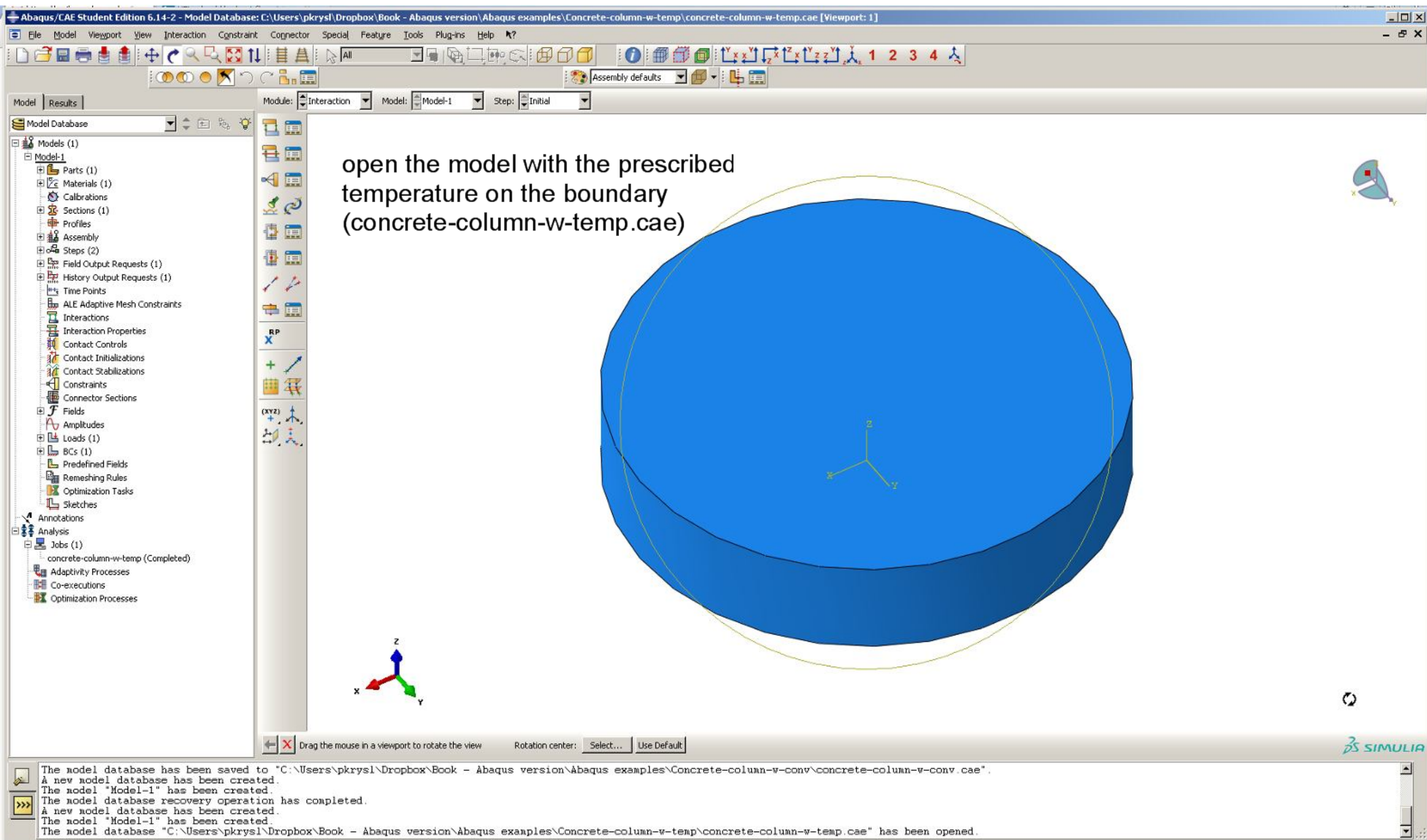
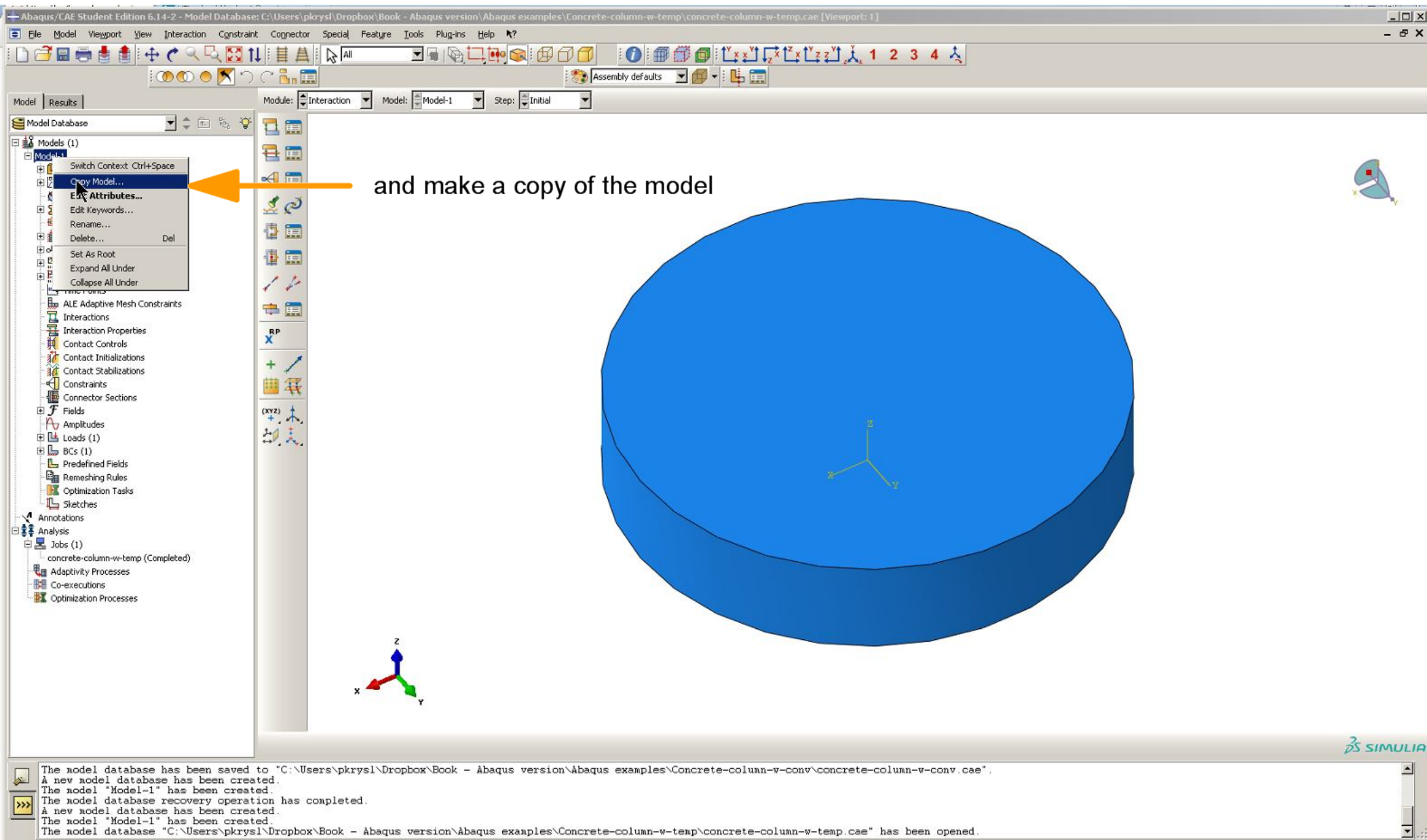


Concrete column with hydration heat load, with convection boundary condition







Model Results

Module: Interaction Model: Model-1 Step: Initial

Model Database

- Models (1)
 - Model-1
 - Date (1)

