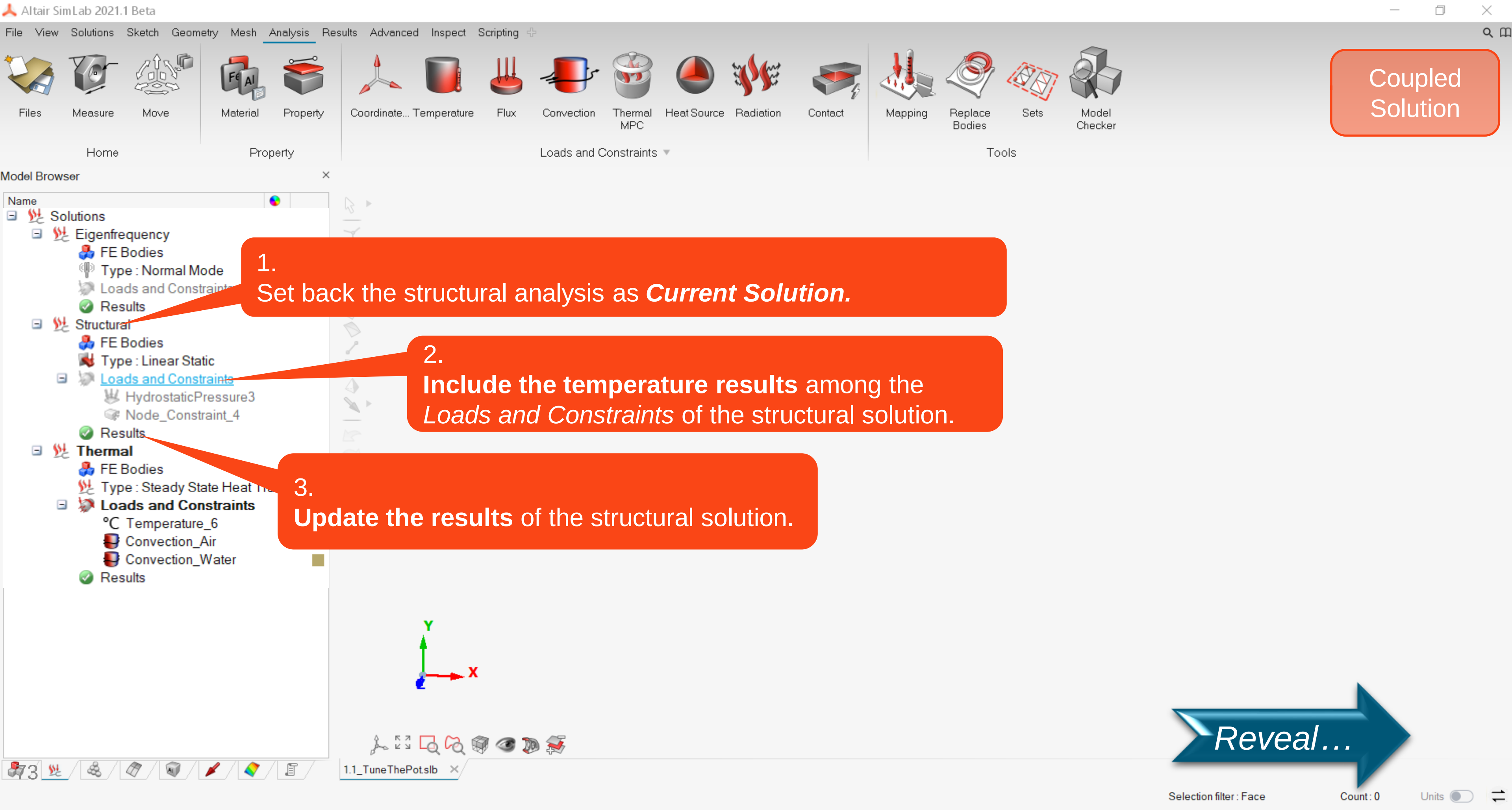
But let’s see now how big is the thermal stress in the material!





Note: the Thermal Solution just computes the temperature distribution, not the stresses!
We must include the temperature field into a Structural Solution to get our “Von Mises” Values.

