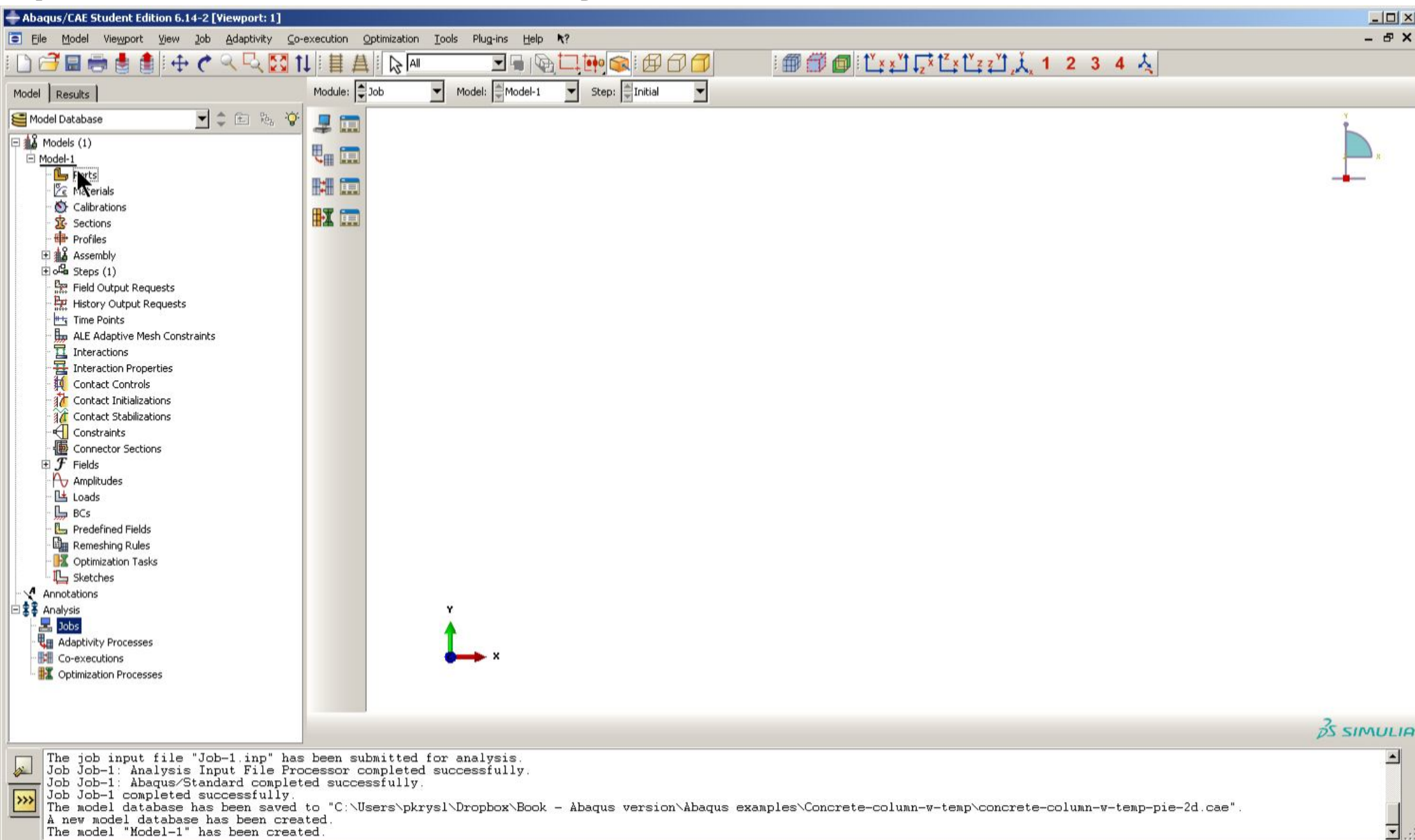


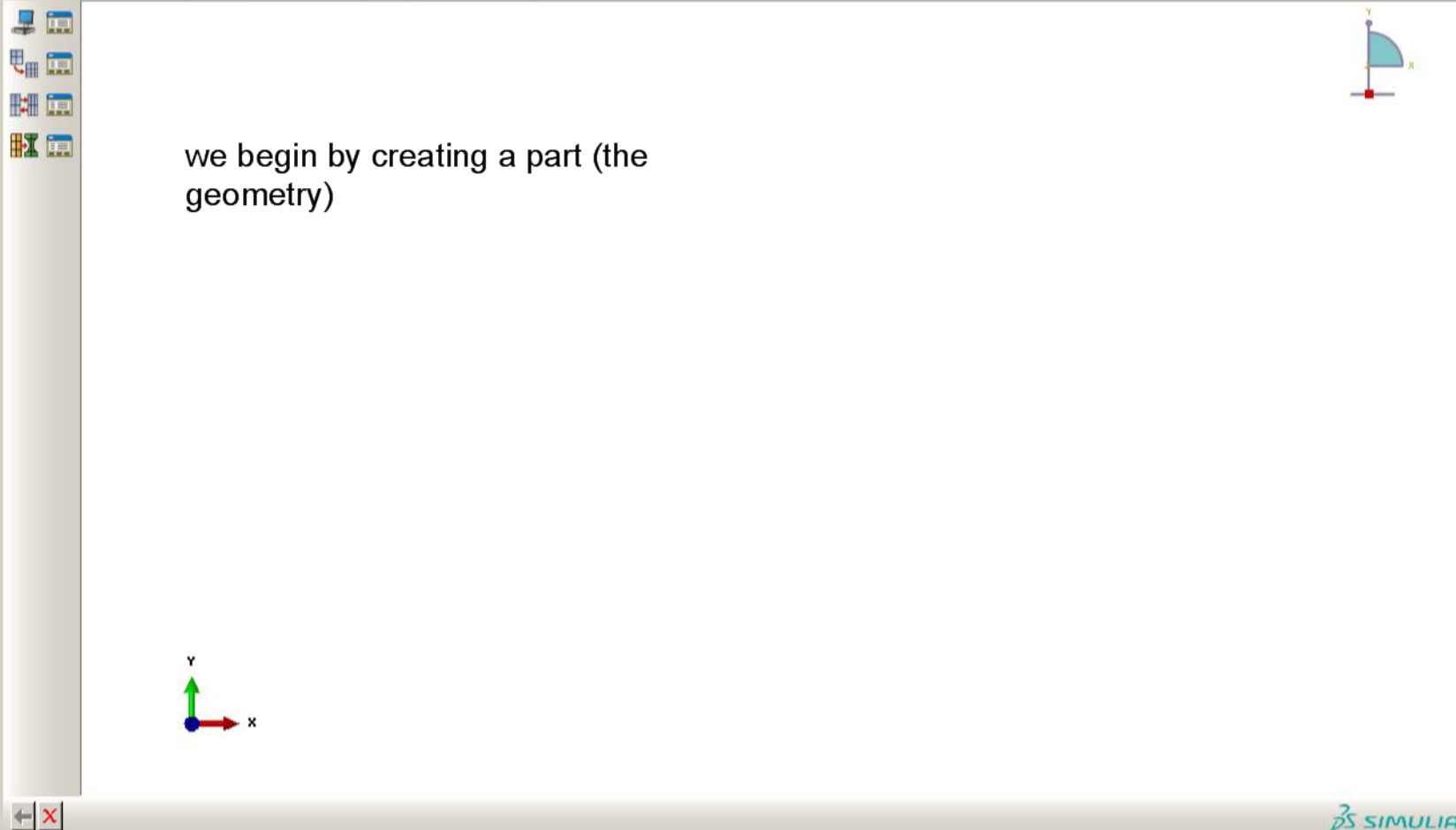
Concrete column with hydration heat and zero temperature prescribed on the boundary: 2-d model of the cross-section



Model Database

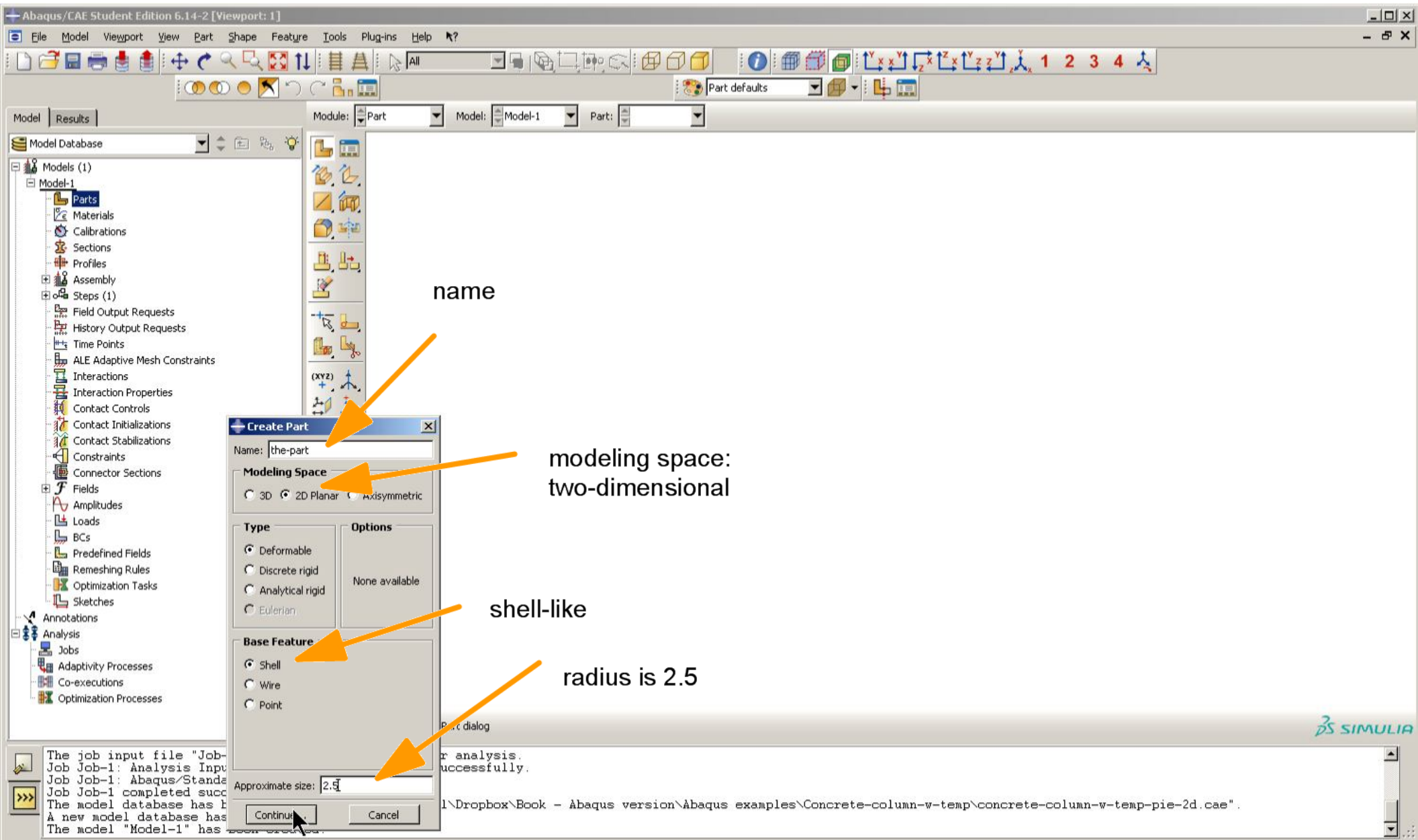
- Models (1)
 - Model-1
 - Switch Context: Ctrl+Space
 - Create...**
 - Impo...
 - Filter... F2
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Module: Job Model: Model-1 Step: Initial

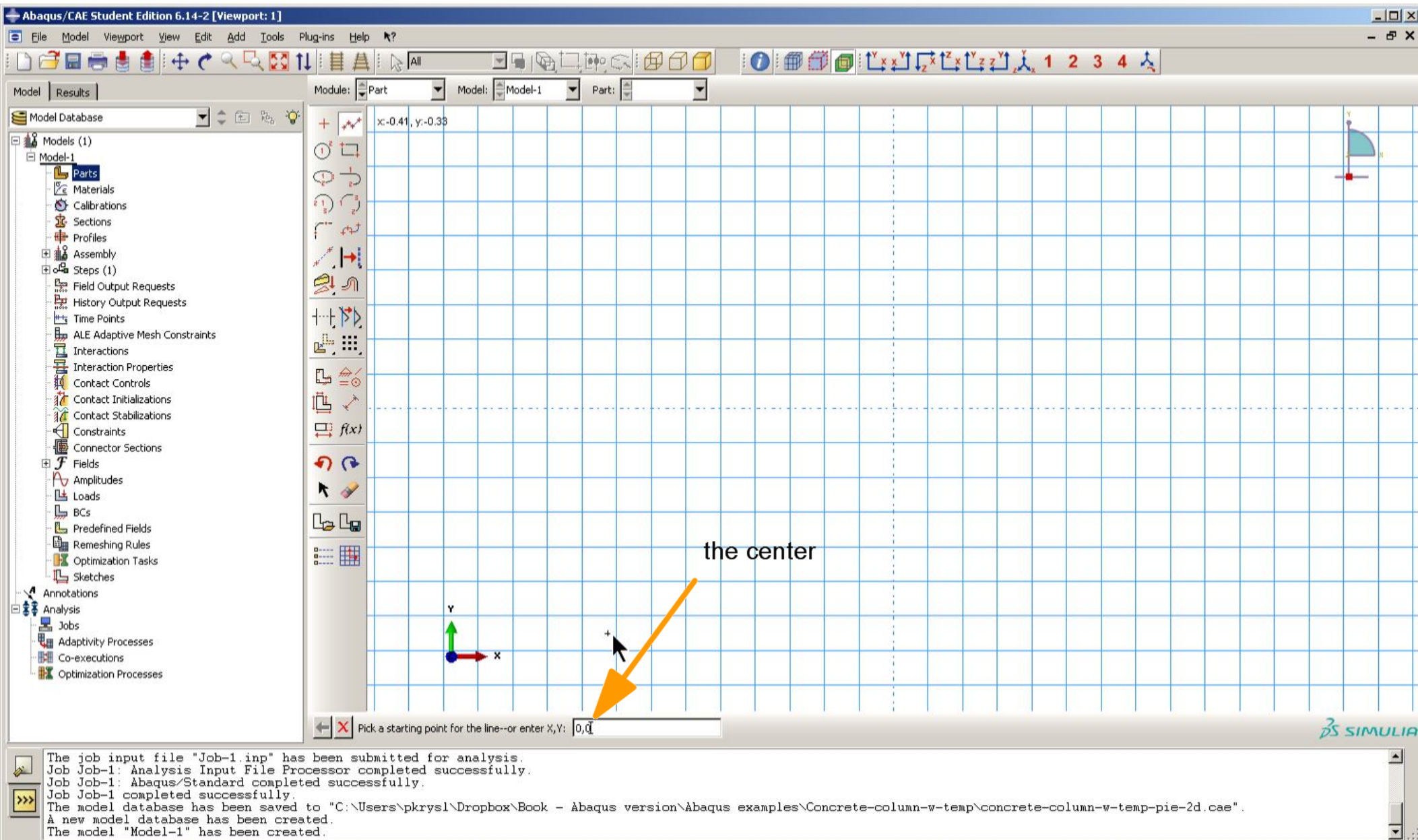


we begin by creating a part (the geometry)

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.
The model database has been saved to "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp-pie-2d.cae".
A new model database has been created.
The model "Model-1" has been created.



We shall draw the outline of a 30° pie-slice shaped geometry: two lines and one arc



Abaqus/CAE Student Edition 6.14-2 [Viewport: 1]

File Model Viewport View Edit Add Tools Plug-ins Help

Model Database

Models (1)

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

Module: Part Model: Model-1 Part:

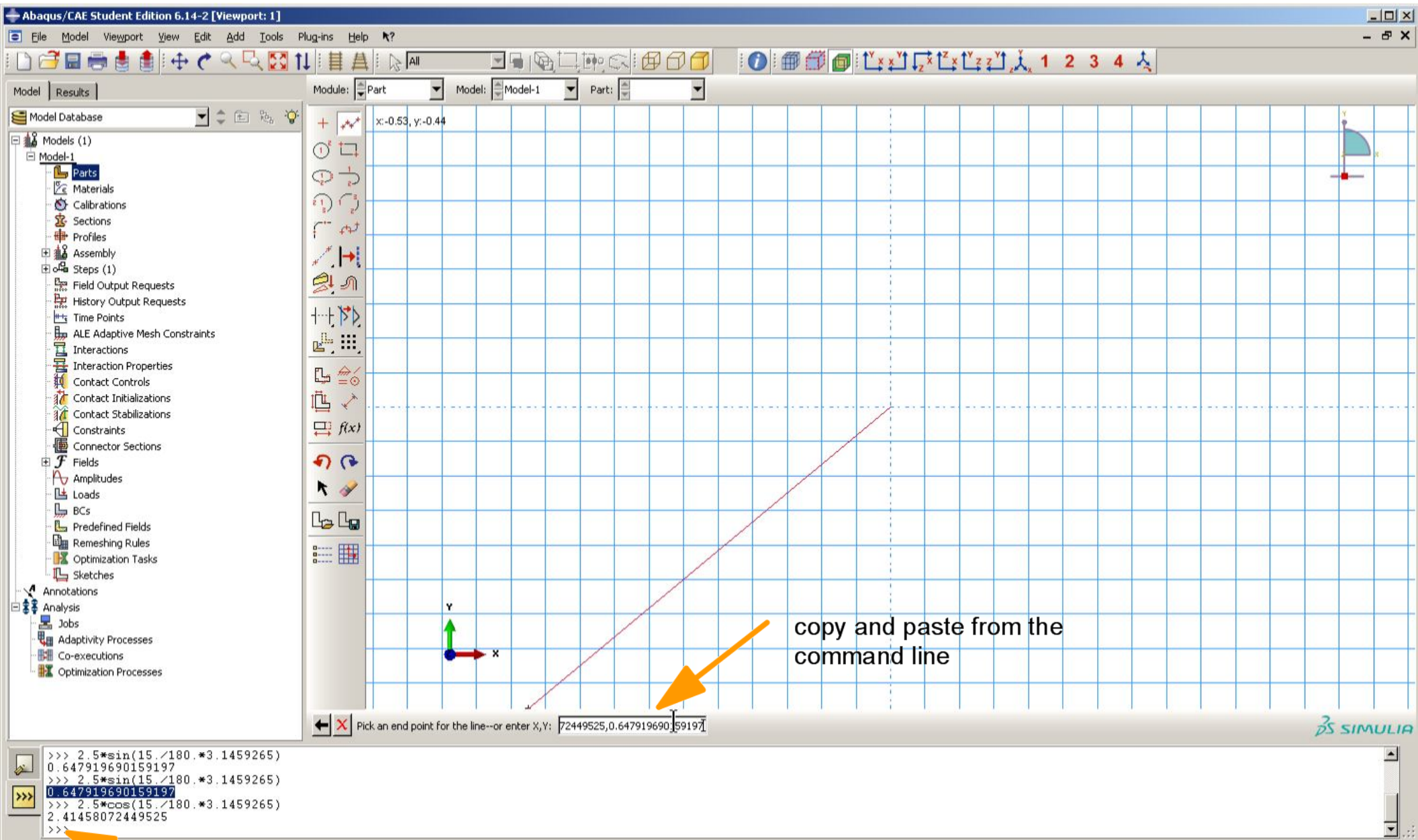
x: -0.41, y: -0.33

the center

Pick a starting point for the line--or enter X,Y: 0,0

PS SIMULIA

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.
The model database has been saved to "C:\Users\pkrysl\Dropbox\Book - Abaqus version\Abaqus examples\Concrete-column-w-temp\concrete-column-w-temp-pie-2d.cae".
A new model database has been created.
The model "Model-1" has been created.



we can use the python command line as a simple calculator

Model Database

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

Module: Part Model: Model-1 Part:

x:0, y:0

this is the first line (15° angle from the horizontal)

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Models (1)
 - Model-1
 - Parts
 - Materials
 - Calibrations
 - Sections
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields
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 - Annotations
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 - Jobs
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 - Optimization Processes

x:0.69, y:-0.35

as the first point pick the center with the mouse

now the second line: again copy and paste from the command line the location of the second point

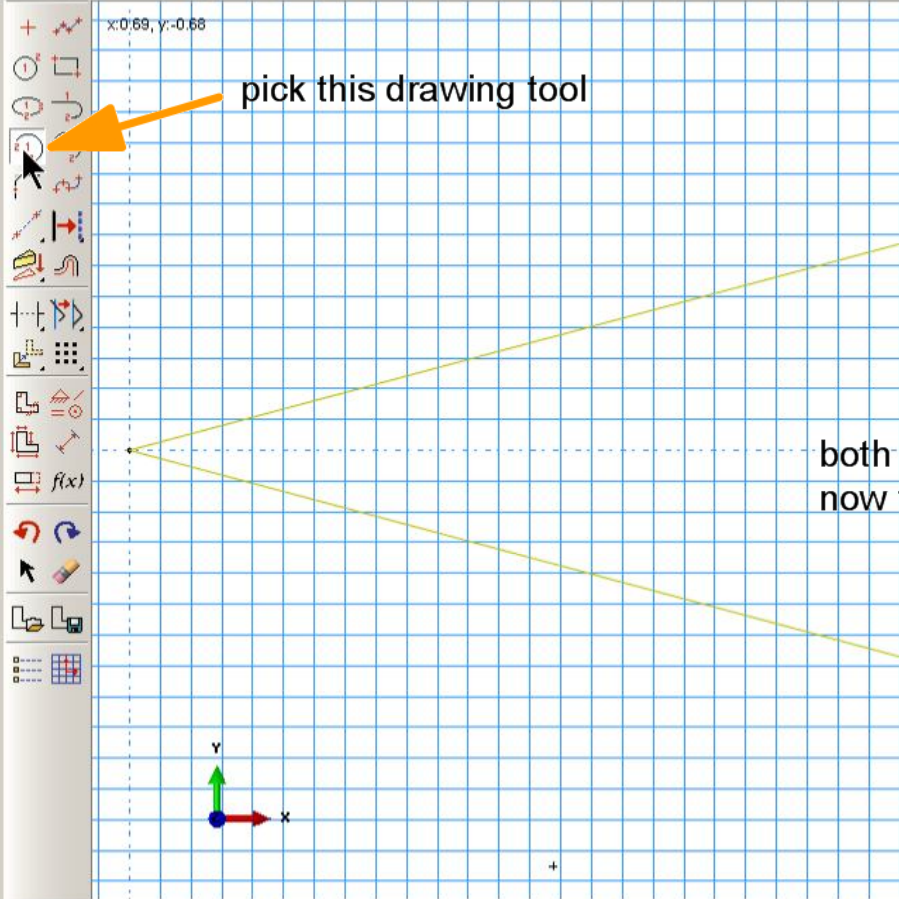
Pick an end point for the line--or enter X,Y: 2449525,-0.647919690159197

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Models (1)
 - Model-1
 - Parts
 - Materials
 - Calibrations
 - Sections
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields
 - Remeshing Rules
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 - Co-executions
 - Optimization Processes

Module: Part Model: Model-1 Part:



pick this drawing tool

both straight lines are drawn:
now for the arc

Pick a center point for the arc--or enter X,Y:

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Models (1)
 - Model-1
 - Parts
 - Materials
 - Calibrations
 - Sections
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
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 - Remeshing Rules
 - Optimization Tasks
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 - Annotations
 - Analysis
 - Jobs
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Module: Part Model: Model-1 Part:

x:0, y:0

pick the center with your mouse

f(x)

Y

X

Pick a center point for the arc--or enter X,Y:

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

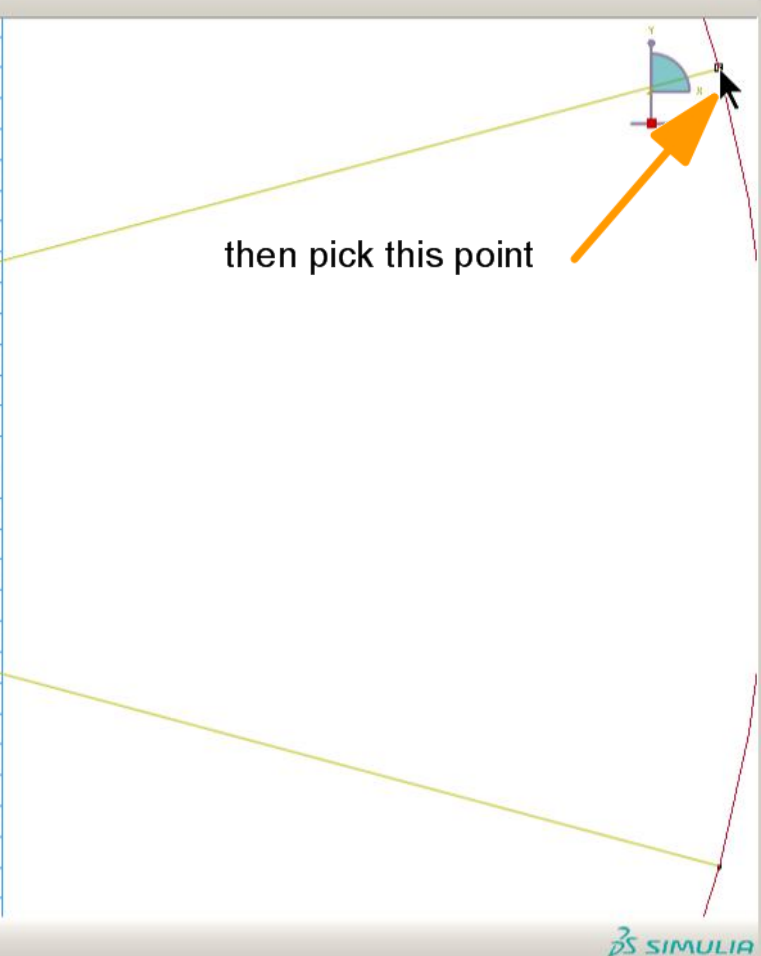
Model Database

- Models (1)
 - Model-1
 - Parts
 - Materials
 - Calibrations
 - Sections
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
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 - Contact Initializations
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 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
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 - Analysis
 - Jobs
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Module: Part Model: Model-1 Part:

x:2.41, y:0.65

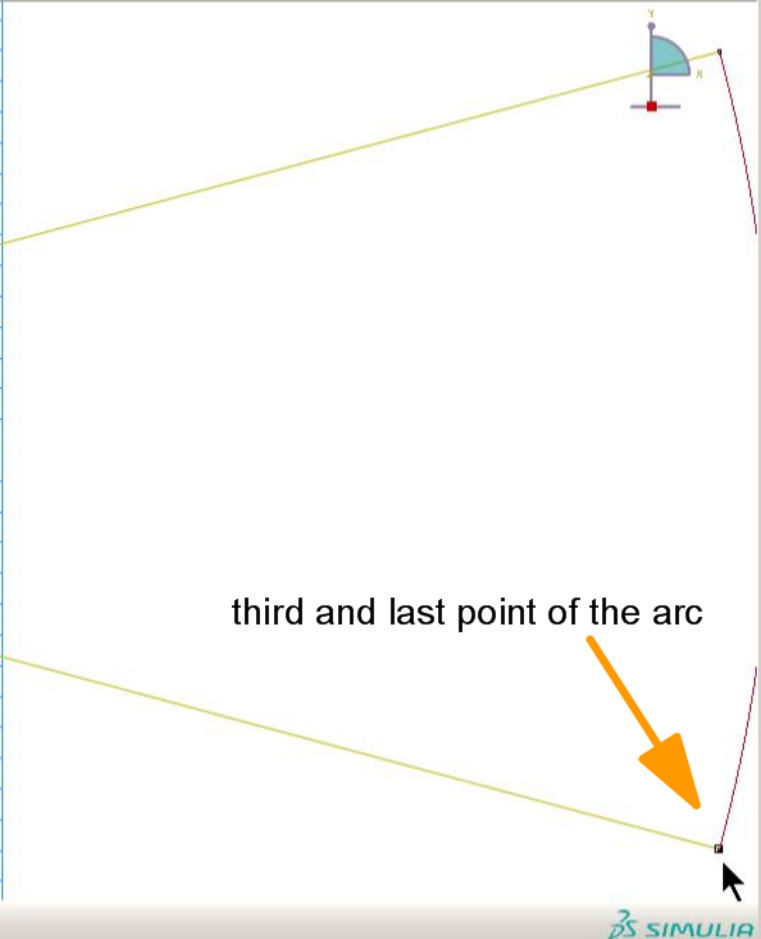
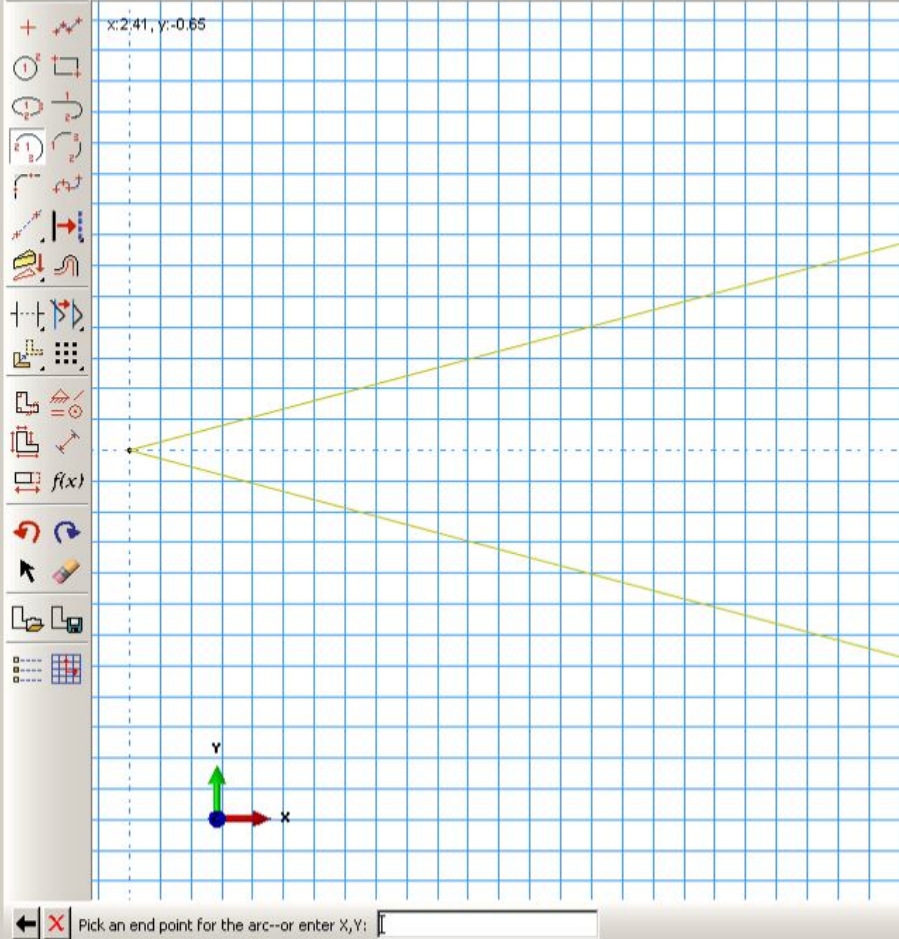
Pick a start point for the arc--or enter X,Y:



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

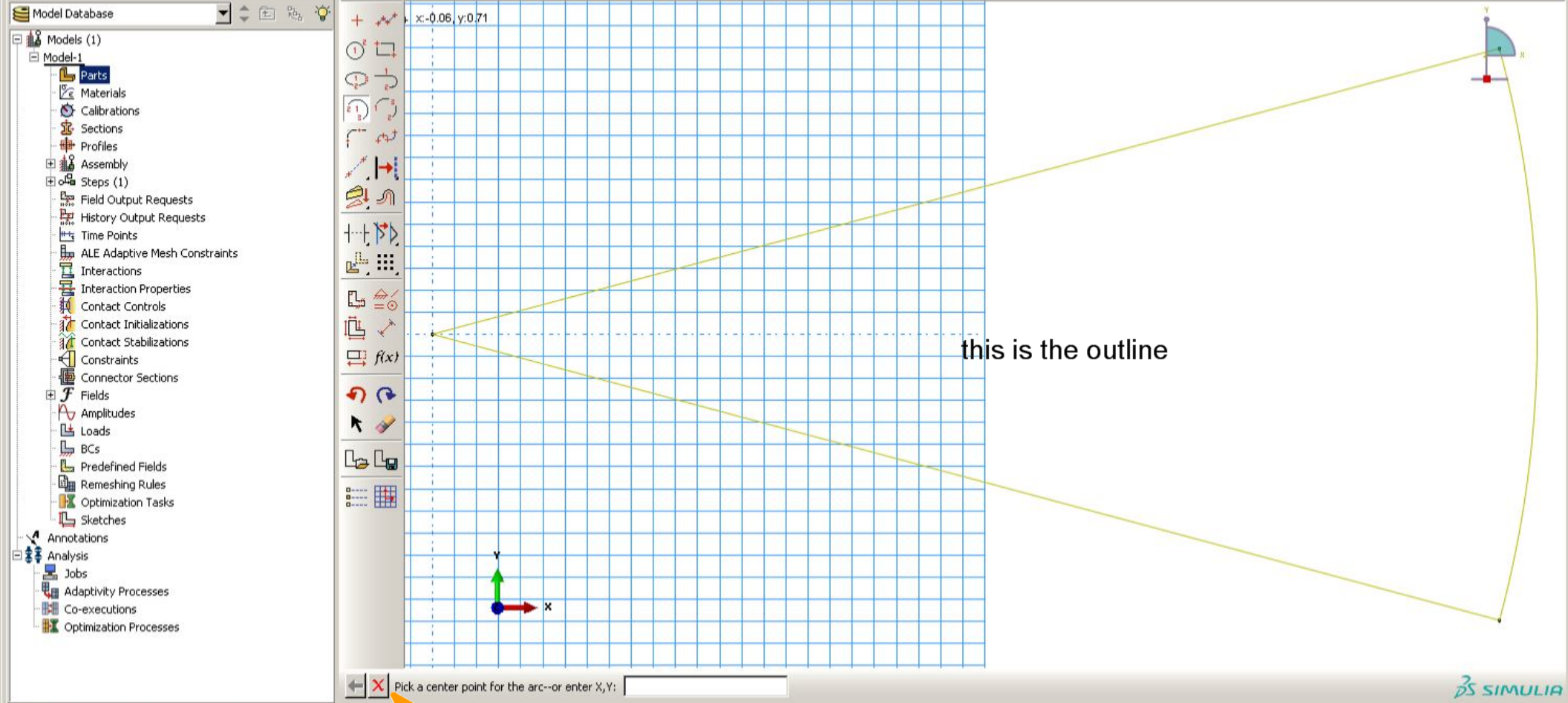
Model Database

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



third and last point of the arc

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

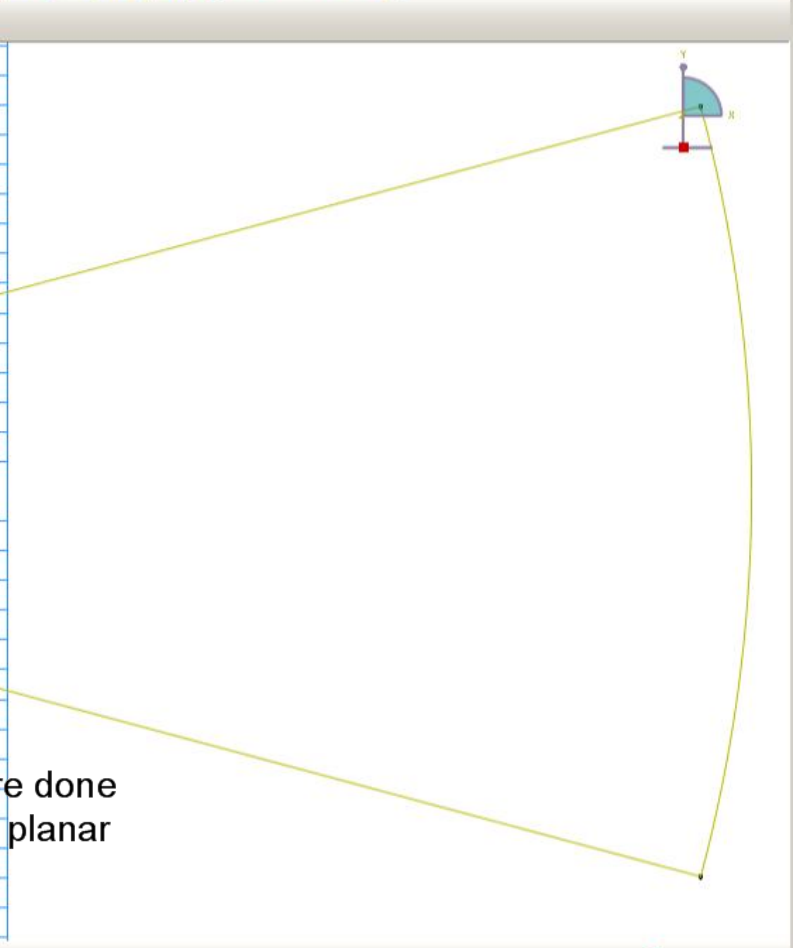
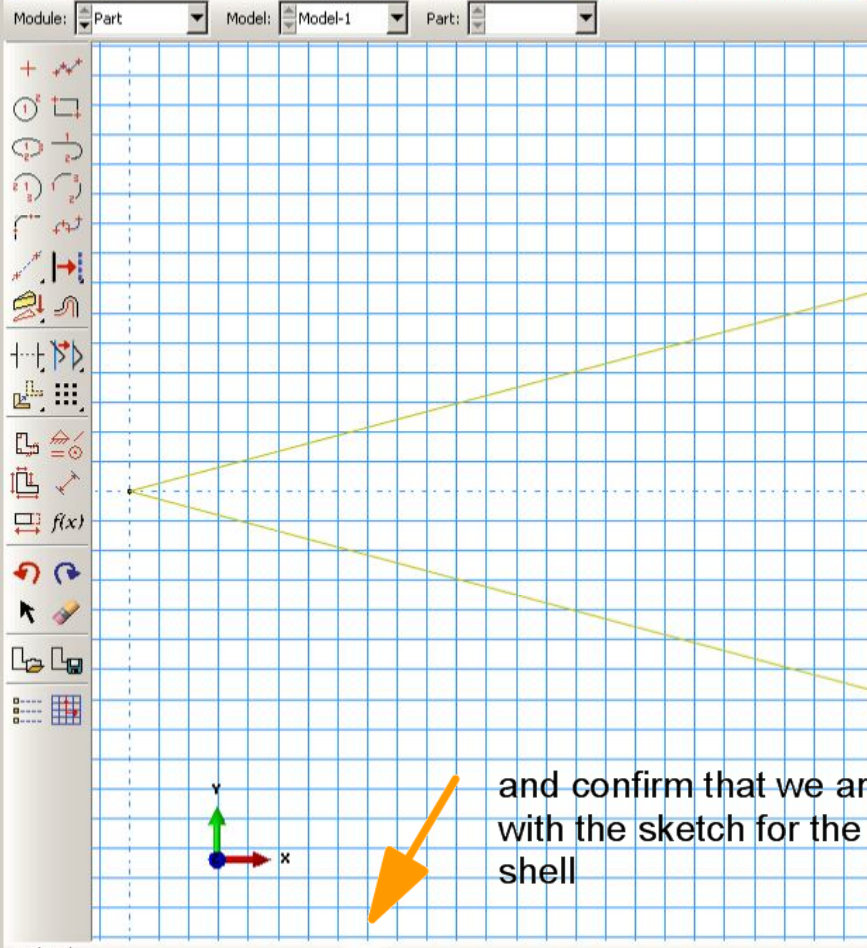


```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

now conclude the drawing of the outline

Model Database

- Models (1)
 - Model-1
 - Parts
 - Materials
 - Calibrations
 - Sections
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
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 - Amplitudes
 - Loads
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 - Predefined Fields
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- Annotations
- Analysis
 - Jobs
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 - Co-executions
 - Optimization Processes



and confirm that we are done with the sketch for the planar shell



Sketch the section for the planar shell Done

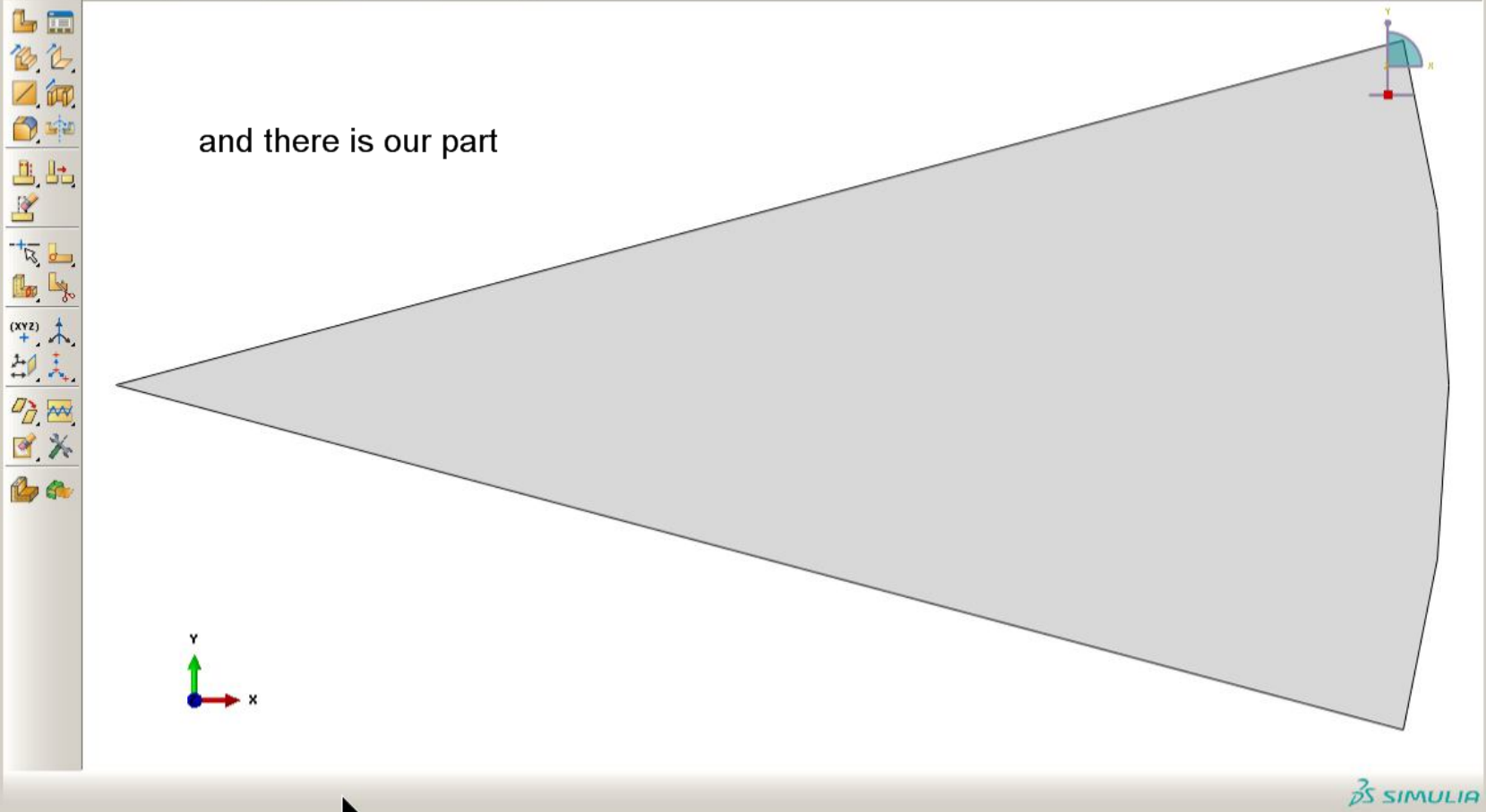
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



Model Database

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

Module: Part Model: Model-1 Part: the-part



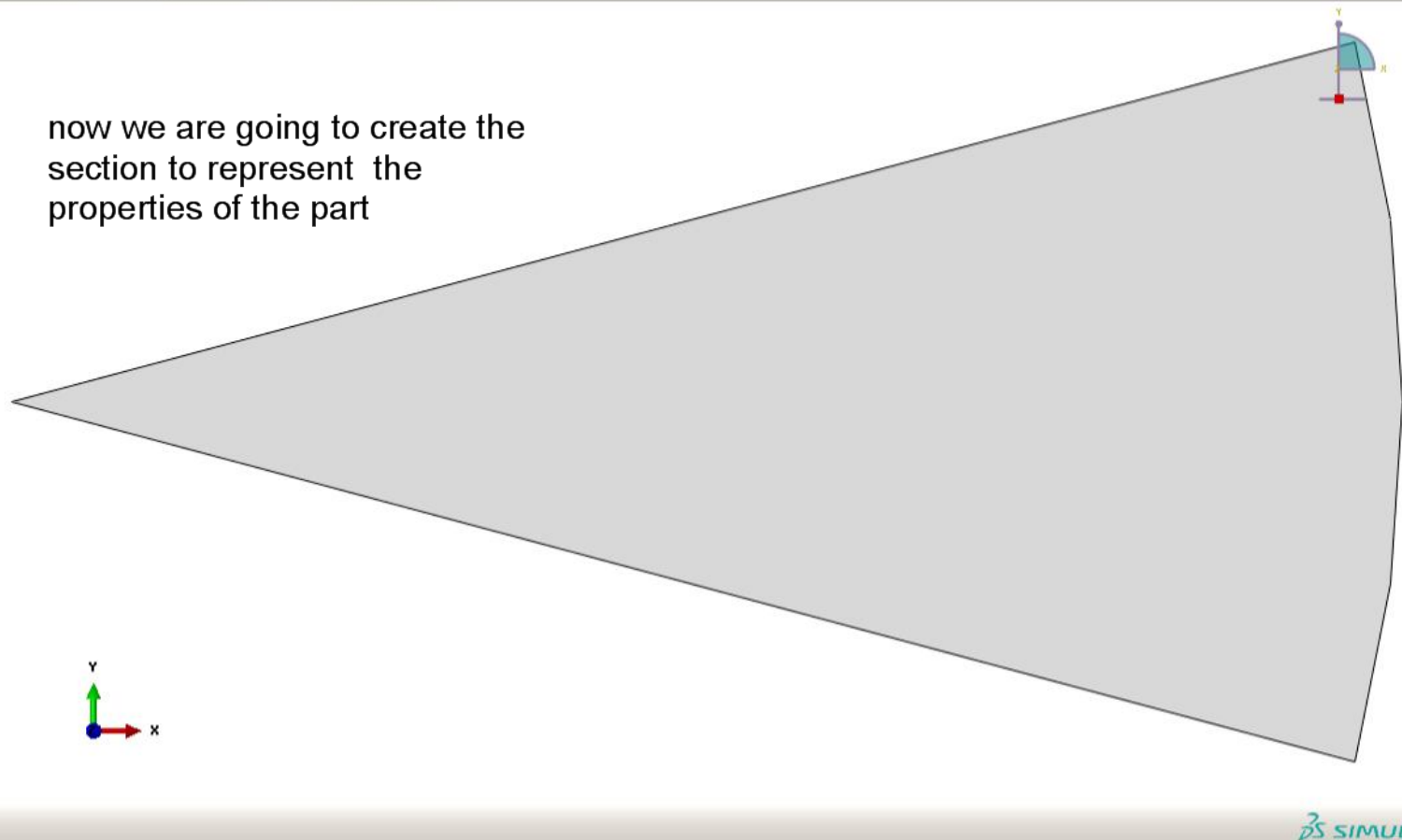
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



Model Database

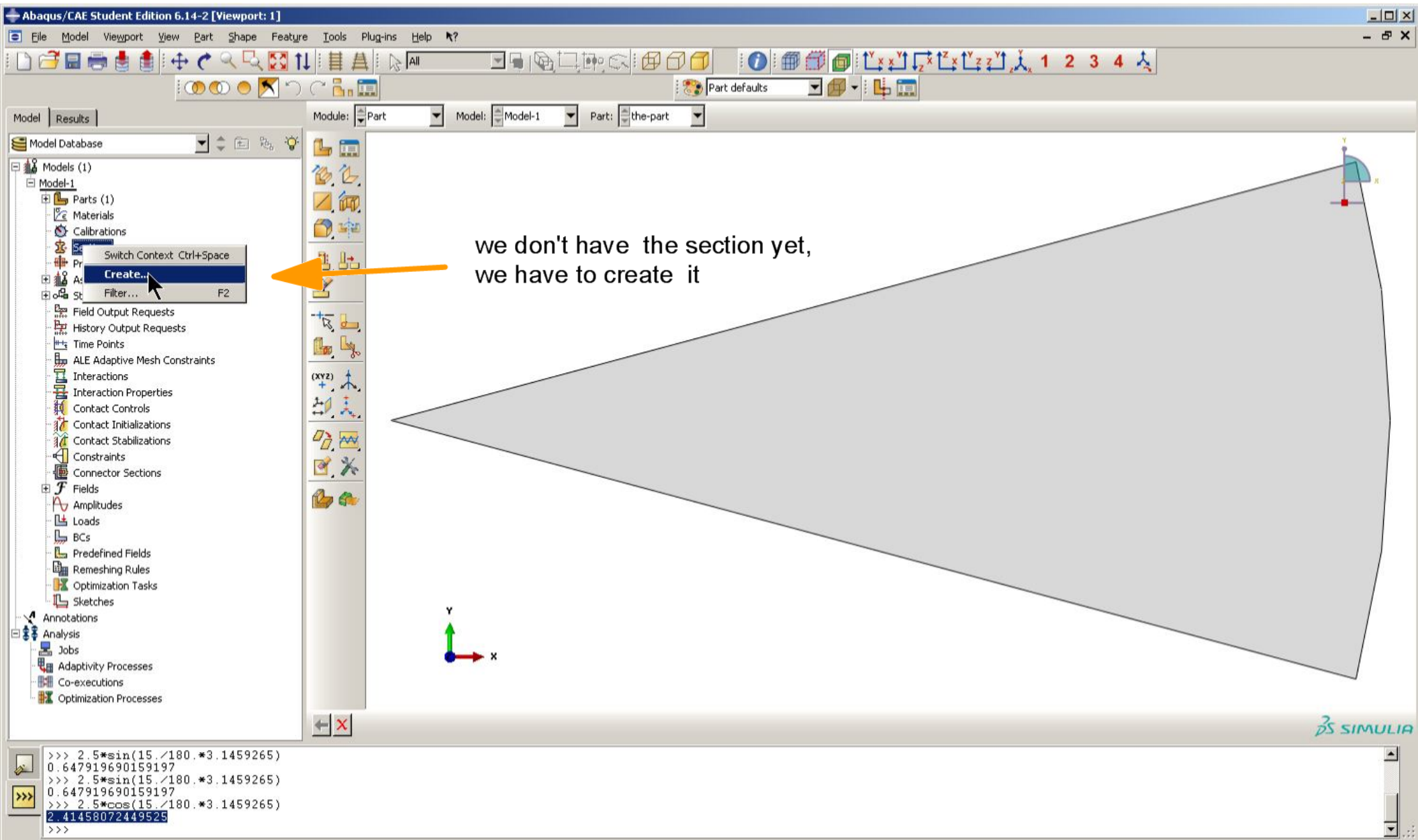
- Models (1)
 - Model-1
 - Parts (1)
 - Materials
 - Calibrations
 - Sections**
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations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

Module: Part Model: Model-1 Part: the-part



now we are going to create the section to represent the properties of the part

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



we don't have the section yet,
we have to create it



Model Database

- Models (1)
 - Model-1
 - Parts (1)

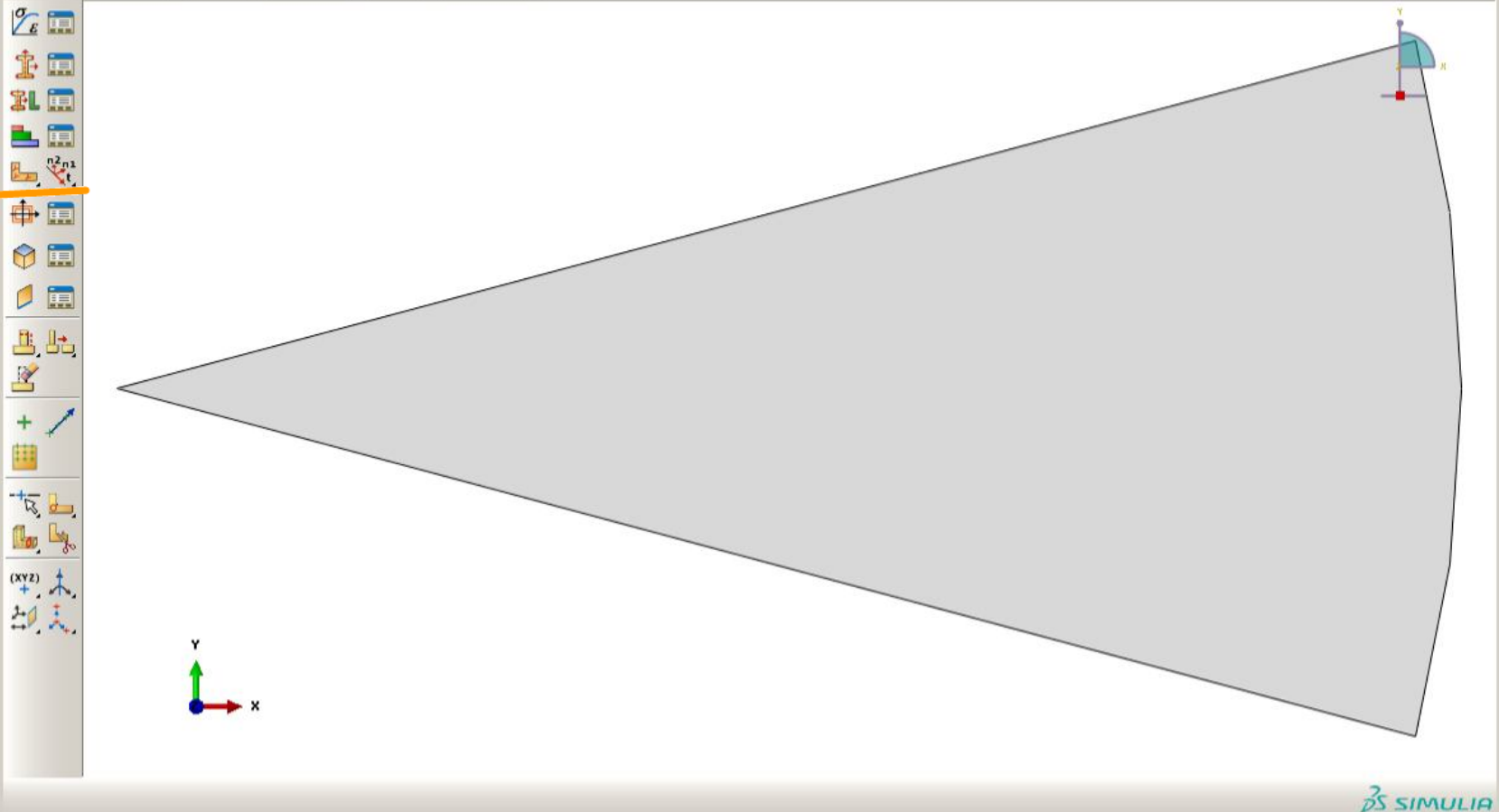
Create Section

Name: the-section

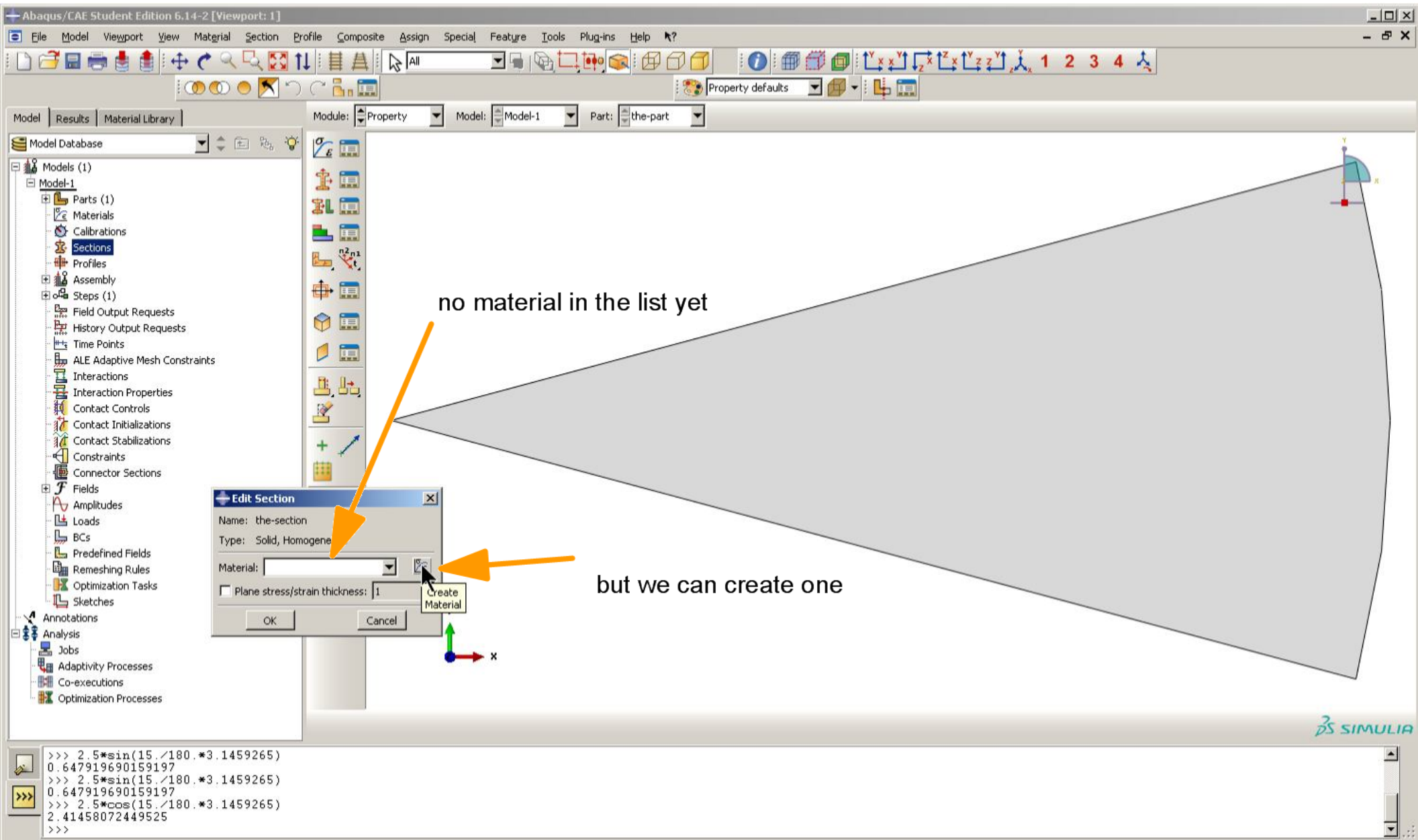
Category	Type
<input checked="" type="radio"/> Solid	Homogeneous
<input type="radio"/> Shell	Generalized plane strain
<input type="radio"/> Beam	Eulerian
<input type="radio"/> Fluid	Composite
<input type="radio"/> Other	

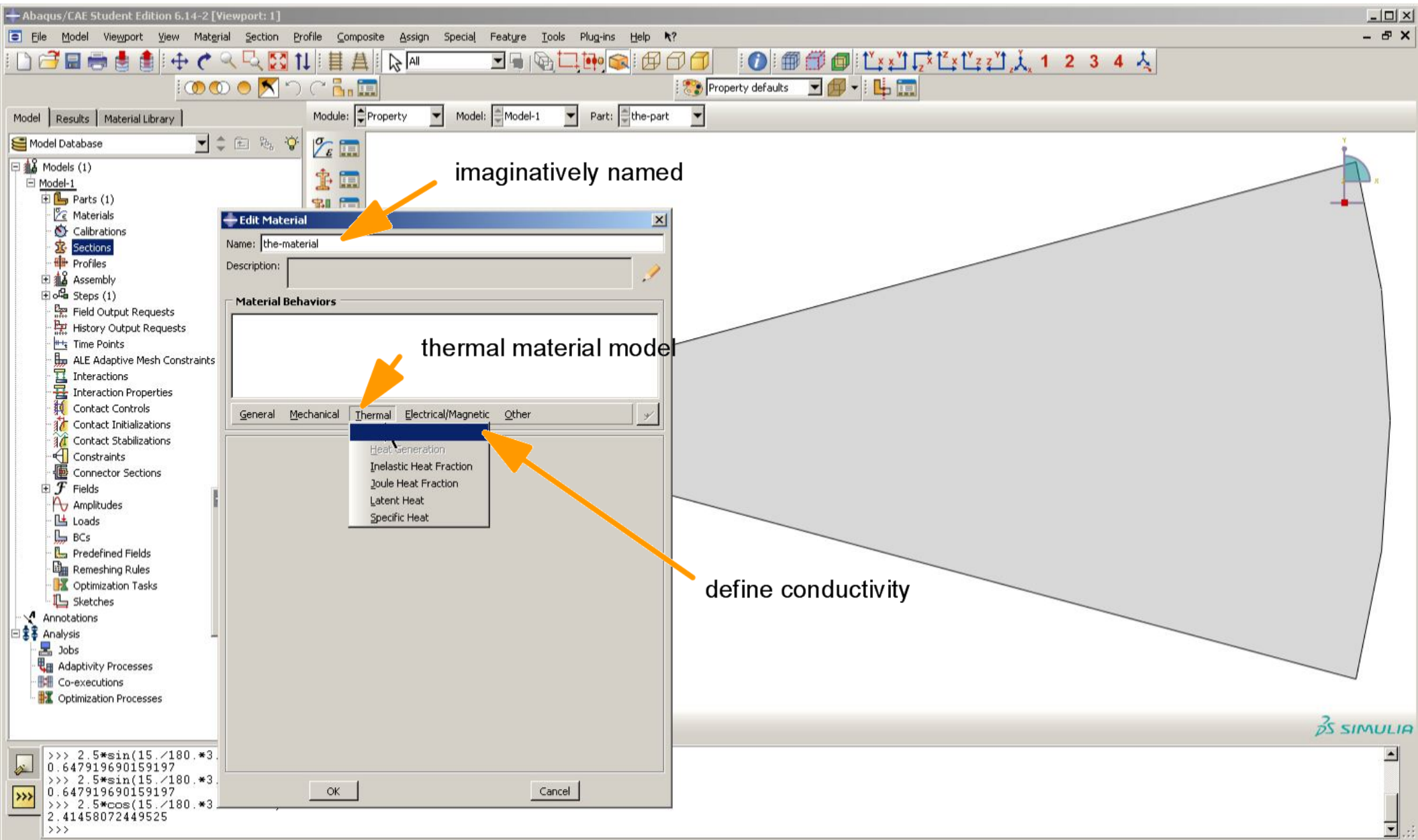
Continue Cancel

- Extract Controls
- Contact Initializations
- Contact Stabilizations
- Constraints
- Connector Sections
- Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
- Sketches
- Annotations
- Analysis
 - Jobs
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

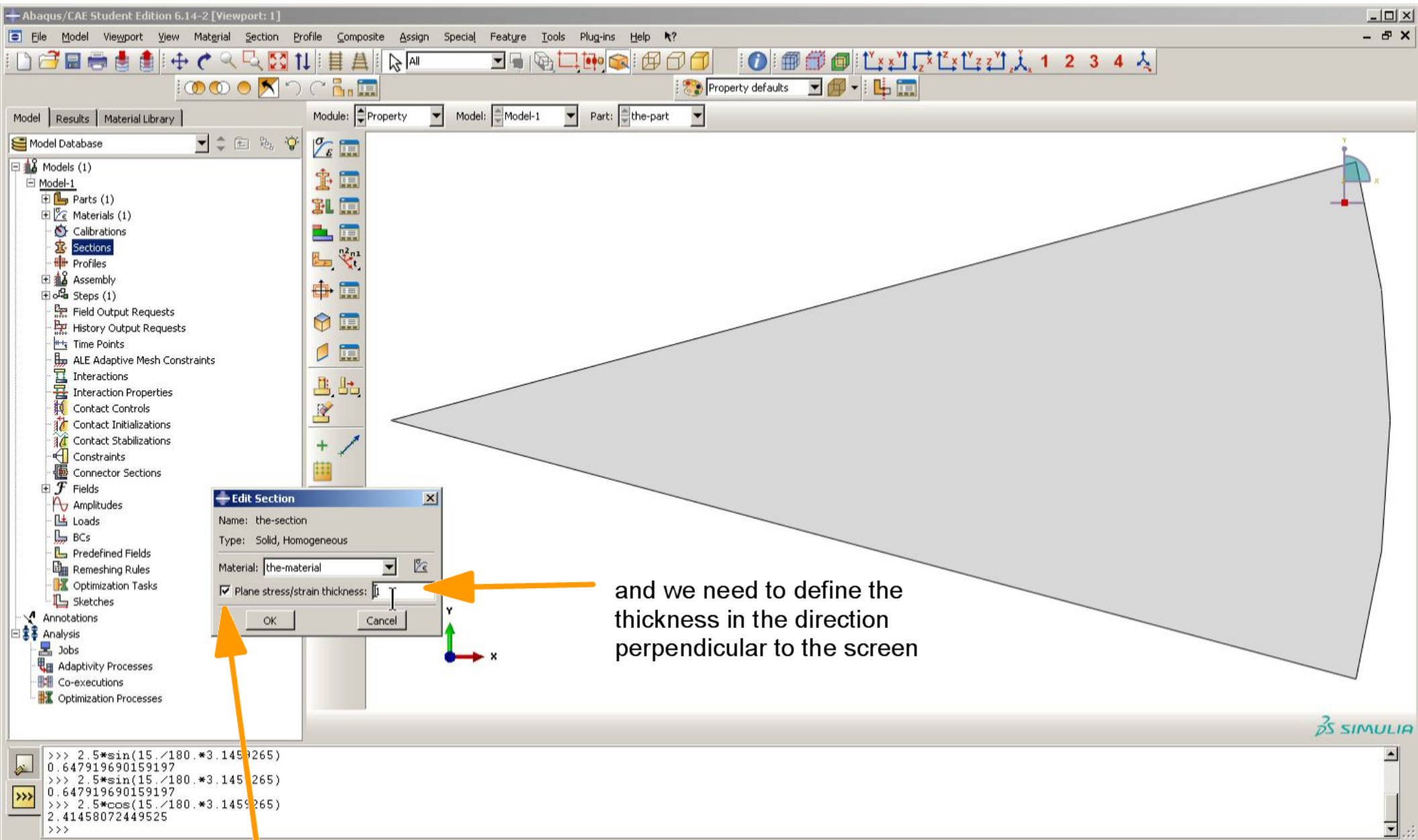




imaginatively named

thermal material model

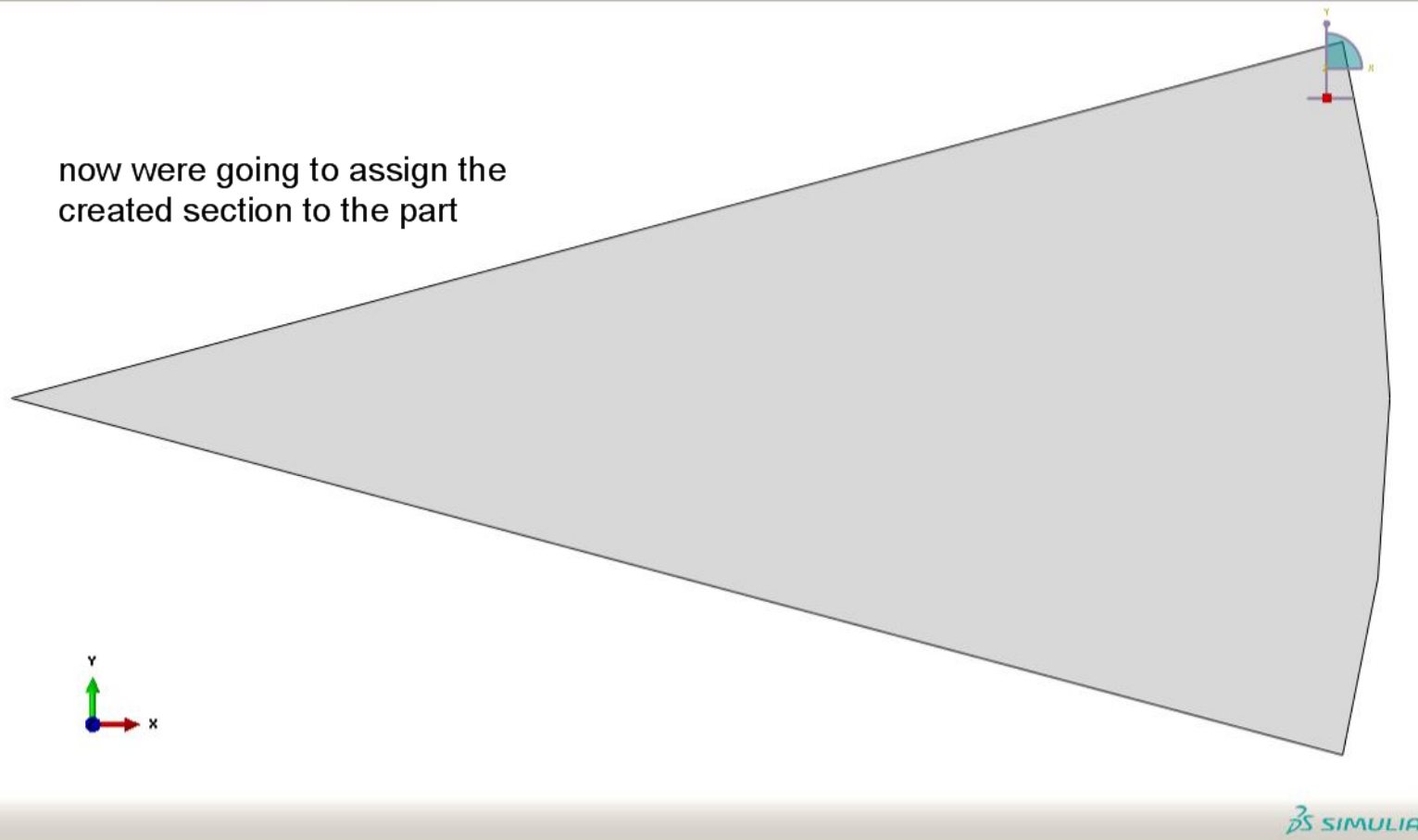
define conductivity



it is a plane stress/strain model

Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets (1)
 - Set-5
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orie
 - Com
 - Eng
 - Filter... F2
 - Inertias
 - Springs/Dashpots
 - Mesh

- Materials (1)
- the-material
- Calibrations
- Sections (1)
- the-section
- Profiles
- Assembly
- Steps (2)
- Field Output Requests (1)
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
- Interaction Properties
- Contact Controls
- Contact Initializations
- Contact Stabilizations
- Constraints
- Connector Sections


now were going to assign the created section to the part

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

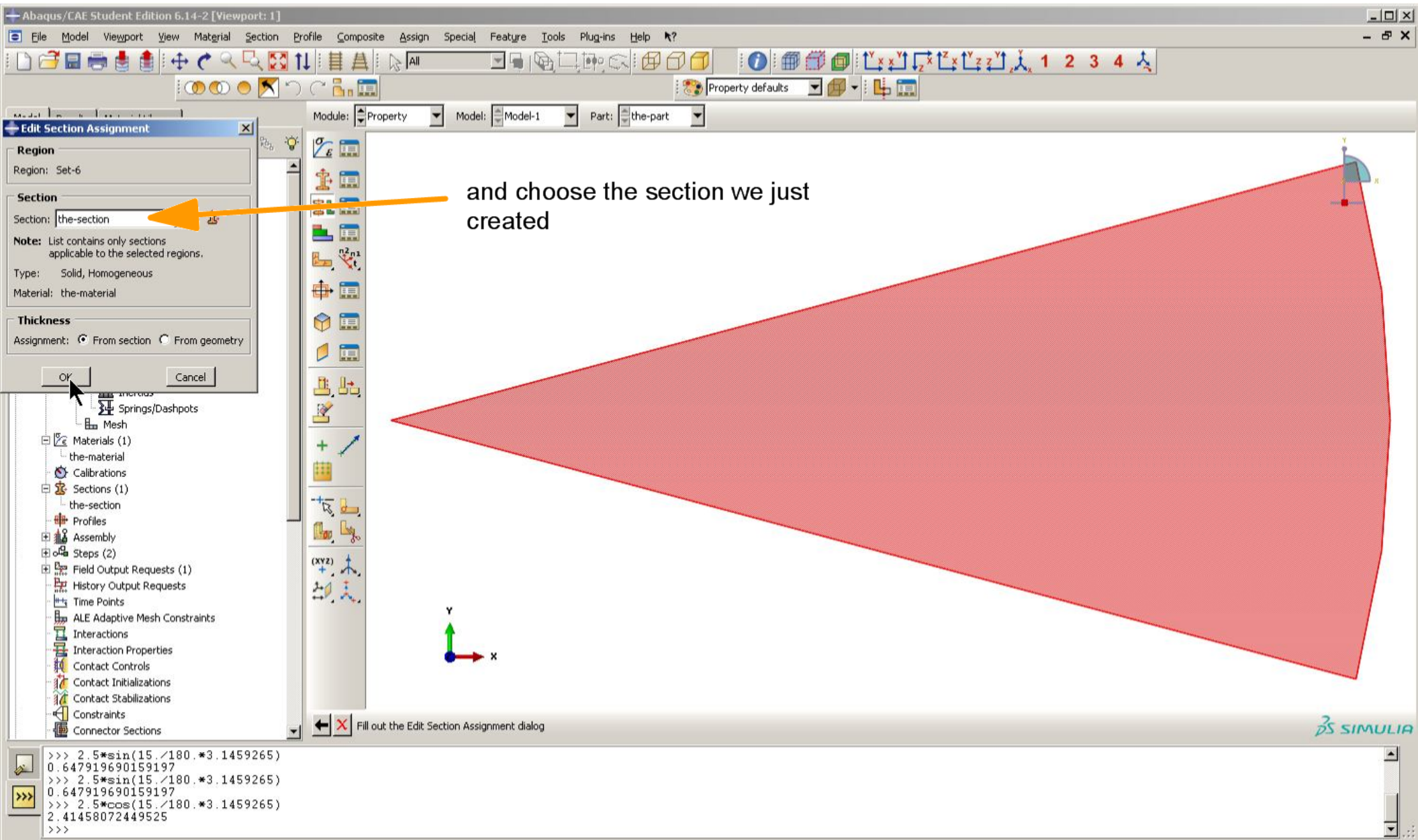
Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets (1)
 - Set-5
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Inertias
 - Springs/Dashpots