Copy Model

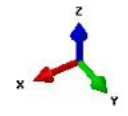
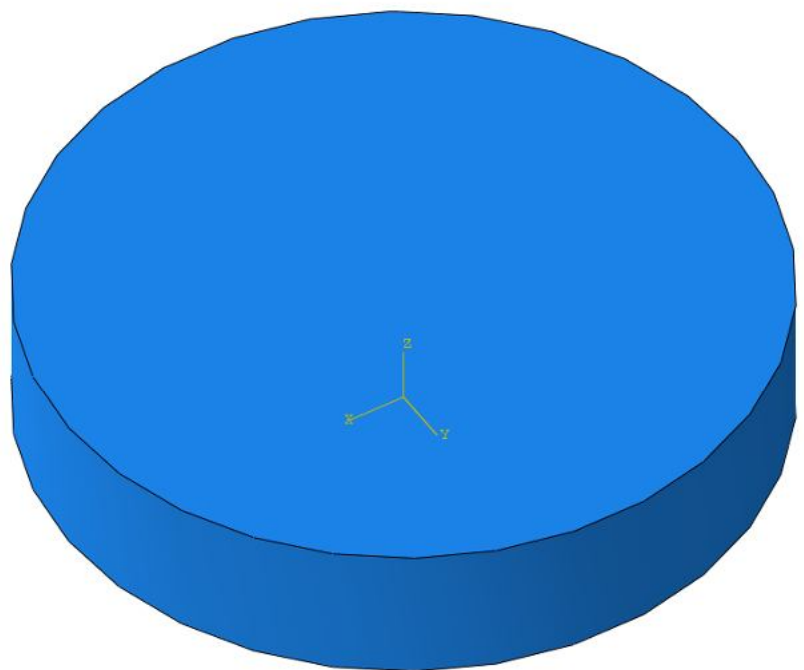
Copy Model-1 to:

convection model

OK Cancel



- Field Output Requests (1)
- History Output Requests (1)
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
- Constraints
- Connector Sections
- Fields
 - Amplitudes
- Loads (1)
- BCs (1)
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
- Annotations
- Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes




The model database has been saved to "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae".
A new model database has been created.
The model "Model-1" has been created.
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.

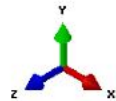
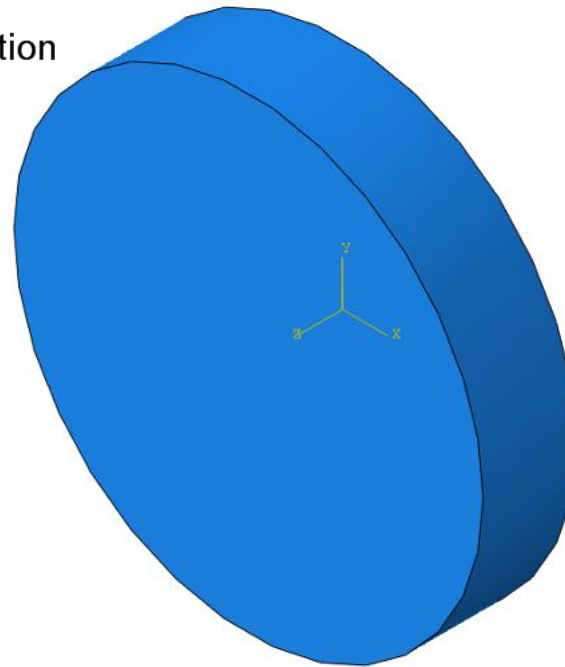
Model Database

- Models (2)
 - Model-1
 - convection model**
 - Annotations
- Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

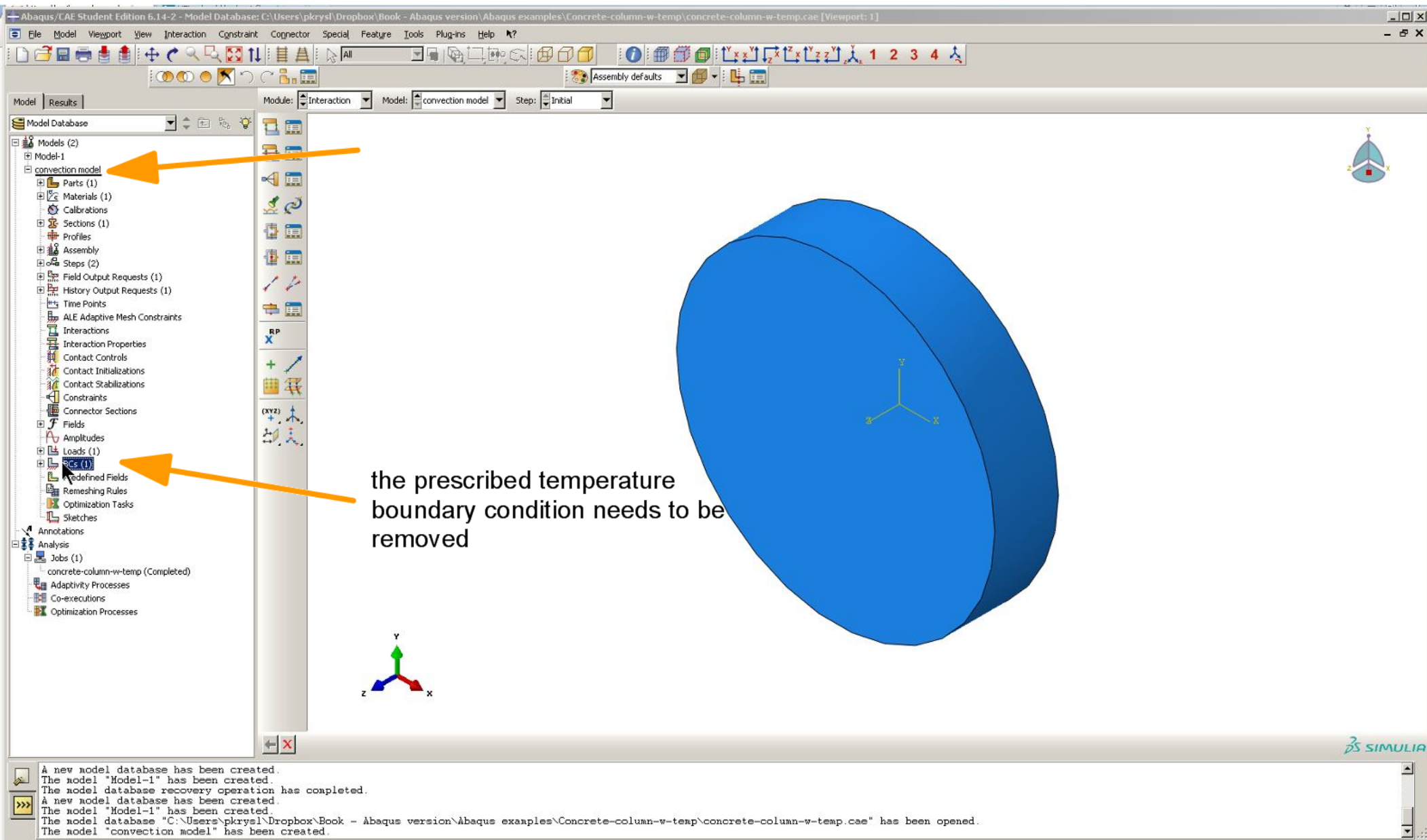
Module: Interaction Model: convection model Step: Initial

