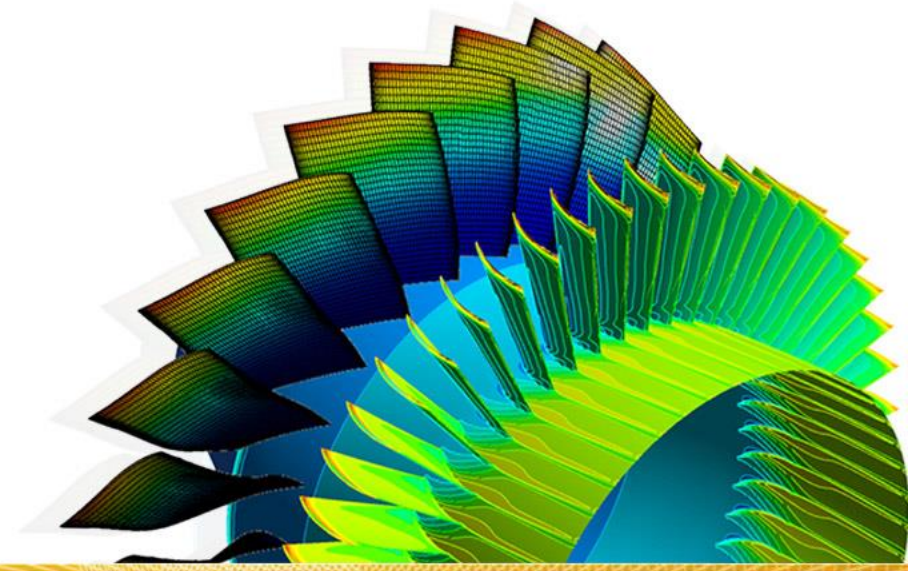
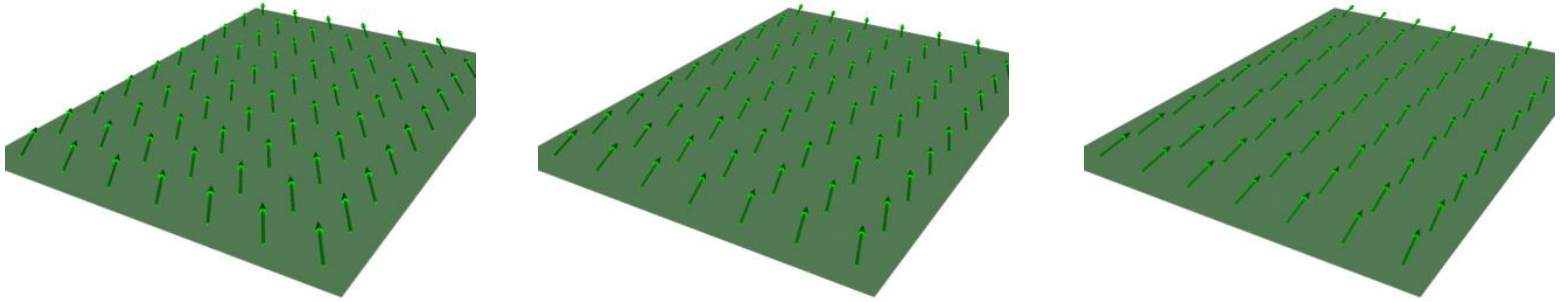
ANSYS Composite PrepPost 19.0

Workshop 03.1 – Introduction to ANSYS Composite PrepPost



1. Introduction Workshop

- In this workshop we will create a simple plate with five plies
- The plies will be stacked up as a (30°,-30°,0°,-30°,30°) layup
- We will use material from the engineering database in ANSYS and go through the modeling process of the composite layup. The solution process and postprocessing process will be covered in the next workshop (kiteboard)



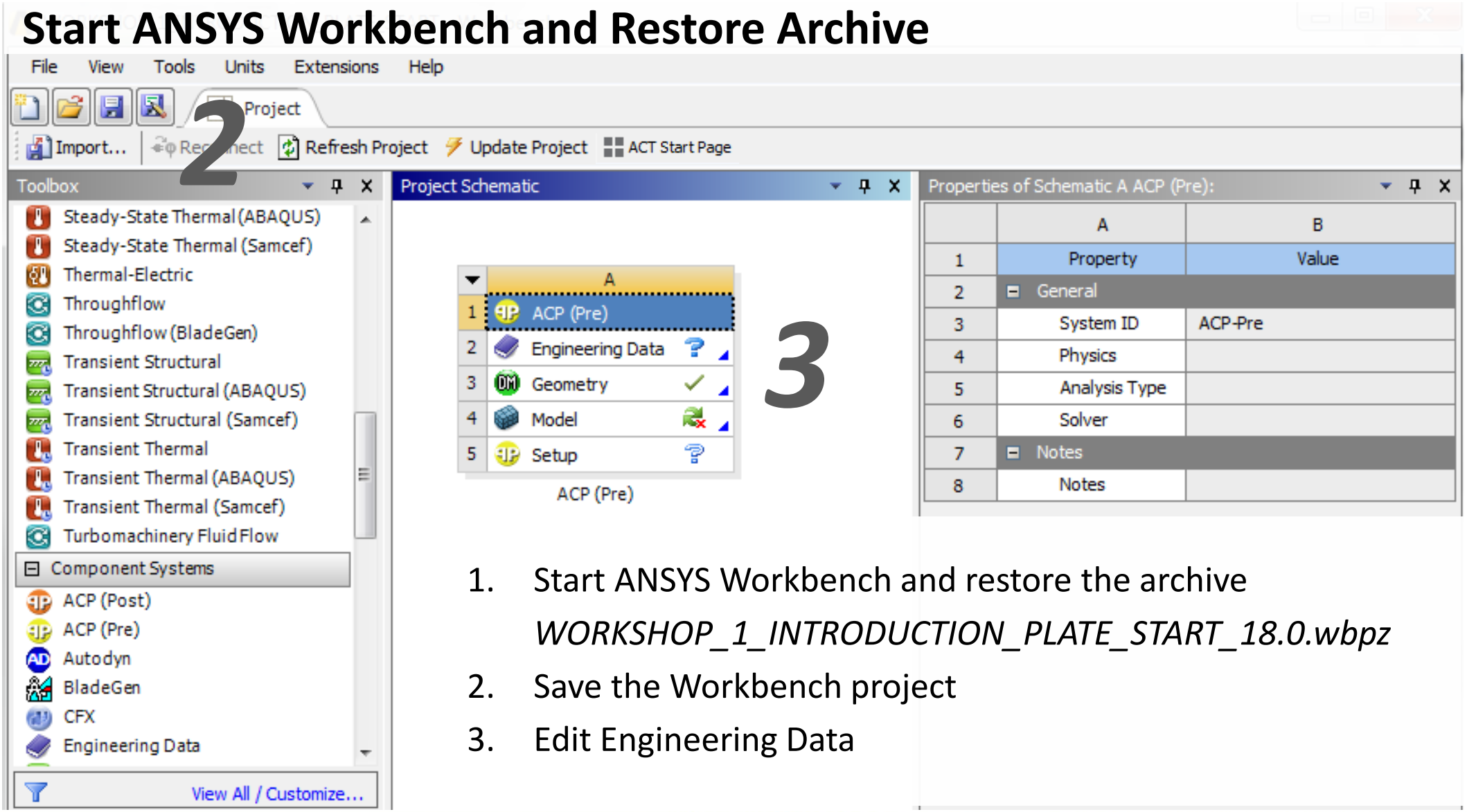
1. Introduction Workshop

Agenda

- Integration in ANSYS Workbench
- Use Engineering Database
- Define Fabrics
- Define a Rosette
- Create an Oriented Selection Set
- Create a Modeling Ply
- Reference Directions, Orientations and Fiber Directions