Coupled Solution

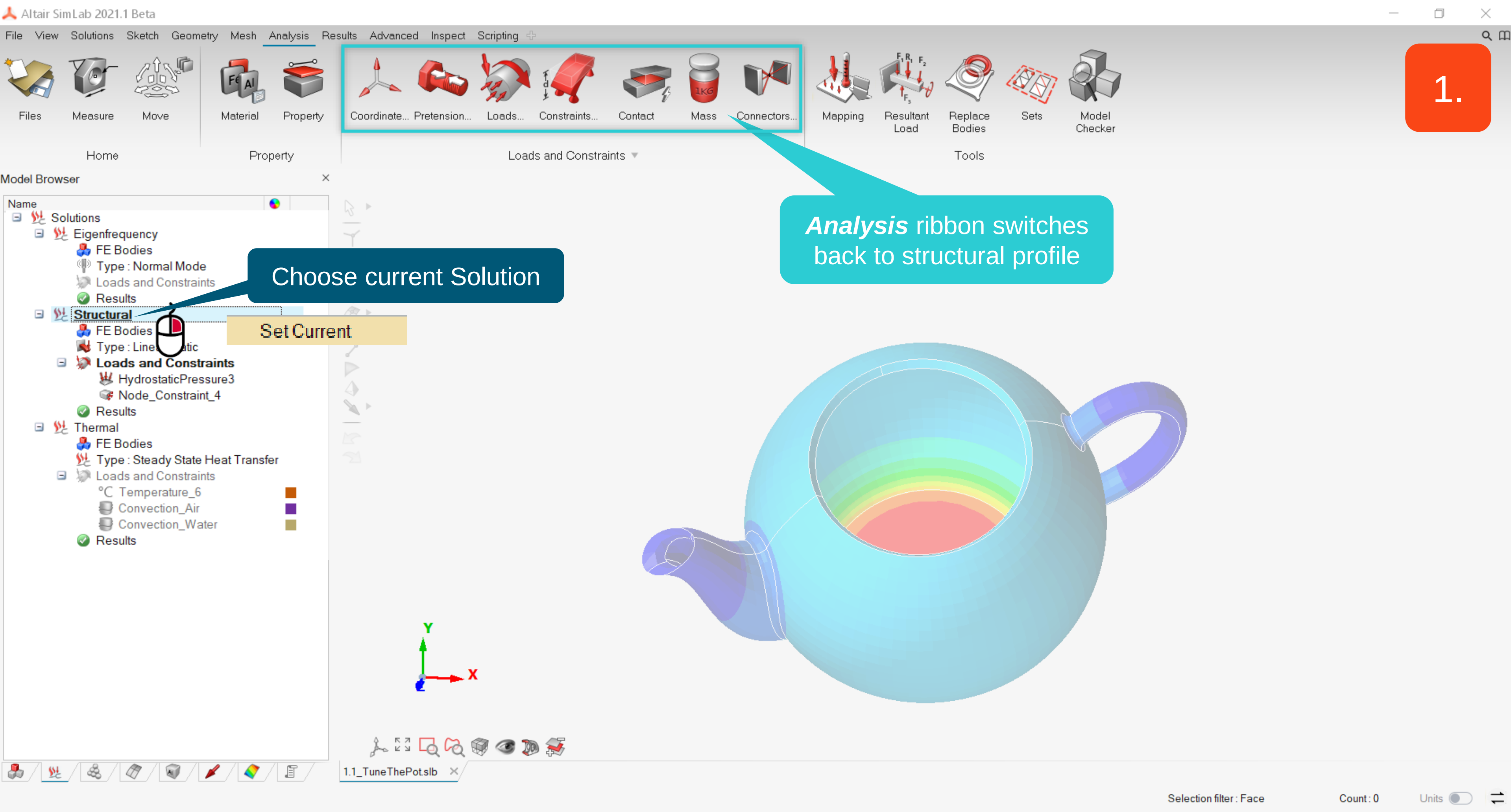


1.
Set back the structural analysis as ***Current Solution.***