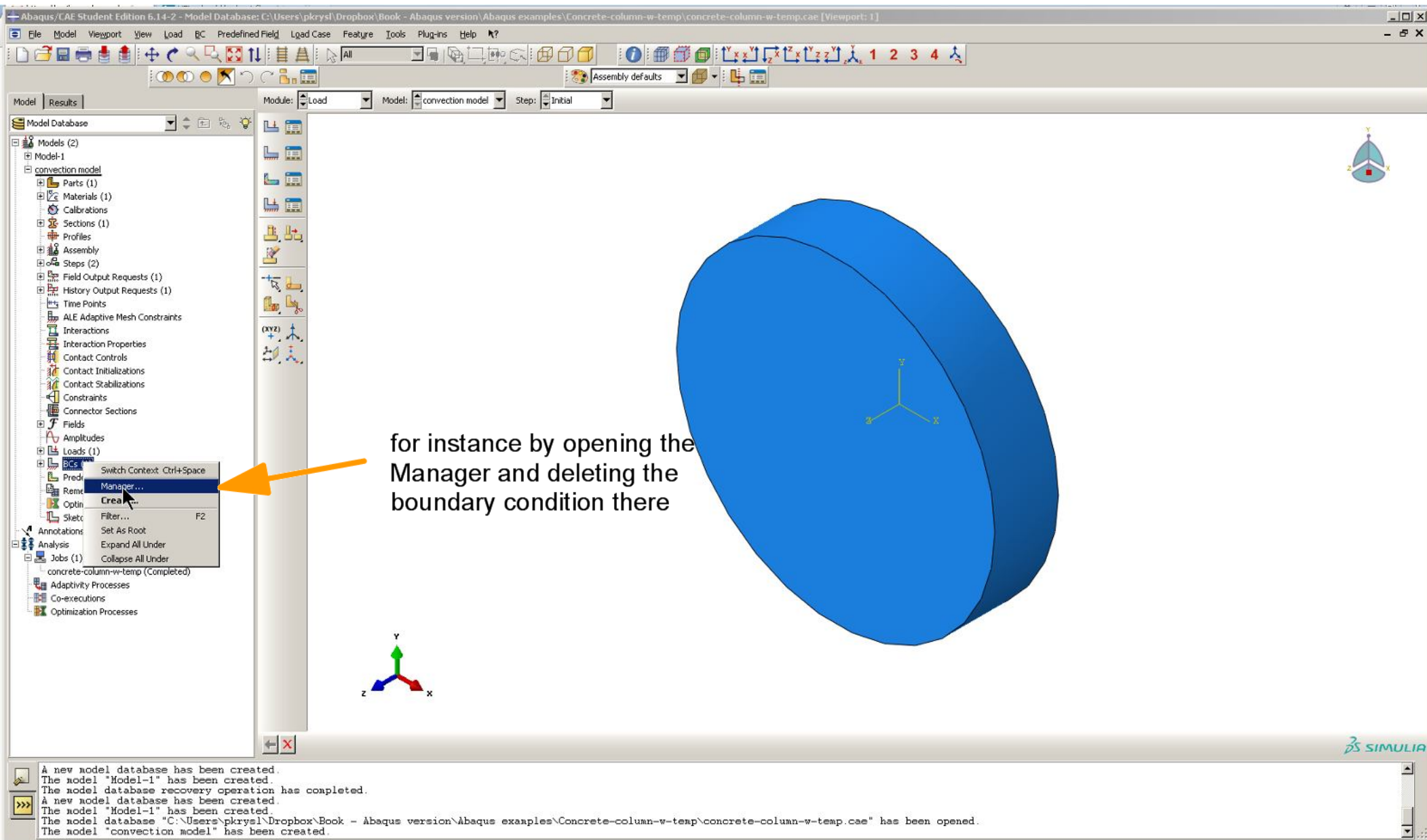


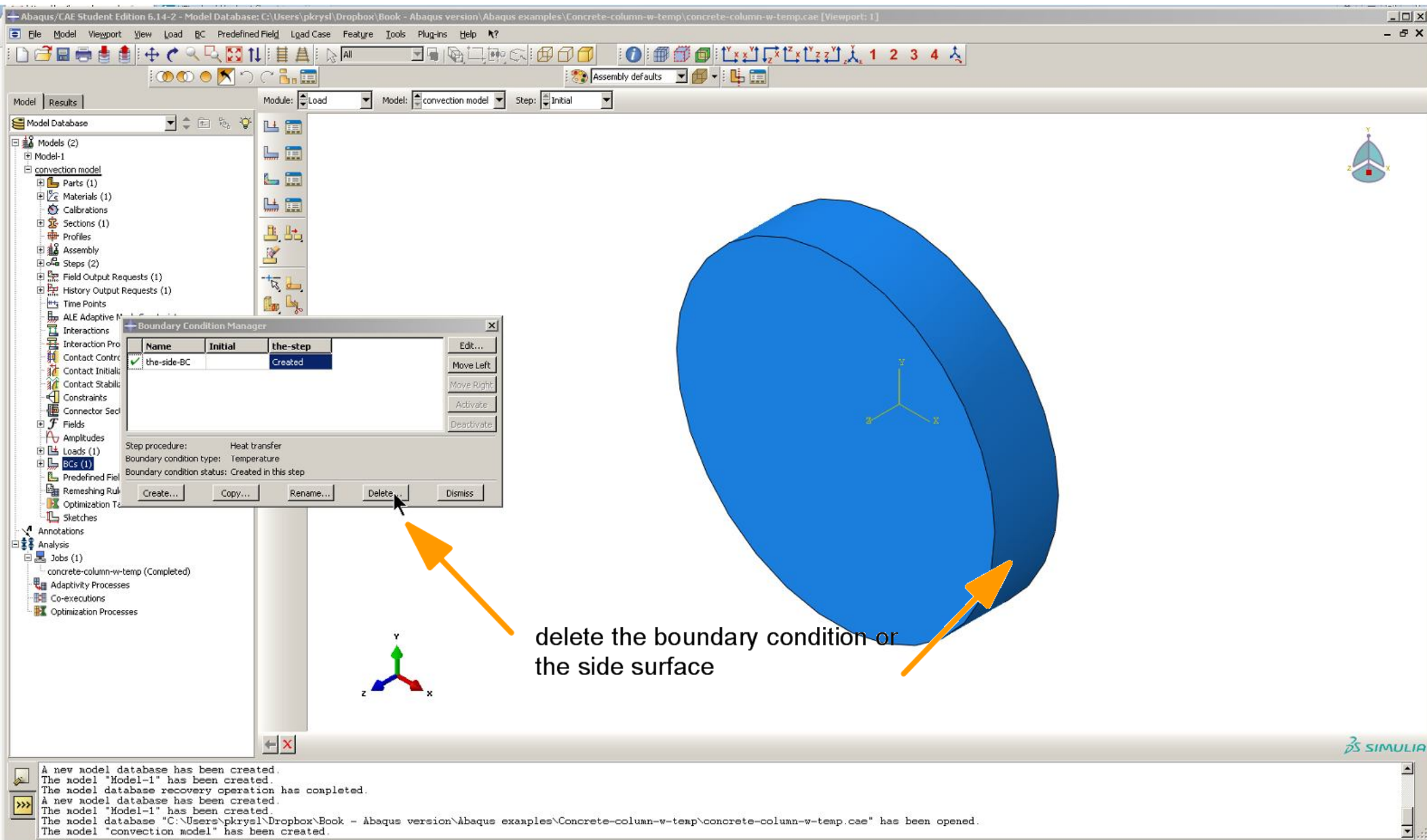
now we have a model we can modify to incorporate the convection boundary condition (film condition)



A new model database has been created.
The model "Model-1" has been created.
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.
The model "convection model" has been created.







Model Database

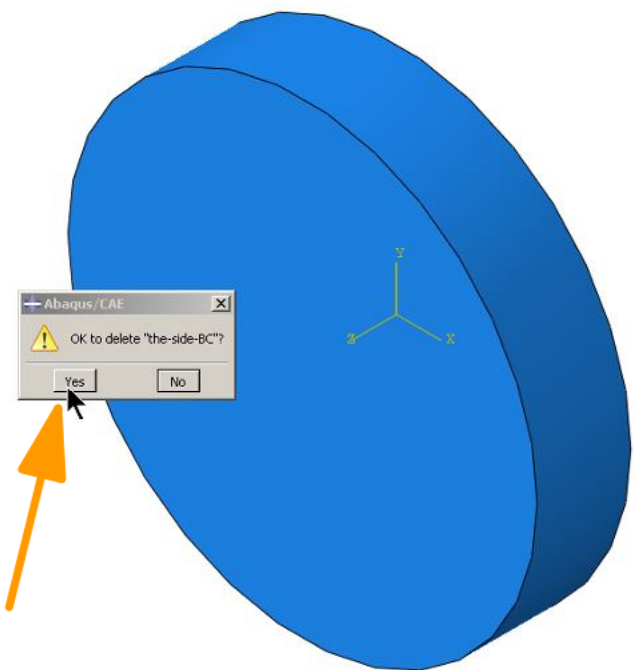
- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points
 - ALE Adaptive M
 - Interactions
 - Interaction Pro
 - Contact Contr
 - Contact Initia
 - Contact Stabili
 - Constraints
 - Connector Secl
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs (1)
 - Predefined Fil
 - Remeshing Rul
 - Optimization T
 - Sketches
 - Annotations
 - Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Boundary Condition Manager

Name	Initial	the-step
the-side-BC		Created

Step procedure: Heat transfer
Boundary condition type: Temperature
Boundary condition status: Created in this step

