Structural Mechanics Simulation Essentials

R2014X

Von Mises Stress (N_m2)
4.43e+6   6.96e+8

Deformation scale: 1

3DEXPERIENCE
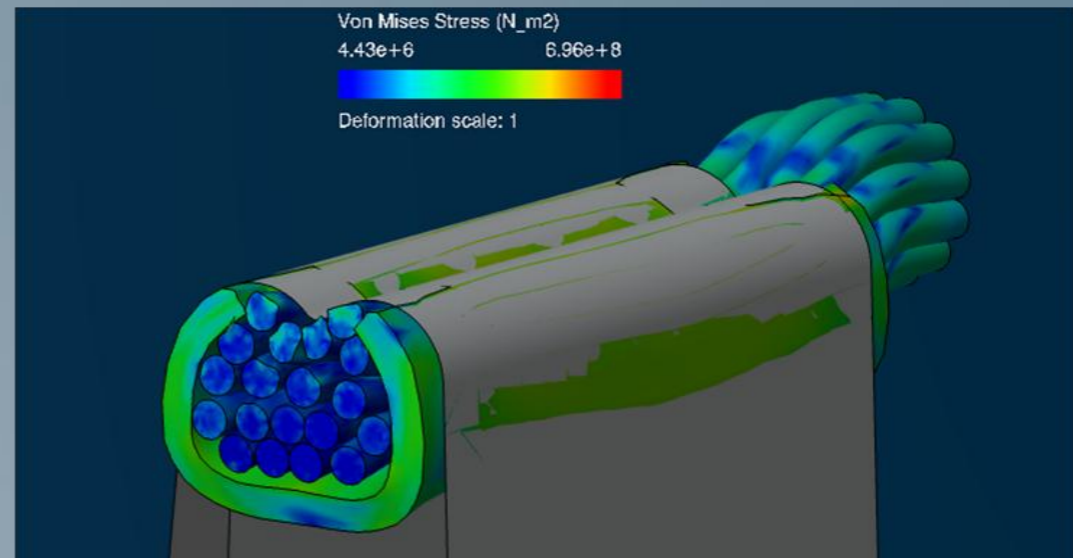
About this Course

Course objectives

Upon completion of this course you will be able to:

▷ Create complete Finite Element models

▷ Run and monitor the simulations

▷ View and evaluate simulation results

▷ Perform structural simulations (such as effects of material nonlinearity, large deformation, and contact)

Targeted audience

Simulation Analysts

Prerequisites

None

2 days

Day 1

▷   Lesson 1   **3D**EXPERIENCE Platform Overview

▷   Workshop 1   Getting Started with the **3D**EXPERIENCE Platform

▷   Lesson 2   Getting Started with Simulation

▷   Workshop 2   Linear Static Analysis of a Cantilever Beam

▷   Lesson 3   Meshing

▷   Workshop 3a   Intersecting Pipes – Mesh
▷   Workshop 3b   Pump – Mesh
▷   Workshop 3c   Reinforced Panel – Mesh

▷   Lesson 4   Material and Section Properties

▷   Workshop 4a   Intersecting Pipes – Materials and Section Properties
▷   Workshop 4b   Pump – Materials and Section Properties
▷   Workshop 4c   Reinforced Panel – Materials and Section Properties

▷   Lesson 5   Steps and Static Simulations

▷   Workshop 5a   Intersecting Pipes – Step Definition and Loads
▷   Workshop 5b   Intersecting Pipes – Submission and Postprocessing

Day 2

▷ Lesson 6   Loads, Restraints and Initial Conditions

▷ Workshop 6a   Pump – Step Definition and Loads

▷ Workshop 6b   Reinforced Panel – Step Definition and Loads

▷ Lesson 7   Connections, Interactions and Rigid Bodies

▷ Workshop 7a   Pump – Connections and Interactions

▷ Workshop 7b   Reinforced Panel – Connections, Submission and Postprocessing

▷ Lesson 8   Running Simulations and Postprocessing

▷ Workshop 8   Pump – Submission and Postprocessing

▷ Lesson 9   Heat Transfer Simulation

▷ Workshop 9   Thermal Simulation of a Pump Housing

Additional Material

▷   Appendix 1   Element Selection Criteria

▷   Appendix 2   High Performance Visualization

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Revision Status

Lesson 1	**2/14**	**Updated for R2014X**	**Workshop 1**	**2/14**	**Updated for R2014X**
Lesson 2	**2/14**	**Updated for R2014X**	**Workshop 2**	**2/14**	**Updated for R2014X**
Lesson 3	**2/14**	**Updated for R2014X**	**Workshop 3a**	**2/14**	**Updated for R2014X**
Lesson 4	**2/14**	**Updated for R2014X**	**Workshop 3b**	**2/14**	**Updated for R2014X**
Lesson 5	**2/14**	**Updated for R2014X**	**Workshop 3c**	**2/14**	**Updated for R2014X**
Lesson 6	**2/14**	**Updated for R2014X**	**Workshop 4a**	**2/14**	**Updated for R2014X**
Lesson 7	**2/14**	**Updated for R2014X**	**Workshop 4b**	**2/14**	**Updated for R2014X**
Lesson 8	**2/14**	**Updated for R2014X**	**Workshop 5a**	**2/14**	**Updated for R2014X**
Lesson 9	**2/14**	**Updated for R2014X**	**Workshop 5b**	**2/14**	**Updated for R2014X**
Appendix 1	**2/14**	**Updated for R2014X**	**Workshop 5c**	**2/14**	**Updated for R2014X**
Appendix 2	**2/14**	**New for R2014X**	**Workshop 6a**	**2/14**	**Updated for R2014X**
			Workshop 6b	**2/14**	**Updated for R2014X**
			Workshop 6c	**2/14**	**Updated for R2014X**
			Workshop 7a	**2/14**	**Updated for R2014X**
			Workshop 7b	**2/14**	**Updated for R2014X**
			Workshop 8a	**2/14**	**Updated for R2014X**
			Workshop 8b	**2/14**	**Updated for R2014X**
			Workshop 9	**2/14**	**Updated for R2014X**

Lesson 1: 3DEXPERIENCE Platform Overview

Lesson content:

▷ What is the **3D**EXPERIENCE Platform?

▷ **3D**EXPERIENCE Platform Architecture

▷ Connecting to the **3D**EXPERIENCE Platform

▷ **3D**EXPERIENCE Platform Interface

▷ Exploring

▷ Authoring

▷ Importing and Exporting Data

▷ Saving Data

▷ Local Save

▷ Deleting Data from the Database

▷ Deleting Data while Authoring

▷ Duplicating Data

▷ Workshop 1

1 hour

Workshop 1: Getting Started with the 3DEXPERIENCE Platform

In this workshop, you will get familiar with **3D**EXPERIENCE platform and learn basic operations.