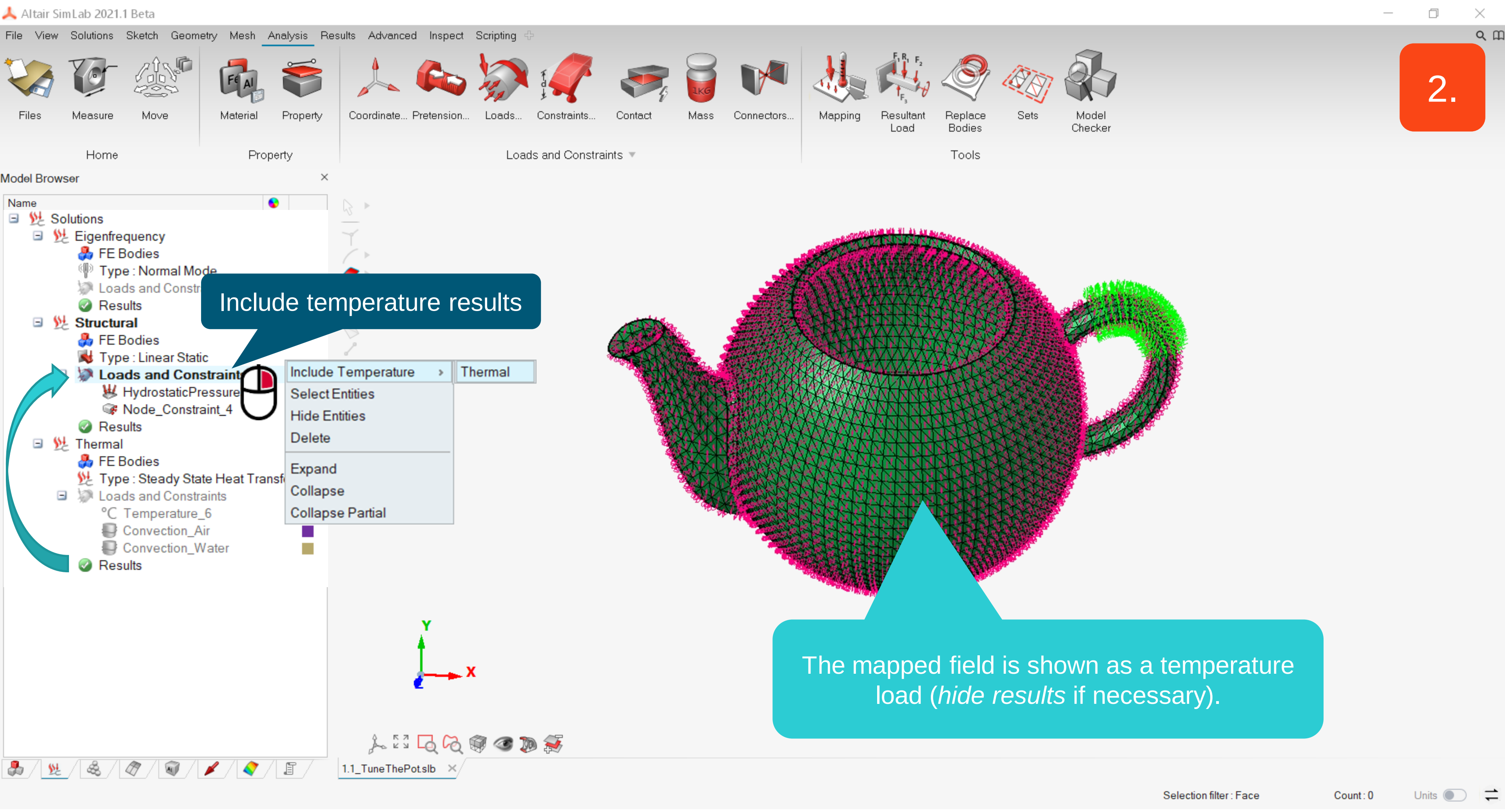
2.
Include the temperature results among the *Loads and Constraints* of the structural solution.