Create... Copy... Rename... Delete... Dismiss



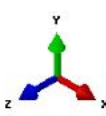
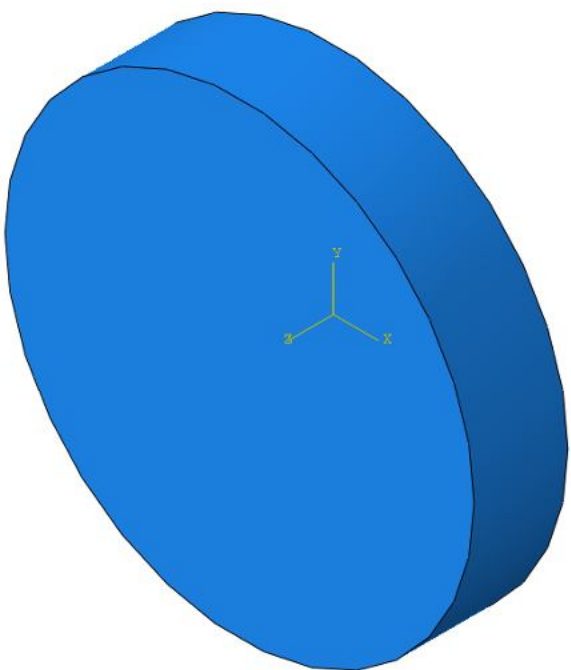
Model Database

- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interaction
 - Switch Context Ctrl+Space
 - Find Contact Pairs...
 - Manager...
 - Create...**
 - Filter... F2
 - Contact Cc
 - Contact Ini
 - Contact St
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Module: Load Model: convection model Step: Initial



the convection boundary condition is an "interaction"



Create Interaction

Name: convection

Step: Initial

Procedures:

Types for Selected Step

- Surface-to-surface contact (Standard)
- Self-contact (Standard)
- Fluid cavity
- Fluid exchange
- Cyclic symmetry (Standard)
- Elastic foundation
- Actuator/sensor

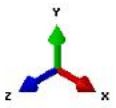
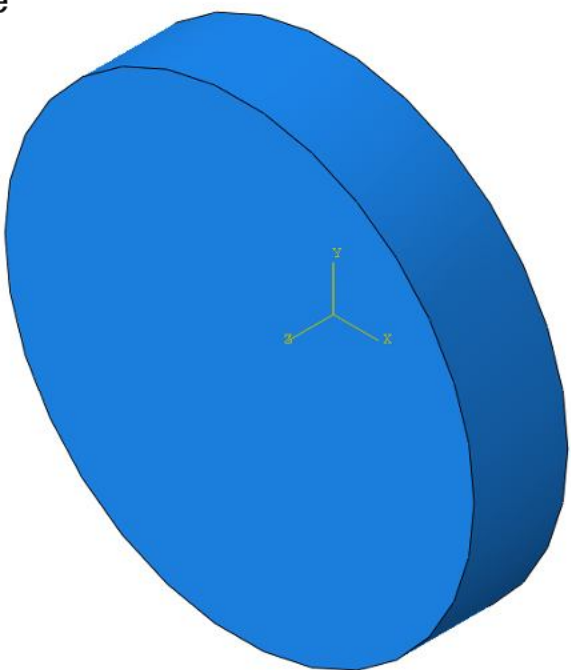
Continue... Cancel



we must select the appropriate step: for us that would be the-step

Module: Interaction Model: convection model Step: Initial

- RP
- (XYZ)



- Contact Stabilizations
- Constraints
- Connector Sections
- Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
- Annotations
- Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Fill out the Create Interaction dialog

A new model database has been created.
The model "Model-1" has been created.
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.
The model "convection model" has been created.

Create Interaction

Name: convection

Step: Initial

Process: Initial

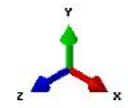
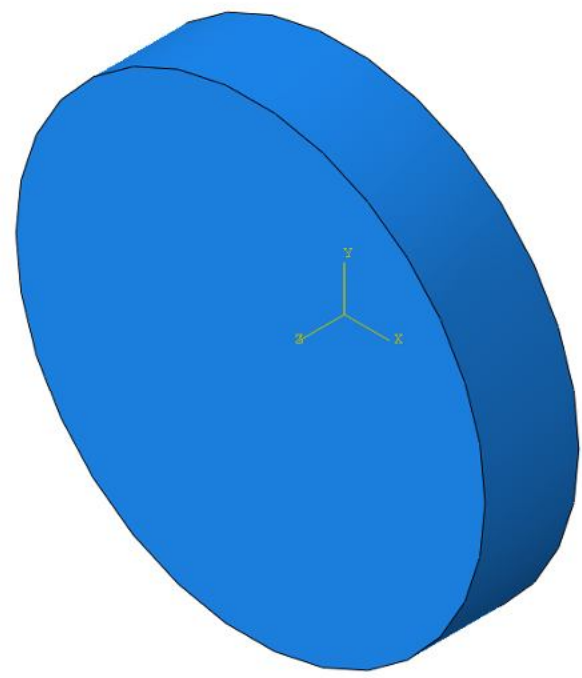
Type: **the-step** **ed Step**

- Surface-to-surface contact (Standard)
- Self-contact (Standard)
- Fluid cavity
- Fluid exchange
- Cyclic symmetry (Standard)
- Elastic foundation
- Actuator/sensor

Continue... Cancel

Module: Interaction Model: convection model Step: Initial

- RP
- +
- (XYZ)



Fill out the Create Interaction dialog

A new model database has been created.
The model "Model-1" has been created.
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.
The model "convection model" has been created.

Create Interaction

Name: convection

Step: the-step

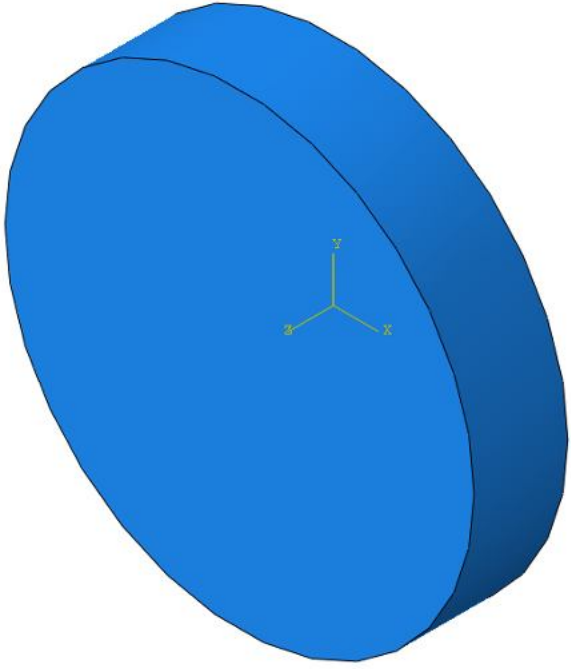
Procedure: Heat transfer

Types for Selected Step

- Surface-to-surface contact (Standard)
- Self-contact (Standard)
- Model change
- Fluid-Structure Co-simulation boundary
- Cavity radiation
- Surface film condition**
- Surface radiation
- Concentrated film condition
- Concentrated radiation to ambient

Continue... Cancel

the type is "Surface film condition"



Model Tree:

- Contact Stabilizations
- Constraints
- Connector Sections
- Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
- Annotations
- Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Module: Interaction Model: convection model Step: the-step

Assembly defaults

RP

(XYZ)

Fill out the Create Interaction dialog

Model Database

- Models (2)
- Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

we select the side surface

and create a surface object at the same time

Select the surface: Individually (Create surface: side-surface) Done

Abaqus/CAE Student Edition 6.14-2 - Model Database: C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae [Viewport: 1]

File Model Viewport View Interaction Constraint Connector Special Feature Tools Plug-ins Help

Model Results

Module: Interaction Model: convection model Step: the-step

Edit Interaction

Name: convection
Type: Surface film condition
Step: the-step (Heat transfer)

Surface: side-surface

Definition: Embedded Coefficient $f(x)$

Film coefficient: 5.0

Film coefficient amplitude: (Instantaneous)

Sink definition: Uniform

Sink temperature: 0.0

Sink amplitude: (Ramp)