After completion of this exercise, you will be able to:

a. Connect to a database
b. Navigate through the **3D**EXPERIENCE Platform interface
c. Import an assembly of parts
d. Explore an assembly of parts
e. Rename objects
f. Change the look of the authoring window
g. Search an assembly of parts in the database
h. Duplicate, delete and save entities
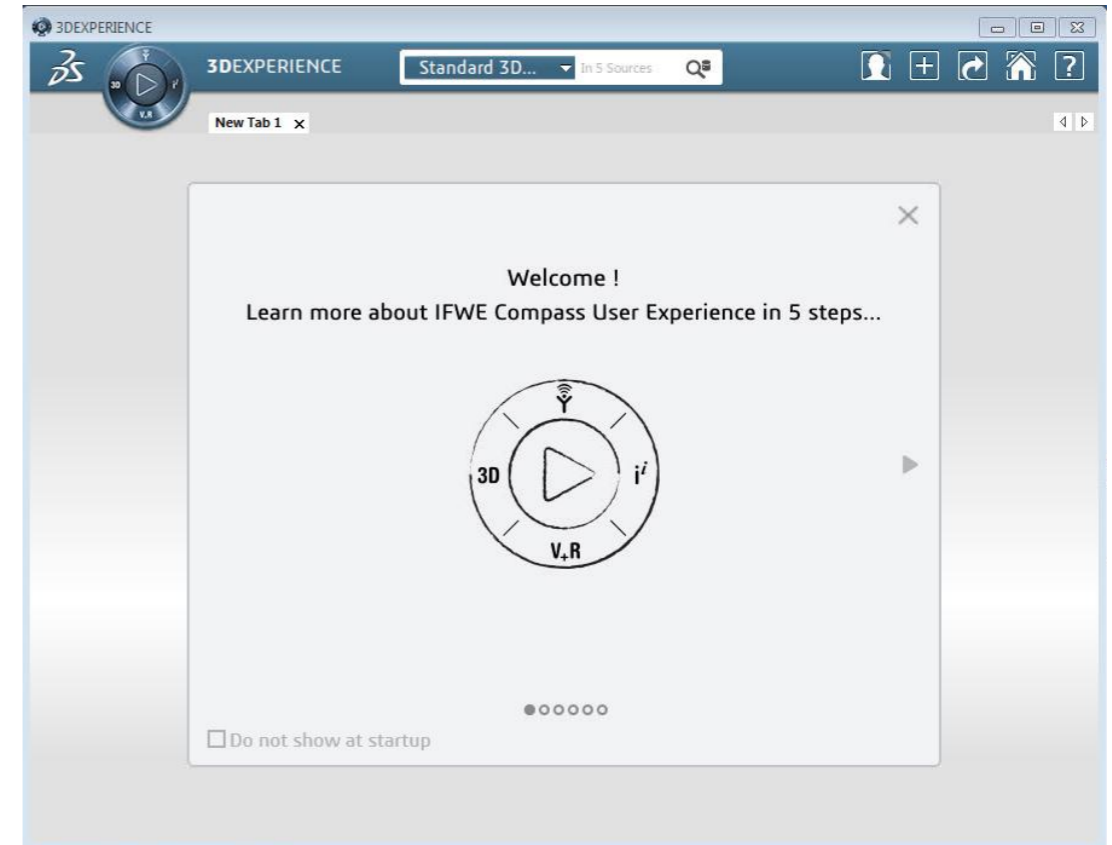
30 minutes

Lesson 2: Getting Started with Simulation

Lesson content:

▷ Simulation Apps in the **3D**EXPERIENCE Platform

▷ Physics Modeling Apps

▷ The Scenario Interface

▷ Workflow to create, execute and review a simulation

▷ Modeling

▷ Scenario

▷ Results

▷ Simulation Conventions in the **3D**EXPERIENCE Platform

▷ Workshop 2

1 hour

Workshop 2: Linear Static Analysis of a Cantilever Beam

In this workshop you will become familiar with the different apps that will be used to set up and execute a simulation. The geometry of the cantilever beam is provided. You will assign a material, create a section property, create a simulation and execute it.

After completion of this exercise, you will be:

a. Familiar with the layout and structure of the **3D**EXPERIENCE Platform.
b. Able to set up a simple simulation.
c. Familiar with navigating between different apps.

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Deformation scale: 1
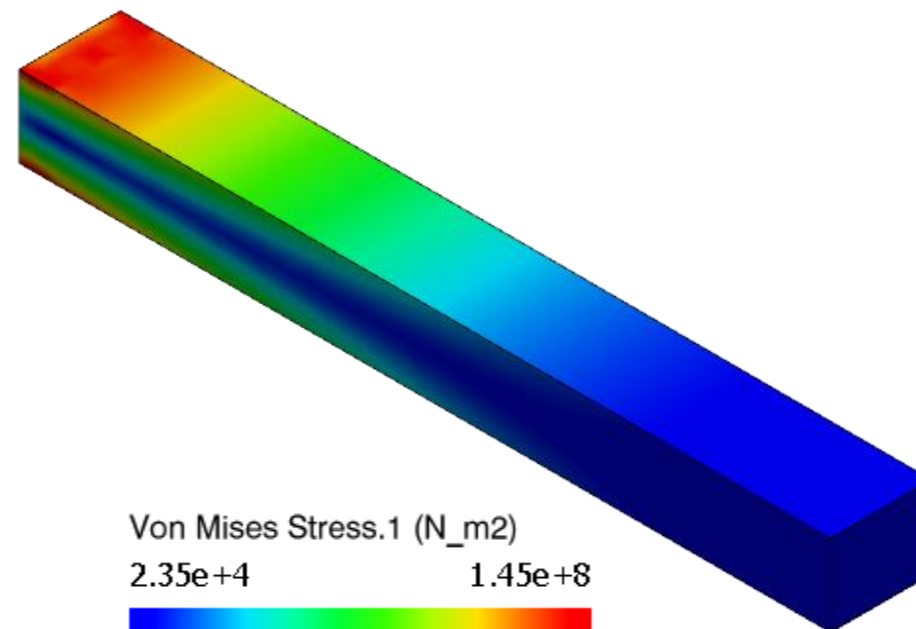
45 minutes

Lesson 3: Meshing

Lesson content:

1 hour

Workshop 3a: Intersecting Pipes – Mesh

In this workshop, you will create a good quality tetrahedral mesh on the three-dimensional intersecting pipe model.

After completion of this exercise, you will be able to:

    a. Import a 3D XML file containing a CATIA Product

    b. Open the Structural Model app and create a Finite Element Model Representation

    c. Create a tetrahedral mesh on a solid geometry
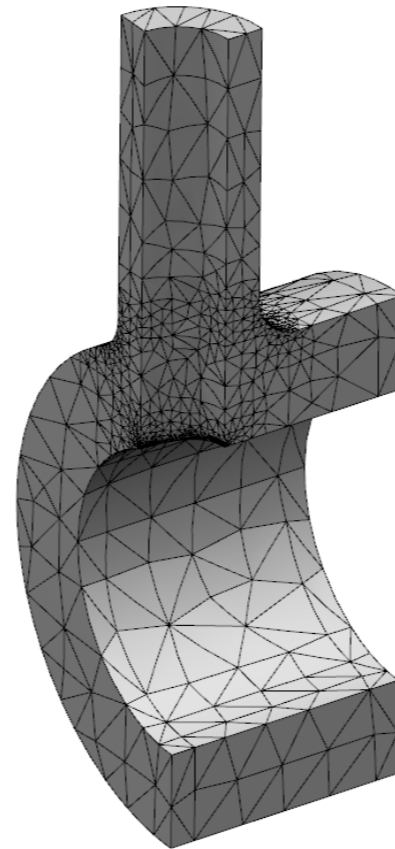
20 minutes

Workshop 3b: Pump – Mesh

In this workshop you will create a Finite Element Mesh Representation for the pump assembly. You will mesh each part with tetrahedral elements.