1. Introduction Workshop

Start ANSYS Workbench and Restore Archive

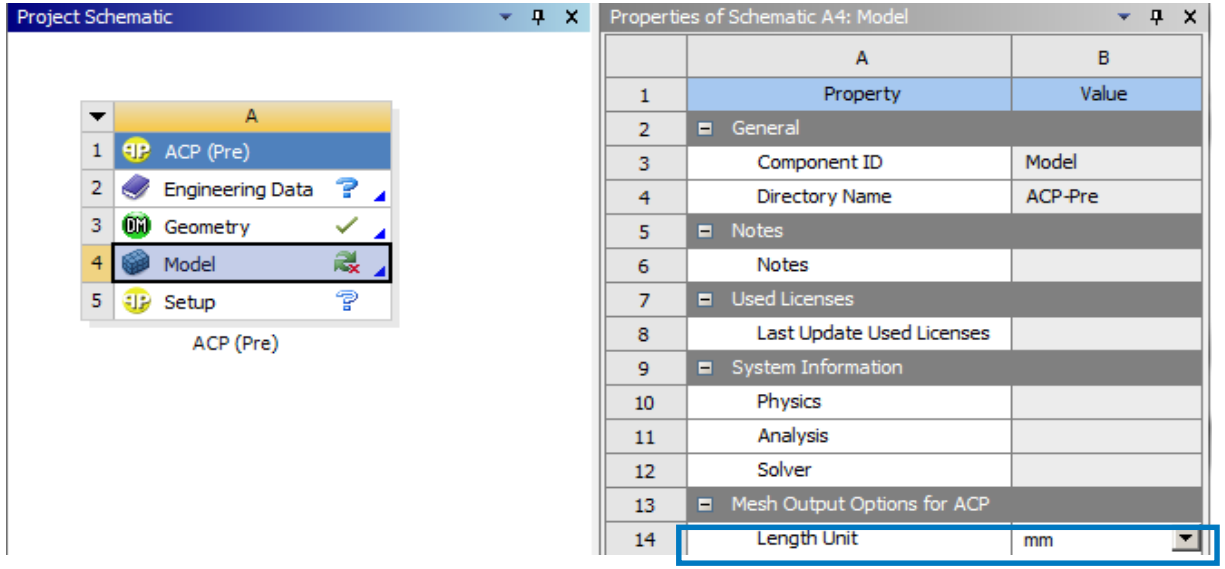


1. Start ANSYS Workbench and restore the archive *WORKSHOP_1_INTRODUCTION_PLATE_START_18.0.wbpz*
2. Save the Workbench project
3. Edit Engineering Data

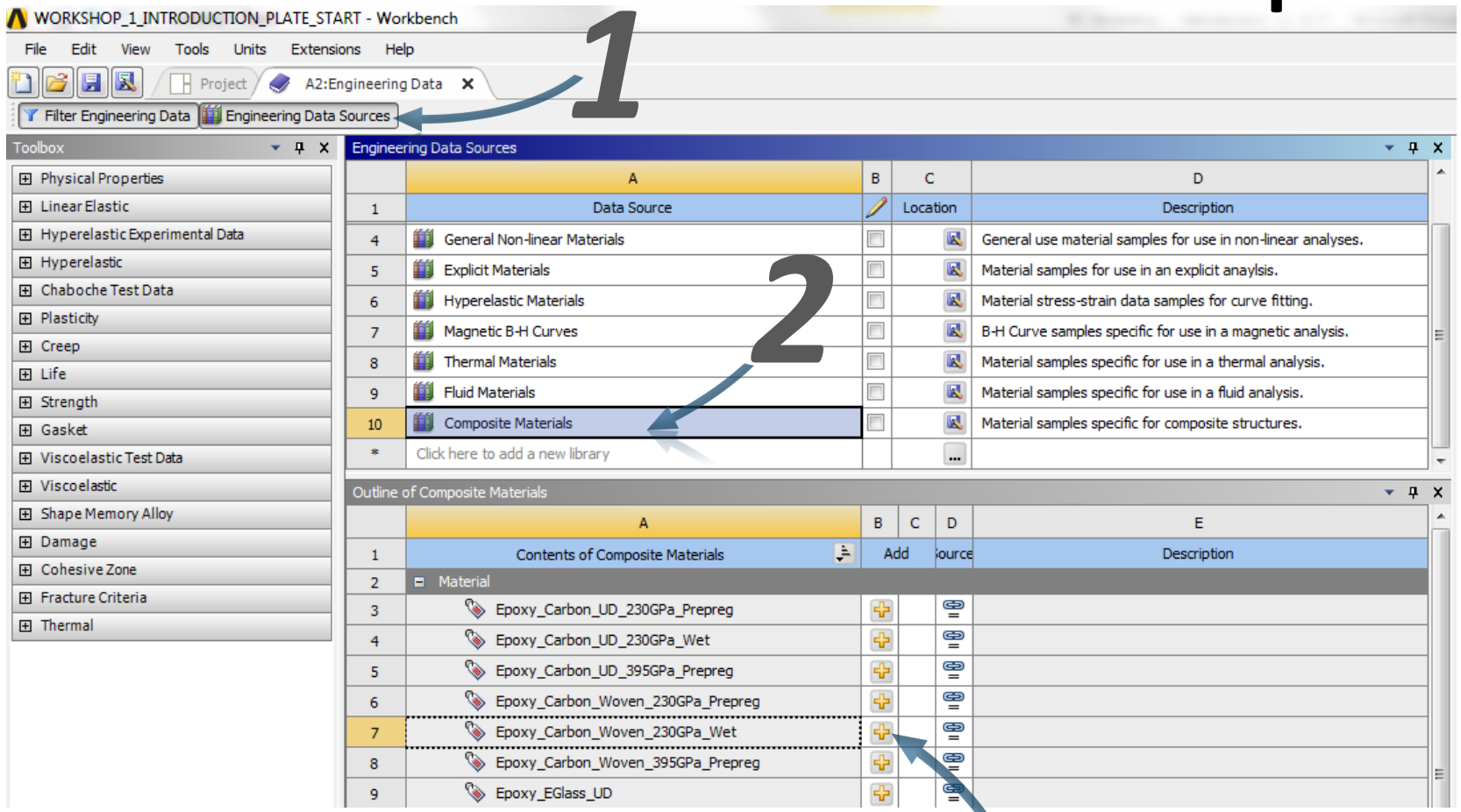
1. Introduction Workshop

Unit System in ANSYS Composite PrePost

- The unit system in ANSYS Composite PrePost is usually defined by the unit system of the CAD model
- The default unit system in ANSYS Composite PrePost is defined to the default system you specified for ANSYS Workbench
- You can switch unit system used inside ACP by changing the mesh output unit system of Mechanical Mesh on Project Schematic