 - Mesh
- Materials (1)
 - the-material
- Calibrations
- Sections (1)
 - the-section
- Profiles
- Assembly
- Steps (2)
- Field Output Requests (1)
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
- Interaction Properties
- Contact Controls
- Contact Initializations
- Contact Stabilizations
- Constraints
- Connector Sections

select the part

Select the regions to be assigned a section (Create set: Set-6) Done

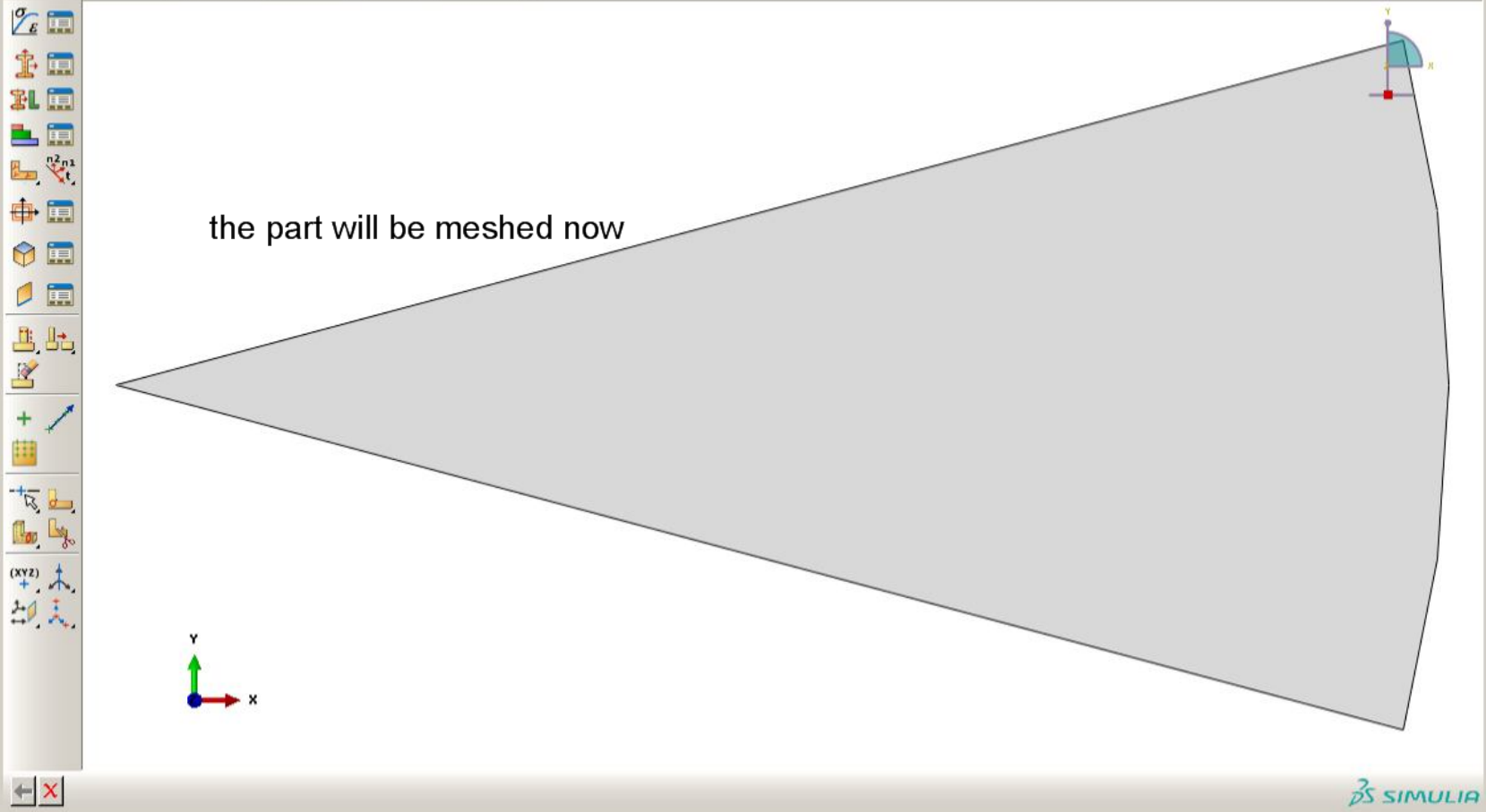
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



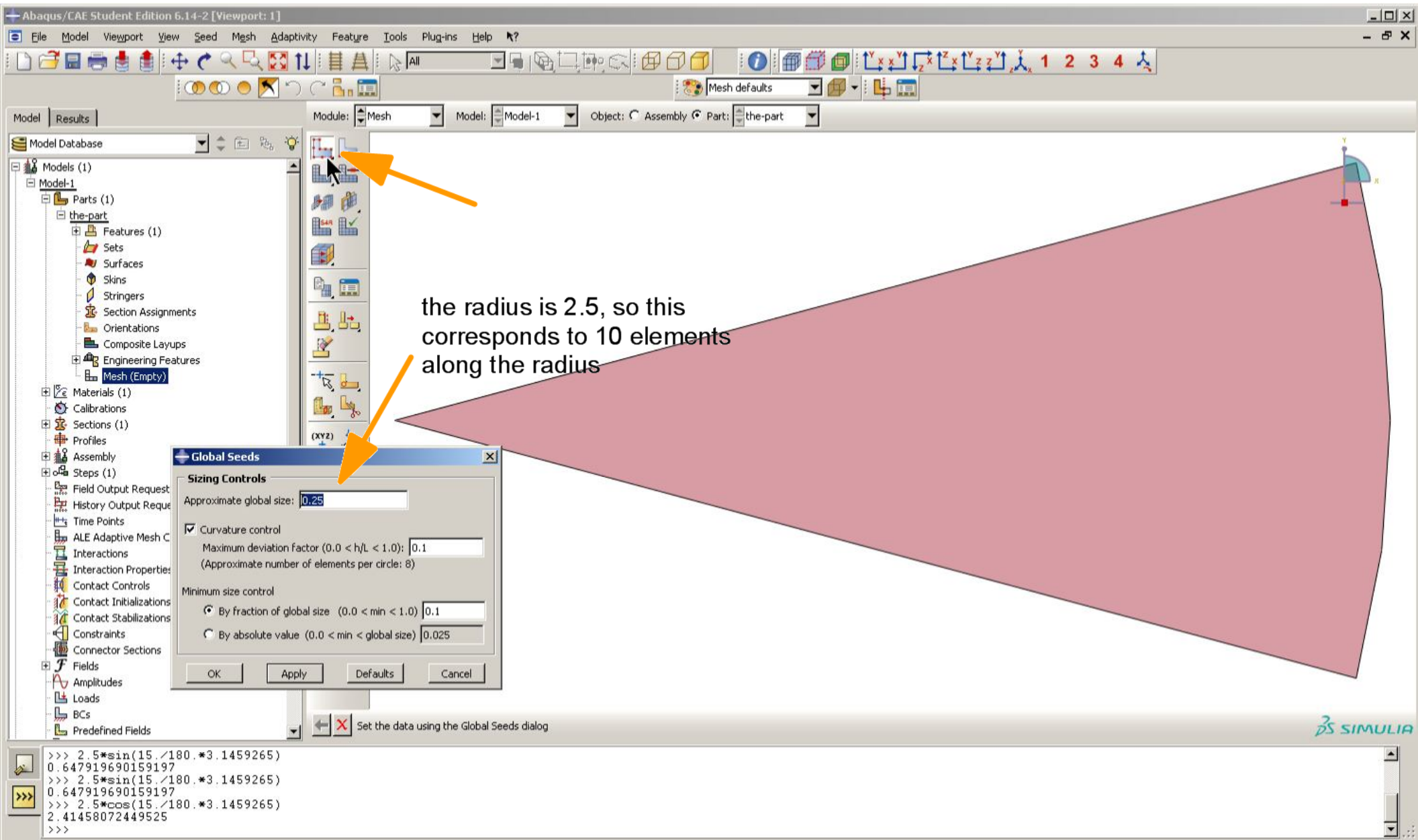
Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
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 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields

Switch Context Ctrl+Space



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



the radius is 2.5, so this corresponds to 10 elements along the radius

Global Seeds

Sizing Controls

Approximate global size:

Curvature control

Maximum deviation factor (0.0 < h/L < 1.0):

(Approximate number of elements per circle: 8)

Minimum size control

By fraction of global size (0.0 < min < 1.0)

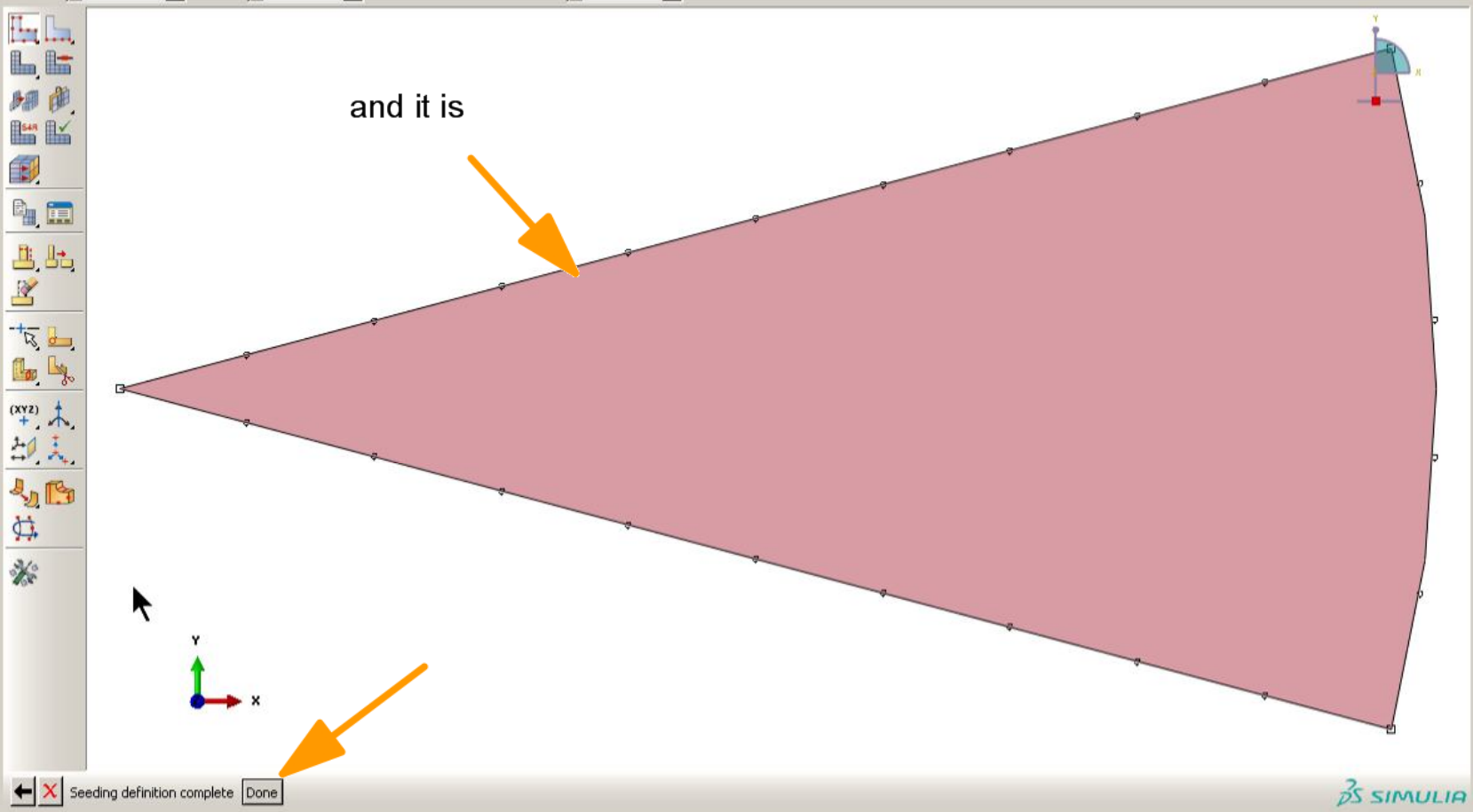
By absolute value (0.0 < min < global size)

OK Apply Defaults Cancel

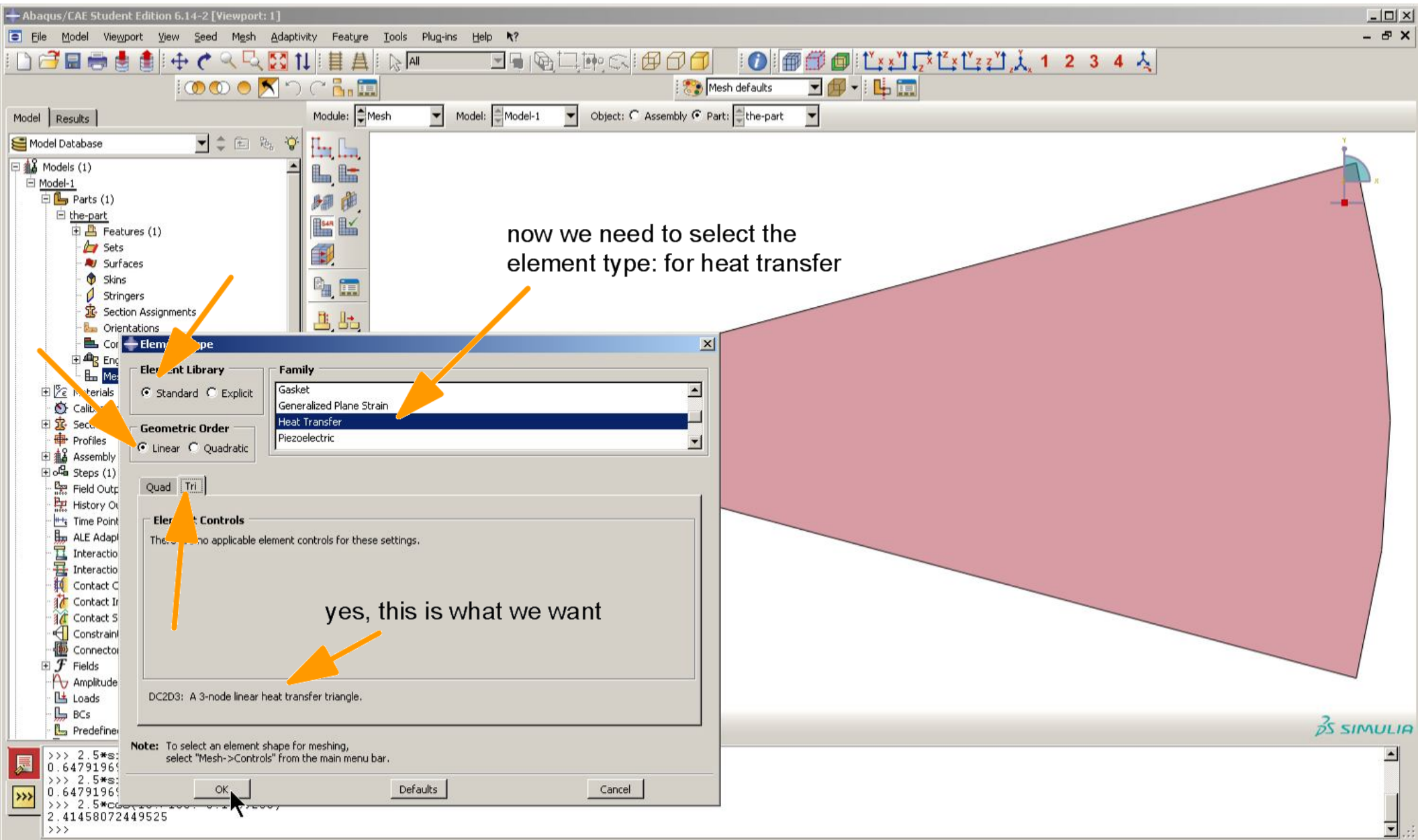
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Mesh (Empty)
- Materials (1)
- Calibrations
- Sections (1)
- Profiles
- Assembly
- Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
- Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields



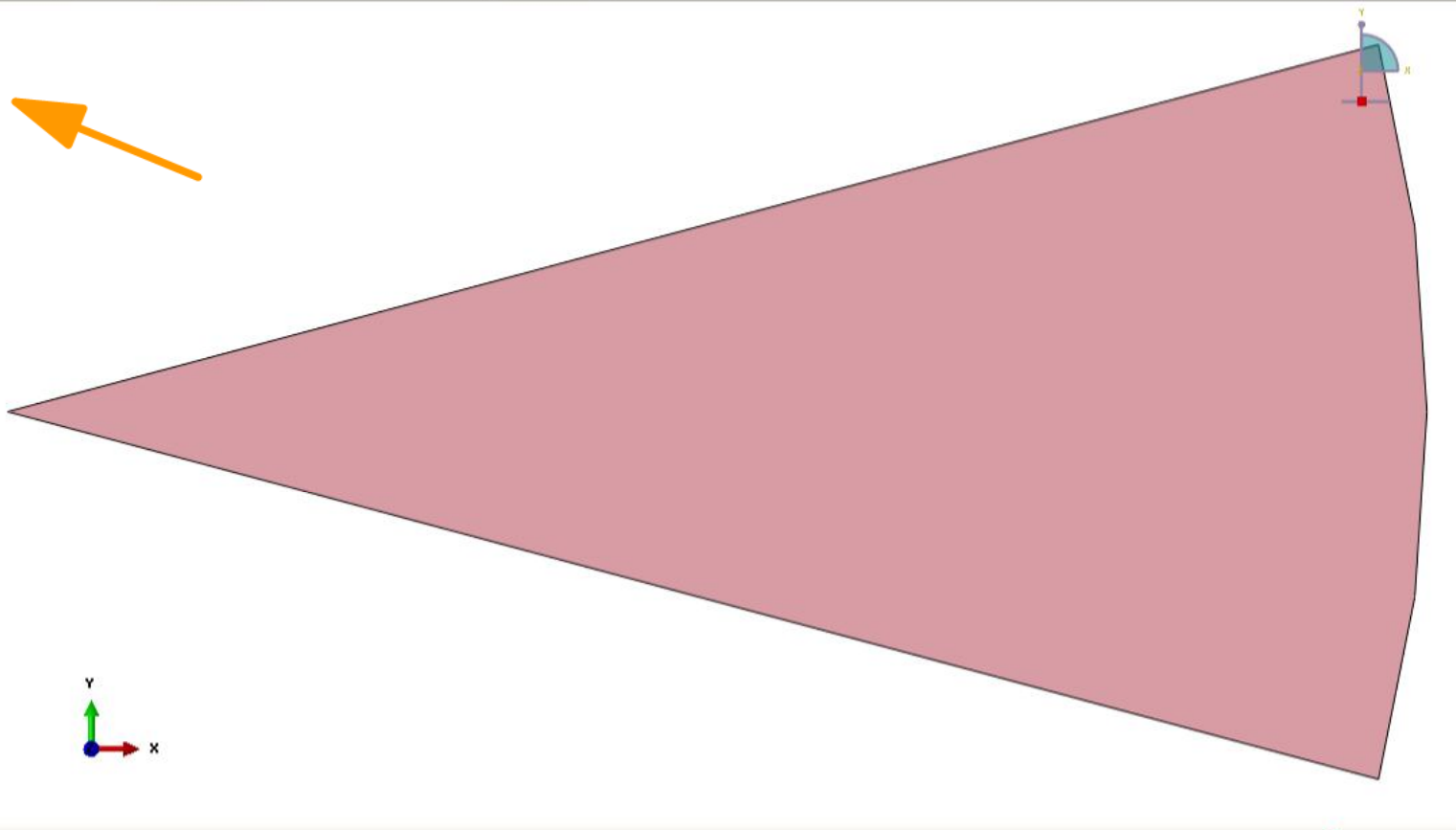
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



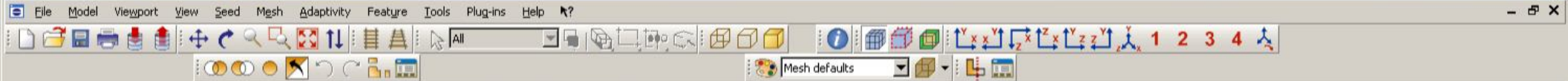
Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Mesh (Empty)
- Materials (1)
- Calibrations
- Sections (1)
- Profiles
- Assembly
- Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
- Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields

Mesh Part



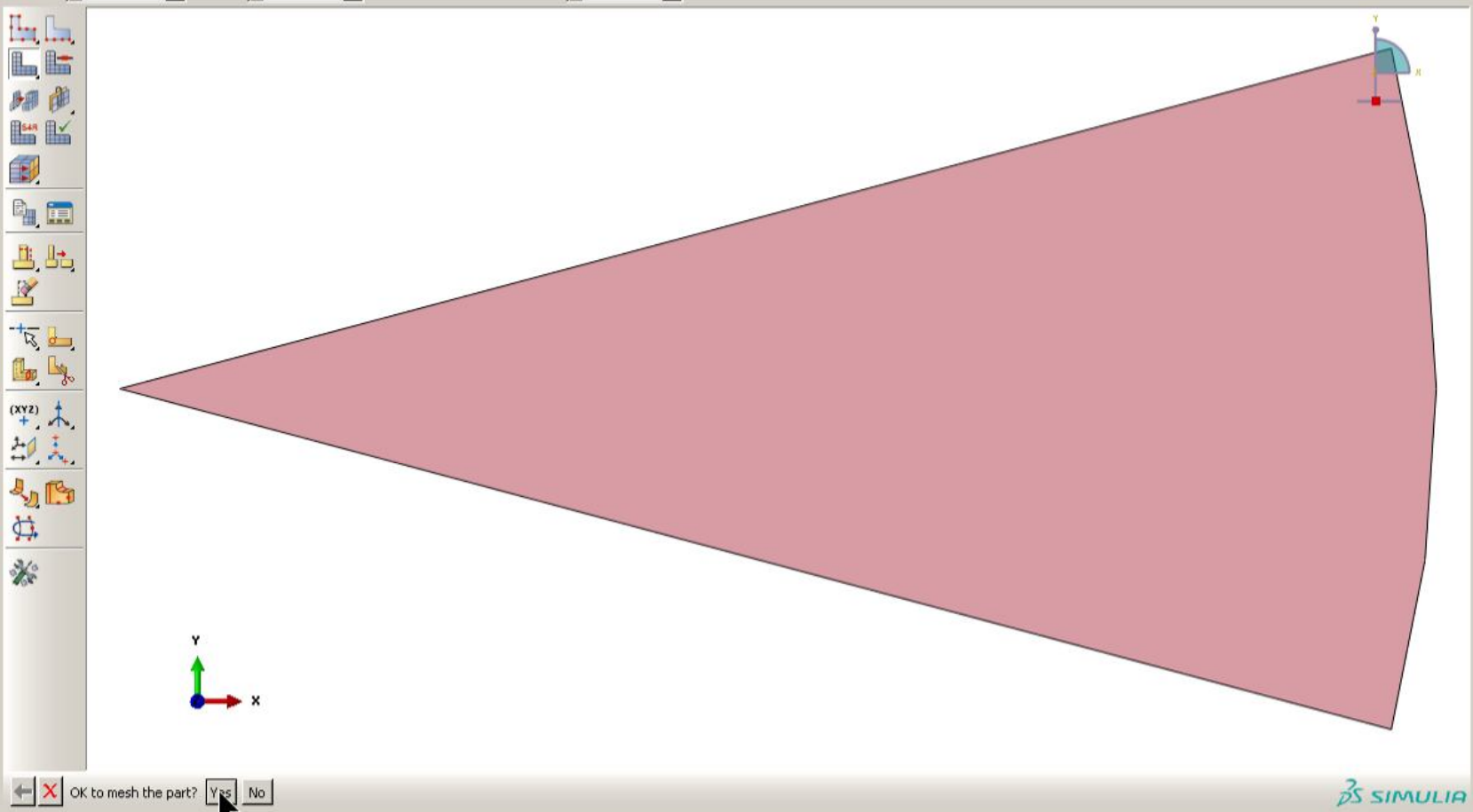
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



Model Results

Module: Mesh Model: Model-1 Object: Assembly Part: the-part

- Model Database
- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Mesh (Empty)
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields



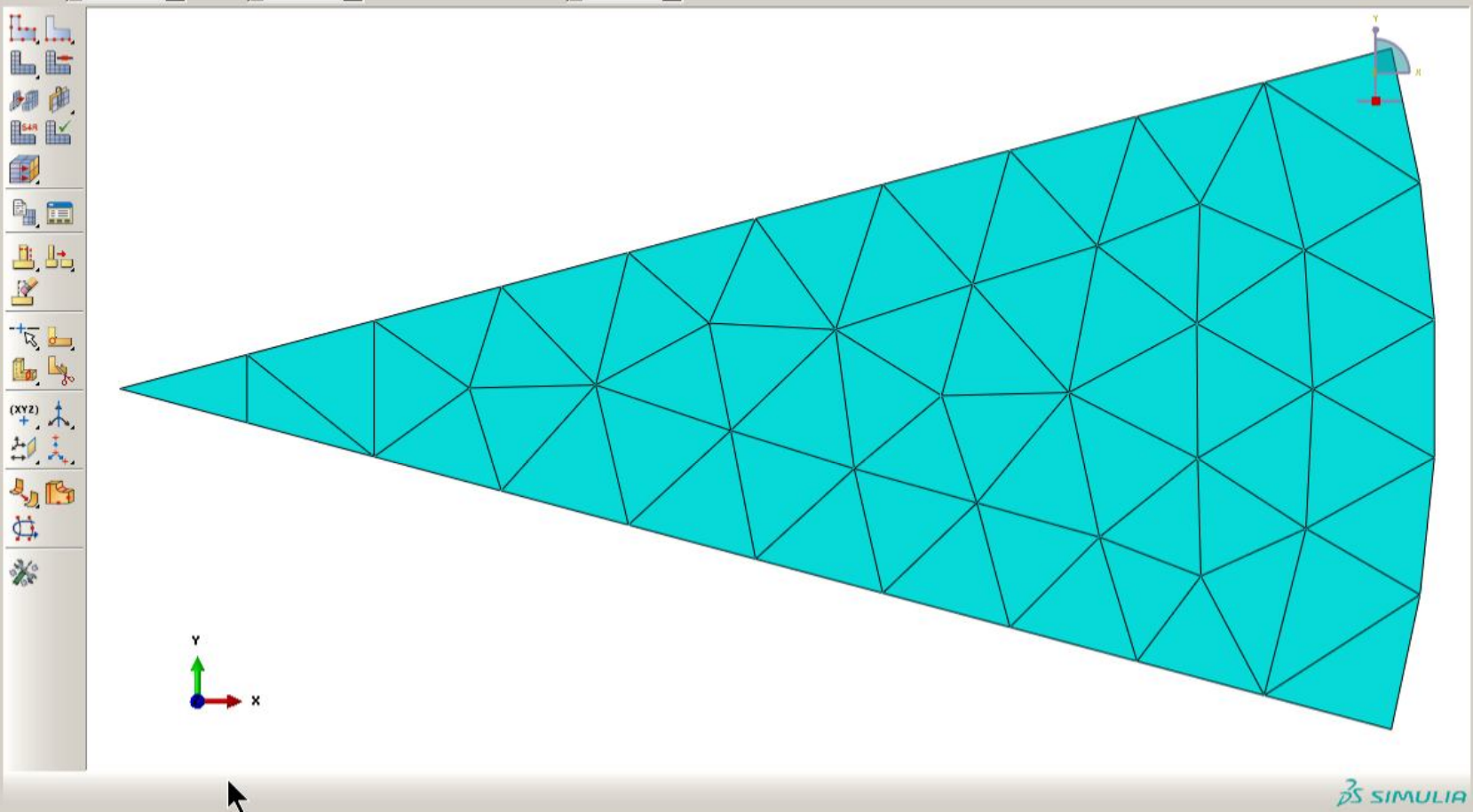
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



Model Results

Module: Mesh Model: Model-1 Object: Assembly Part: the-part

- Model Database
- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Mesh
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields



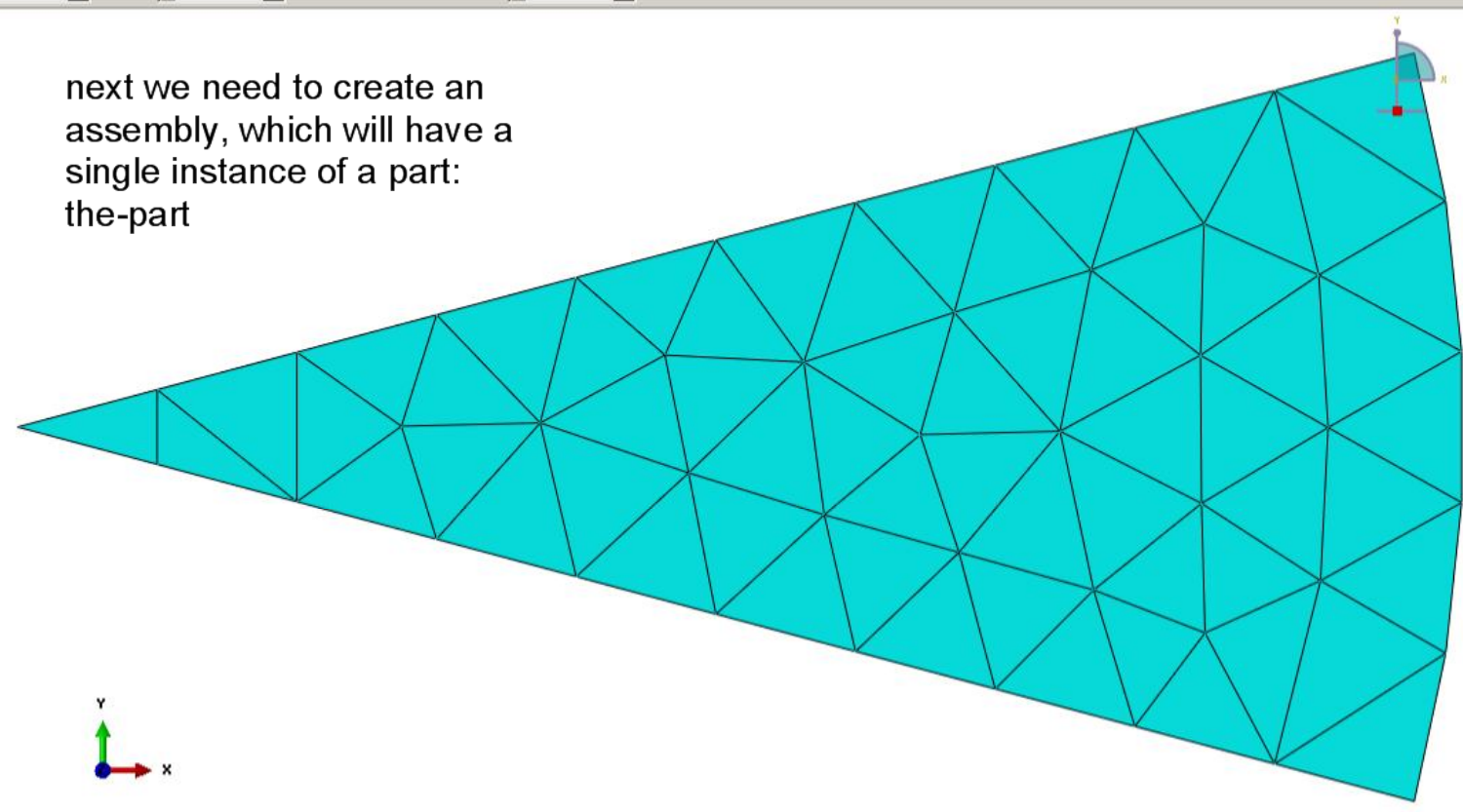
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



Model Database

Models (1)

- Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets
 - Surfaces
 - Skins
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Mesh
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Switch Context: Ctrl+Space
 - Create...**
 - Generate
 - Options...
 - Filter... F2
 - Engineering Features
 - Steps (1)
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations



next we need to create an assembly, which will have a single instance of a part:
the-part

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Sets

Create Instance

Create instances from:
 Parts Models

Parts

- the-part

Instance Type

A meshed part has been selected, so the instance type will be Dependent.

Note: To change a Dependent instance's mesh, you must edit its part's mesh.

Auto-offset from other instances

OK Apply Cancel

Select the parts/models to instance from the dialog