OK Cancel

provide the definition data

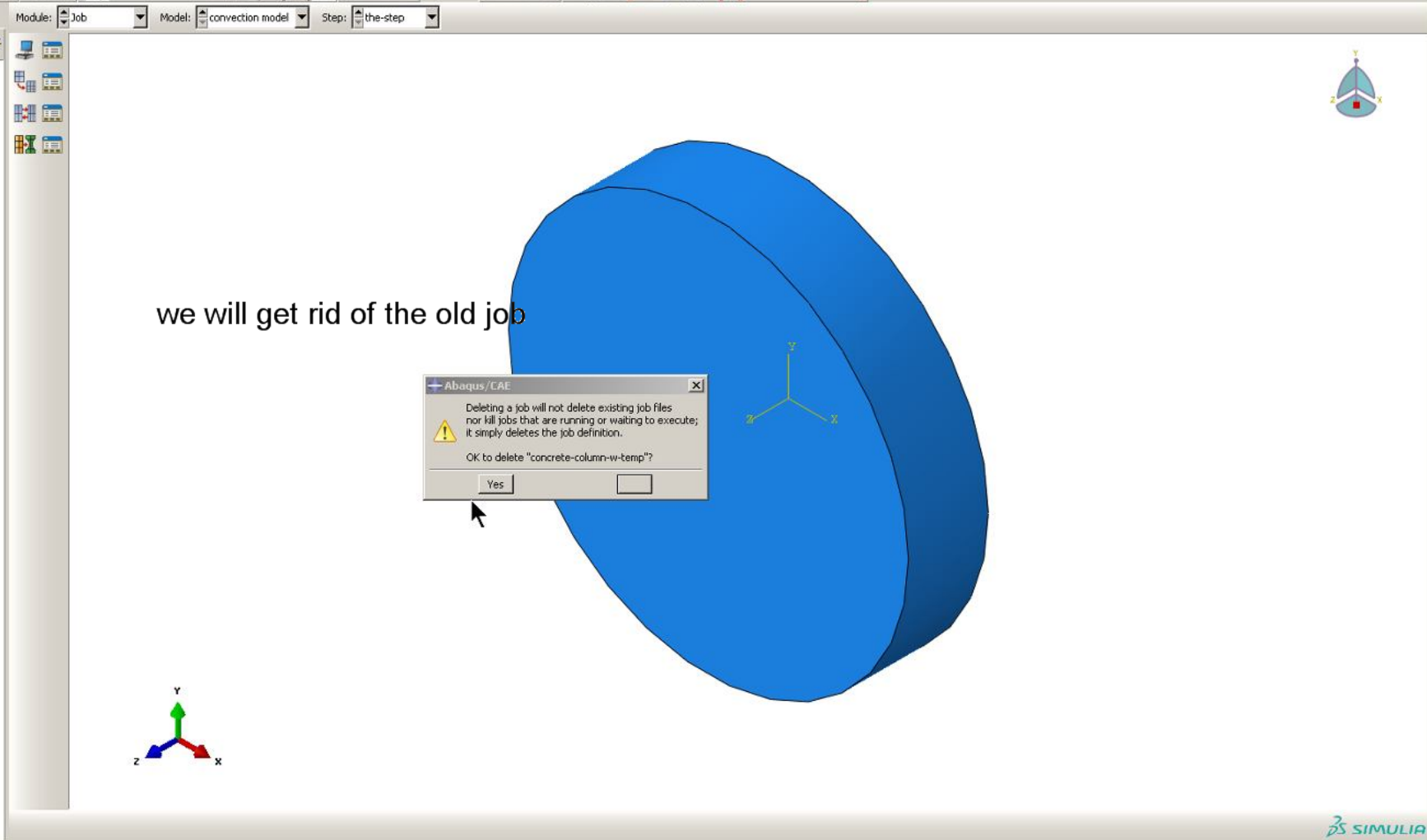
both are uniformly distributed on the side surface

A new model database has been created.
The model "Model-1" has been created.
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.
The model "convection model" has been created.

SIMULIA

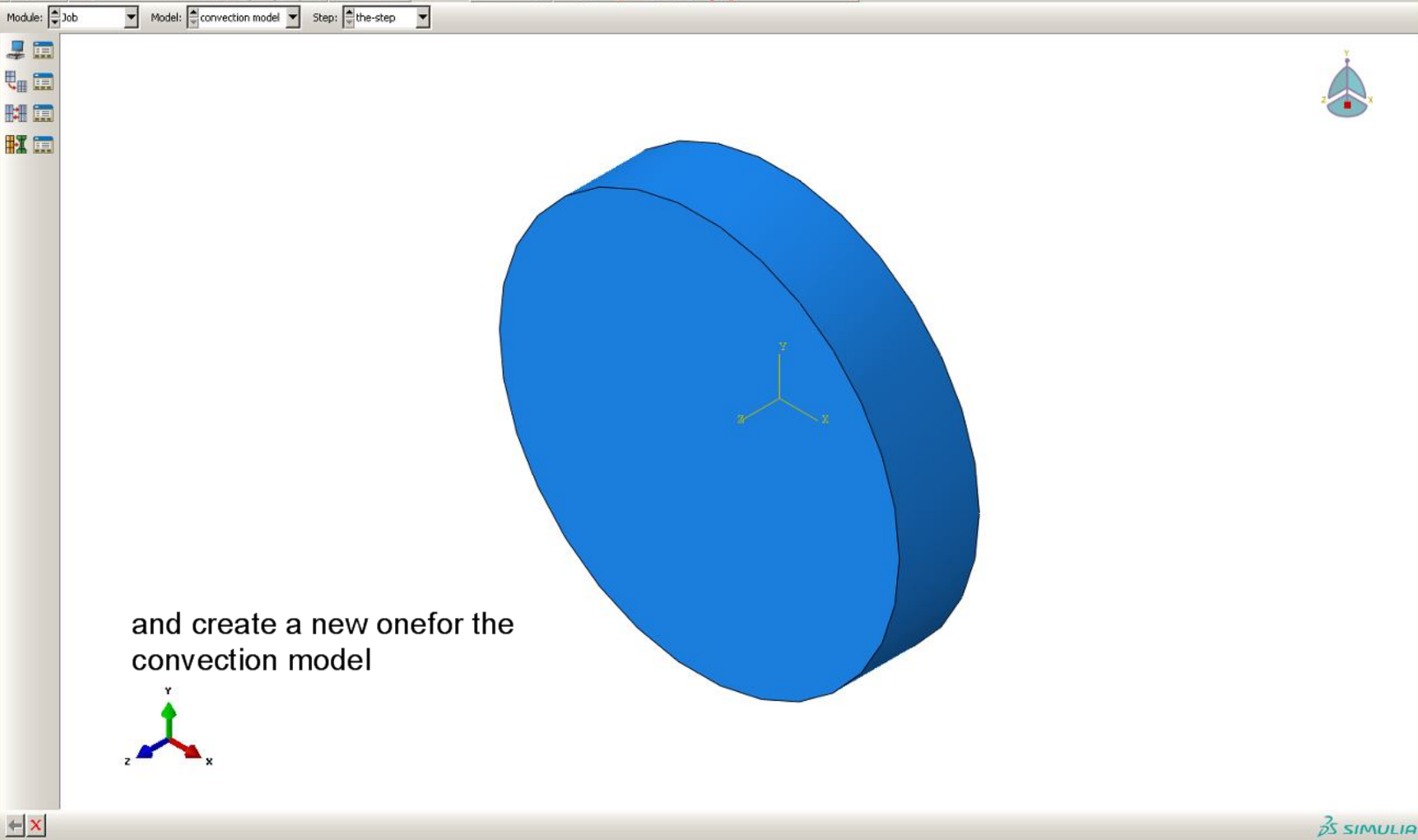
Model Database

- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
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 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs (1)
 - concrete-column-w-temp (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes



Model Database

- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
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 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Ar Switch Context Ctrl+Space
 - Cr Manager...
 - Co Create...**
 - Of Filter... F2



and create a new one for the convection model

Model Database

- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points

Create Job

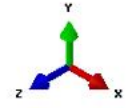
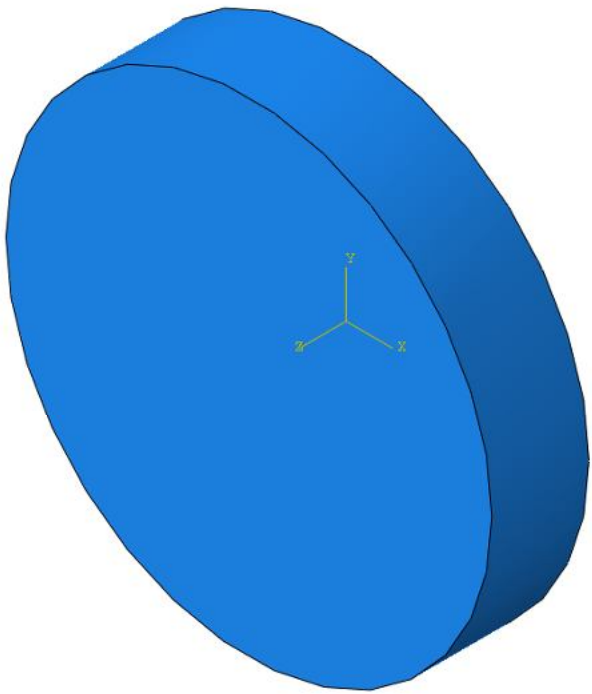
Name: Job-1

Source: Model

- Model-1
- convection model

Continue Cancel

pick the correct model



Model Database

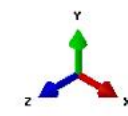
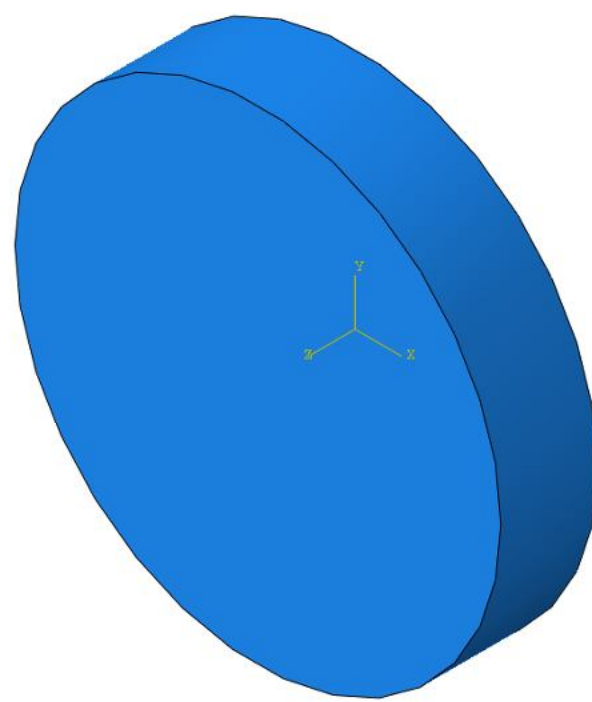
- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points
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 - Interactions (1)
 - Interaction Properties
 - Contact Controls
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 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches

Annotations

Analysis

- Jobs (1)
 - Job
 - Switch Context Ctrl+Space
 - Edit...
 - Copy...
 - Rename...
 - Delete... Del
 - Write Input
 - Data Check
 - Submit
 - Continue
 - Monitor...
 - Results
 - Kill
 - Export

Module: Job Model: convection model Step: the-step



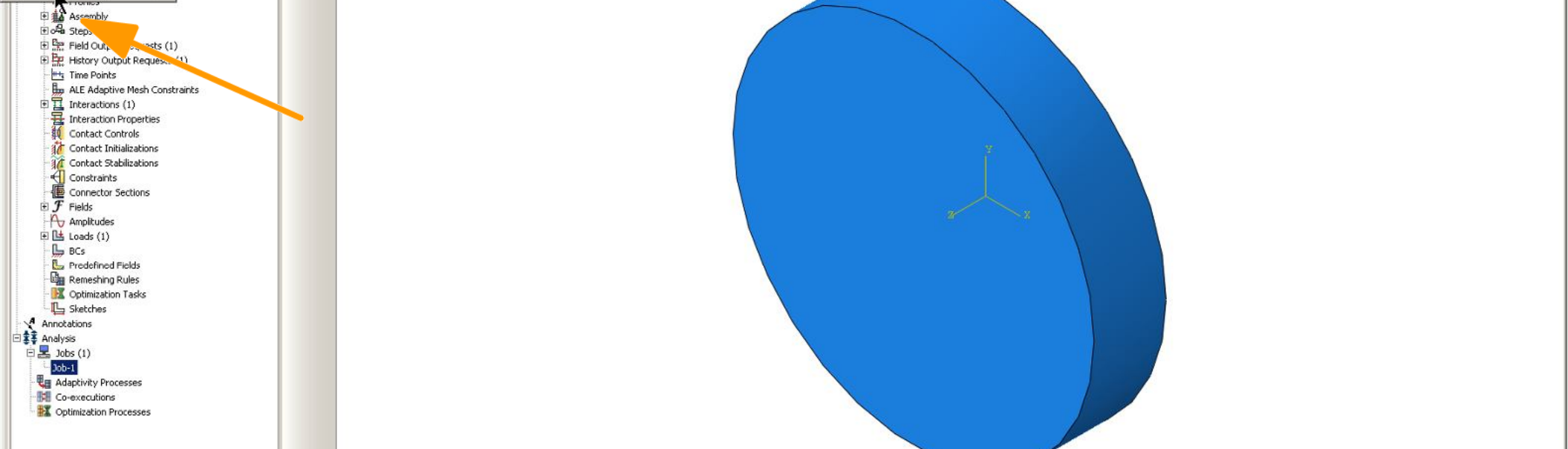
The model database recovery operation has completed.
A new model database has been created.
The model "Model-1" has been created.
The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.
The model "convection model" has been created.
The interaction "convection" has been created.
The job "Job-1" has been created.

Abaqus

Job files already exist for Job-1. OK to overwrite?

Show this warning next time

OK Cancel



The image shows the Abaqus model tree on the left and a 3D viewport on the right. The model tree is expanded to show the 'Jobs' folder, which contains 'Job-1'. An orange arrow points from the 'Job-1' folder to the 'OK' button in the warning dialog. The 3D viewport displays a blue, curved, shell-like structure with a coordinate system (X, Y, Z) centered on it. A smaller coordinate system is visible in the bottom left corner of the viewport area.