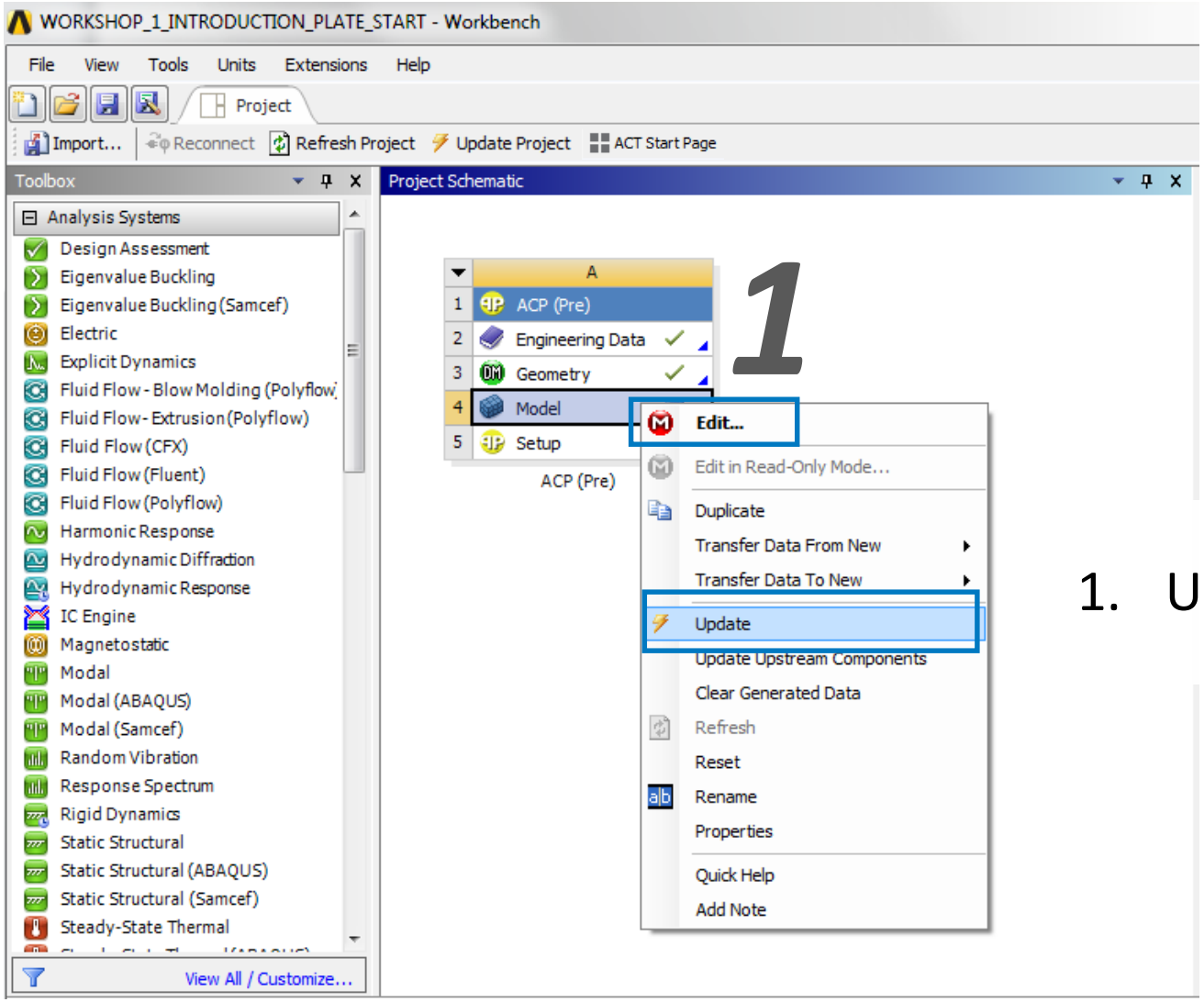


1. Introduction Workshop



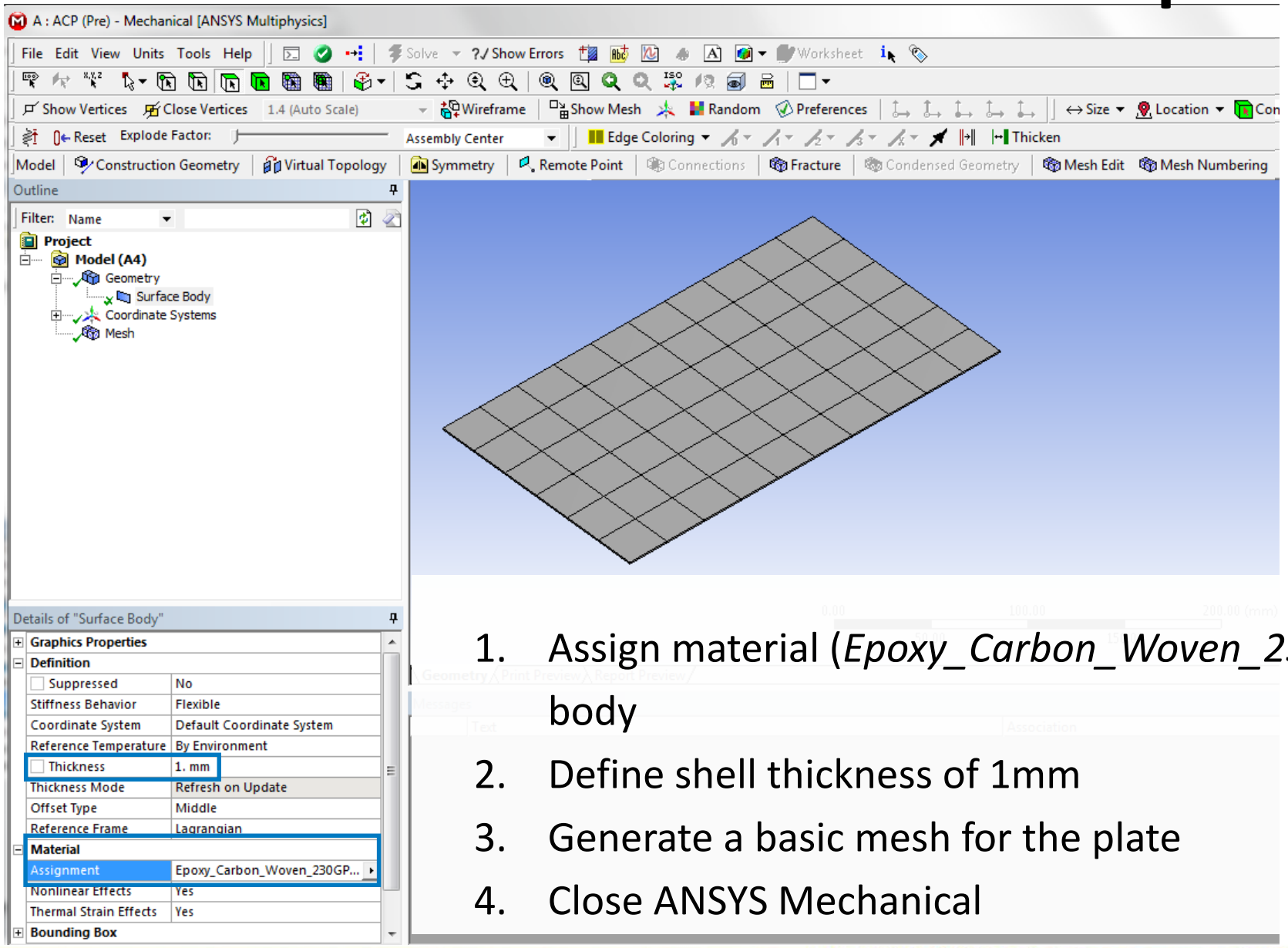
1. Switch to Engineering Data Sources
2. Go to Composite Materials
3. Select *Epoxy_Carbon_Woven_230GPa_Wet* and add it to Engineering Data
4. Return to Project

1. Introduction Workshop



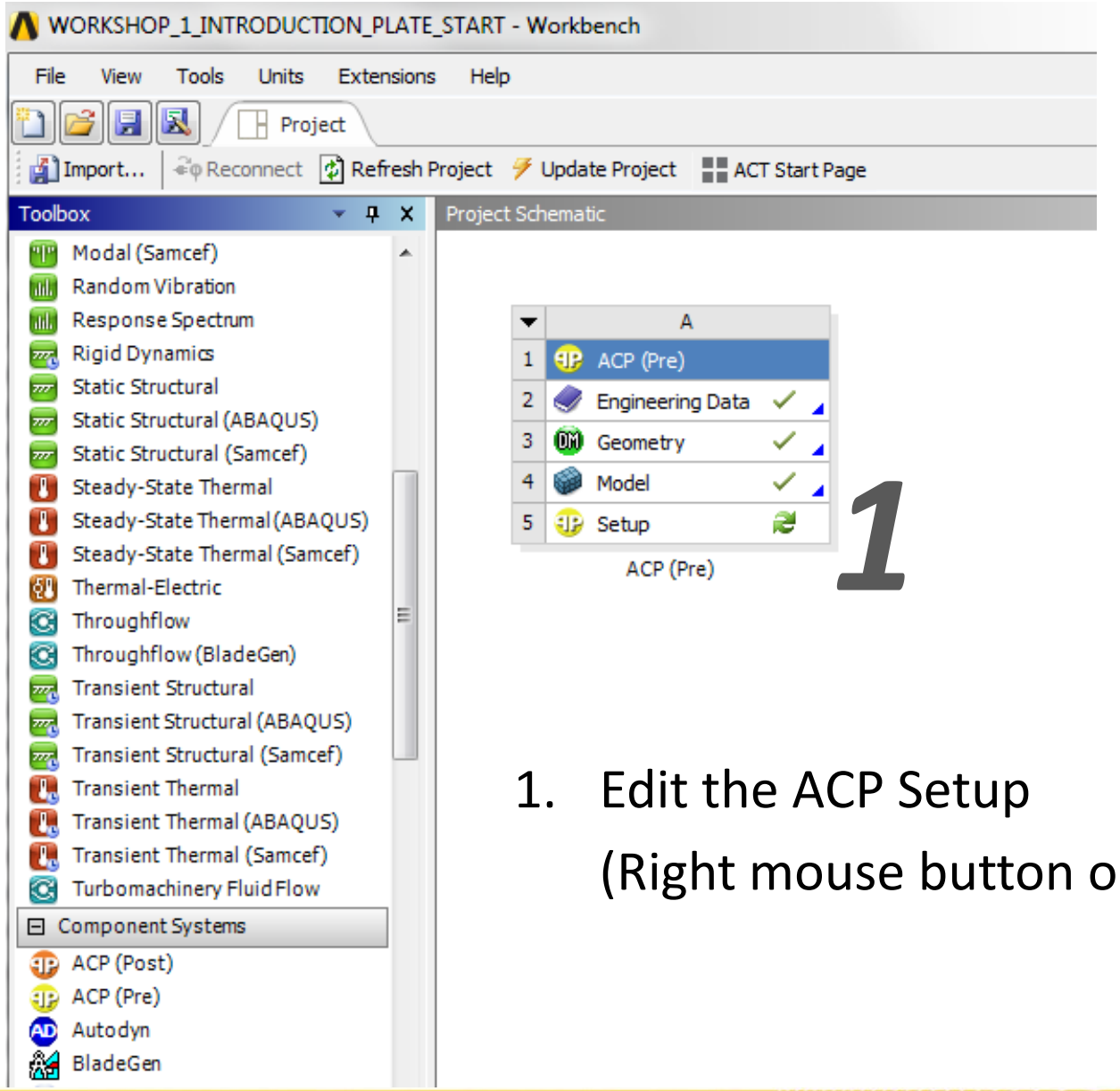
1. Update and Edit Model in ANSYS Mechanical