- Field Output Requests
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
- Interaction Properties
- Contact Controls
- Contact Initializations
- Contact Stabilizations

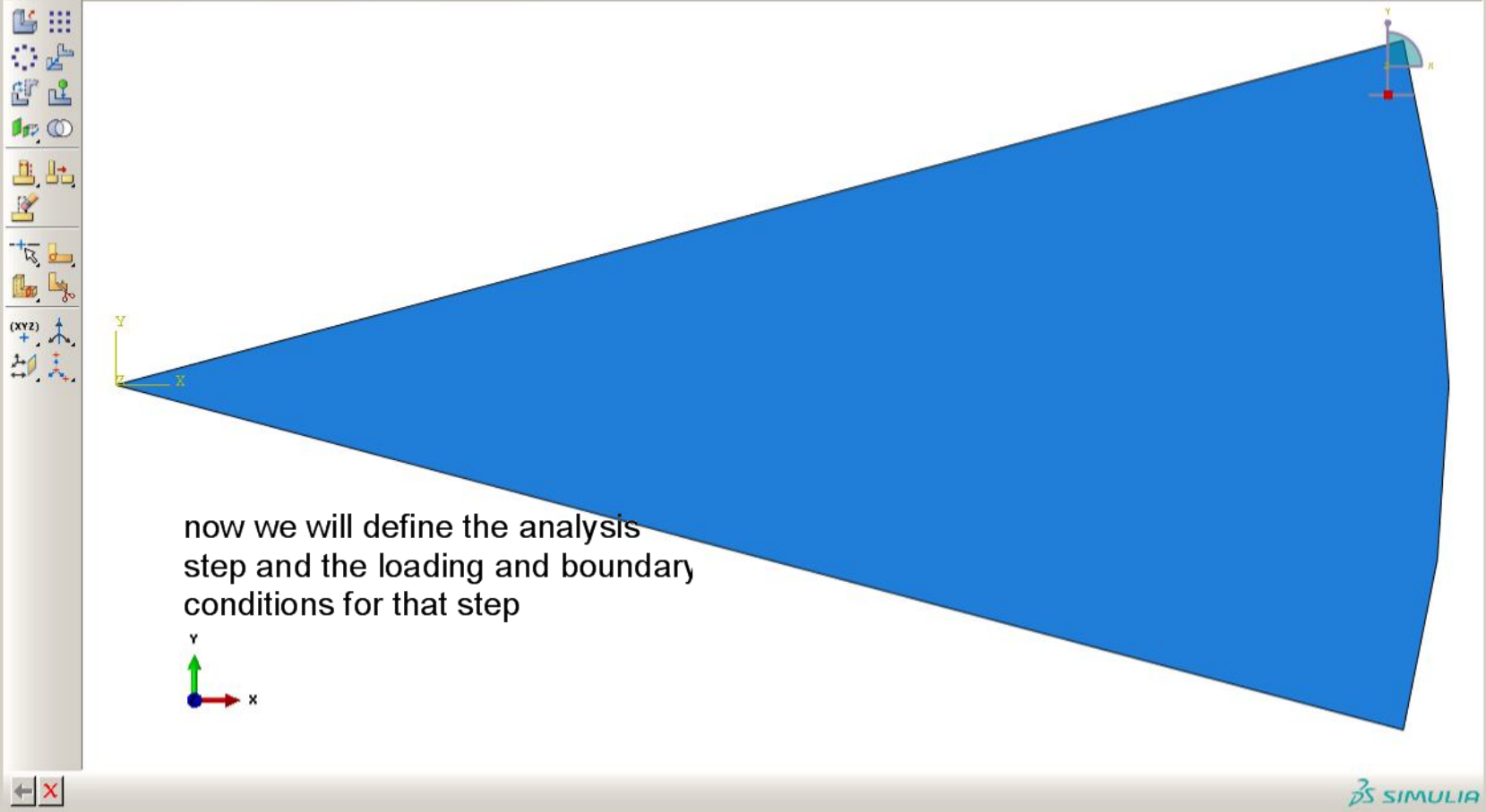
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```



Model Database

- Stringers
- Section Assignments
- Orientations
- Composite Layups
- Engineering Features
 - Mesh
- Materials (1)
- Calibrations
- Sections (1)
- Profiles
- Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets
 - Surfaces
 - Connector Assignments
 - Engineering Features
 - Step
 - Switch Context: Ctrl+Space
 - Create...
 - Filter... F2
 - Set As Root
 - Expand All Under
 - Collapse All Under
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
- Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields

Module: Assembly Model: Model-1 Step: Initial



now we will define the analysis step and the loading and boundary conditions for that step

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

- Model Database
 - Stringers
 - Section Assignments
 - Orientations
 - Composite Layups
 - Engineering Features
 - Mesh
 - Materials (1)
 - Calibrations
 - Sections (1)
 - Profiles
 - Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets
 - Surfaces
 - Connector Assignment
 - Engineering Features
 - Steps (1)
 - Initial
 - Field Output Requests
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Const
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields

Create Step

Name: the-step

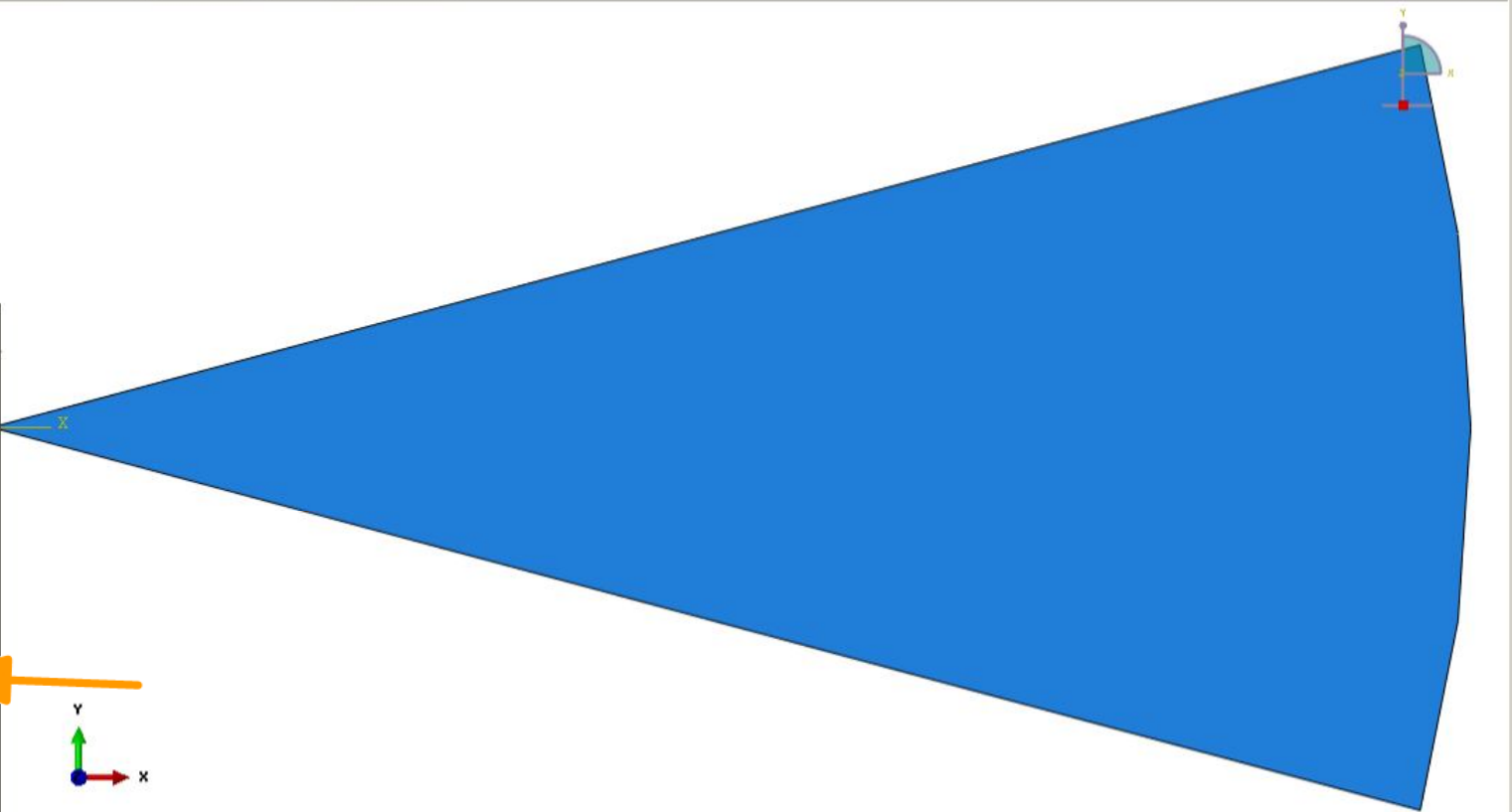
Insert new step after:

- Initial

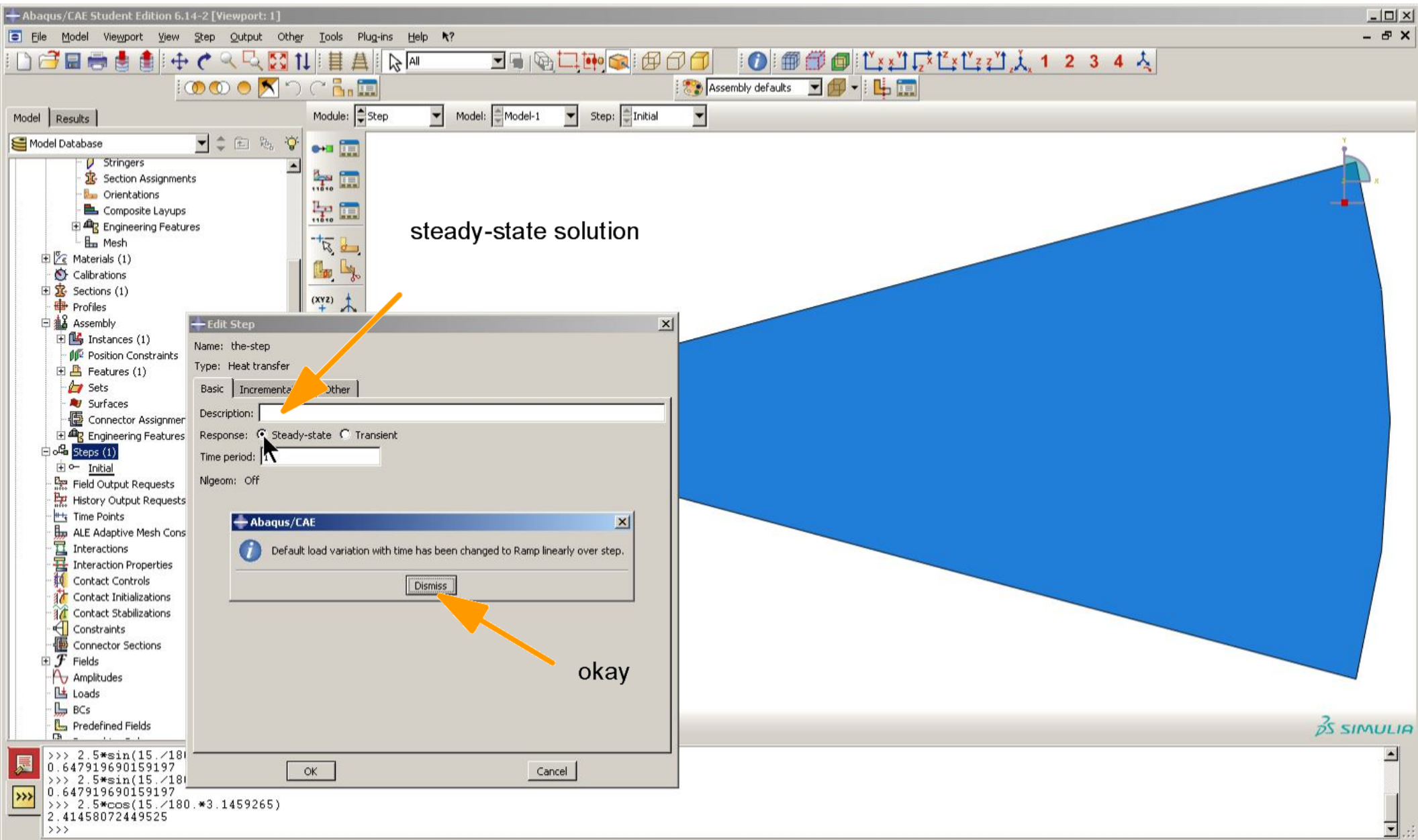
Procedure type: General

- Dynamic, Explicit
- Dynamic, Temp-disp, Explicit
- Geostatic
- Heat transfer**
- Mass diffusion
- Soils
- Static, General
- Static, Riks

Continue... Cancel



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```





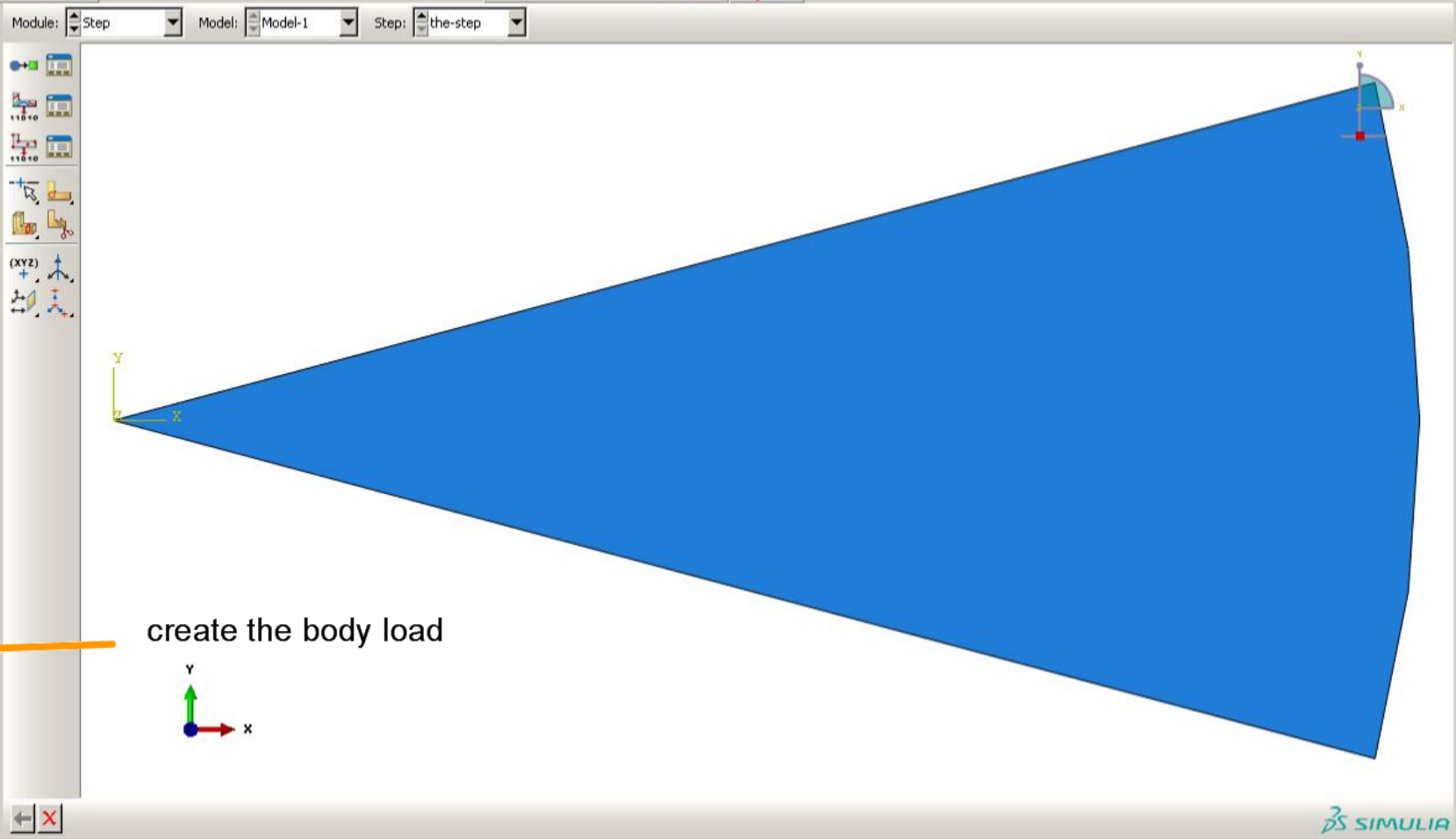
Model Database

- Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets
 - Surfaces
 - Connector Assignments
 - Engineering Features
- Steps (2)
 - Initial
 - the-step
- Field Output Requests (1)
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
- Constraints
- Connector Sections
- Fields
 - Amplitudes
 - Manager...
 - Switch Context: Ctrl+Space
 - Create...**
 - Filter... F2
- Sketches

Annotations

Analysis

- Jobs
- Adaptivity Processes
- Co-executions
- Optimization Processes



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets
 - Surfaces
 - Connector Assignments
 - Engineering Features
- Steps (2)
 - Initial
 - the-step
- Field Output Requests (1)
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
 - Interaction Properties
- Contact Controls
- Contact Initializations
- Contact Stabilizations
- Constraints
- Connector Sections
- Fields
- Amplitudes
- Loads
- BCs
- Predefined Fields
- Remeshing Rules
- Optimization Tasks
- Sketches

Annotations

Analysis

- Jobs
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

Create Load

Name: the-body-load

Step: the-step

Procedure: Heat transfer

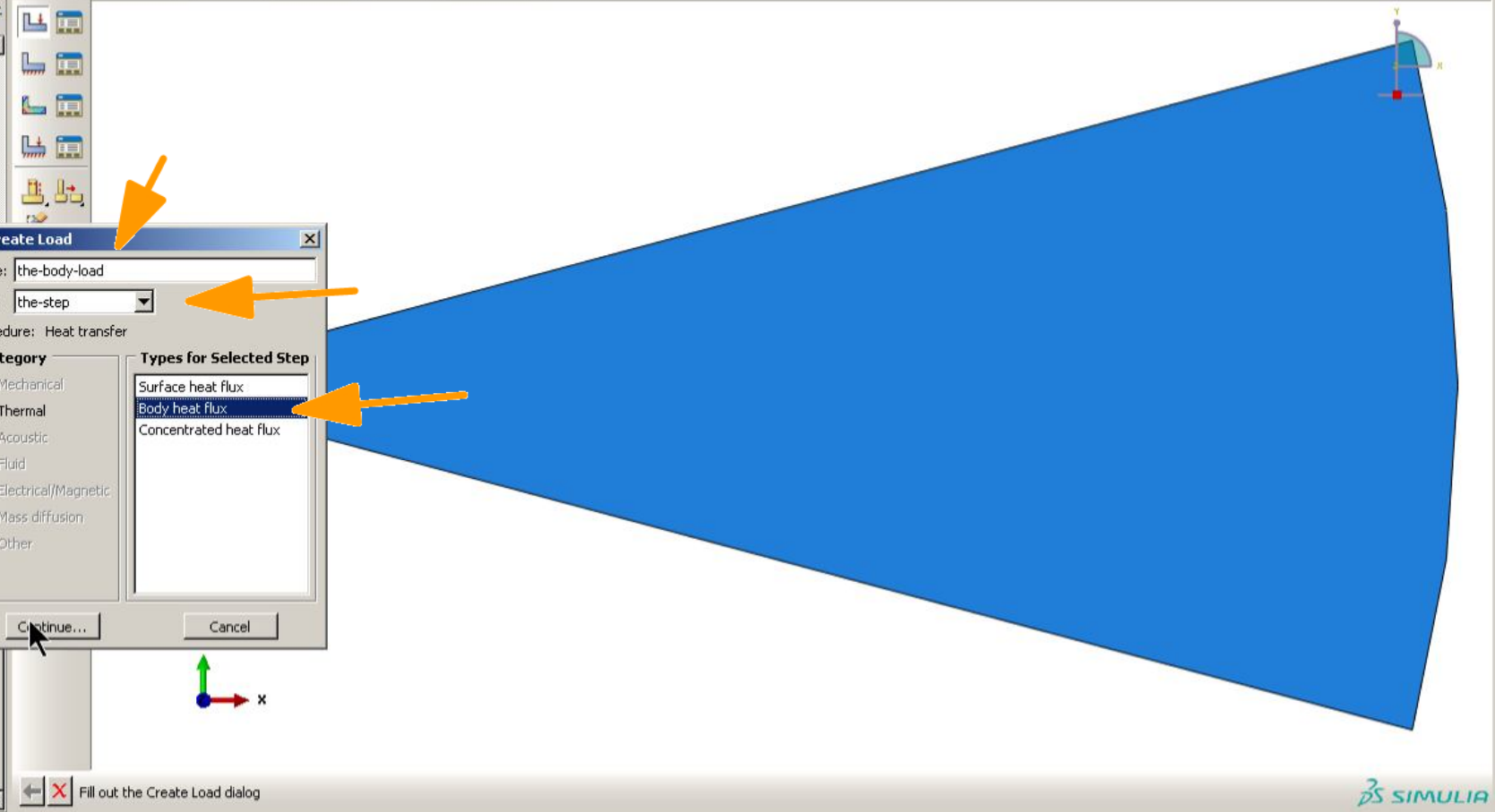
Category

- Mechanical
- Thermal
- Acoustic
- Fluid
- Electrical/Magnetic
- Mass diffusion
- Other

Types for Selected Step

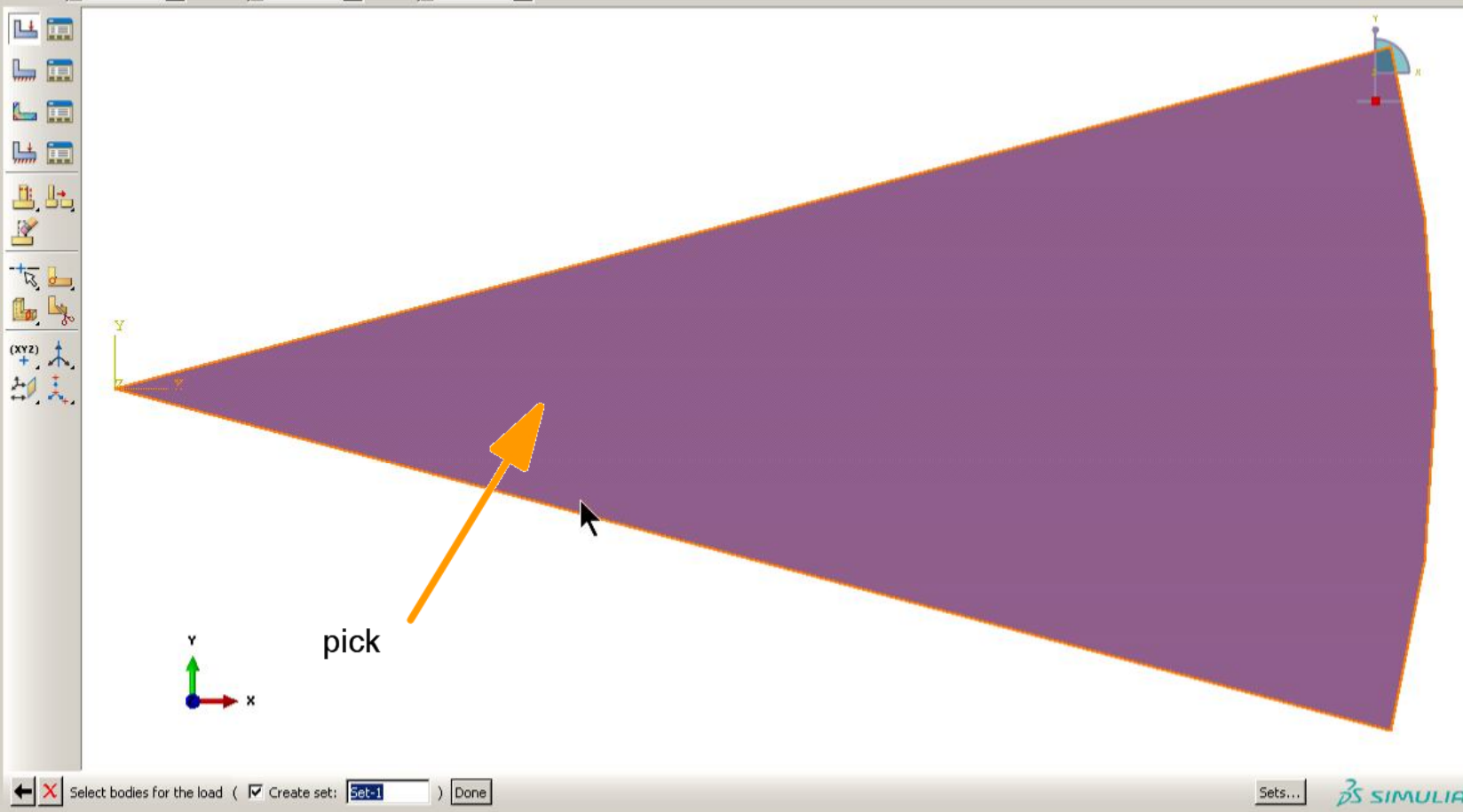
- Surface heat flux
- Body heat flux
- Concentrated heat flux

Continue... Cancel



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

- Model Database
 - Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets
 - Surfaces
 - Connector Assignments
 - Engineering Features
 - Steps (2)
 - Initial