After completion of this exercise, you will be able to:

    a. Import a 3D XML file containing a CATIA Product
    b. Open the Structural Model Create app and create a FEM Representation
   c. Mesh the different parts of an assembly

Pump housing

Gasket

Pump cover

Bolts
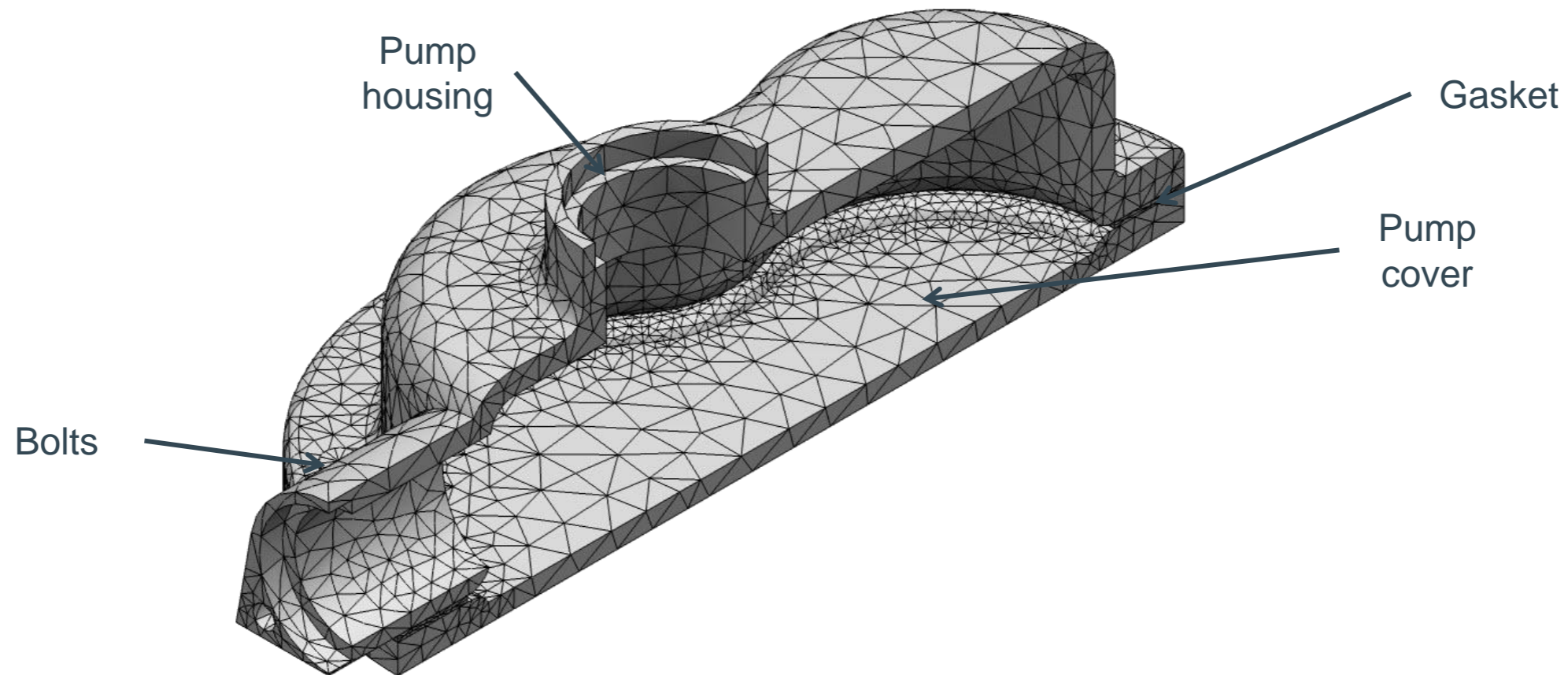
30 minutes

Workshop 3c: Reinforced Panel – Mesh

In this workshop, you will create surface meshes on all components of the panel.

After completion of this exercise, you will be able to:

a. Create a Finite Element Model Representation.
b. Link FEM Reps with one another.
c. Create a meshing rule.
d. Create surface meshes on all parts.

C-beam

L-beam

Panel

Z-beam
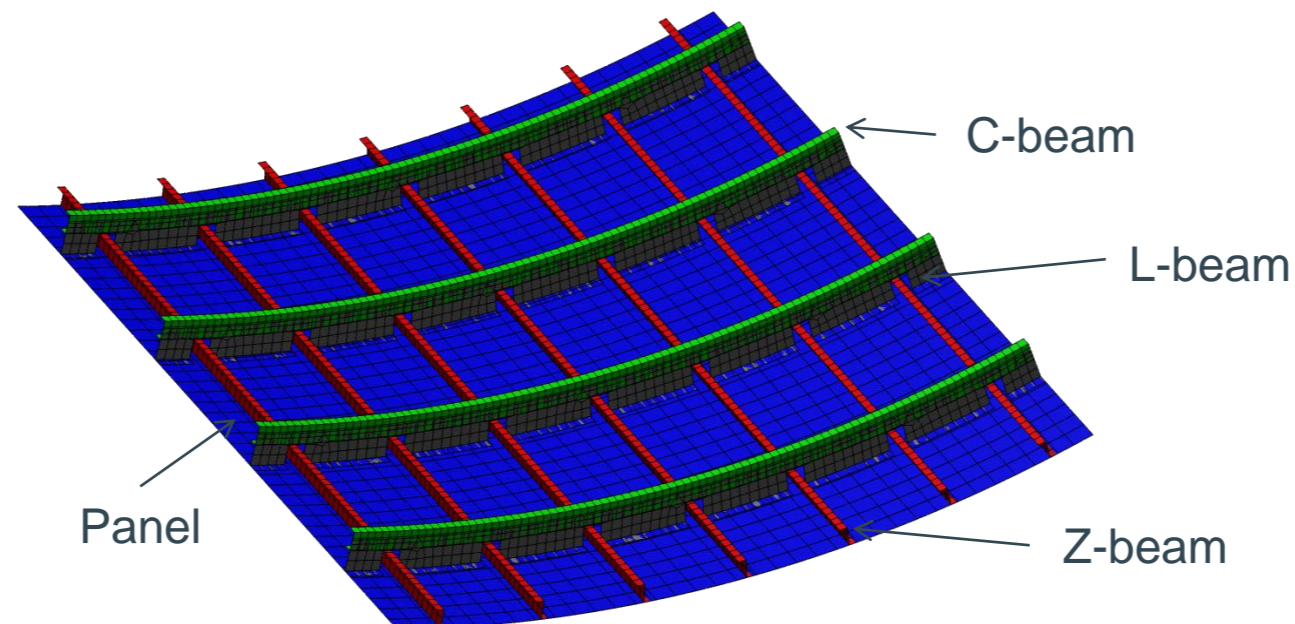
45 minutes

Lesson 4: Materials and Section Properties (1/2)

Lesson content:

▷ Understanding Materials

▷ Core and Covering Materials

▷ Material Definition

▷ Creating a Material

▷ Adding New Domains

▷ Editing a Material Domain

▷ Understanding Simulation Domains

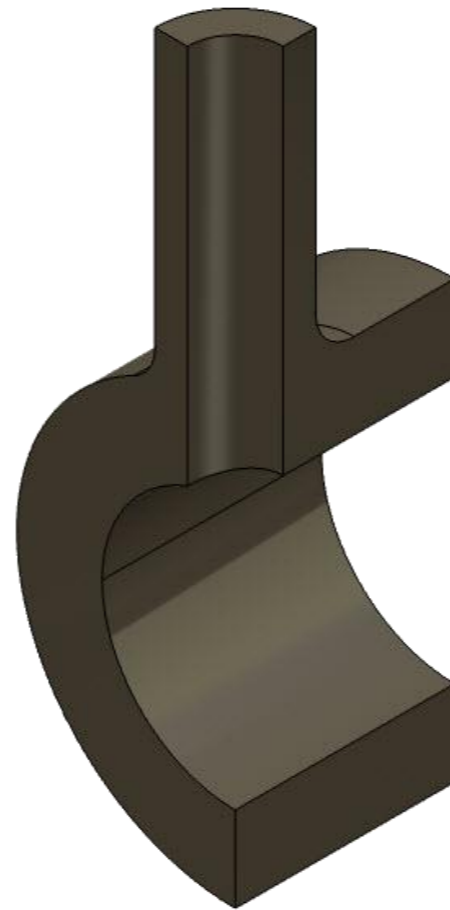▷ Material Models

▷ Working with Materials

▷ Applying a Material

1 hour

Workshop 4a: Intersecting Pipes – Materials and Section Properties

In this workshop, you will create an elastic material and apply it to the intersecting pipe geometry.

After completion of this exercise, you will be able to:

a. Define elastic, expansion, and creep material properties
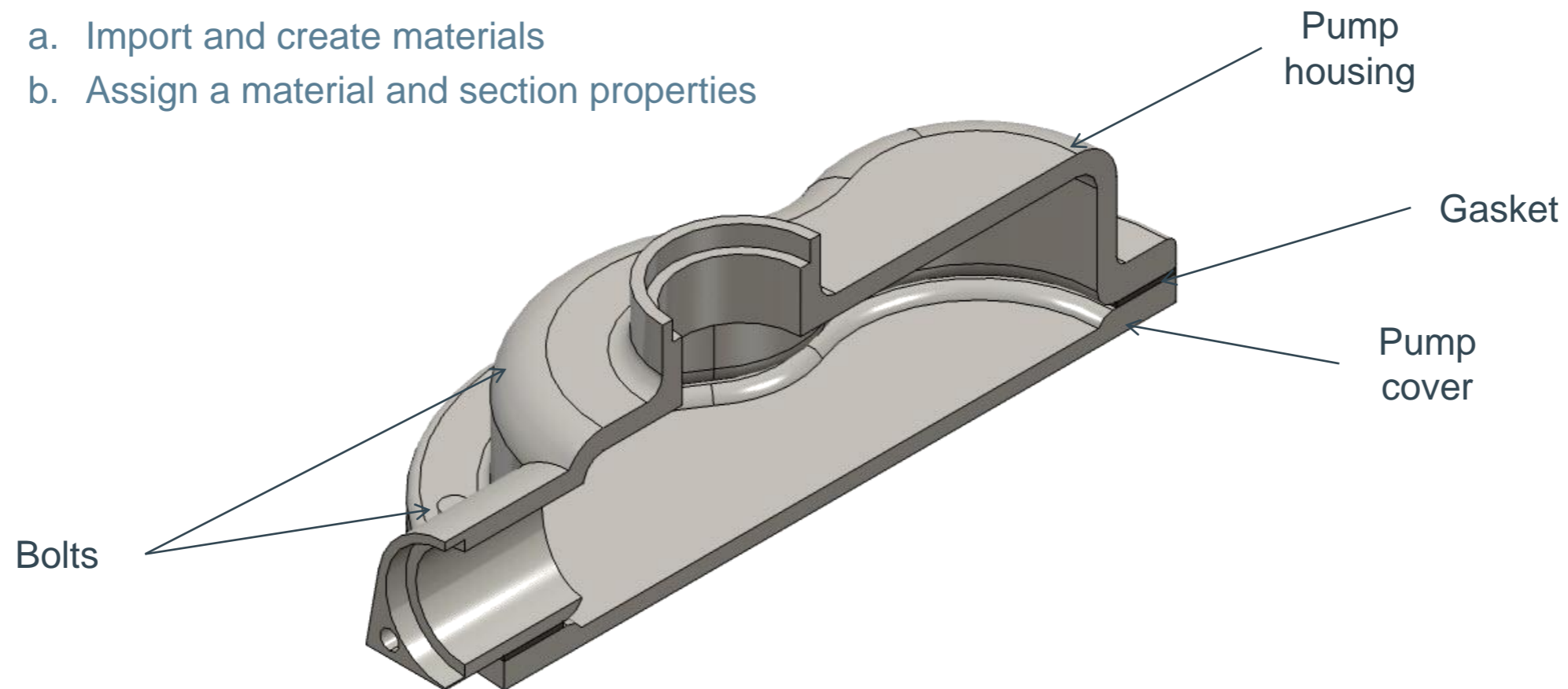b. Apply materials and create section properties

20 minutes

Workshop 4b: Pump – Materials and Section Properties

In this workshop you will create and assign the material and section properties for the parts in the pump assembly.

After completion of this exercise, you will be able to:

    a. Import and create materials

    b. Assign a material and section properties

Pump housing

Gasket

Pump cover

Bolts

45 minutes

Workshop 4c: Reinforced Panel – Materials and Section Properties

In this workshop, you will create an elastic material and apply it to all the components of the panel.

After completion of this exercise, you will be able to:

a. Create an elastic material
b. Apply a material to all the components of an assembly
c. Create shell sections and assign it to the different components of the panel
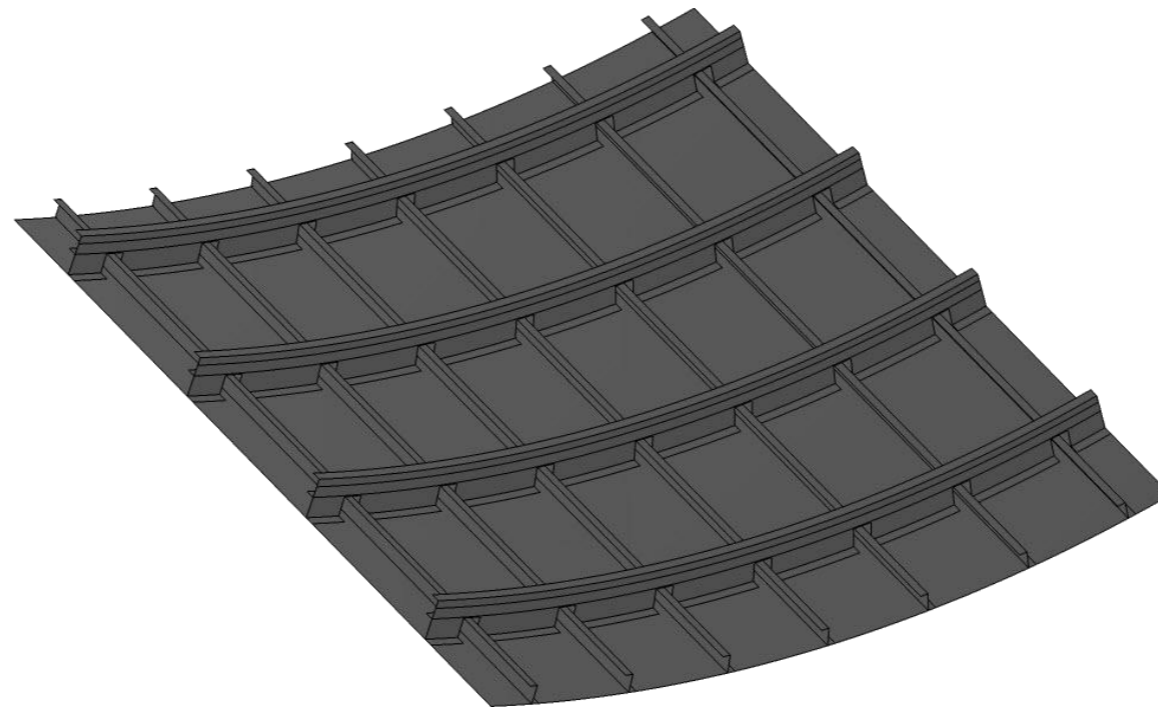
45 minutes