1. Introduction Workshop



1. Assign material (*Epoxy_Carbon_Woven_230GPa_Wet)* to surface body
2. Define shell thickness of 1mm
3. Generate a basic mesh for the plate
4. Close ANSYS Mechanical

1. Introduction Workshop



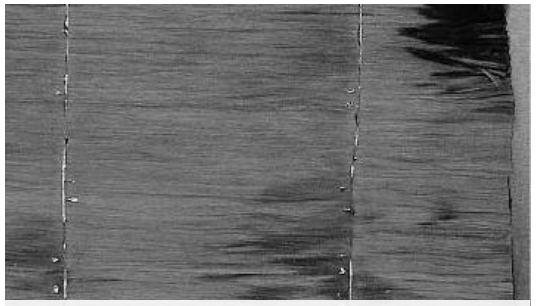
1. Edit the ACP Setup

   (Right mouse button on Setup → Edit, or double-click on Setup)

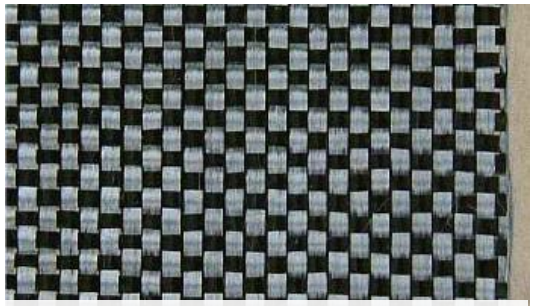
1. Introduction Workshop

Fabrics

- As a first step in ANSYS Composite PrepPost we will define the fabrics we are going to use for our composite design
- Fabrics are defined by a material, which we have already defined in the Engineering Data, and a thickness
- The type of fabric (UD, Woven, Core,…) is indirectly defined by the material

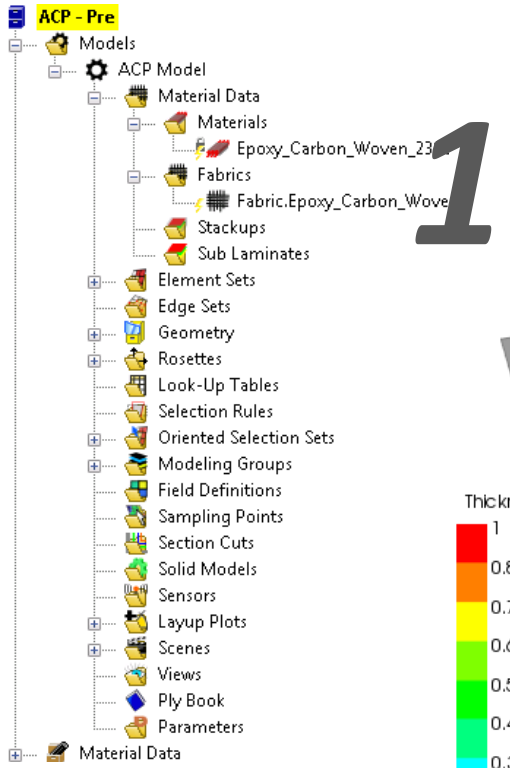


Unidirectional

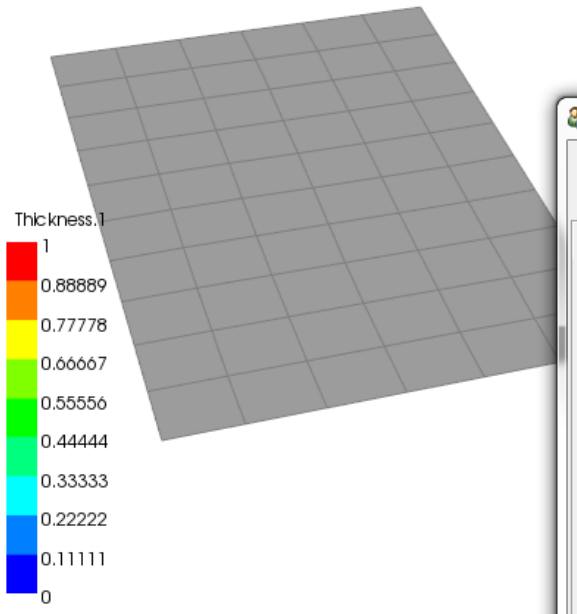


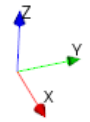
Woven

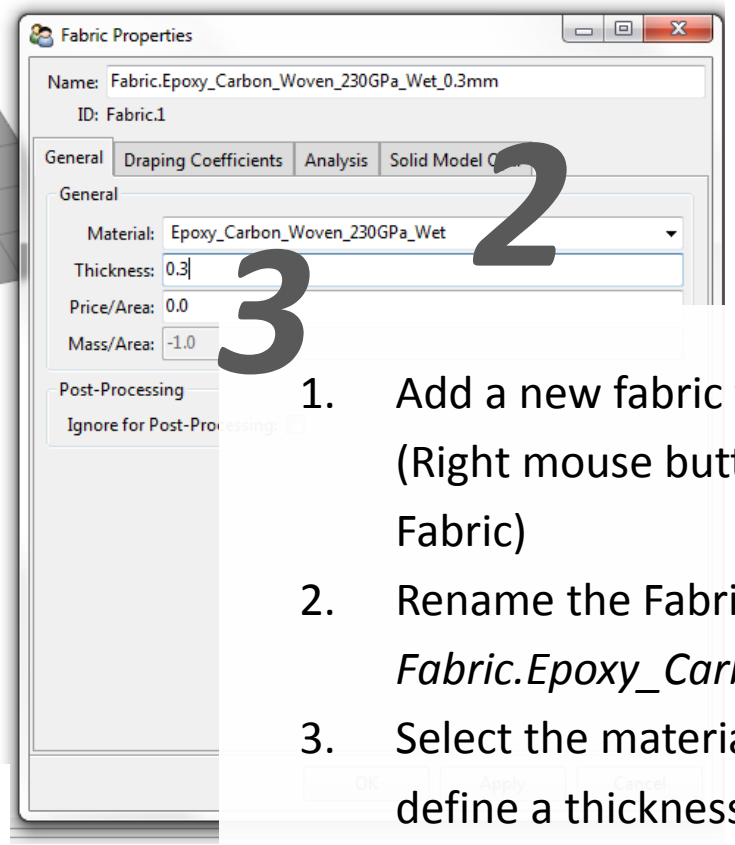
1. Introduction Workshop



1







2

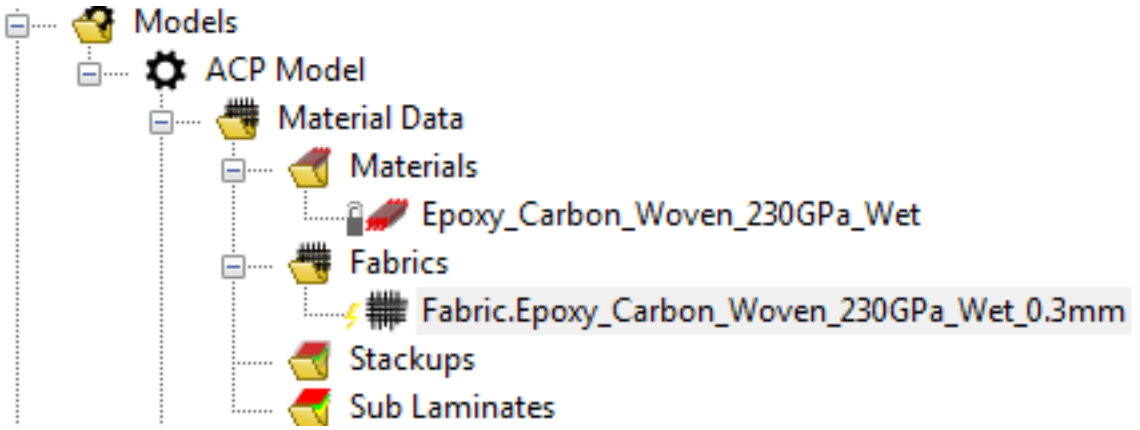
3

1. Add a new fabric to the model (Right mouse button on Fabrics → Create Fabric)
2. Rename the Fabric to *Fabric.Epoxy_Carbon_Woven_0.3mm*
3. Select the material used for the fabric and define a thickness for the fabric of *0.3mm*