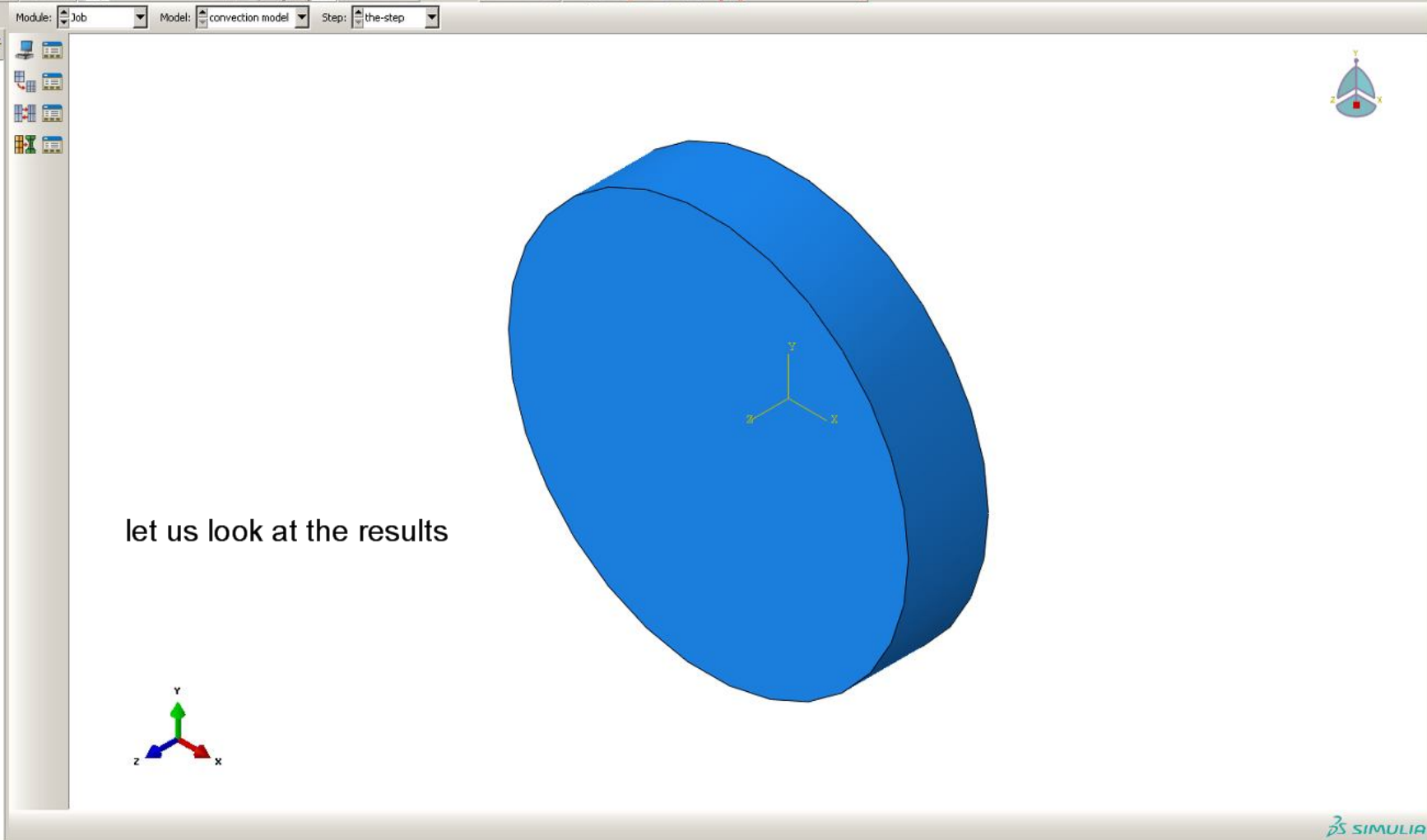


The status bar at the bottom of the window contains a series of messages:

- The model database recovery operation has completed.
- A new model database has been created.
- The model "Model-1" has been created.
- The model database "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp.cae" has been opened.
- The model "convection model" has been created.
- The interaction "convection" has been created.
- The job "Job-1" has been created.

Model Database

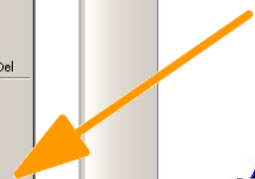
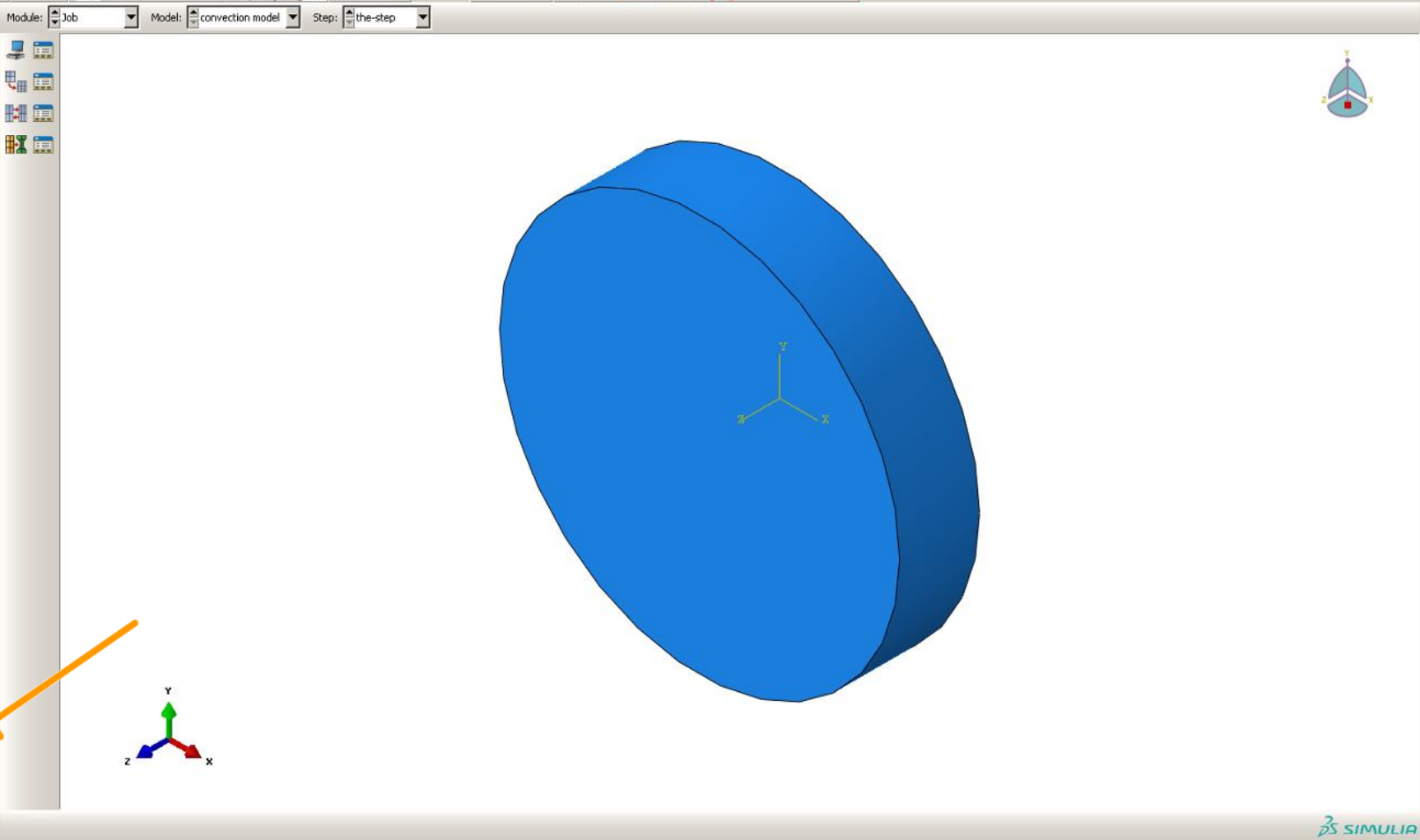
- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions (1)
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs (1)
 - Job-1 (Completed)
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes



The model "convection model" has been created.
The interaction "convection" has been created.
The job "Job-1" has been created.
The job input file "Job-1.inp" has been submitted for analysis.
Job Job-1: Analysis Input File Processor completed successfully.
Job Job-1: Abaqus/Standard completed successfully.
Job Job-1 completed successfully.

Model Database

- Models (2)
 - Model-1
 - convection model
 - Parts (1)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (2)
 - Field Output Requests (1)
 - History Output Requests (1)
 - Time Points
 - ALE Adaptive Mesh Constraints
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 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs
 - Job-1 (Con)
 - Switch Context Ctrl+Space
 - Edit...
 - Copy...
 - Rename...
 - Delete... Del
 - Write Input
 - Data Check
 - Submit
 - Continue...
 - Monitor...
 - Results**
 - Kill
 - Export

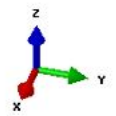
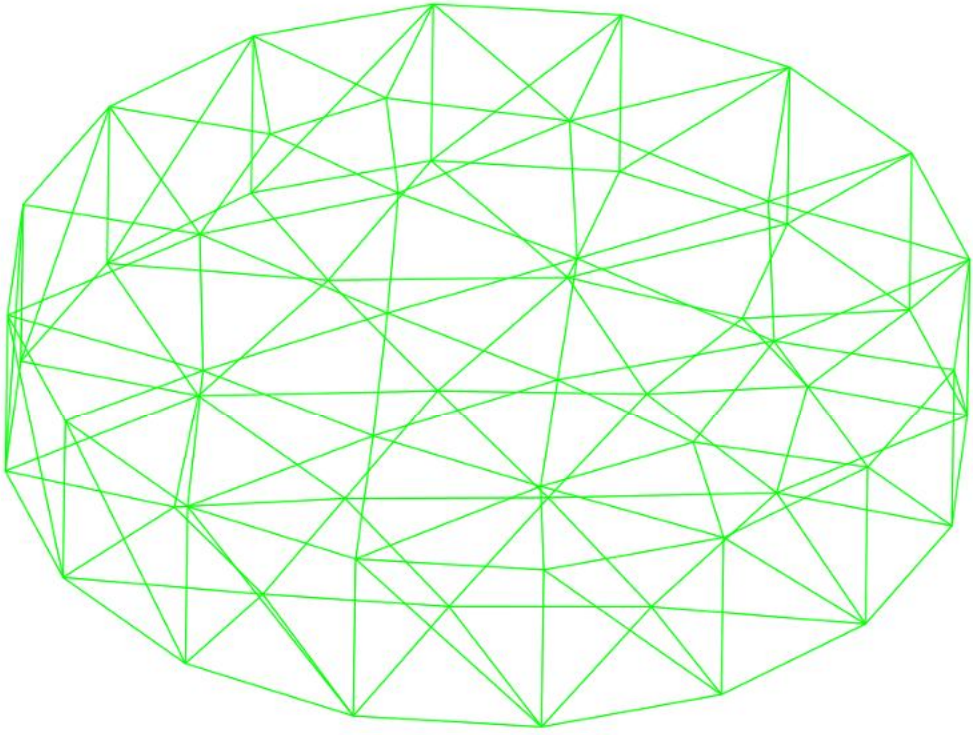


The model "convection model" has been created.
The interaction "convection" has been created.
The job "Job-1" has been created.
The job input file "Job-1.inp" has been submitted for analysis.
Job Job-1: Analysis Input File Processor completed successfully.
Job Job-1: Abaqus/Standard completed successfully.
Job Job-1 completed successfully.

