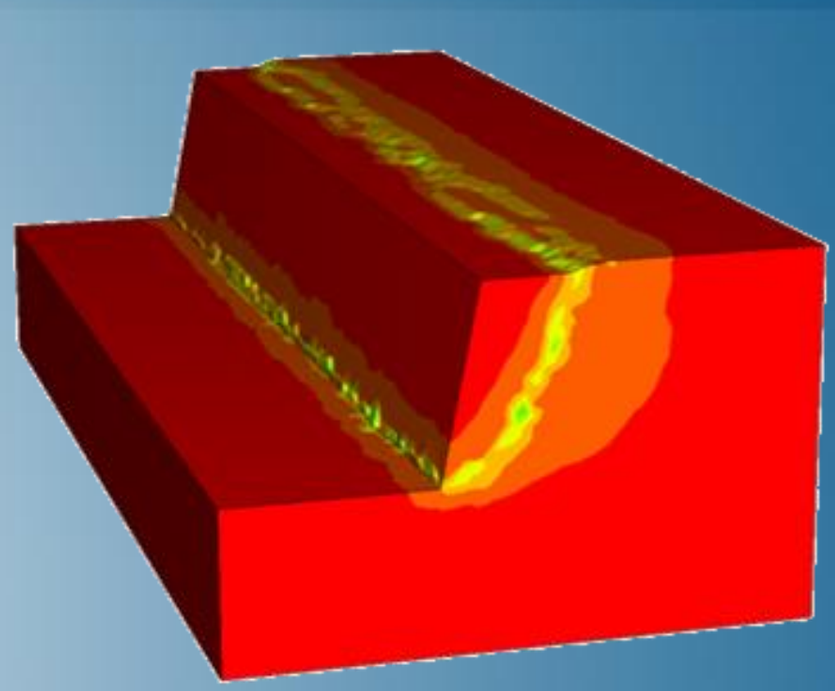
Analysis of Geotechnical Problems with Abaqus

Abaqus 2018



3DEXPERIENCE®

About this Course

Course objectives

Upon completion of this course you will be able to:

- An overview of modeling geotechnical problems
- Experimental testing and how it relates to the calibration of constitutive models for geotechnical materials
- How to use and calibrate the different geotechnical material constitutive models available in Abaqus
- The limitations of these models
- The coupling between fluid flow and stress/deformation in the analysis of porous media
- Modeling issues related to geotechnical problems

Targeted audience

This seminar is recommended for engineers with experience using Abaqus/Standard.

Prerequisites

None

2 days

Day 1

- Lecture 1 — Introduction
- Lecture 2 — Physical Testing
- Lecture 3 — Constitutive Models: Part 1
- Lecture 4 — Constitutive Models: Part 2
  - Workshop 1 — Material Models for Geotechnical Applications