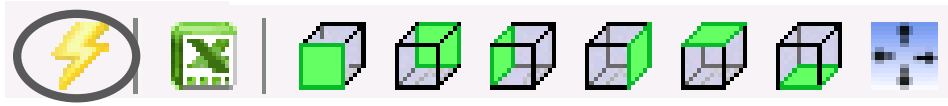
1. Introduction Workshop

The Update Function

- The ANSYS Composite PrepPost model requires an update whenever we define a new item or modify one
- This is indicated by a yellow lightning next to the items in the tree
- Please remember to update your model whenever you add new items or modify some



Update Required

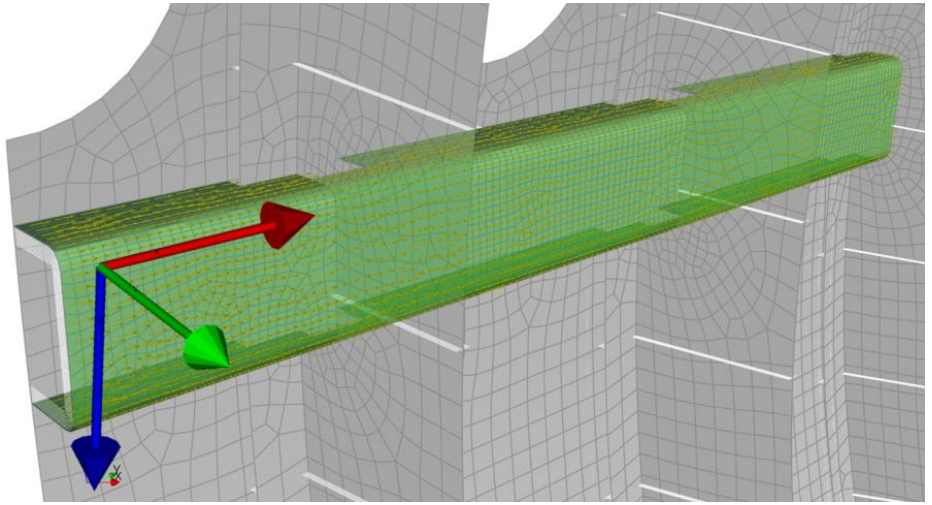


Update Button in the Task Bar

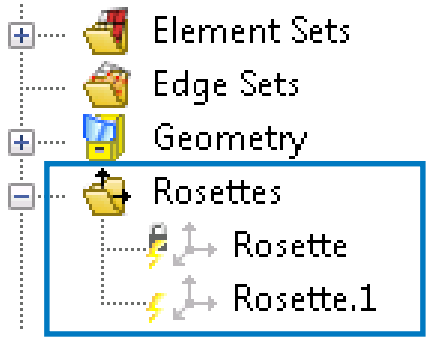
1. Introduction Workshop

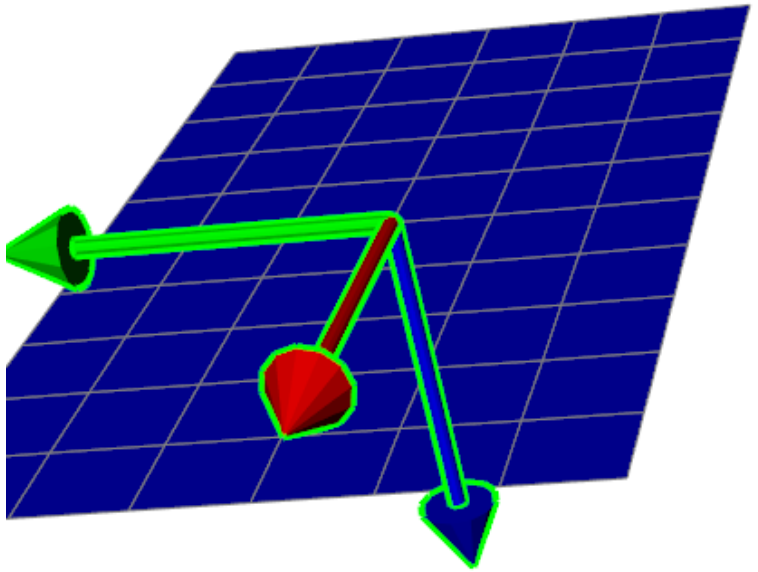
Rosettes

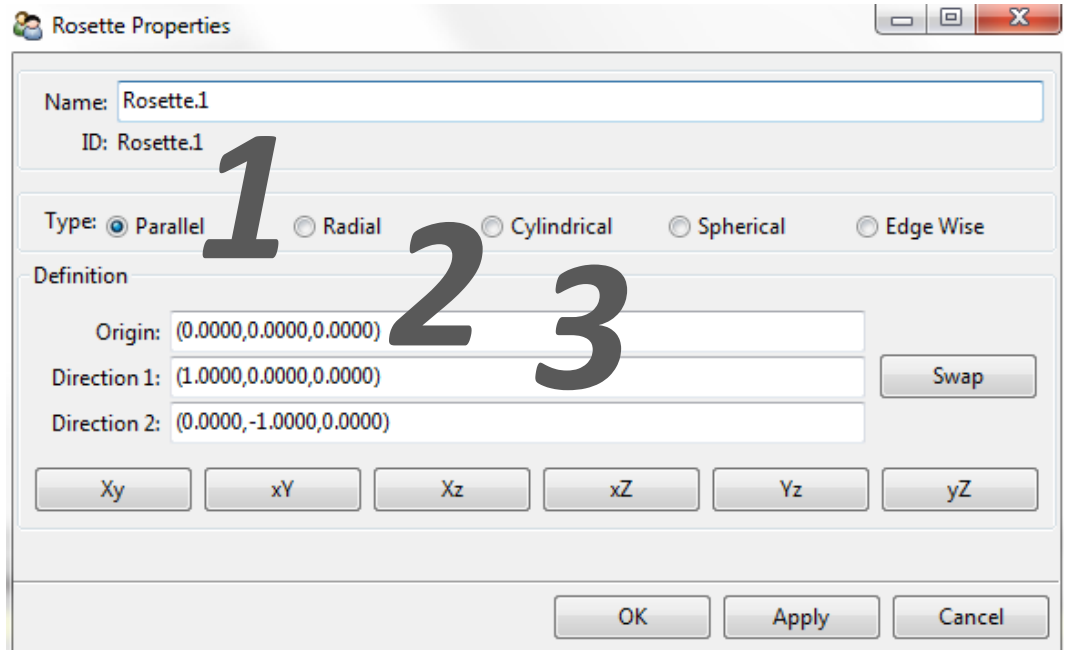
- Rosettes are used to define the 0° fiber direction or also called reference direction
- We will define a parallel rosette for our introduction example
- Rosettes X-Achsis are used to define 0° - direction