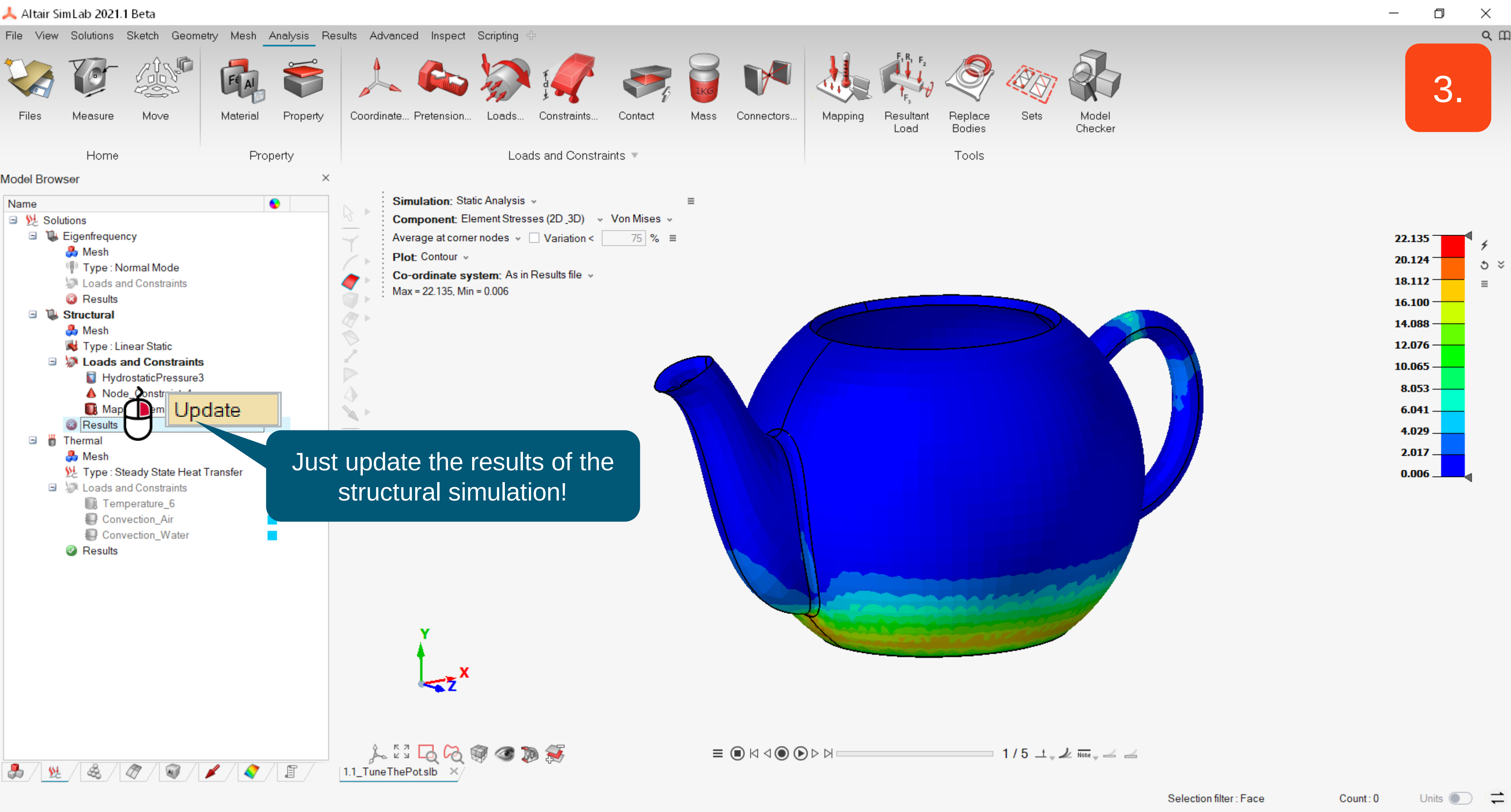
3.
Update the results of the structural solution.

Reveal…



Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move Material Property Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors... Mapping Resultant Load Replace Bodies Sets Model Checker
Home Property Loads and Constraints Tools
1.
Model Browser
Name
Solutions
Eigenfrequency
FE Bodies
Type : Normal Mode
Loads and Constraints
Results
Structural
FE Bodies
Type : Line atic
Loads and Constraints
HydrostaticPressure3
Node_Constraint_4
Results
Thermal
FE Bodies
Type : Steady State Heat Transfer
Loads and Constraints
°C Temperature_6
Convection_Air
Convection_Water
Results
Choose current Solution
Set Current
Analysis ribbon switches back to structural profile
1.1_TuneThePot.slb
Selection filter : Face
Count : 0
Units