Day 2

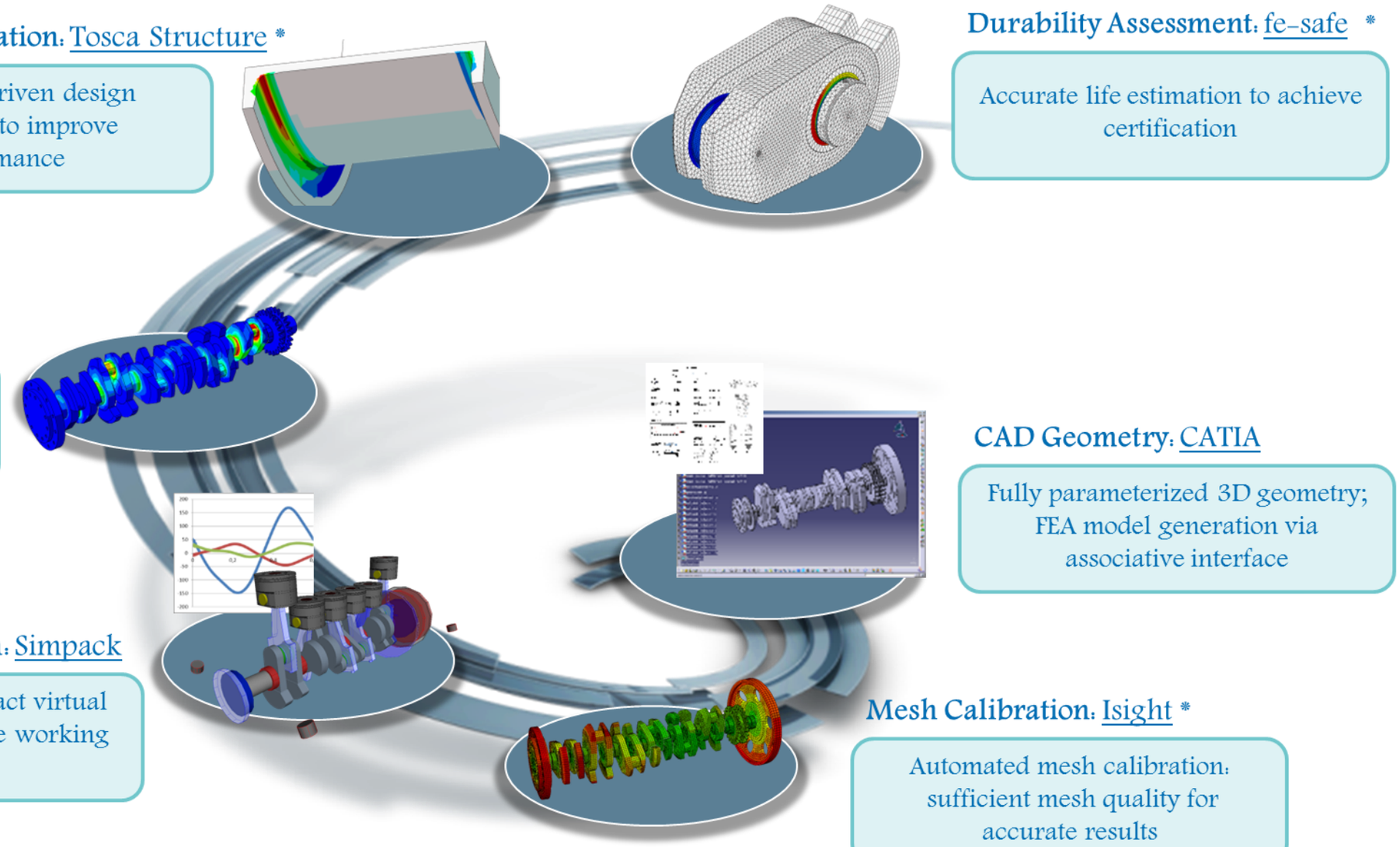
- Lecture 5 Analysis of Porous Media
  - Workshop 2 Pore Fluid Flow Analysis: Consolidation
- Lecture 6 Modeling Aspects
  - Workshop 3 Pore Fluid Flow Analysis: Wicking
  - Workshop 4 Mixing of Granular Media in a Drum Mixer (*Optional*)

Additional Material

- Appendix 1 Stress Equilibrium and Fluid Continuity Equations
- Appendix 2 Bibliography of Geotechnical Example Problems
- Appendix 3 Infinite Domains
- Appendix 4 Hydraulic Fracture

SIMULIA

- SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions
- Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack



Design Optimization: Tosca Structure *

Simulation-driven design refinement to improve performance

Durability Assessment: fe-safe *

Accurate life estimation to achieve certification

FEA Stress Analysis: Abaqus *

Detailed stress analysis using extracted load history from MBS

CAD Geometry: CATIA

Fully parameterized 3D geometry; FEA model generation via associative interface

Multibody Simulation: Simpack

System analysis to extract virtual load history of complete working cycle

Mesh Calibration: Isight *

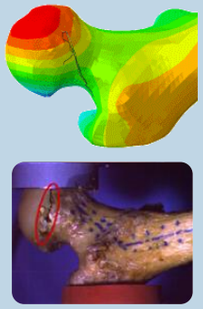
Automated mesh calibration: sufficient mesh quality for accurate results

* Included in extended licensing pool

SIMULIA's Power of the Portfolio

Abaqus

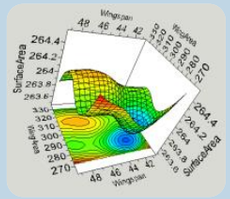
- Routine and Advanced Simulation
- Linear and Nonlinear, Static and Dynamic
- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization



Realistic Human Simulation
High Speed Crash & Impact
Noise & Vibration

Isight

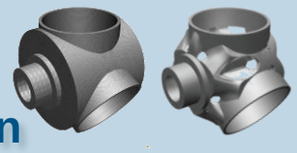
- Process Integration
- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments



Material Calibration
Workflow Automation
Design Exploration

Tosca

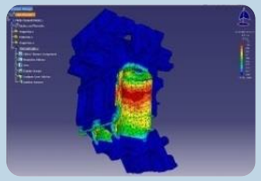
- Non-Parametric Optimization
- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization



Conceptual/Detailed Design
Weight, Stiffness, Stress
Pressure Loss Reduction

fe-safe

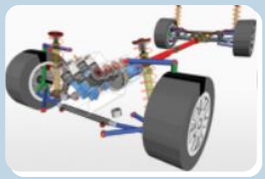
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics



Safety Factors
Creep-Fatigue Interaction
Weld Fatigue

Simpack

- 3D Multibody Dynamics Simulation
- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)



Complete System Analyses
(Quasi-)Static, Dynamics, NVH
Flex Bodies, Advanced Contact

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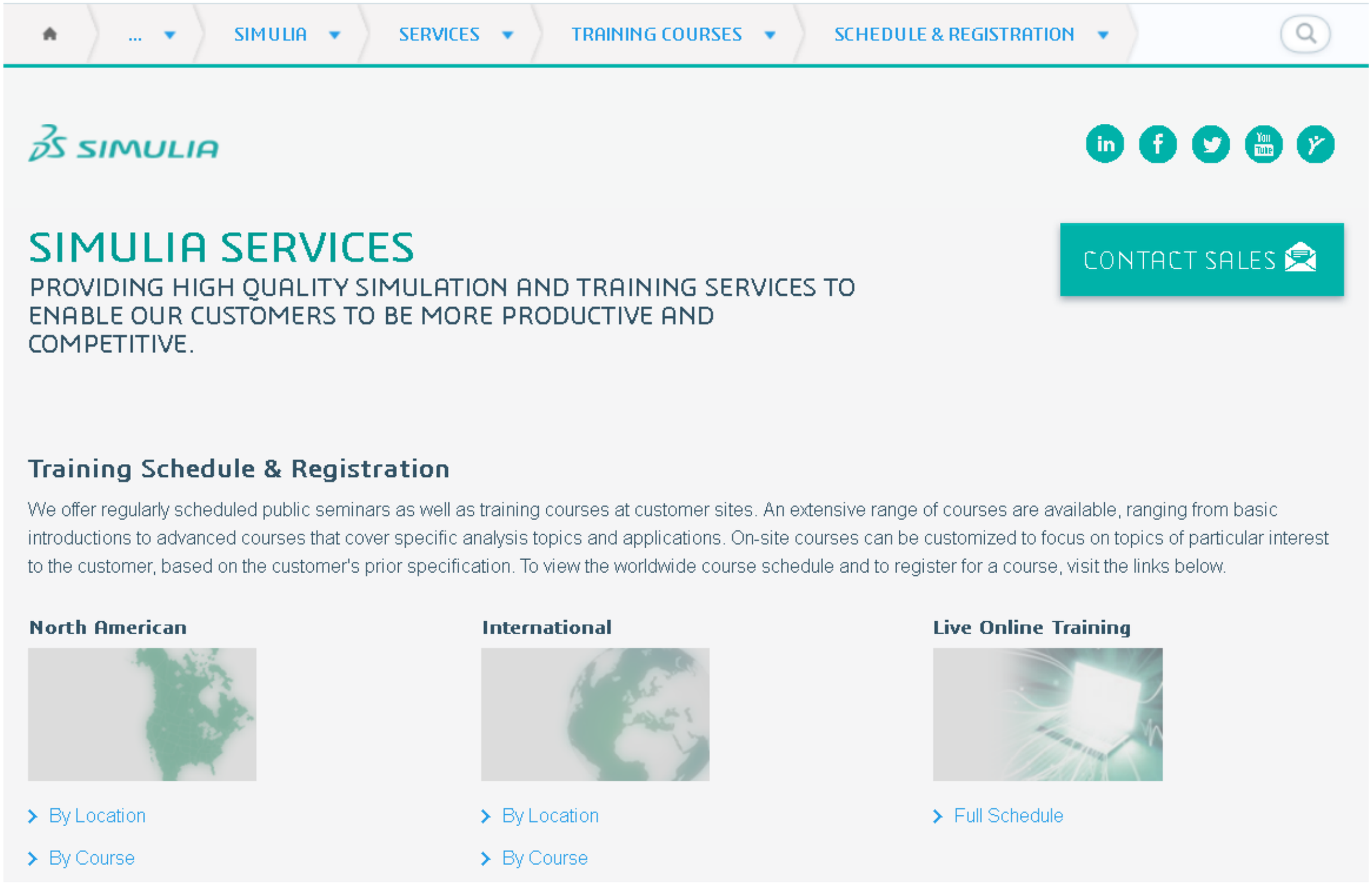