1. Introduction Workshop

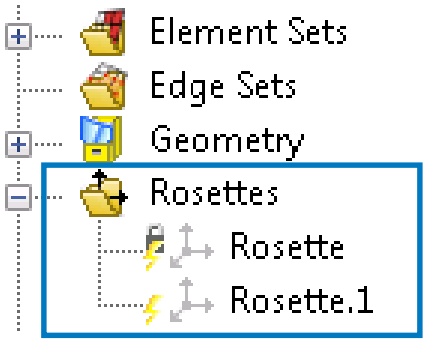


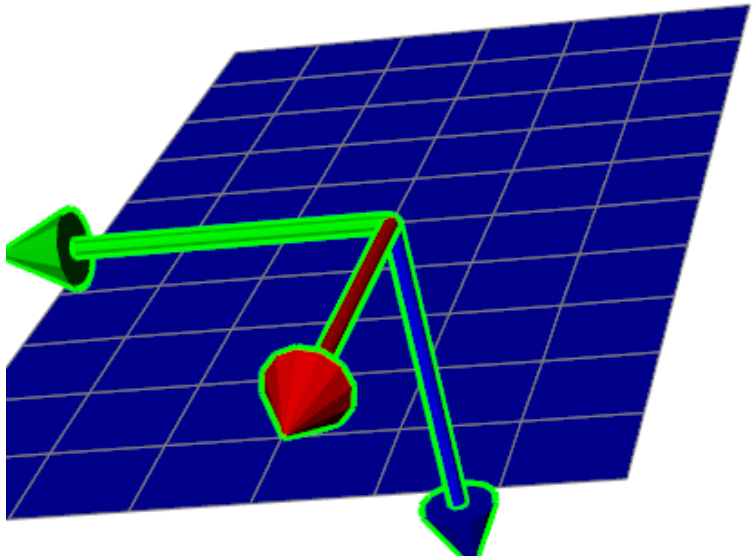


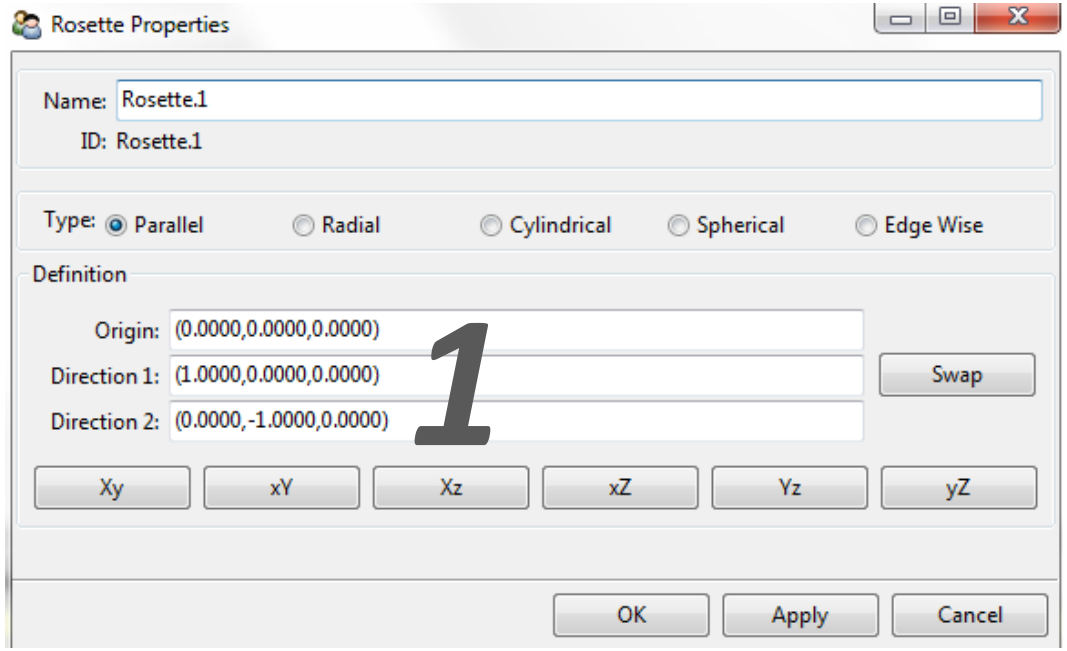


1. Add a new rosette to the model and define the rosette type as parallel
   (Right mouse button on Rosettes → Create Rosette)
2. Define the origin of the rosette to (0, 0, 0) if necessary (Click into the white area behind origin and type in the origin)
3. Define the x-axis of the rosette by specifying Direction 1 to (1,0,0)
   (Click into the white area behind Direction 1 and type in vector for the x-axis which is based on the global coordinate system)

1. Introduction Workshop







1. Define the y-axis of the rosette by specifying Direction 2 to (0,-1,0)
   (Click into the white area behind Direction 2 and type in vector for the y-axis which is based on the global coordinate system)

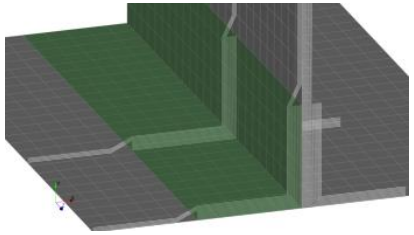
- *In the next workshops (Kiteboard, T-Joint) we will use more convenient ways to define locations and directions in ANSYS Composite PrepPost*

1. Introduction Workshop

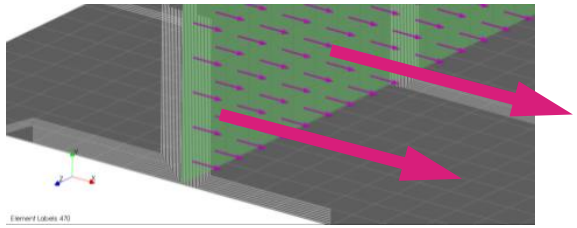
Oriented Selection Sets

- The next step is to define the Oriented Selection Sets we use to model our composite layup
- Oriented Selection Sets contain information about the layup area, the layup direction and the reference direction for the fiber orientations
- Layers of the composite design are then placed on the oriented selection set