2.
Include temperature results
The mapped field is shown as a temperature load (*hide results* if necessary).
Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move Material Property Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors... Mapping Resultant Load Replace Bodies Sets Model Checker
Home Property Loads and Constraints Tools
Model Browser
Name
Solutions
Eigenfrequency
FE Bodies
Type : Normal Mode
Results
Structural
FE Bodies
Type : Linear Static
Loads and Constraint
HydrostaticPressure
Node_Constraint_4
Results
Thermal
FE Bodies
Type : Steady State Heat Transf
Loads and Constraints
°C Temperature_6
Convection_Air
Convection_Water
Results
Include Temperature
Thermal
Select Entities
Hide Entities
Delete
Expand
Collapse
Collapse Partial
Y
X
1.1_TuneThePot.slb
Selection filter : Face
Count : 0
Units



3.
Altair SimLab 2021.1 Beta
File View Solutions Sketch Geometry Mesh Analysis Results Advanced Inspect Scripting
Files Measure Move
Home
Material Property
Property
Coordinate... Pretension... Loads... Constraints... Contact Mass Connectors...
Loads and Constraints
Mapping Resultant Load Replace Bodies Sets Model Checker
Tools
Model Browser
Name
Solutions
Eigenfrequency
Mesh
Type : Normal Mode
Loads and Constraints
Results
Structural
Mesh
Type : Linear Static
Loads and Constraints
HydrostaticPressure3
Results
Thermal
Mesh
Type : Steady State Heat Transfer
Loads and Constraints
Temperature_6
Convection_Air
Convection_Water
Results
Update
Just update the results of the structural simulation!
Simulation: Static Analysis
Component: Element Stresses (2D 3D) Von Mises
Average at corner nodes Variation < 75 %
Plot: Contour
Co-ordinate system: As in Results file
Max = 22.135, Min = 0.006
22.135
20.124
18.112
16.100
14.088
12.076
10.065
8.053
6.041
4.029
2.017
0.006
Y
X
Z
1.1_TuneThePot.slb
1 / 5
Selection filter : Face
Count : 0
Units

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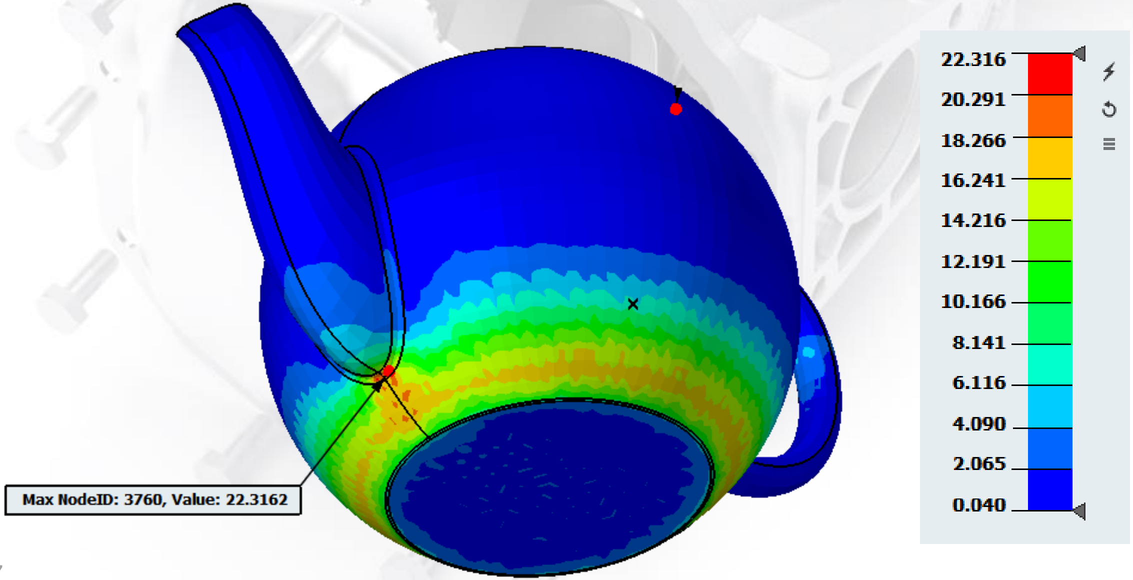
As expected, the stresses related to the temperature are much higher than the ones related to the weight of the tea!