 - the-step
 - Field Output Requests (1)
 - History Output Requests
 - Time Points
 - ALE Adaptive Mesh Constraints
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads
 - BCs
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
 - Annotations
 - Analysis
 - Jobs
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Assembly
- Interactions
- Interaction Properties
- Contact Controls
- Contact Initializations
- Contact Stabilizations
- Constraints
- Connector Sections
- Fields
- Amplitudes
- Loads
- BCs
- Predefined Fields
- Remeshing Rules
- Optimization Tasks
- Sketches
- Annotations
- Analysis
- Jobs
- Adaptivity Processes
- Co-executions
- Optimization Processes

Edit Load

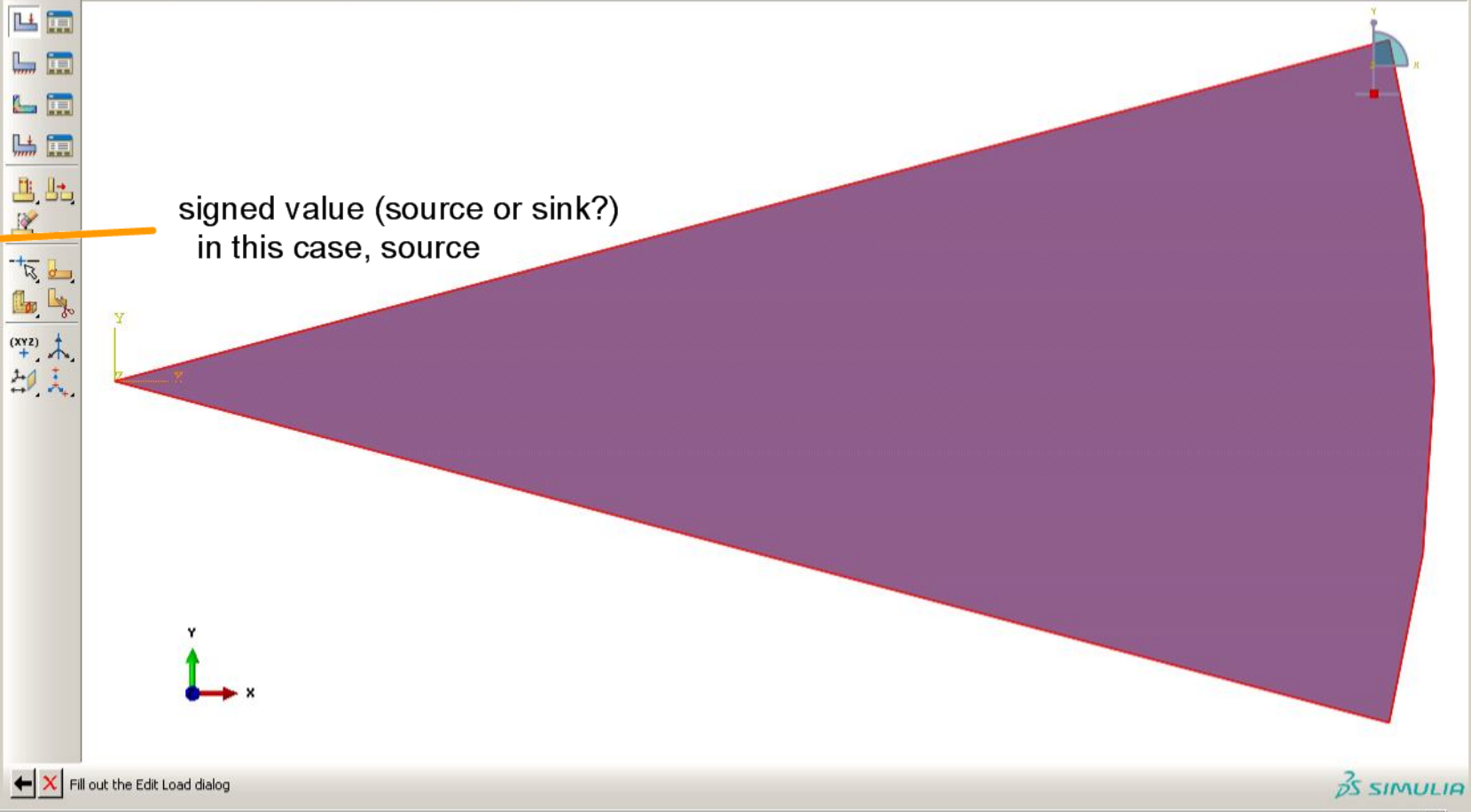
Name: the-body-load
Type: Body heat flux
Step: the-step (Heat transfer)
Region: Set-1

Distribution: Uniform $f(x)$

Magnitude: 4.5

Amplitude: (Ramp)

OK Cancel



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

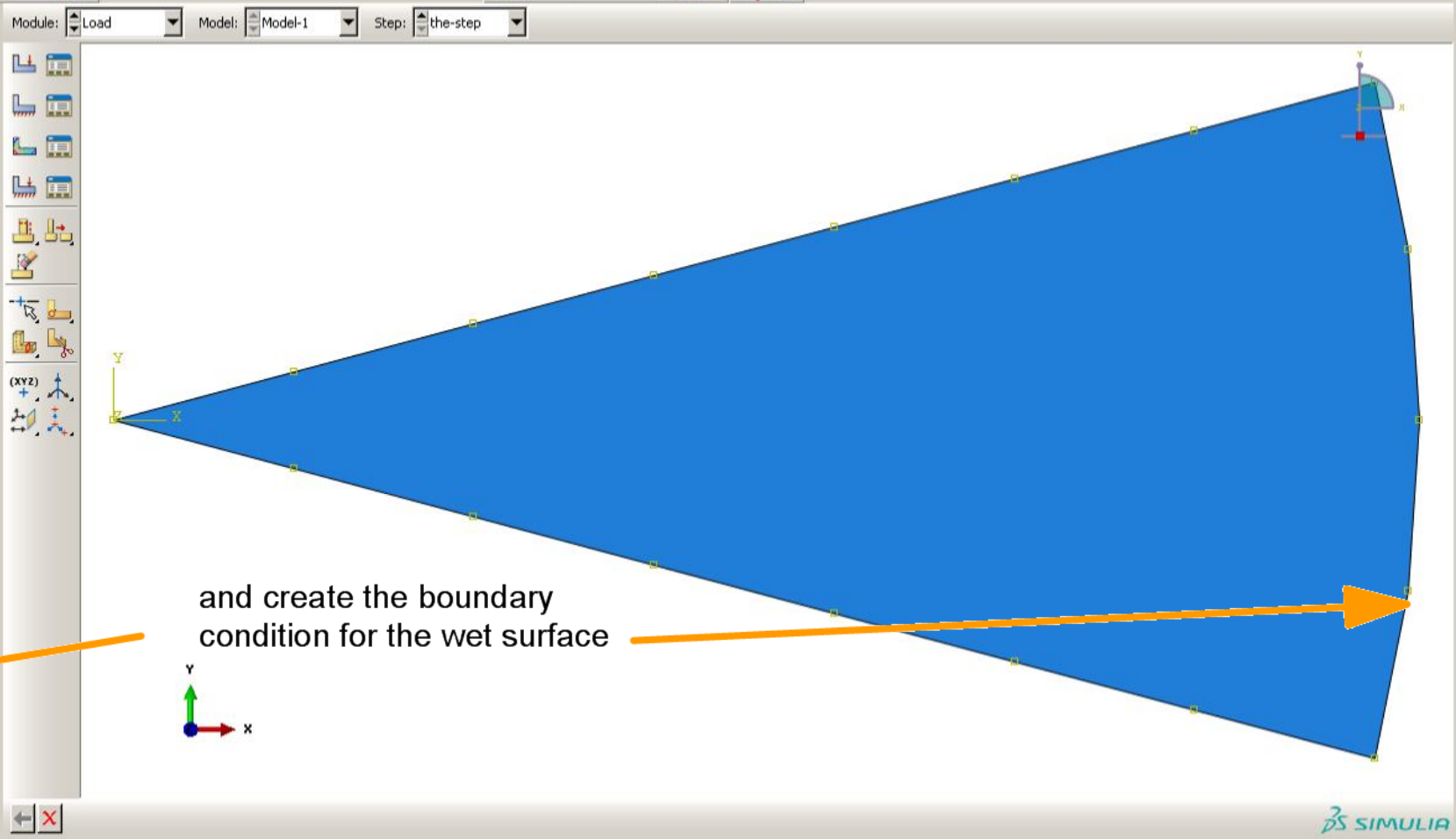
Model Database

- Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets (1)
 - Surfaces
 - Connector Assignments
 - Engineering Features
- Steps (2)
 - Initial
 - the-step
- Field Output Requests (1)
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
- Constraints
- Connector Sections
- Fields
- Amplitudes
- Loads (1)
- Switch Context: Ctrl+Space
- Manager...
- Create...**
- Filter. F2

Annotations

Analysis

- Jobs
- Adaptivity Processes
- Co-executions
- Optimization Processes



and create the boundary condition for the wet surface

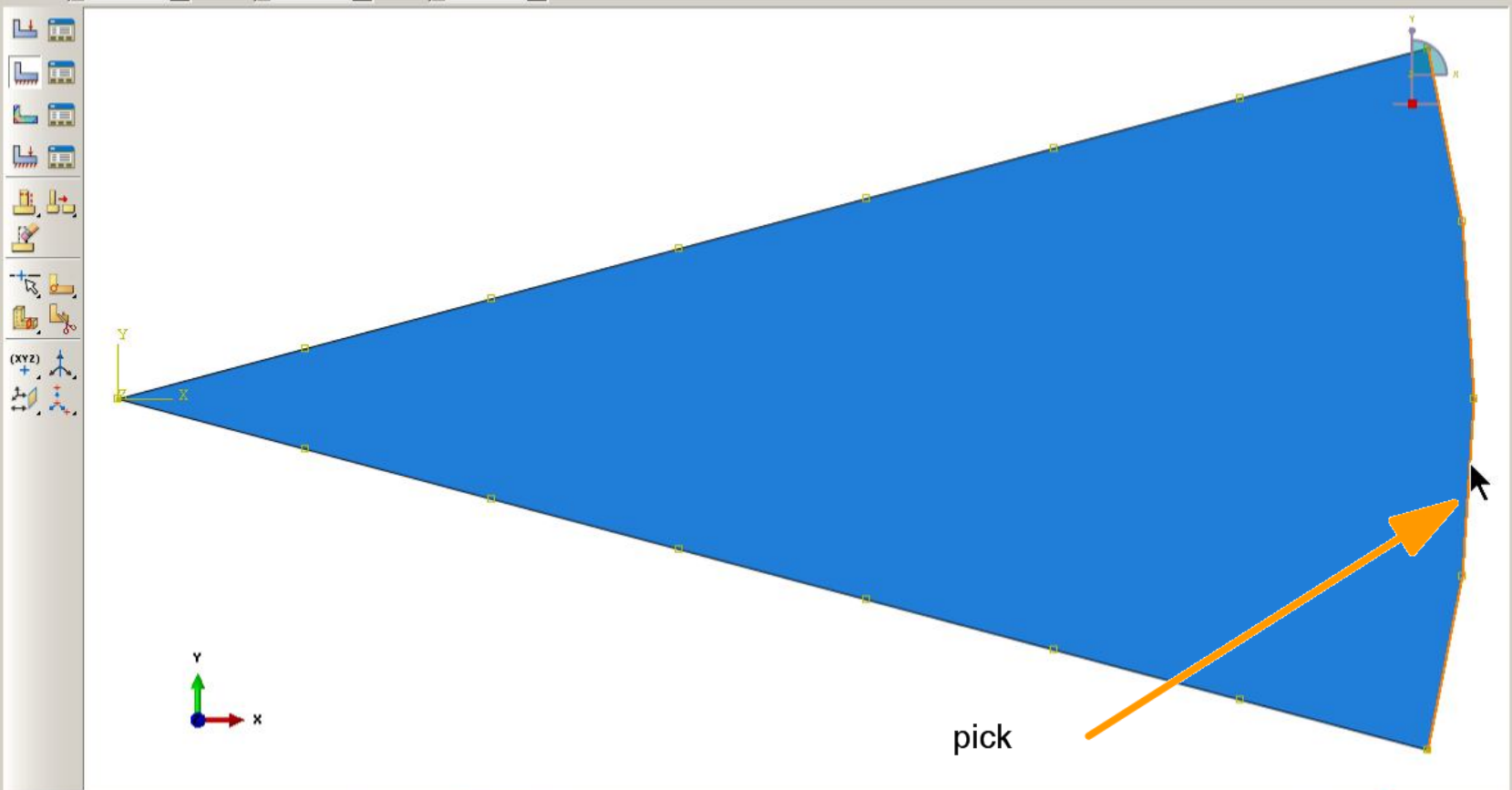
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```




Model Results

Module: Load Model: Model-1 Step: the-step

- Model Database
 - Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets (1)
 - Surfaces
 - Connector Assignments
 - Engineering Features
 - Steps (2)
 - Initial
 - the-step
 - Field Output Requests (1)
 - History Output Requests
 - 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
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes

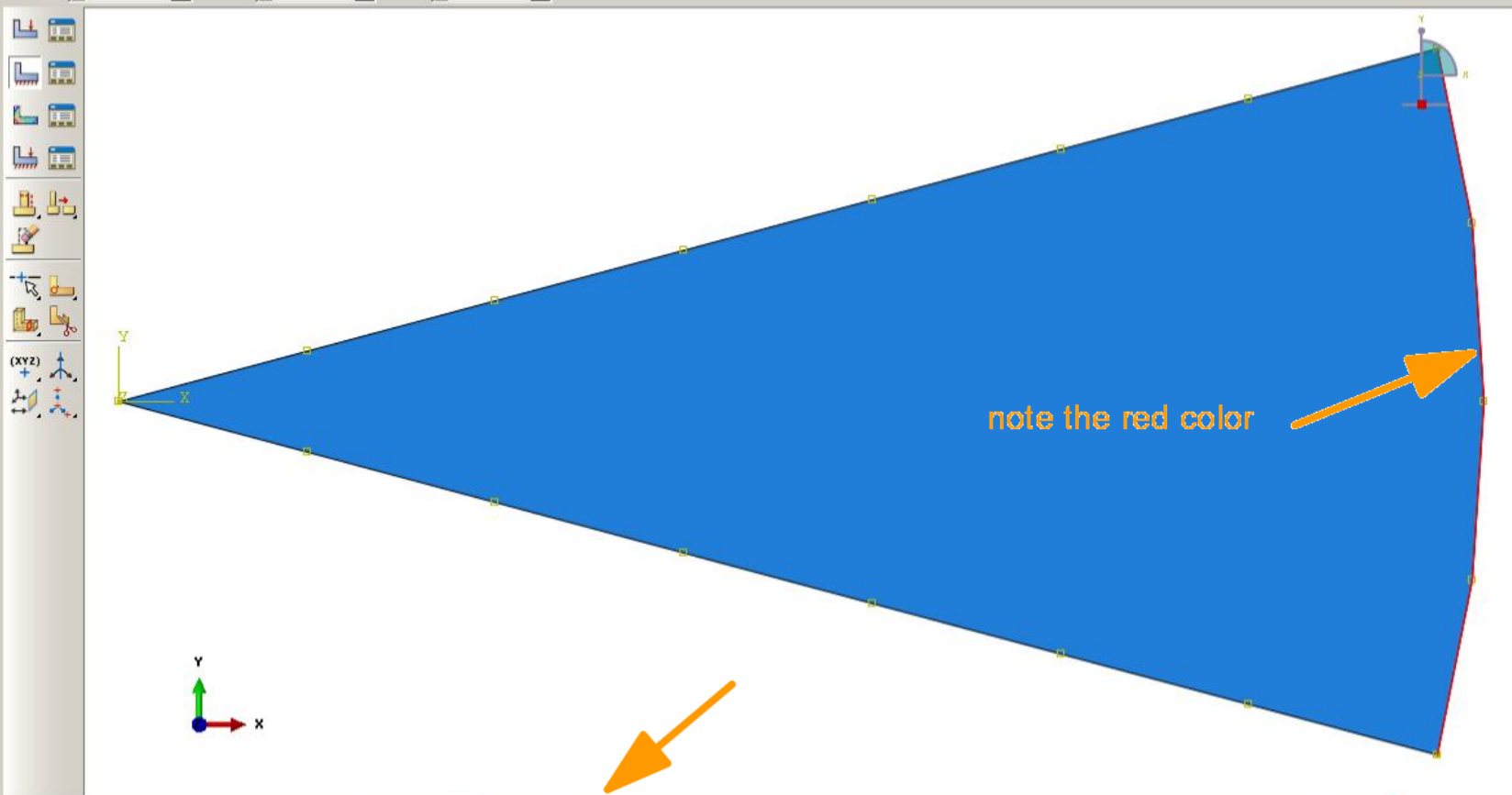


Select regions for the boundary condition (Create set: Set-2) Done

Sets... SIMULIA

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

- Model Database
 - Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets (1)
 - Surfaces
 - Connector Assignments
 - Engineering Features
 - Steps (2)
 - Initial
 - the-step
 - Field Output Requests (1)
 - History Output Requests
 - 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
 - Adaptivity Processes
 - Co-executions
 - Optimization Processes



Select regions for the boundary condition (Create set: Set-2) Don

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

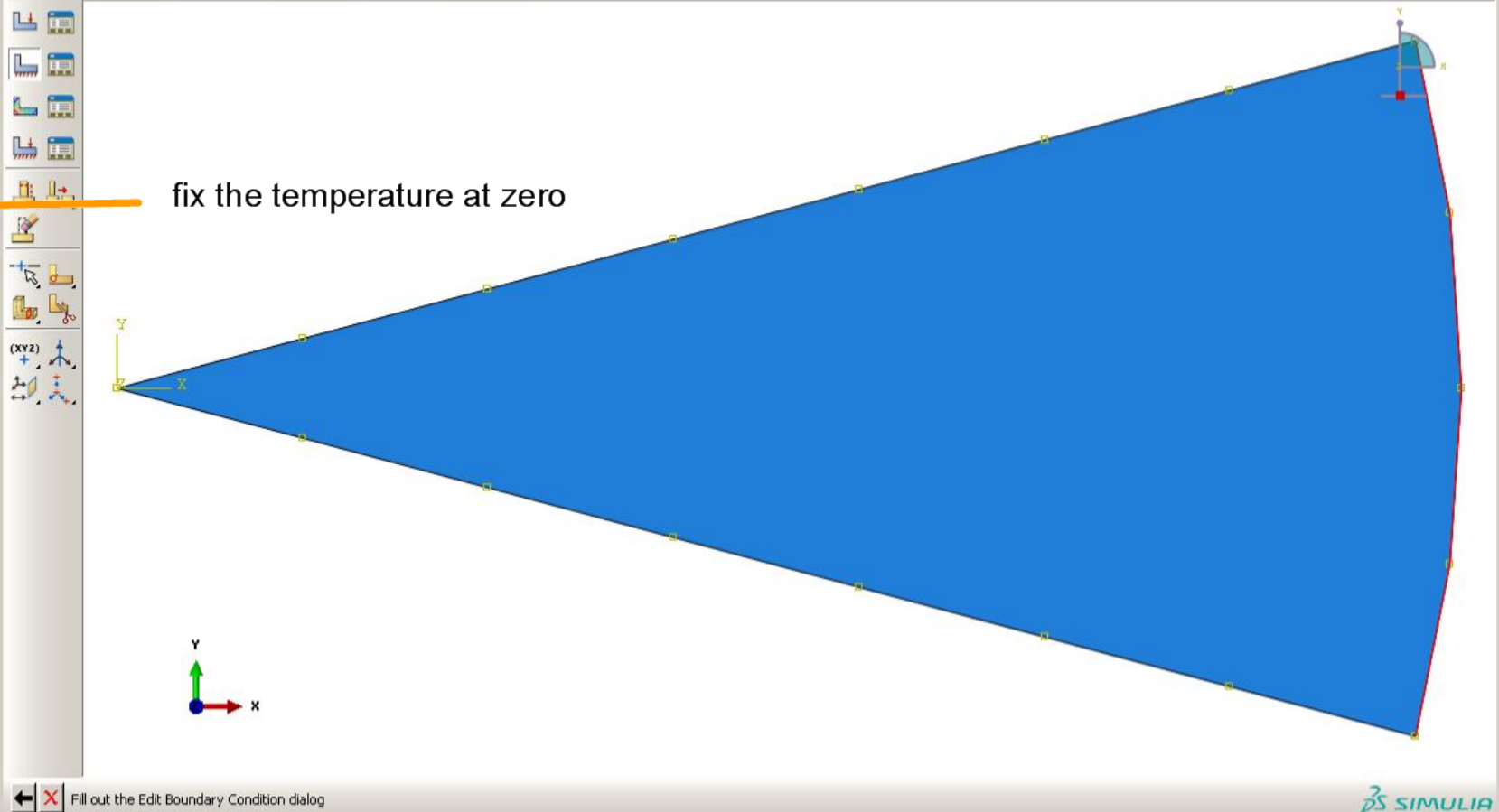
Model Database

Edit Boundary Condition

Name: the-BC
Type: Temperature
Step: the-step (Heat transfer)
Region: Set-2

Distribution: Uniform $f(x)$
Magnitude: 0.0
Amplitude: (Ramp)

OK Cancel



- 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
- Adaptivity Processes
- Co-executions
- Optimization Processes

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

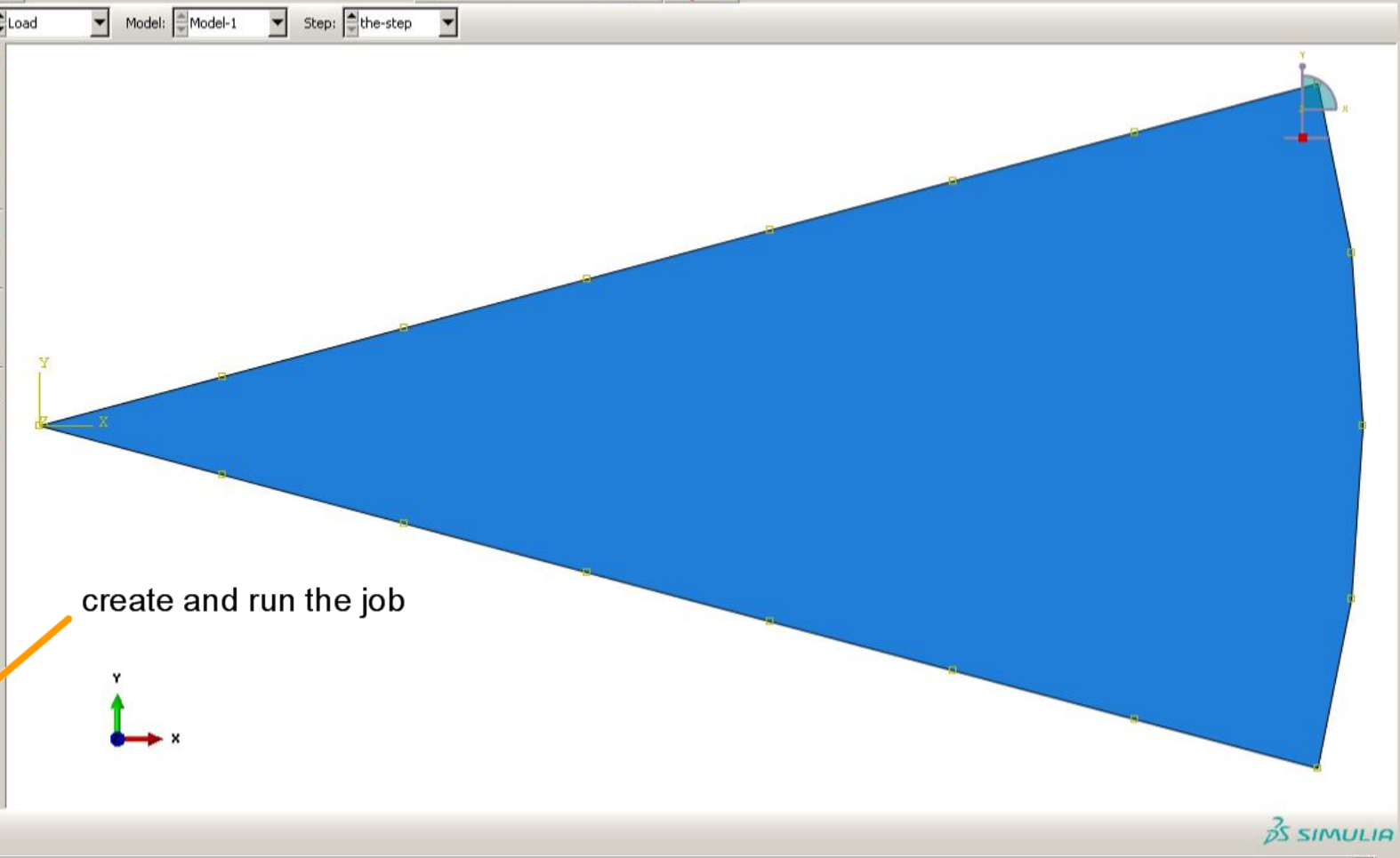
Model Database

- Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets (2)
 - Surfaces
 - Connector Assignments
 - Engineering Features
- Steps (2)
 - Initial
 - the-step
- Field Output Requests (1)
- History Output Requests
- 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

- Job
 - Switch Context Ctrl+Space
 - Manager...
 - Create...**
 - Filter... F2



create and run the job