- Output Databases (1)
- Model Database (2)
- Spectrums (7)
- XYPlots
- XYData
- Paths
- Display Groups (1)
- Free Body Cuts
- Streams
- Movies
- Images



choose primary



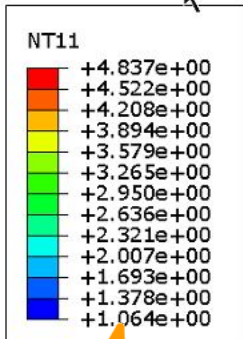

Drag the mouse in a viewport to rotate the view Rotation center: Select... Use Default

The model "convection model" has been created.
The interaction "convection" has been created.
The job "Job-1" has been created.
The job input file "Job-1.inp" has been submitted for analysis.
Job Job-1: Analysis Input File Processor completed successfully.
Job Job-1: Abaqus/Standard completed successfully.
Job Job-1 completed successfully.

Model Results

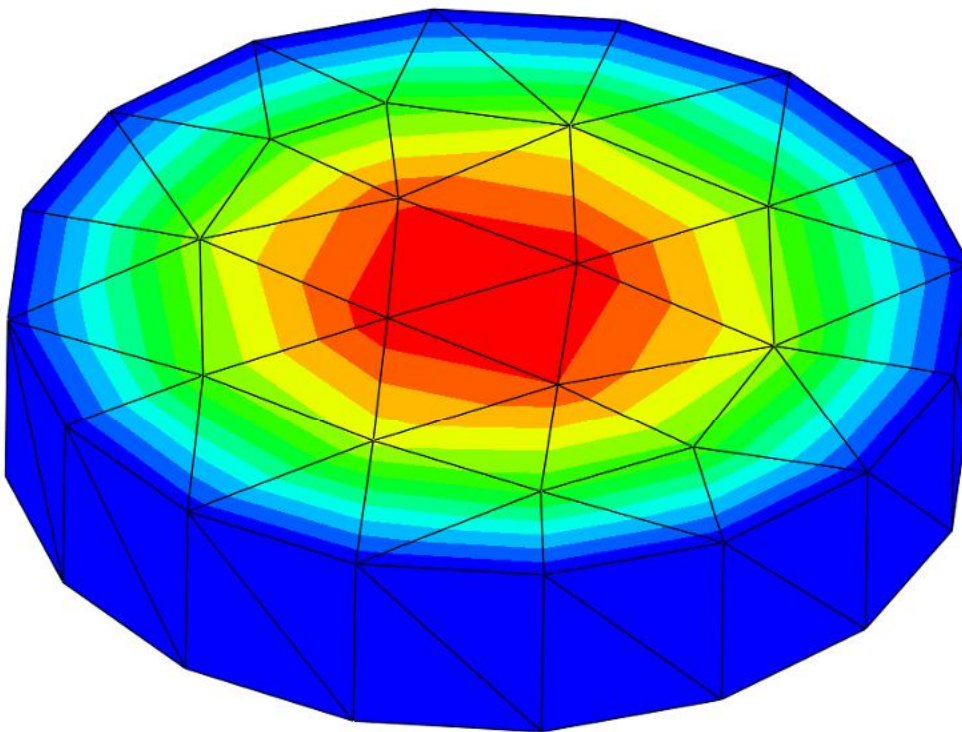
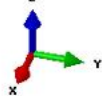
Session Data

- Output Databases (1)
- Model Database (2)
- Spectrums (7)
- XYPlots
- XYData
- Paths
- Display Groups (1)
- Free Body Cuts
- Streams
- Movies
- Images



and temperature

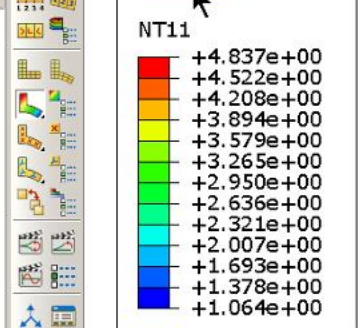
note that the temperature on the side surface is different from zero: the column loses heat through the boundary layer



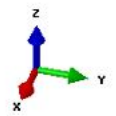
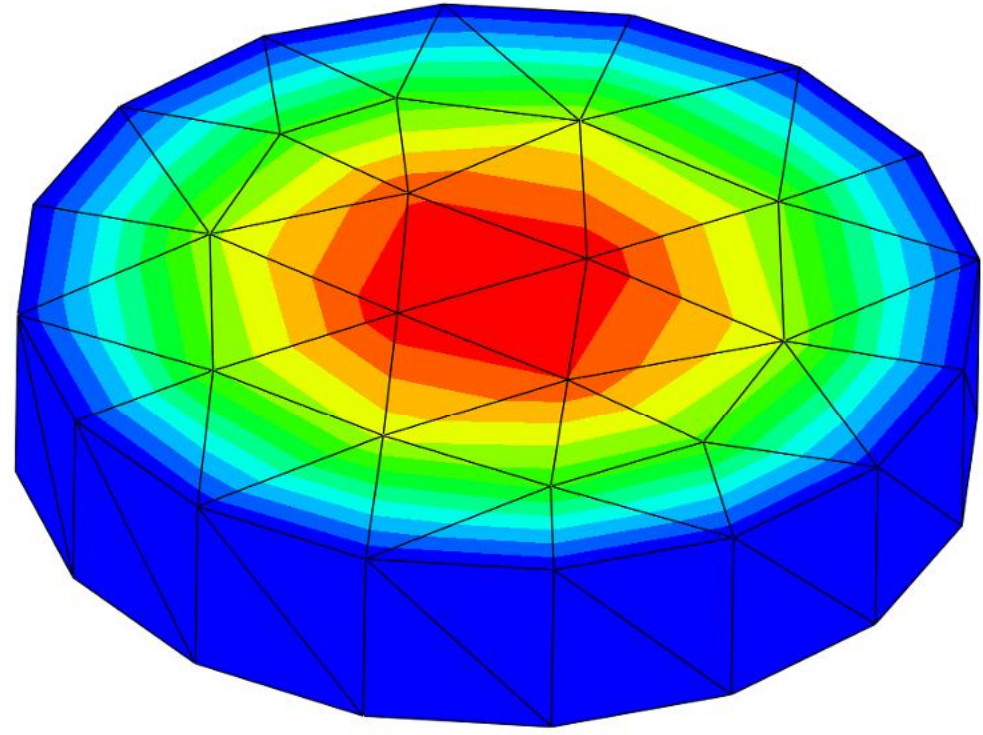
Drag the mouse in a viewport to rotate the view Rotation center: Select... Use Default

The model "convection model" has been created.
The interaction "convection" has been created.
The job "Job-1" has been created.
The job input file "Job-1.inp" has been submitted for analysis.
Job Job-1: Analysis Input File Processor completed successfully.
Job Job-1: Abaqus/Standard completed successfully.
Job Job-1 completed successfully.

- Session Data
- Output Databases (1)
- Model Database (2)
- Spectrums (7)
- XYPlots
- XYData
- Paths
- Display Groups (1)
- Free Body Cuts
- Streams
- Movies
- Images



let us look at the heat flux: choose Symbol, HFL



Drag the mouse in a viewport to rotate the view Rotation center: Select... Use Default

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