The maximum of >22 MPa (Von Mises Stress) is higher than the tensile strength of porcelain (15 MPa) and quite close to the allowed shear stress (30 MPa)!



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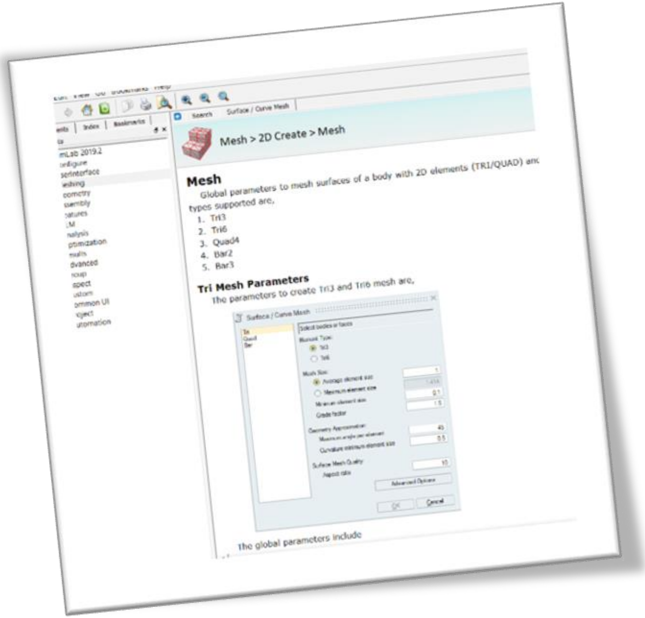

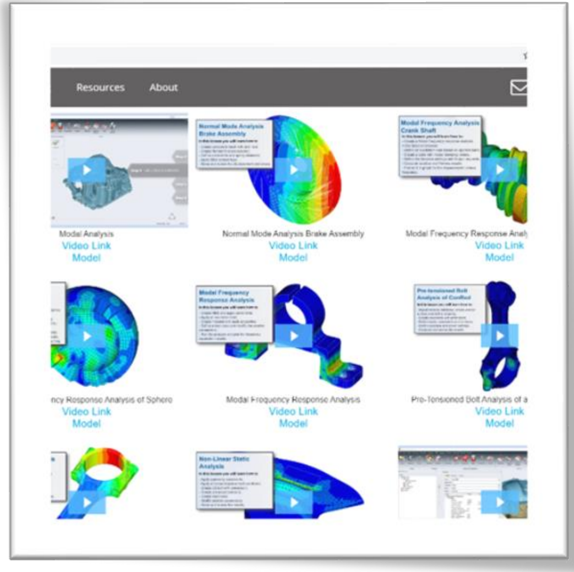

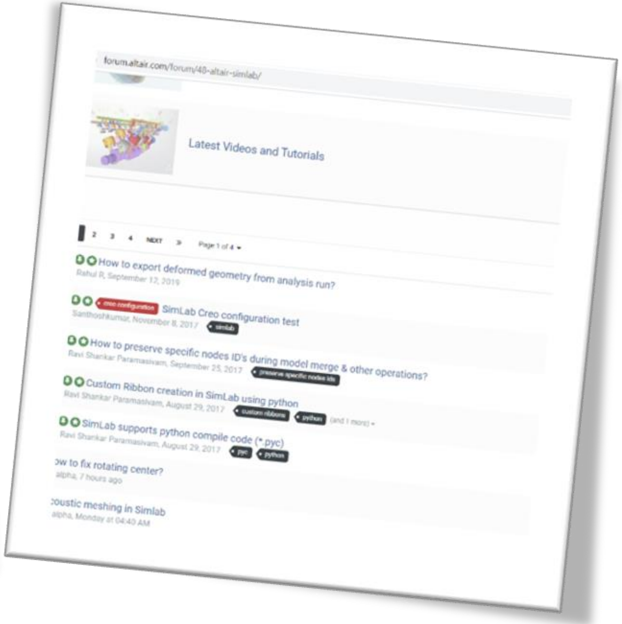

SimLab Help

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SimLab Forum

https://forum.altair.com/forum/48-altair-simlab

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THANK YOU

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#ONLYFORWARD

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