```
>>> 59265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Sections (1)
- Profiles
- Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets (2)
 - Surfaces
 - Connector Assignments
 - Engineering Features
- Steps (2)
 - Initial
 - the-step

Create Job

Name: the-job

Source: Model

Model-1

Continue... Cancel

BCs (1)

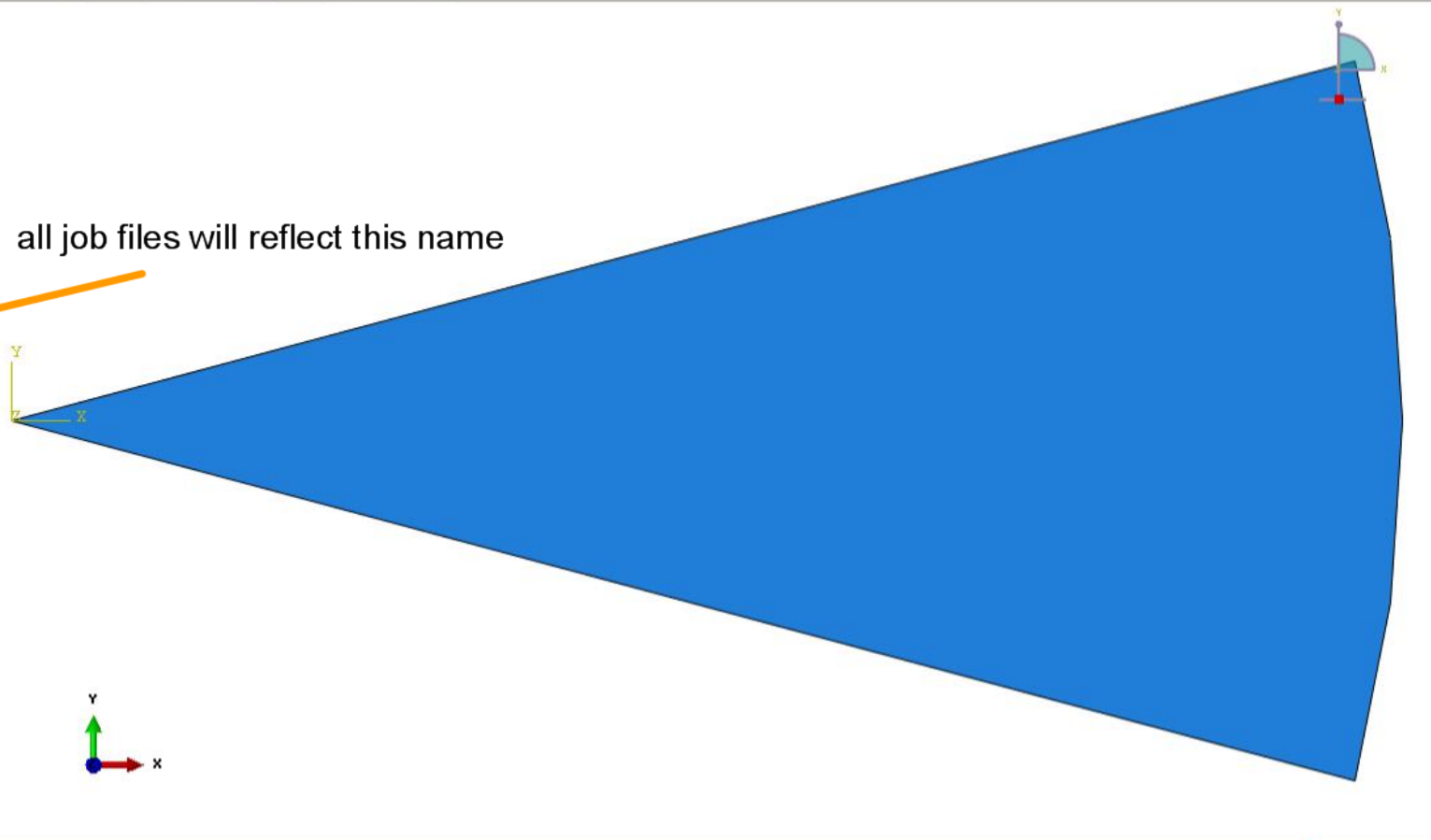
- Predefined Fields
- Remeshing Rules
- Optimization Tasks
- Sketches

Annotations

Analysis

- Jobs
- Adaptivity Processes
- Co-executions
- Optimization Processes

all job files will reflect this name



```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

- Model Database
 - Sections (1)
 - Profiles
 - Assembly
 - Instances (1)
 - Position Constraints
 - Features (1)
 - Sets (2)
 - Surfaces
 - Connector Assignm
 - Engineering Featur
 - Steps (2)
 - Initial
 - the-step
 - Field Output Requests
 - History Output Reques
 - Time Points
 - ALE Adaptive Mesh Co
 - Interactions
 - Interaction Properties
 - Contact Controls
 - Contact Initializations
 - Contact Stabilizations
 - Constraints
 - Connector Sections
 - Fields
 - Amplitudes
 - Loads (1)
 - the-body-load
 - BCs (1)
 - Predefined Fields
 - Remeshing Rules
 - Optimization Tasks
 - Sketches
- Annotations
- Analysis
 - Jobs
 - Adaptivity Processes
 - Co-executions

Edit Job

Name: the-job
Model: Model-1
Analysis product: Abaqus/Standard
Description:

Submission | General | Memory | Parallelization | Precision

Job Type

Full analysis
 Recover (Explicit)
 Restart

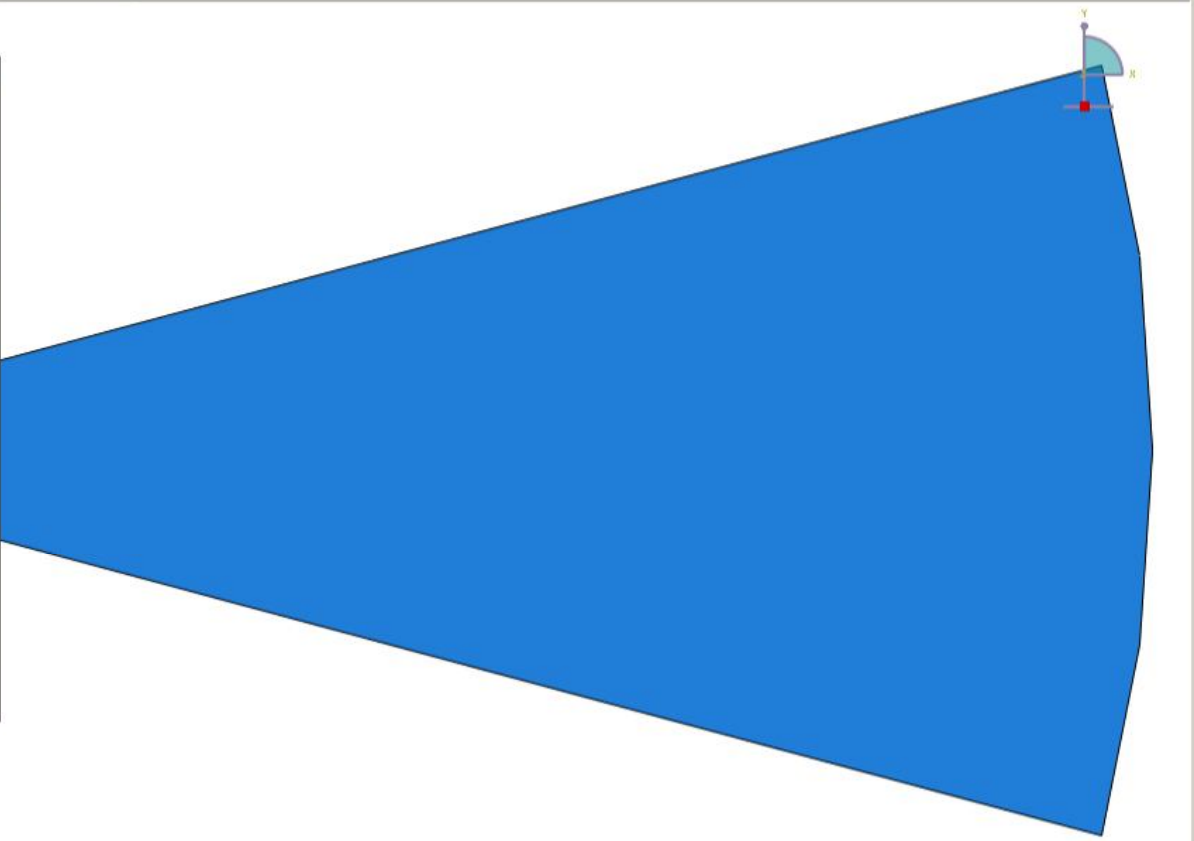
Run Mode

Background Queue: Host name:
Type:

Submit Time

Immediately
 Wait: hrs. min.
 At:

OK Cancel



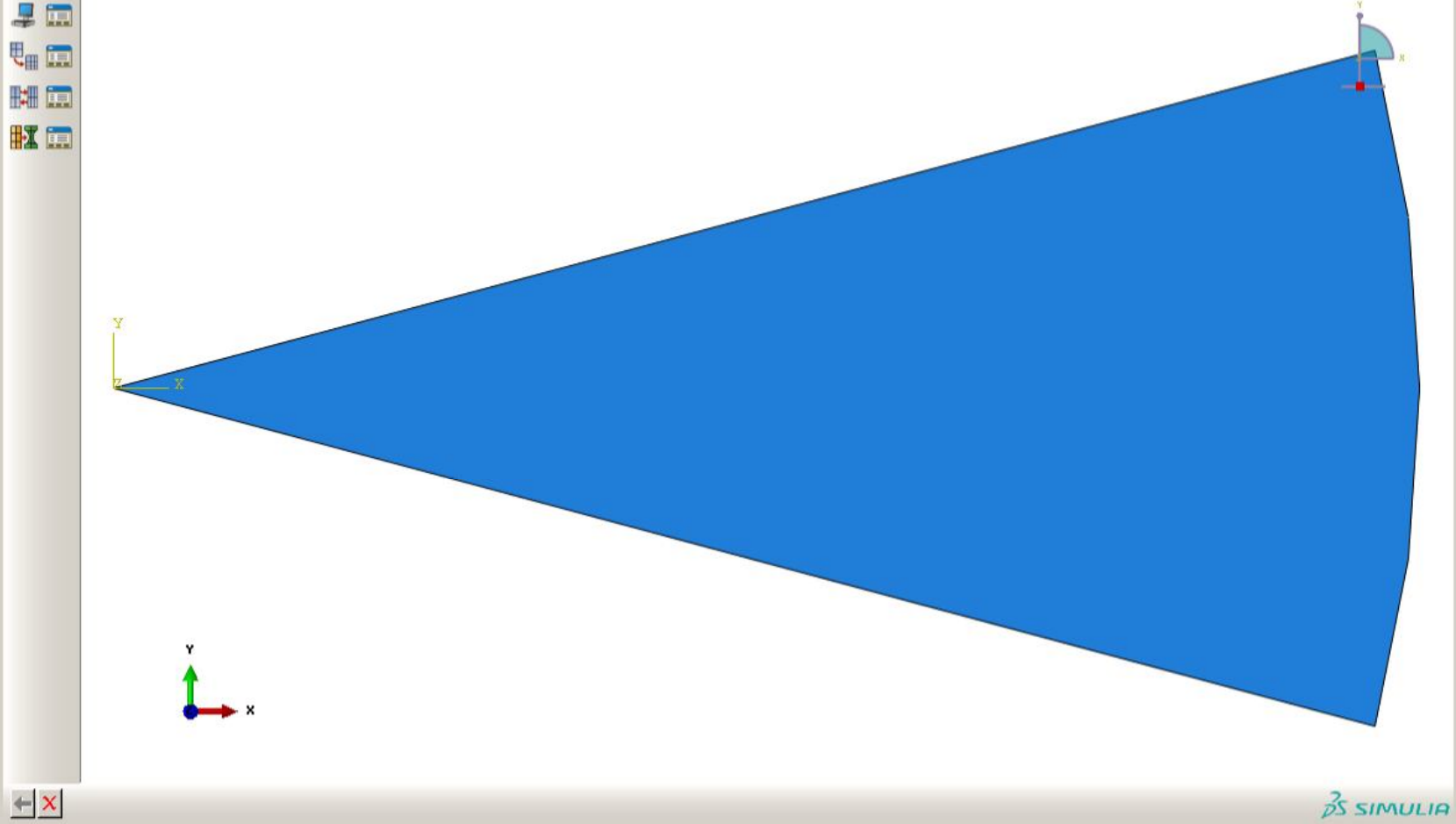
```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Shell planar-1

Analysis

- Job
 - the



>>>	Submit	59265)
>>>	Continue	59265)
>>>	Monitor...	59265)
>>>	Results	59265)
>>>	Kill	
>>>	Export	

submit the job for execution

Model Database

- Models (1)
 - Model-1
 - Parts (1)
 - the-part
 - Features (1)
 - Shell planar-1

Materials (1)

- the-material

Sections (1)

- the-section

Assembly

- Instances (1)
 - the-part-1

Features (1)

- Sets (2)
 - Set-1
 - Set-2

Steps (2)

- Initial
- the-step

Field Output Requests (1)

- F-Output-1

States (1)

- States (1)

Loads (1)

- the-body-load

BCs (1)

- the-BC

States (1)

- States (1)

Analysis

- Jobs (1)
 - the-job

Module: Job Model: Model-1 Step: the-step

Abaqus/CAE dialog box:

History output is not requested in the following steps:
the-step

OK to continue with job submission?

Yes No

at this point we do not worry about this

```
>>> 2.5*sin(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
0.647919690159197
>>> 2.5*cos(15./180.*3.1459265)
2.41458072449525
>>>
```

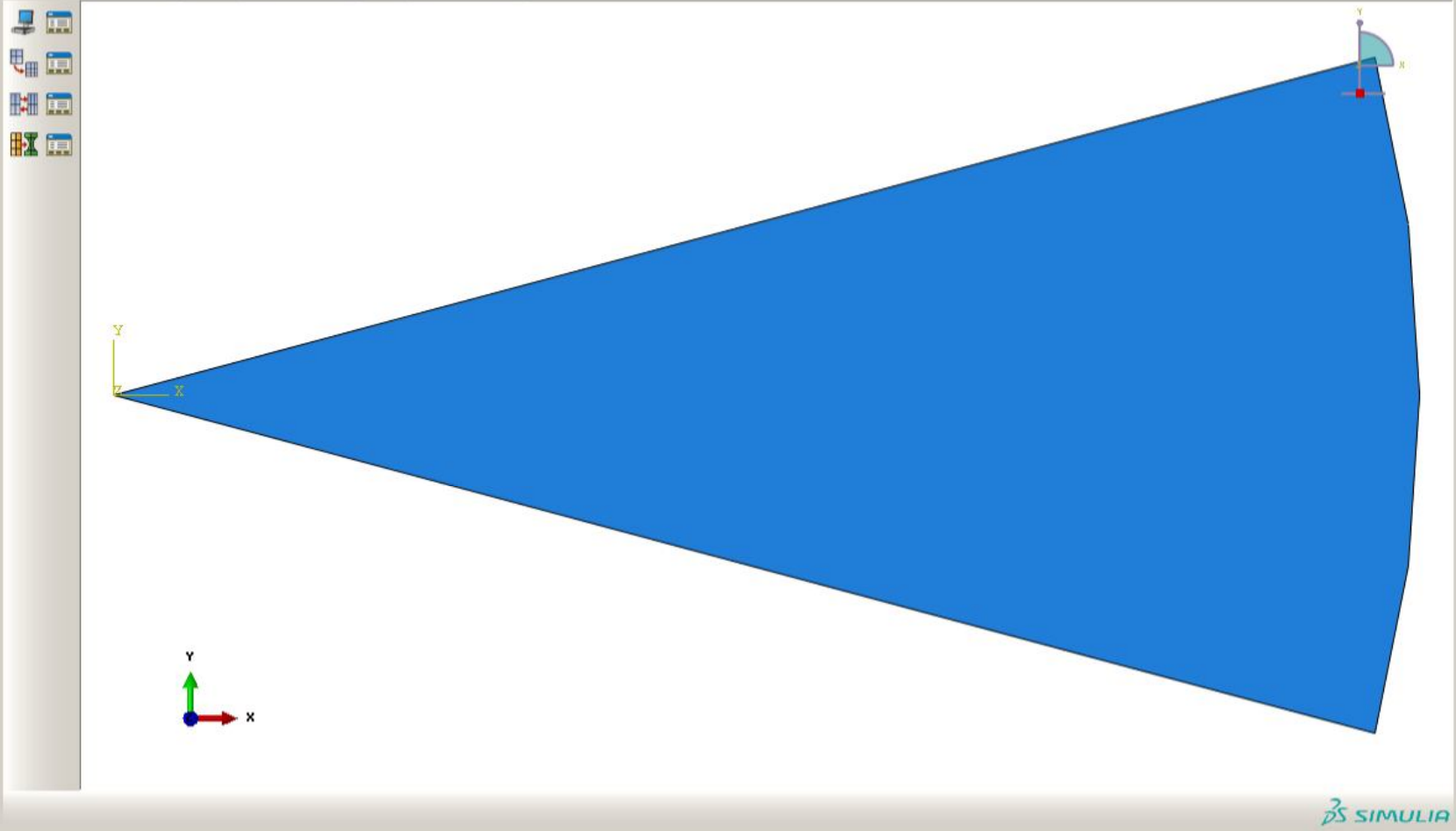
Model Database

- the-material
- Calibrations
- Sections (1)
 - the-section
 - Profiles
- Assembly
- Steps (2)
- Field Output Requests (1)
- History Output Requests
- Time Points
- ALE Adaptive Mesh Constraints
- Interactions
- Interaction Properties
- Contact Controls
- Contact Initializations
- Contact Stabilizations
- Constraints
- Connector Sections
- Fields
 - Discrete Fields
 - $f(x)$ Analytical Fields
 - Amplitudes
- Loads (1)
 - the-body-load
 - States (1)
- BCs (1)
 - the-BC
 - States (1)
- Predefined Fields
- Remeshing Rules
- Optimization Tasks
- Sketches