Workshop 5a: Intersecting Pipes – Step Definition and Loads

In this workshop, you will define static and quasi-static simulation steps and apply loads, restraints, and initial conditions to the model.

After completion of this exercise, you will be able to:

a. Define static and quasi-static simulation steps
b. Apply the symmetry restraints
c. Apply pressure loads
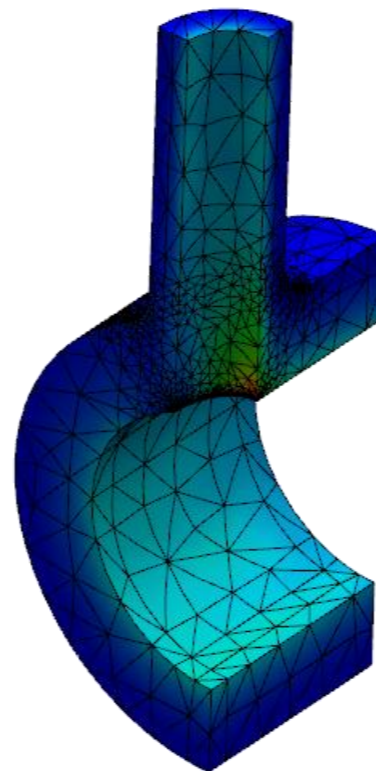d. Apply initial conditions
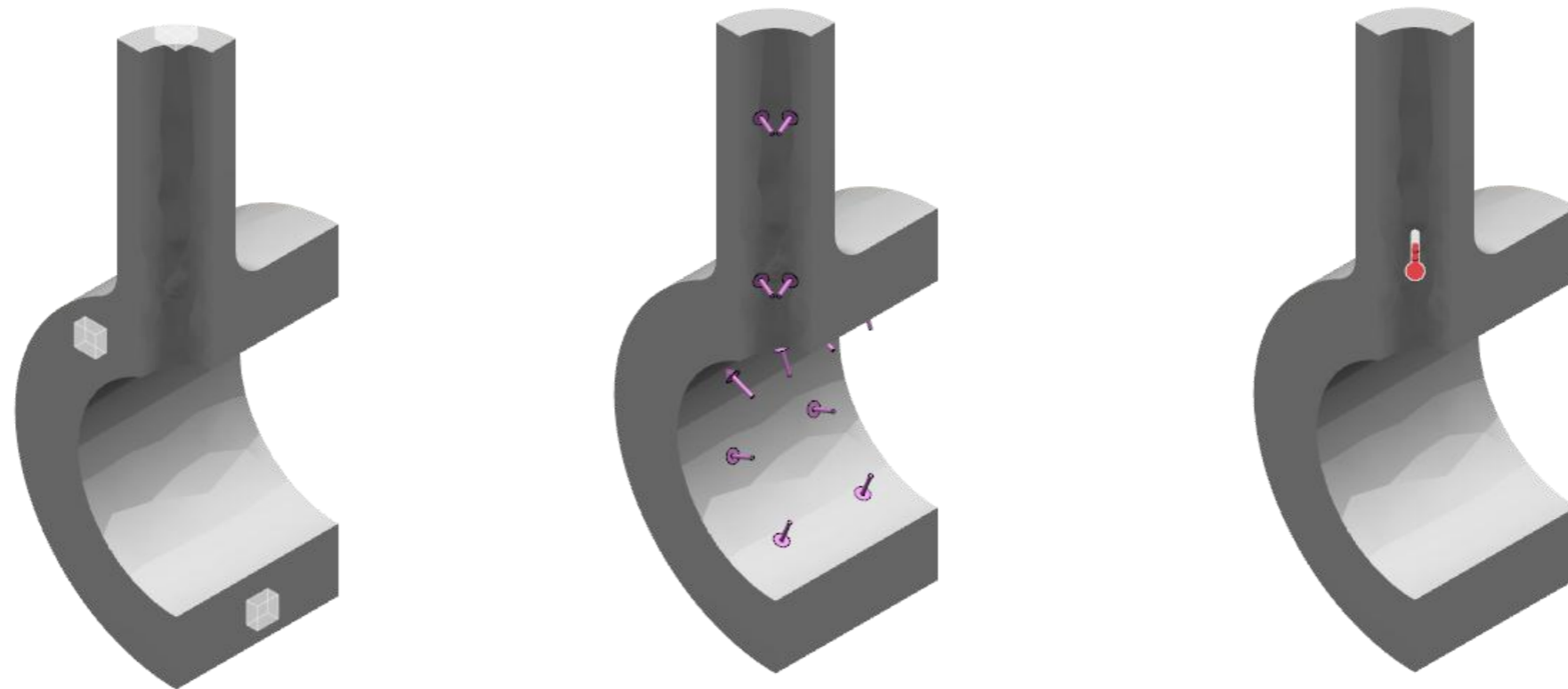
30 minutes

Workshop 5b: Intersecting Pipes – Submission and Postprocessing

In this workshop, you will execute the simulation and visualize the results.

After completion of this exercise, you will be able to:

    a. Execute a simulation

    b. Postprocess the results using different techniques

30 minutes

Lesson 6: Loads, Restraints and Initial Conditions

Lesson content:

▷ Defining Loads and Restraints

▷ Understanding Amplitudes

▷ Working with Local Coordinate Systems

▷ Defining Initial Conditions
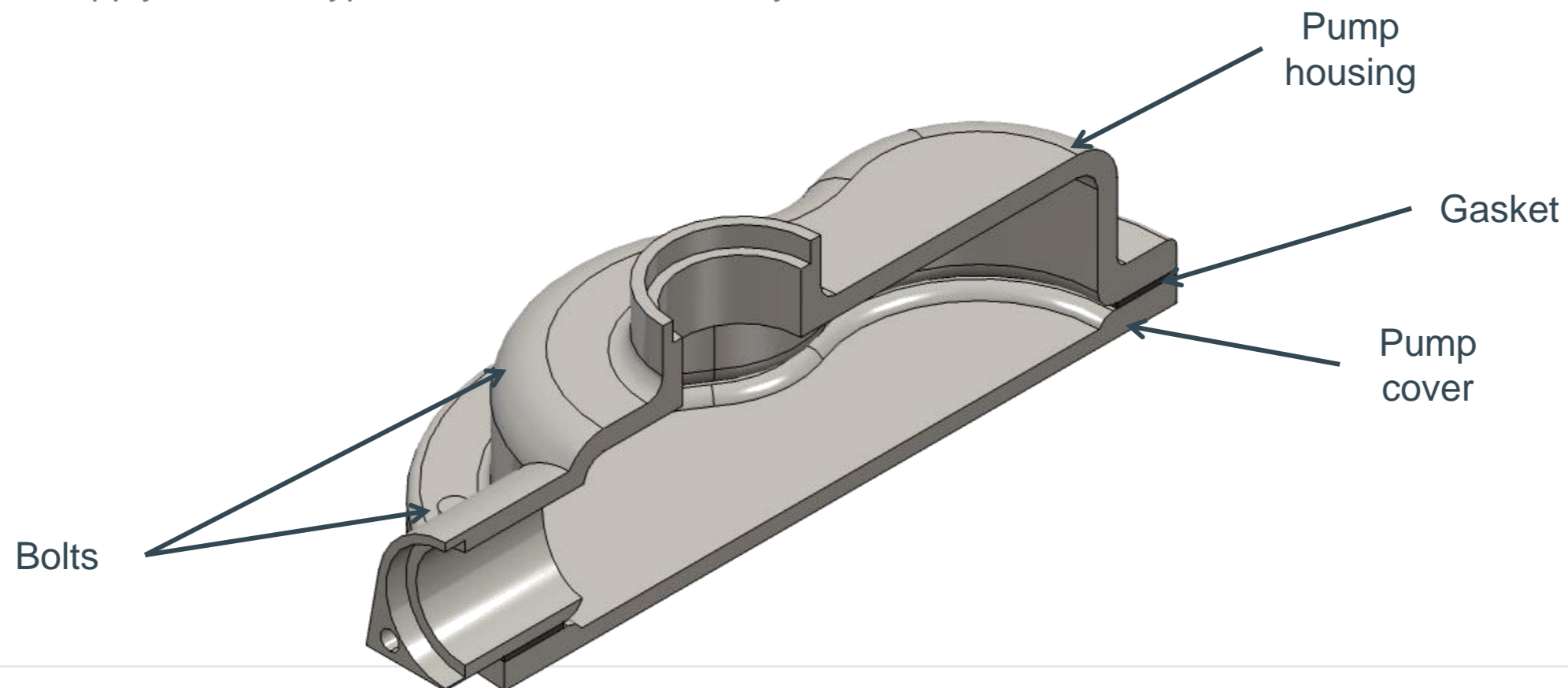
▷ Workshop 6a

▷ Workshop 6b

30 minutes

Workshop 6a: Pump – Step Definition and Loads

In this workshop you will create two static steps. In the first static step, you will introduce a state of pre-tension in the bolts by applying bolt loads. In the second static step, the bolts will be fixed and a pressure load will be applied to the interior faces of the assembly. Since interactions, loads, and boundary conditions can be step dependent, simulation steps must be defined before loads and boundary conditions.

After completion of this exercise, you will be able to:

a. Create simulation steps
b. Apply different types of loads and boundary conditions to a model
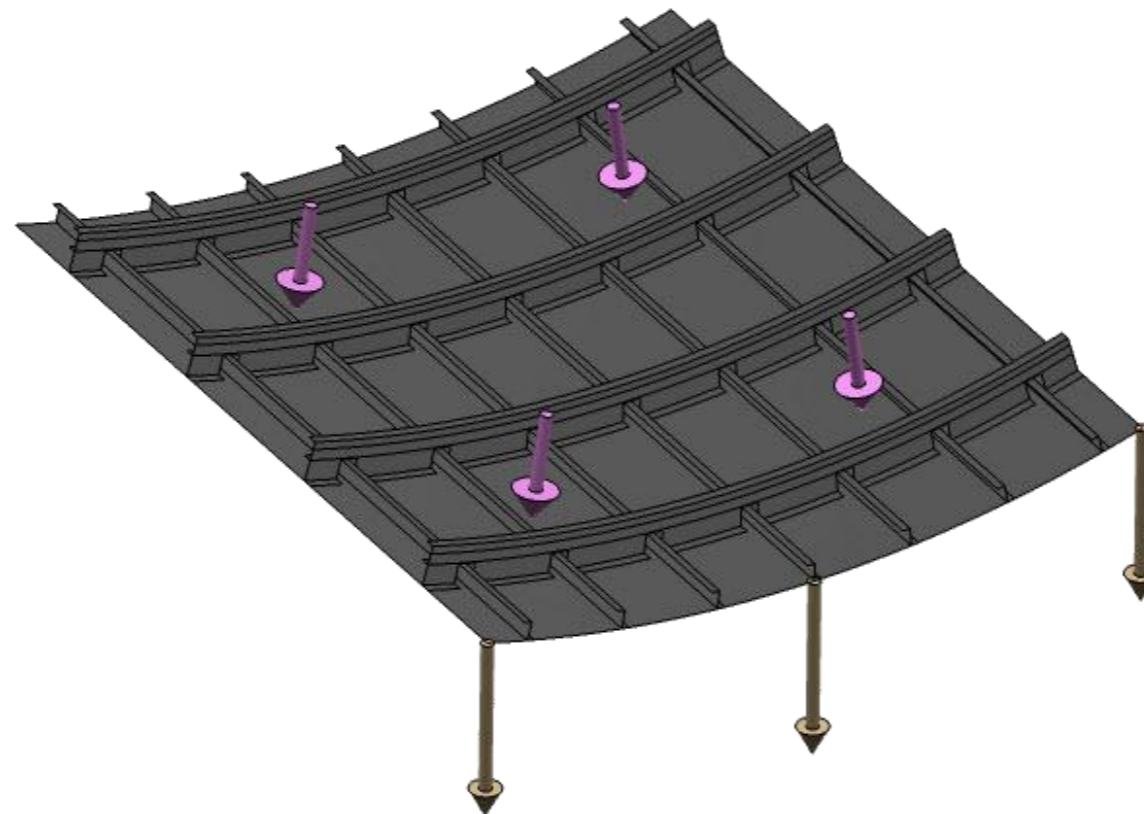

Pump housing

Gasket

Pump cover

Bolts

45 minutes

Workshop 6b: Reinforced Panel – Step Definition and Loads

In this workshop, you will define a static step and define the loads and restraints.

After completion of this exercise, you will be able to:

  a. Define static simulation steps
  b. Create pressure loads
  c. Apply translational loads and displacement restraints

45 minutes

Lesson 7: Connections, Interactions and Rigid Bodies

Lesson content:

▷ Overview of Connections, Interactions and Rigid Bodies

▷ Understanding Connections

▷ Understanding Connection Types

▷ Applying Loads and Restraints to Connections

▷ Understanding General Connections

▷ Understanding Rigid Bodies

▷ Defining Rigid Bodies and Analytical Rigid Surfaces

▷ Applying Loads and Restraints to Rigid Bodies

▷ Understanding Interactions

▷ Approaches to Modeling Contact

▷ Defining Interactions
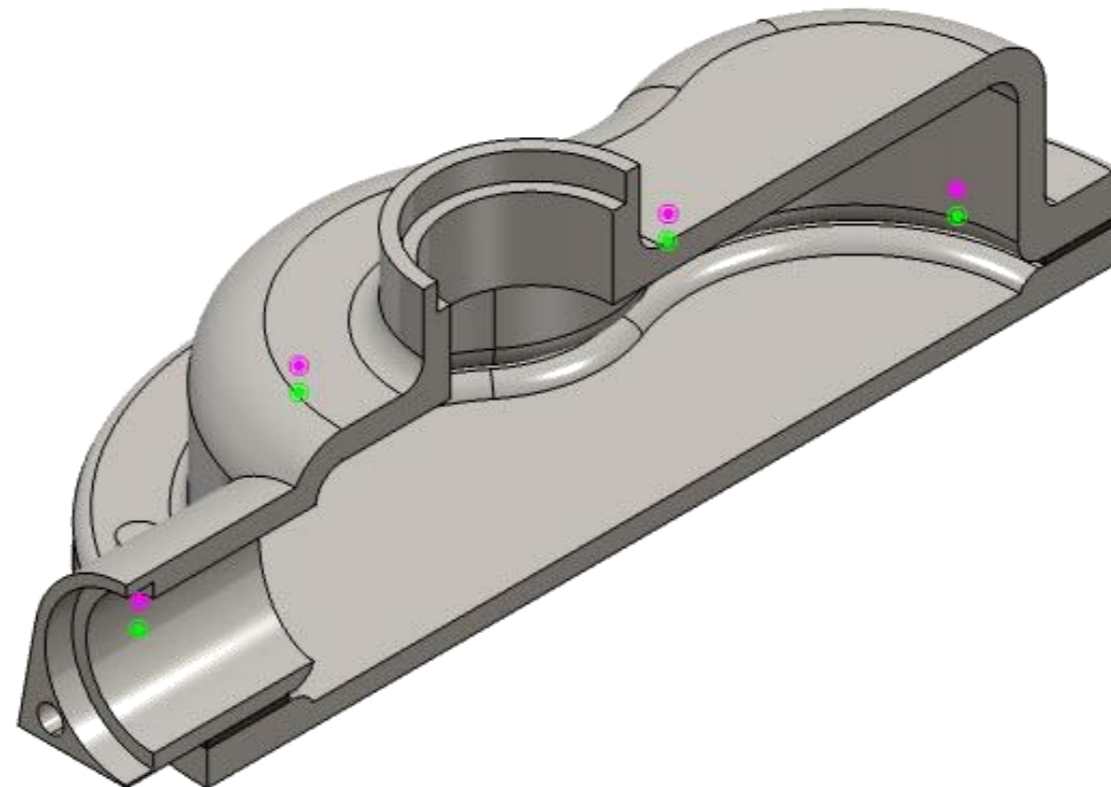
▷ Workshop 7a

▷ Workshop 7b

45 minutes

Workshop 7a: Pump – Connections and Interactions

In this workshop, you will define contact between the various parts of the assembly. In addition, you will also define tie connections between the bolt shanks and the pump cover.

After completion of this exercise, you will be able to:

a. Define contact between the different parts of the assembly
b. Create tie connections using free engineering connections

25 minutes

Workshop 7b: Reinforced Panel – Connections, Submission and Postprocessing

In this workshop, you will connect the different parts of the panel assembly. In addition, you will execute the simulation, visualize and postprocess the results.

After completion of this exercise, you will be able to:

    a. Create point fasteners between different geometric entities

    b. Define tied contact

    c. Execute a simulation

    d. Perform basic postprocessing
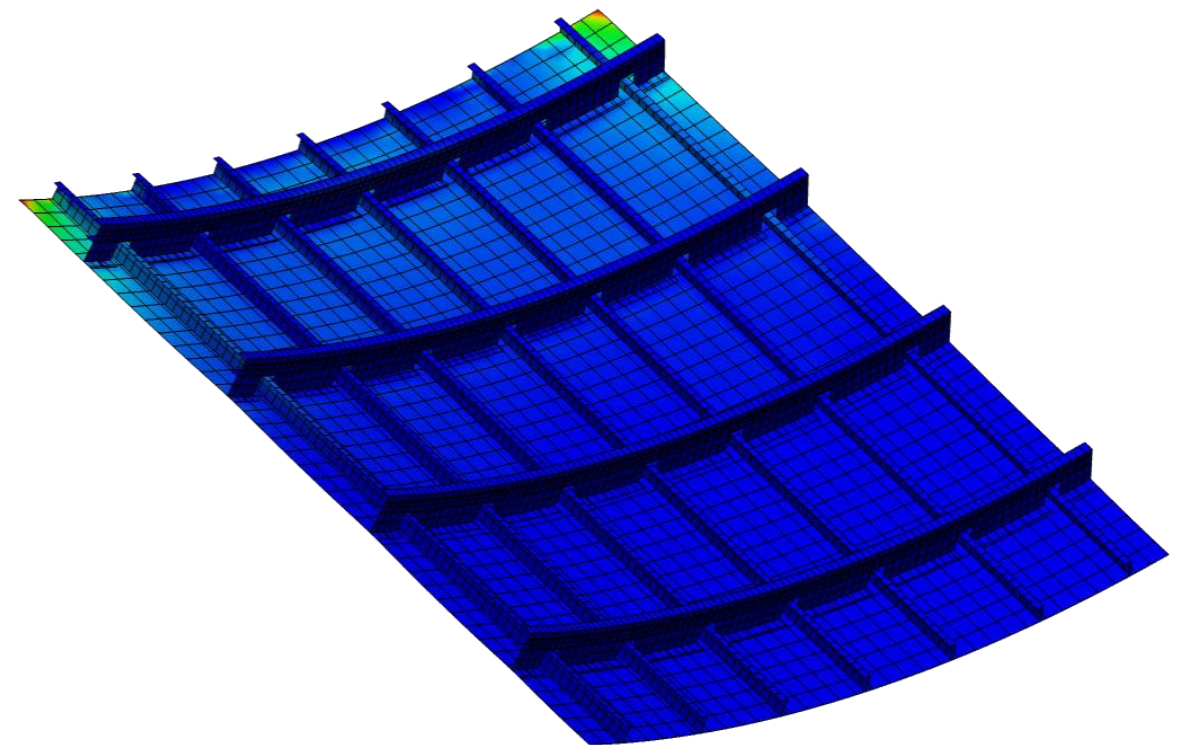
45 minutes

Lesson 8: Running Simulations and Postprocessing

Lesson content:

▷ Completing the Simulation Model

▷ Running Simulations

▷ Exploring Results

▷ Results Storage

▷ High Performance Visualization

▷ Workshop 8

45 minutes

Workshop 8: Pump – Submission and Postprocessing

In this workshop, you will execute the previously saved simulation and will apply different postprocessing techniques to visualize the results.