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Revision Status

Lecture 1	11/17	Updated for Abaqus 2018
Lecture 2	11/17	Updated for Abaqus 2018
Lecture 3	11/17	Updated for Abaqus 2018
Lecture 4	11/17	Updated for Abaqus 2018
Lecture 5	11/17	Updated for Abaqus 2018
Lecture 6	11/17	Updated for Abaqus 2018
Appendix 1	11/17	Updated for Abaqus 2018
Appendix 2	11/17	Updated for Abaqus 2018
Appendix 3	11/17	Updated for Abaqus 2018
Appendix 4	11/17	Updated for Abaqus 2018
Workshop 1	11/17	Updated for Abaqus 2018
Workshop 2	11/17	Updated for Abaqus 2018
Workshop 3	11/17	Updated for Abaqus 2018
Workshop 4	11/17	Updated for Abaqus 2018

Lesson 1: Introduction

Lesson content:

- Introduction
- Overview of Geotechnical Applications
- Classical and Modern Design Approaches
- Some Cases for Numerical (FE) Analysis
- Experimental Testing and Numerical Analysis
- Requirements for Realistic Constitutive Theories

45 minutes

Lesson 2: Physical Testing

Lesson content:

- Physical Testing
- Basic Experimental Observations
- Testing Requirements and Calibration of Constitutive Models

30 minutes

Lesson 3: Constitutive Models: Part 1

Lesson content:

- Stress Invariants and Spaces
- Overview of Constitutive Models
- Elasticity
- Plastic Behavior of Soils
- Mohr-Coulomb Model
- Extended Drucker-Prager Models

2 hours

Lesson 4: Constitutive Models: Part 2

Lesson content:

- Modified Drucker-Prager/Cap Model
- Critical State (Clay) Plasticity Model
- Soft Rock Plasticity Model
- Jointed Material Model
- Soil Plasticity Models - Summary
- Comments on the Numerical Implementation
- Workshop Preliminaries
- Workshop 1: Material Models for Geotechnical Applications (IA)
- Workshop 1: Material Models for Geotechnical Applications (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.

2.5 hours

Lesson 5: Analysis of Porous Media

Lesson content:

- Overview
- Basic Assumptions and Effective Stress
- Stress Equilibrium and Flow Continuity
- Types of Analyses and Usage
- Saturated Example Problems
- Partially Saturated Example Problems
- Workshop 2: Pore Fluid Flow Analysis: Consolidation (IA)
- Workshop 2: Pore Fluid Flow Analysis: Consolidation (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.

2.5 hours

Lesson 6: Modeling Aspects

Lesson content:

- Element Technology
- Geostatic States of Stress
- Pore Fluid Surface Interactions
- Element Addition and Removal
- Material Wear/Ablation through Adaptive Meshing
- Reinforced Soil Slopes
- Modeling Large Deformations in Soils
- Discrete Element Method
- DEM Model Definition
- Applications
- Tips and Suggestions
- Workshop 3: Pore Fluid Flow Analysis: Wicking (IA)
- Workshop 3: Pore Fluid Flow Analysis: Wicking (KW)
- Workshop 4: Mixing of Granular Media in a Drum Mixer

3 hours

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.

Appendix 1: Stress Equilibrium and Fluid Continuity Equations

Appendix content:

- General equations
- Fully saturated fluid flow
- Partially saturated fluid flow

30 minutes

Appendix 2: Bibliography of Geotechnical Example Problems

Appendix content:

- Abaqus Example Problems
- Abaqus Benchmark Problems

This appendix provides a list of Abaqus Example and Benchmark Problems that show the use of capabilities for geotechnical modeling

5 minutes

Appendix 3: Infinite Domains

Appendix content:

- Infinite Domains

30 minutes

Appendix 4: Hydraulic Fracture

Appendix content:

- Hydraulic Fracture
- Coupled Pore Pressure-Displacement Cohesive Elements
- Hydraulic Fracture with XFEM
- Enabling Technologies for a 1D Borehole Model
- Fluid Pipe Elements
- Fluid Pipe Connectors Elements
- Input file example for fluid pipe and fluid connector
- Coupling Fluid Pipe Elements to Continuum and Cohesive Elements
- Automatic Application of Mechanical Distributed Pressure Load
- Automatic Application of Nodal Pressures to Fractures
- Hydraulic Fracture: XFEM and Surface Tie Constraints
- Hydraulic Fracture: Cohesive Elements and Surface Tie Constraints
- Consolidation Analysis: Embedded Fluid Pipe Element
- Multistage Injection Process Using Valve Connectors
- “Submodeling” with Fluid Pipe Connectors
- Modeling Tips
- Limitations

3 hours