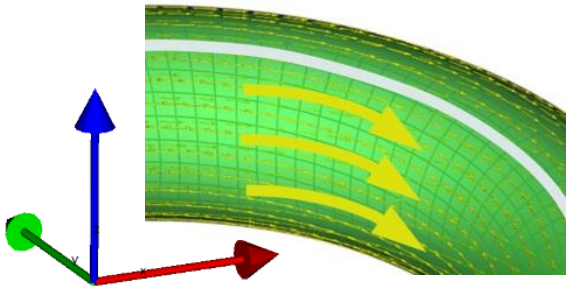
Layup Area



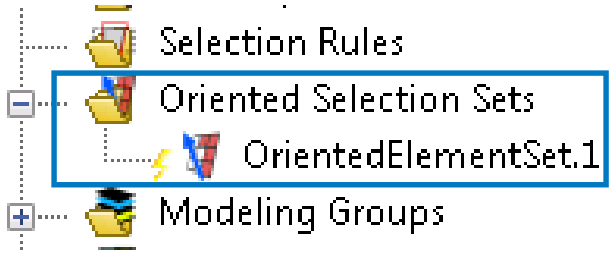
Layup Direction

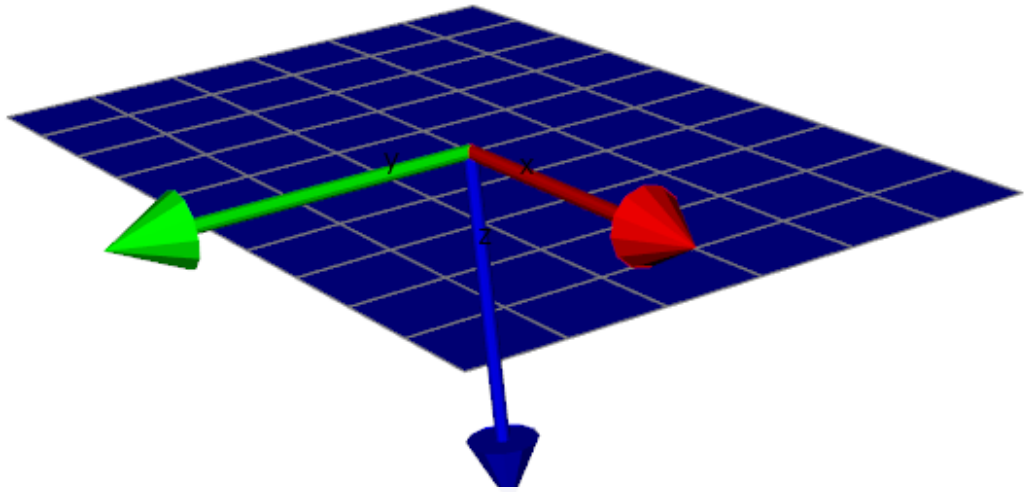


Reference Direction



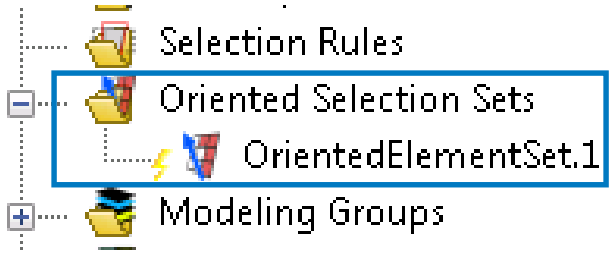
1. Introduction Workshop

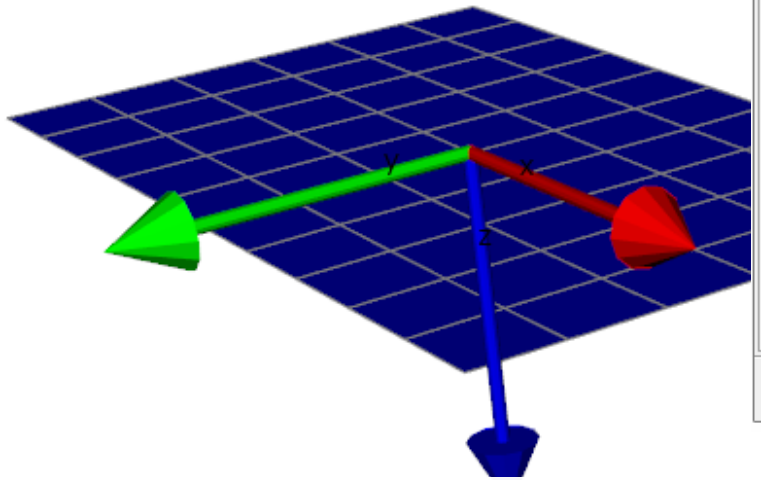


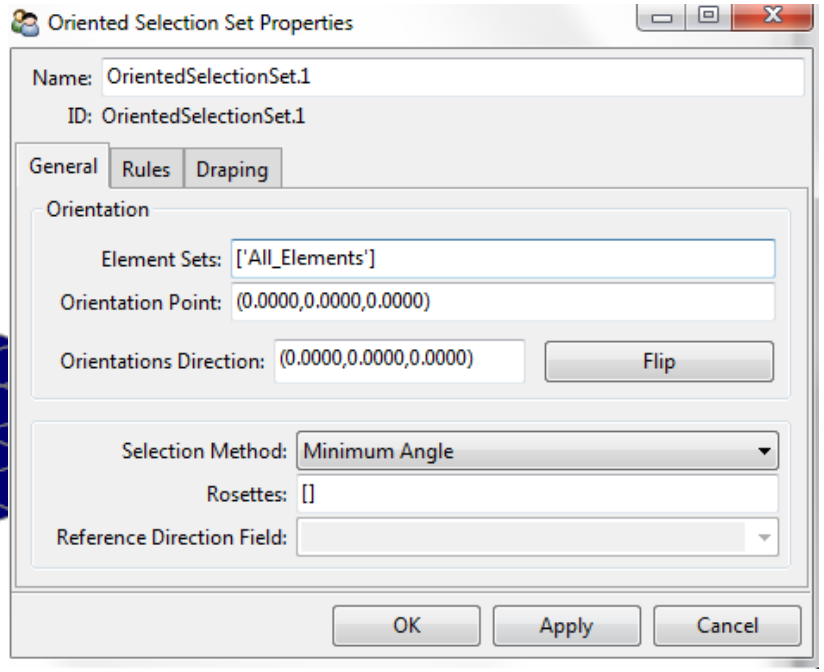


1. Create a new oriented selection set (Right mouse button on Oriented Selection Sets → Create Oriented Selection Set)

1. Introduction Workshop







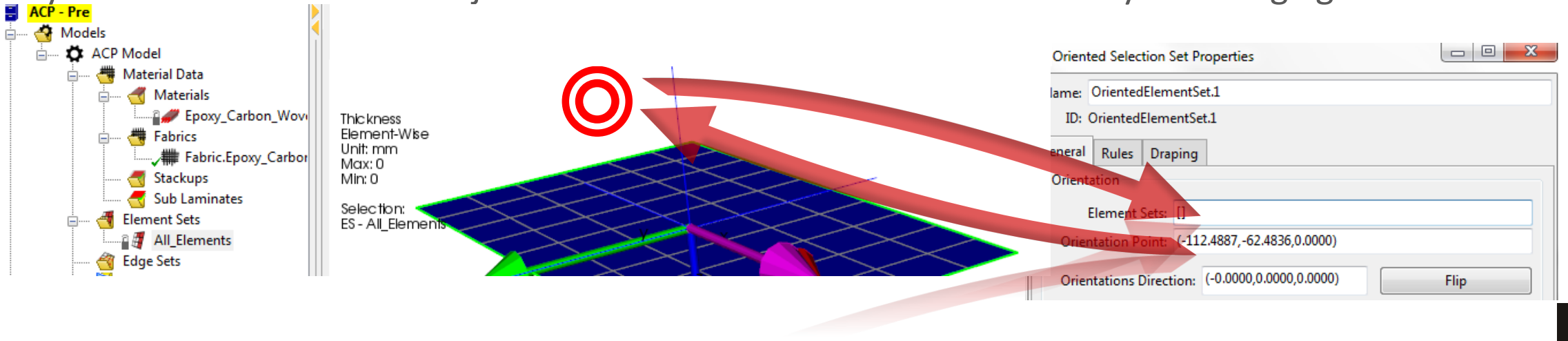
1. The layup area is defined by selecting element sets (Click into the white area behind Element Sets and select the element set **All_Elements**)

1. Introduction Workshop

Tip: Reselecting

- Sometimes you will experience that items you want to select are not selectable (for example when selecting the element set a step before)
- In this case it helps to click with a left mouse click somewhere into the model and try to select the item you want to select again

If you can not select an item just click somewhere in the model and try selecting again