Annotations

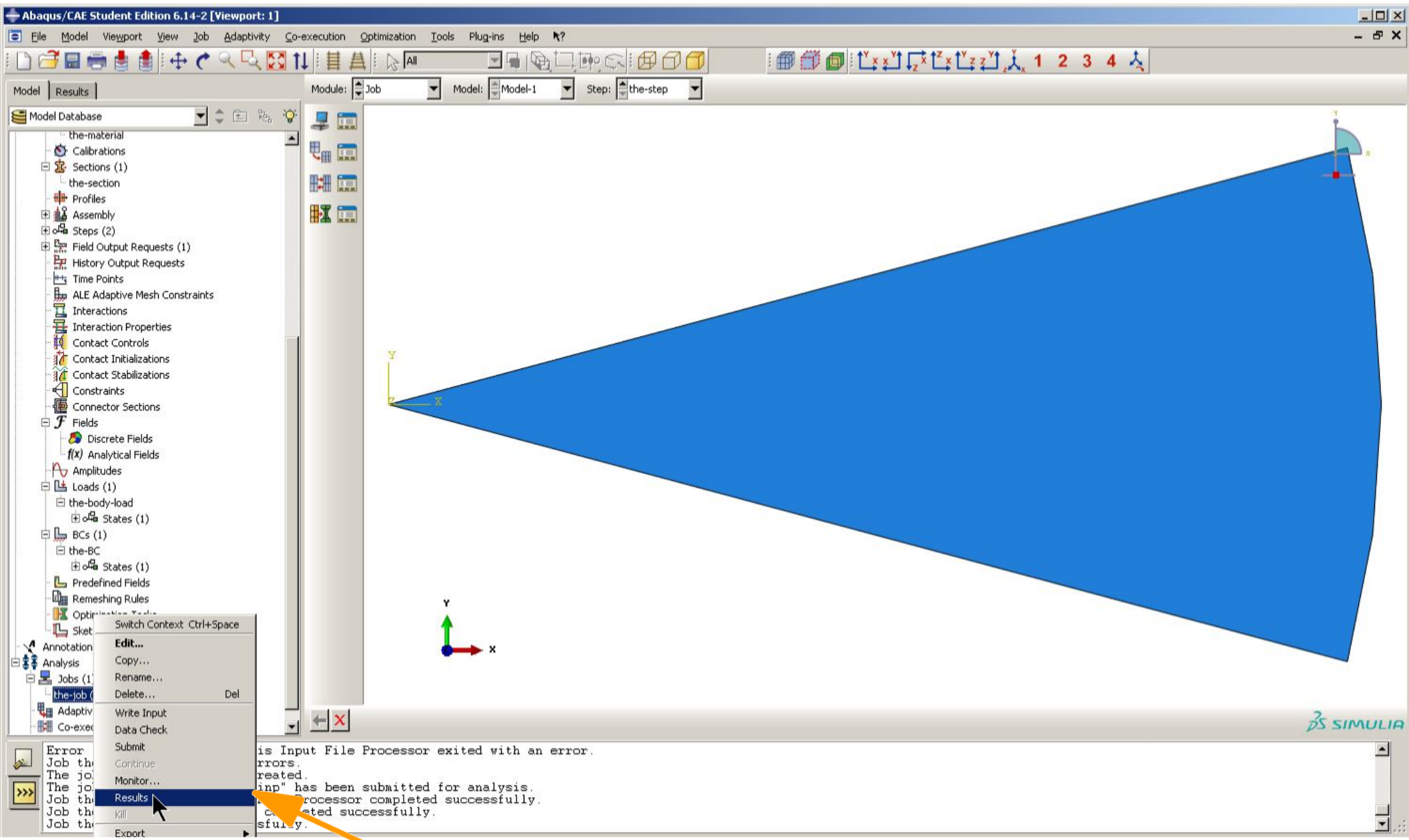
Analysis

- Jobs (1)
 - the-job (Completed)
- Adaptivity Processes
- Co-executions



```
Error in job the-job: Analysis Input File Processor exited with an error.  
Job the-job aborted due to errors.  
The job "the-job" has been created.  
The job input file "the-job.inp" has been submitted for analysis.  
Job the-job: Analysis Input File Processor completed successfully.  
Job the-job: Abaqus/Standard completed successfully.  
Job the-job completed successfully.
```

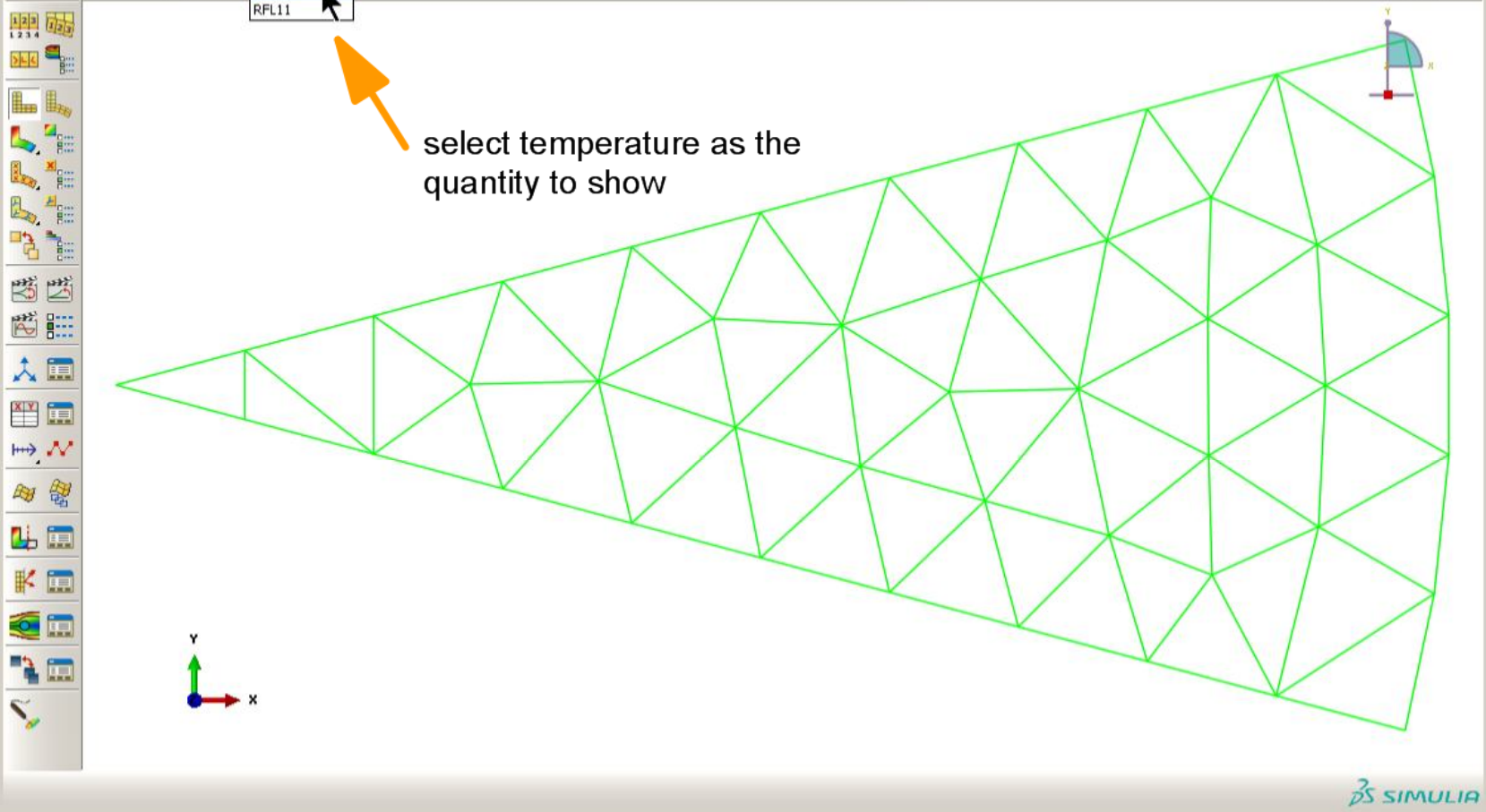
job completed successfully



let us look at the results

Session Data

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

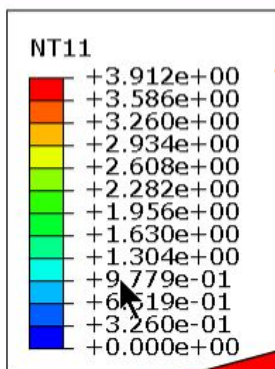


select temperature as the quantity to show

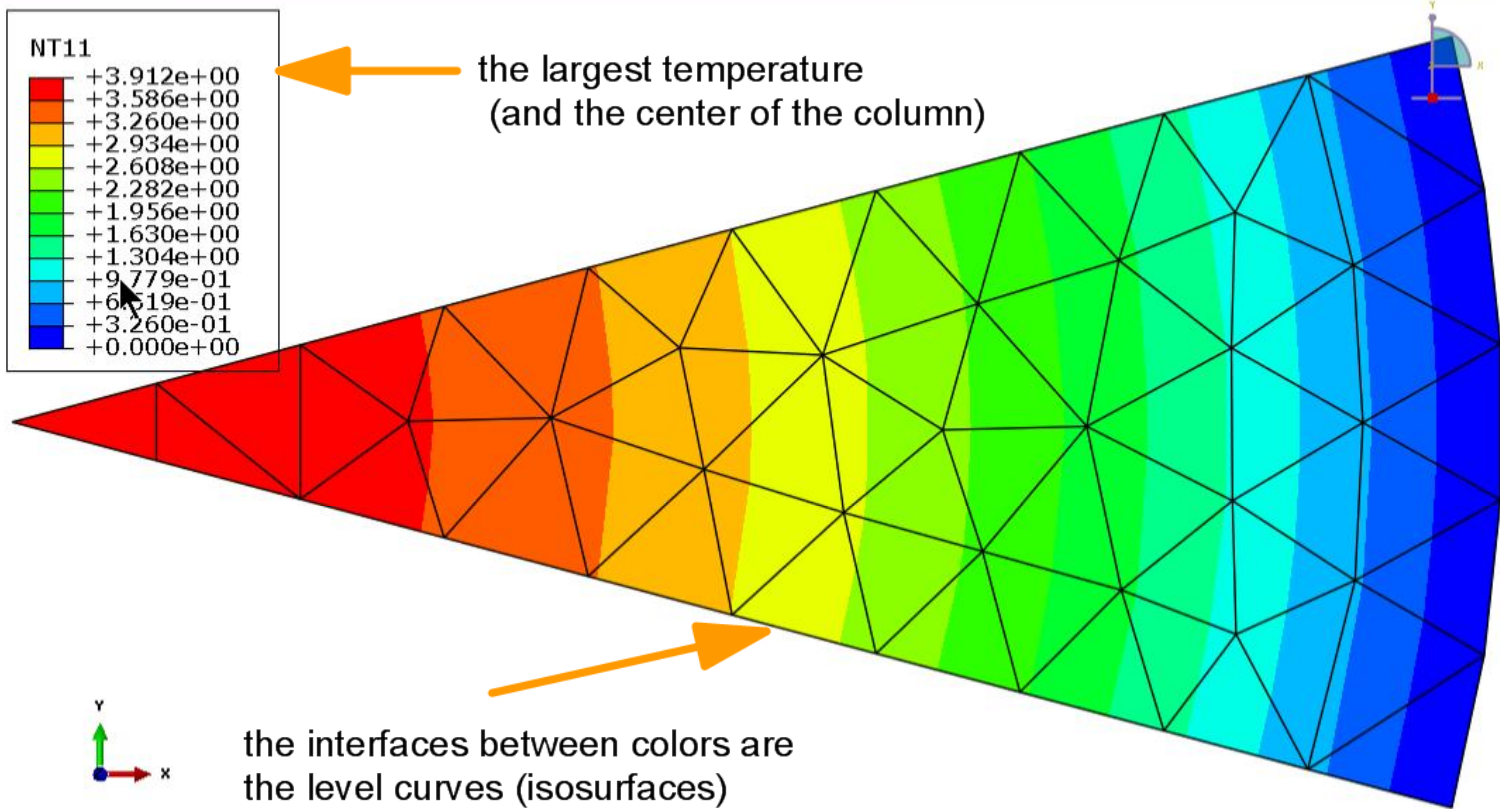
Error in job the-job: Analysis Input File Processor exited with an error.
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Session Data

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- Images



the largest temperature (and the center of the column)

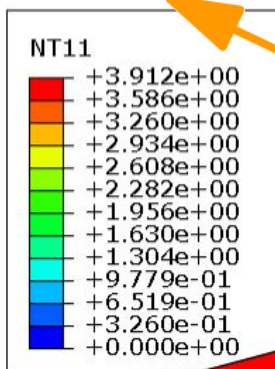


the interfaces between colors are the level curves (isosurfaces)

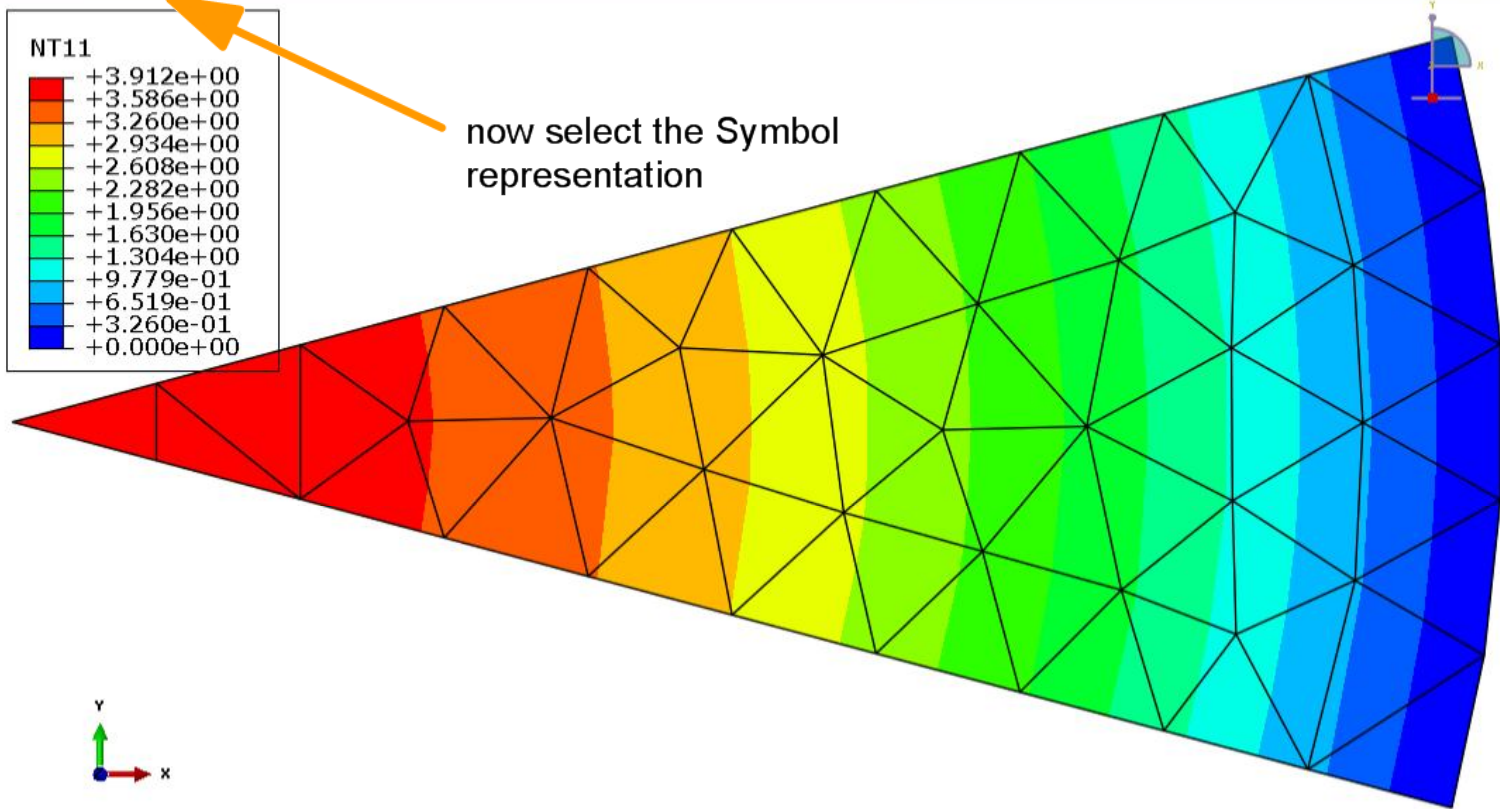
```
Error in job the-job: Analysis Input File Processor exited with an error.
Job the-job aborted due to errors.
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```

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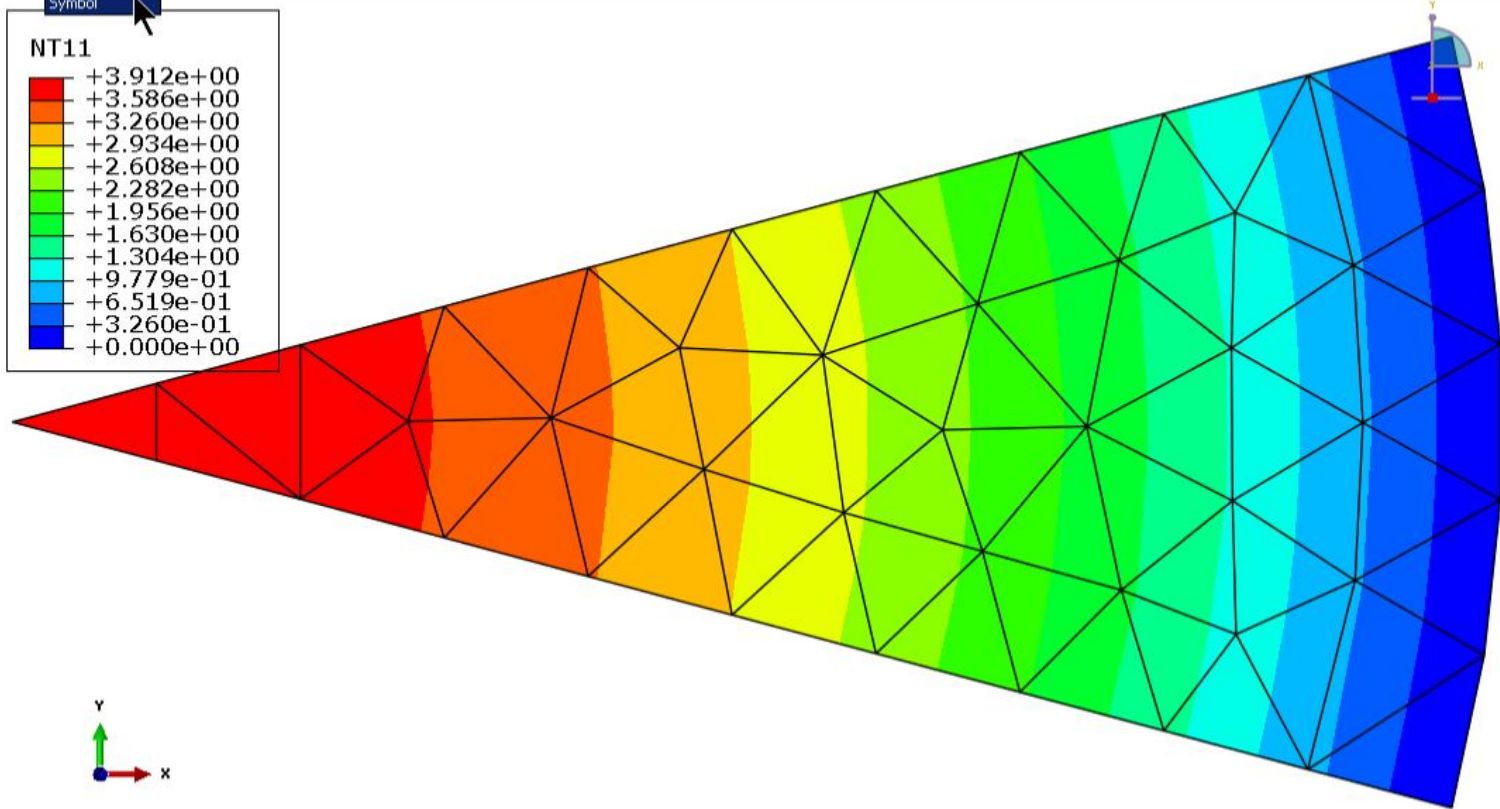
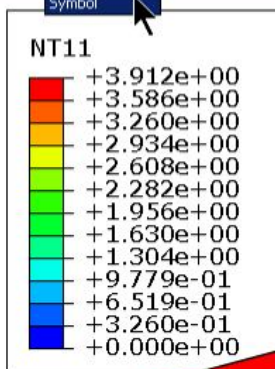
now select the Symbol representation



Error in job the-job: Analysis Input File Processor exited with an error.
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The job "the-job" has been created.
The job input file "the-job.inp" has been submitted for analysis.
Job the-job: Analysis Input File Processor completed successfully.
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Session Data

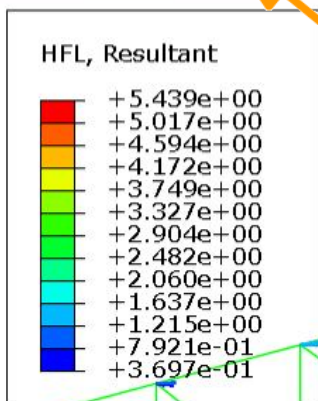
- Output Databases (2)
- Model Database (1)
- Spectrums (7)
- XYPlots
- XYData
- Paths
- Display Groups (1)
- Free Body Cuts
- Streams
- Movies
- Images



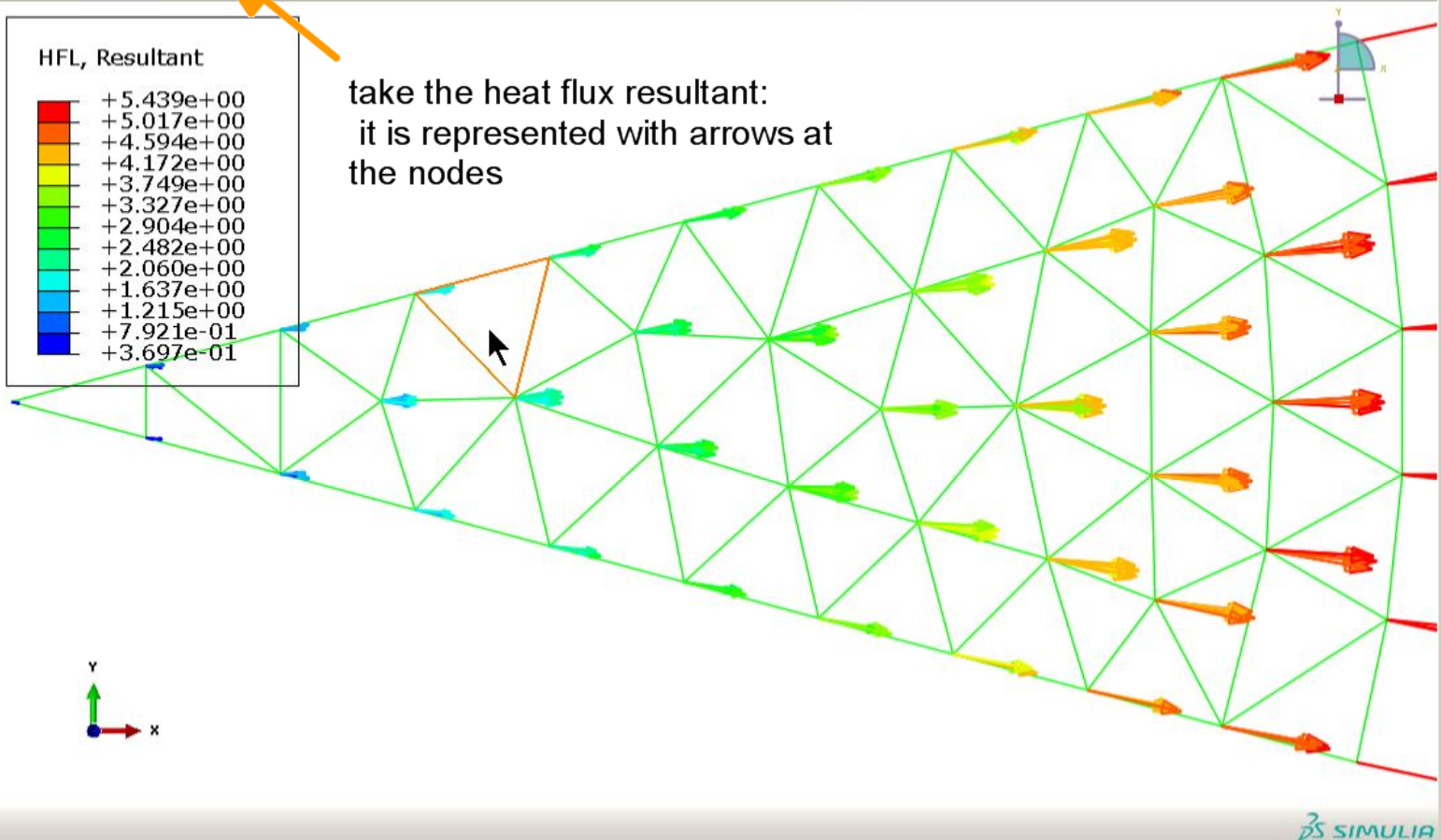
Error in job the-job: Analysis Input File Processor exited with an error.
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Session Data

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take the heat flux resultant:
it is represented with arrows at
the nodes



Error in job the-job: Analysis Input File Processor exited with an error.
Job the-job aborted due to errors.
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