After completion of this exercise, you will be able to:

a. Execute a simulation
b. Postprocess the results using different techniques
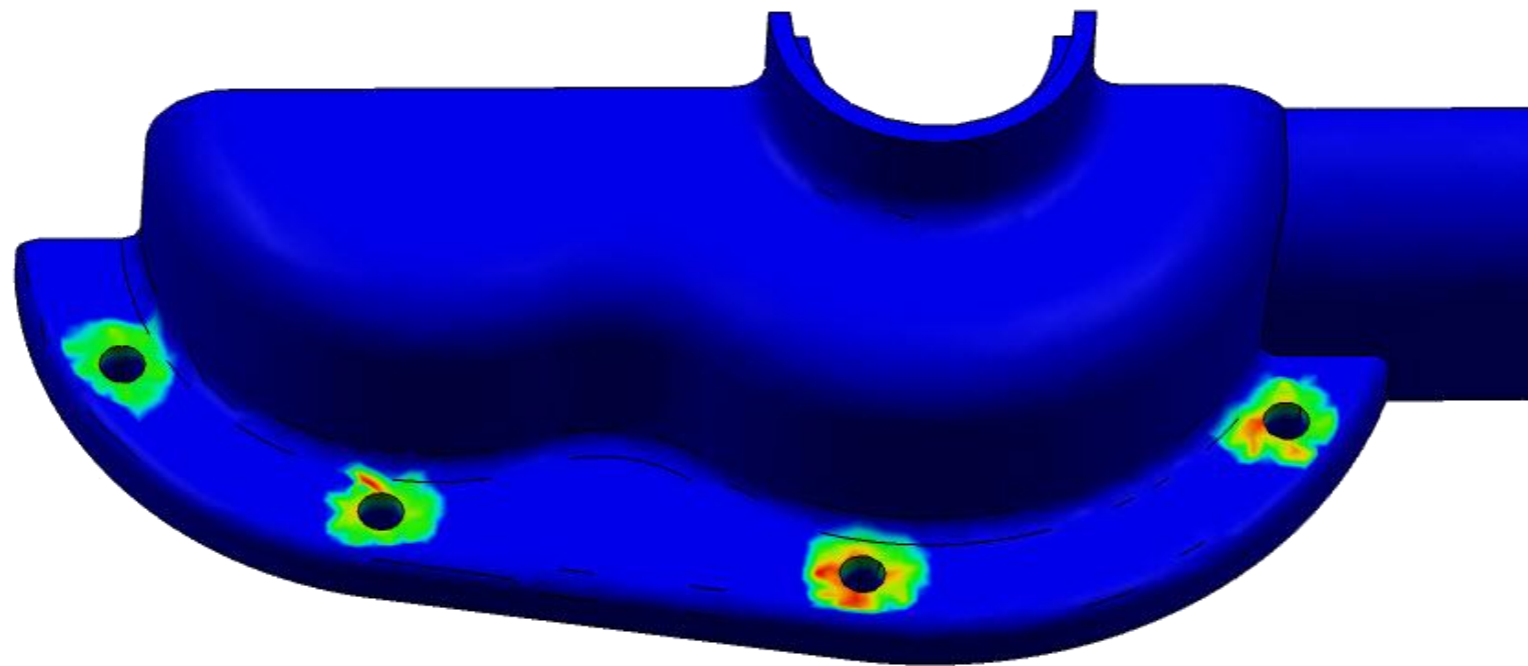
45 minutes

Lesson 9: Heat Transfer Simulation

Lesson content:

▷ Introduction

▷ Thermal and Initial Conditions

▷ Thermal Material Properties

▷ Creating Heat Transfer Steps

▷ Thermal Interactions

▷ Steady-State Heat Transfer Example

▷ Transient Heat Transfer Example

▷ Sequentially Coupled Thermal-Stress Analysis

▷ Thermal-Stress Analysis Example

▷ Workshop 9: Thermal Analysis of a Pump Housing

45 minutes

Workshop 9: Thermal Simulation of a Pump Housing

In this workshop, we will perform a steady-state heat transfer analysis of a pump housing containing a hot fluid.

After completion of this exercise, you will be able to:

a. Conduct a steady-state heat transfer analysis.
b. Set up thermal interactions between bodies in contact
c. Prescribe a number of different thermal boundary conditions
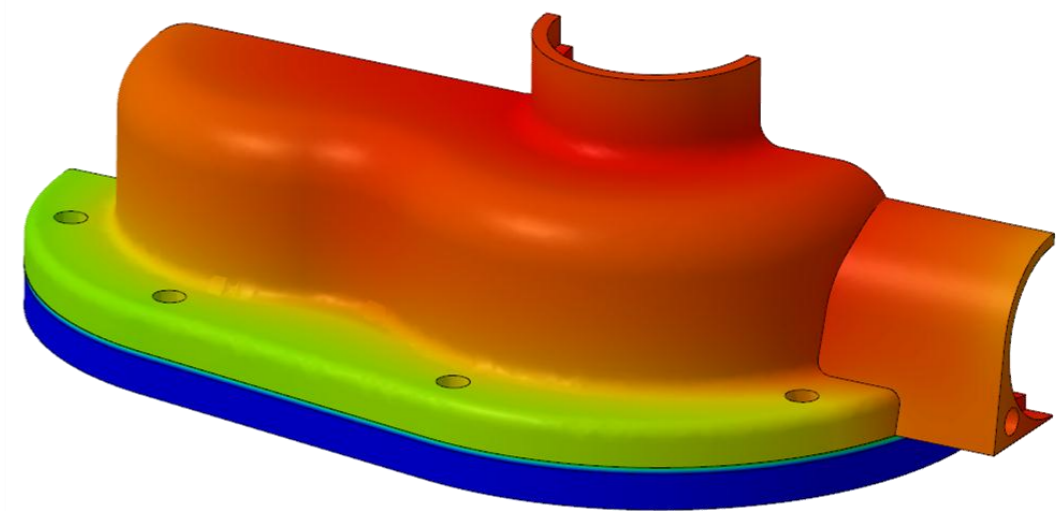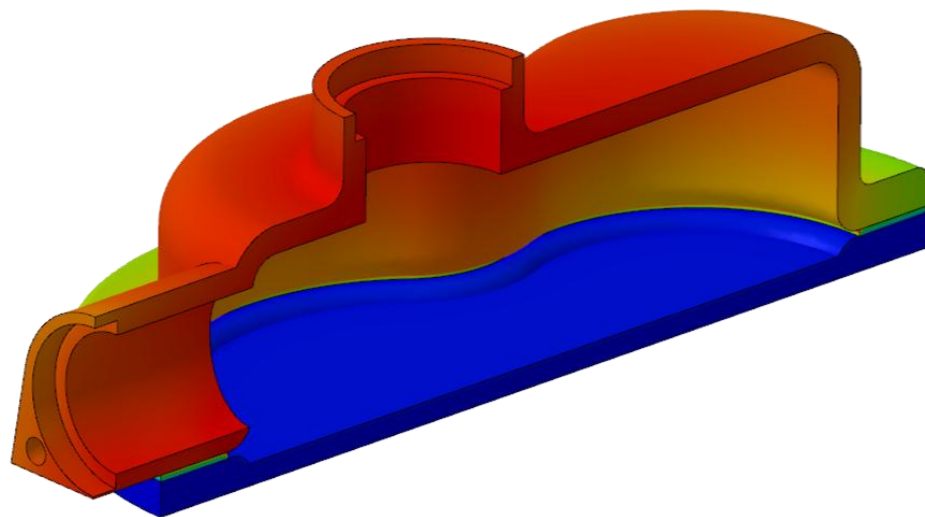
60 minutes

Appendix 1: Element Selection Criteria

Appendix content:

▷ Elements

▷ Structural (Shells and Beams) vs. Continuum Elements

▷ Modeling Bending Using Continuum Elements

▷ Stress Concentrations

▷ Contact

▷ Incompressible Materials

▷ Mesh Generation

▷ Solid Element Selection Summary

1 hour

Appendix 2: High Performance Visualization

Appendix content:

▷ Introduction

▷ Client – Server Architecture

▷ High Performance Visualization execution setup

▷ Importing external simulation results files

45 minutes