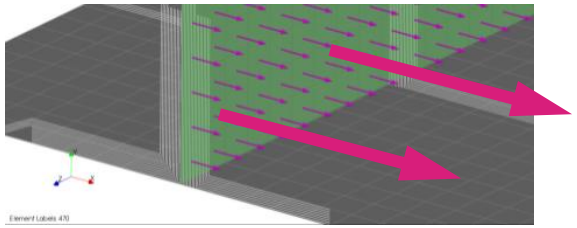


1. Introduction Workshop

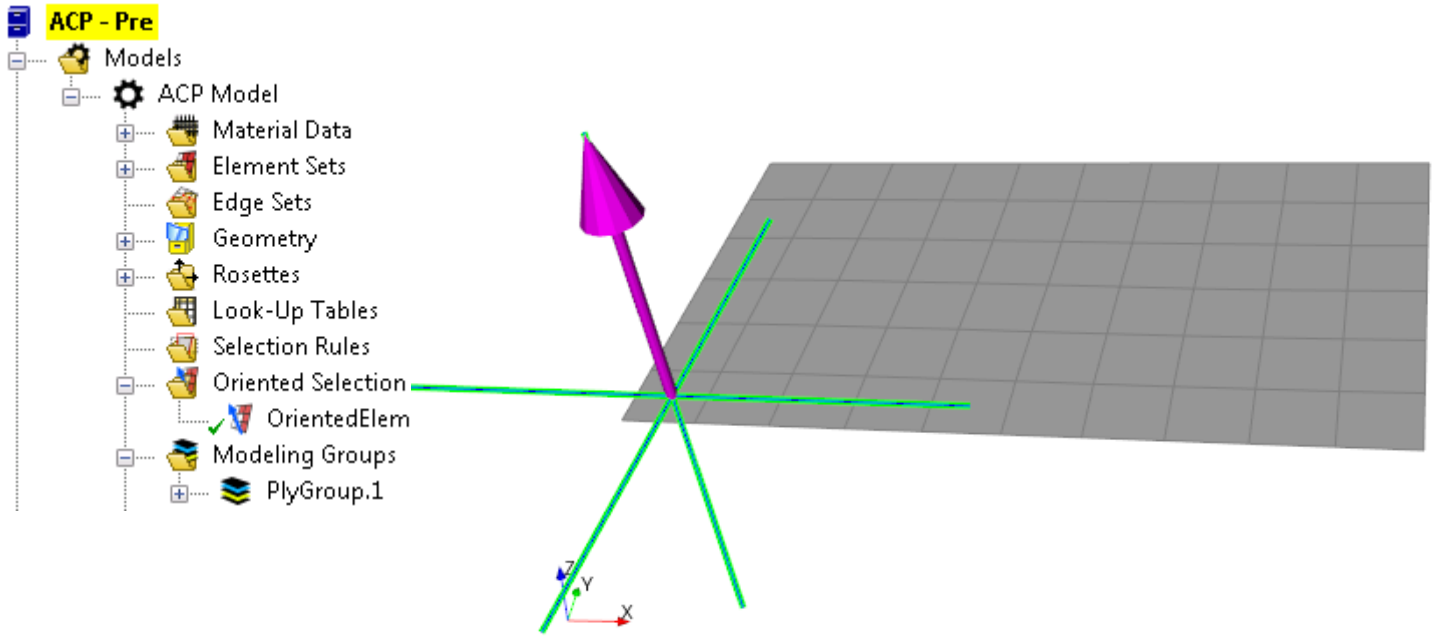
Oriented Selection Sets

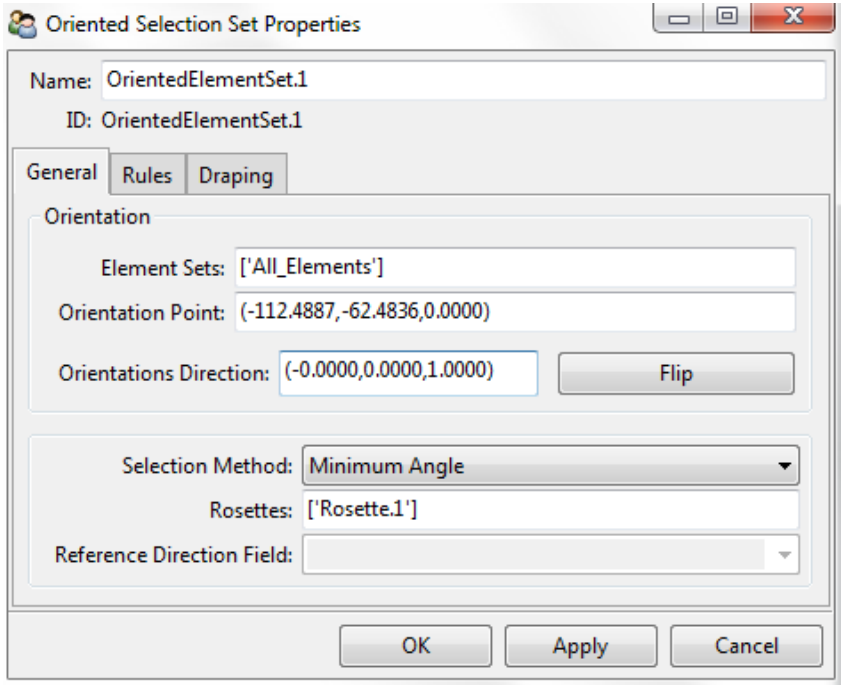
- The next purpose of the oriented selection set is to define the direction in which we place the layers on the mold surface
- The direction (orientation direction) is either going in the normal direction of the elements or opposite to the normal direction

Layup Direction



1. Introduction Workshop





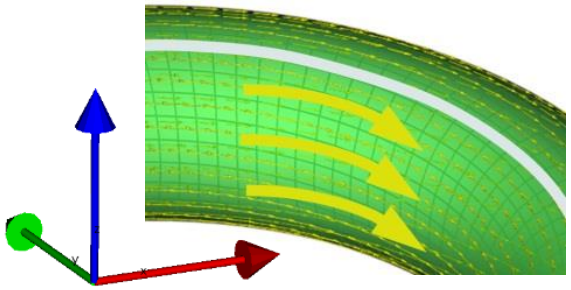
1. Define the orientation direction by clicking into the white area behind Orientation Point and selecting an element of the model
2. The normal of the element will automatically define the orientation direction. The direction can be flipped to the opposite direction

1. Introduction Workshop

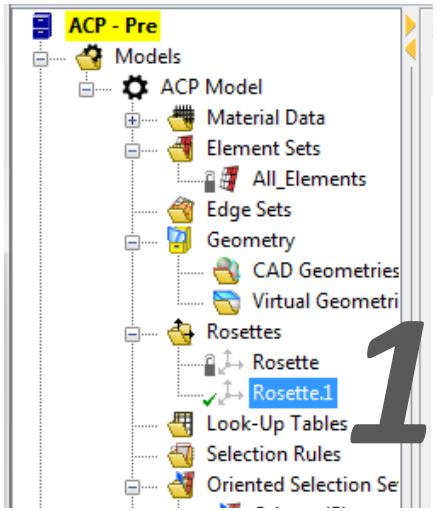
Oriented Selection Sets

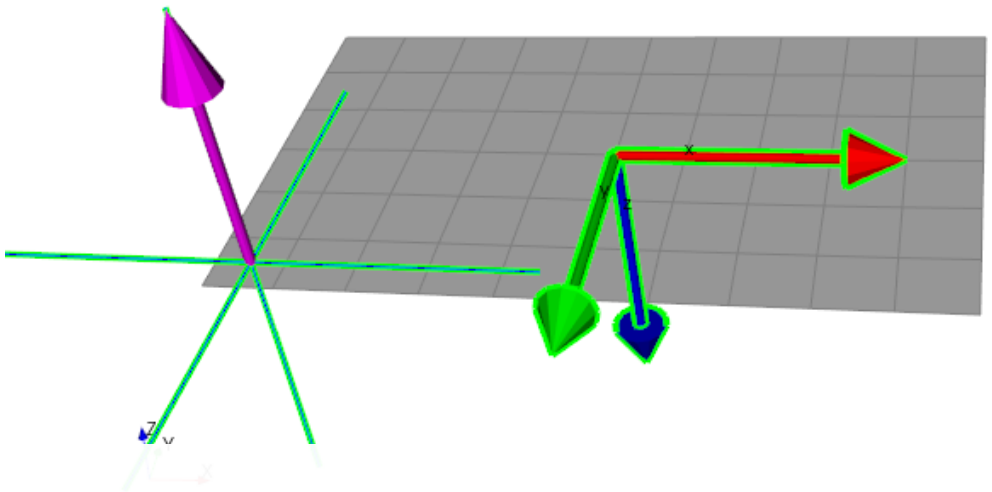
- The last purpose of the oriented selection sets is to define the reference direction or 0° fiber direction
- When we place fabrics on the oriented selection set we can define angles. These angles refer to the reference direction specified now
- Each element defines its own reference direction based on the selected rosettes

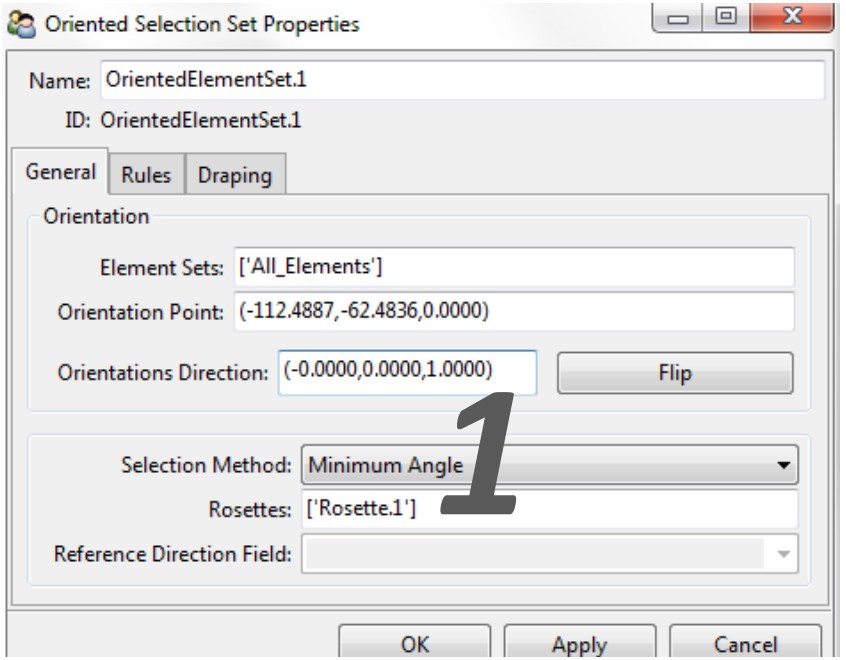
Reference Direction



1. Introduction Workshop



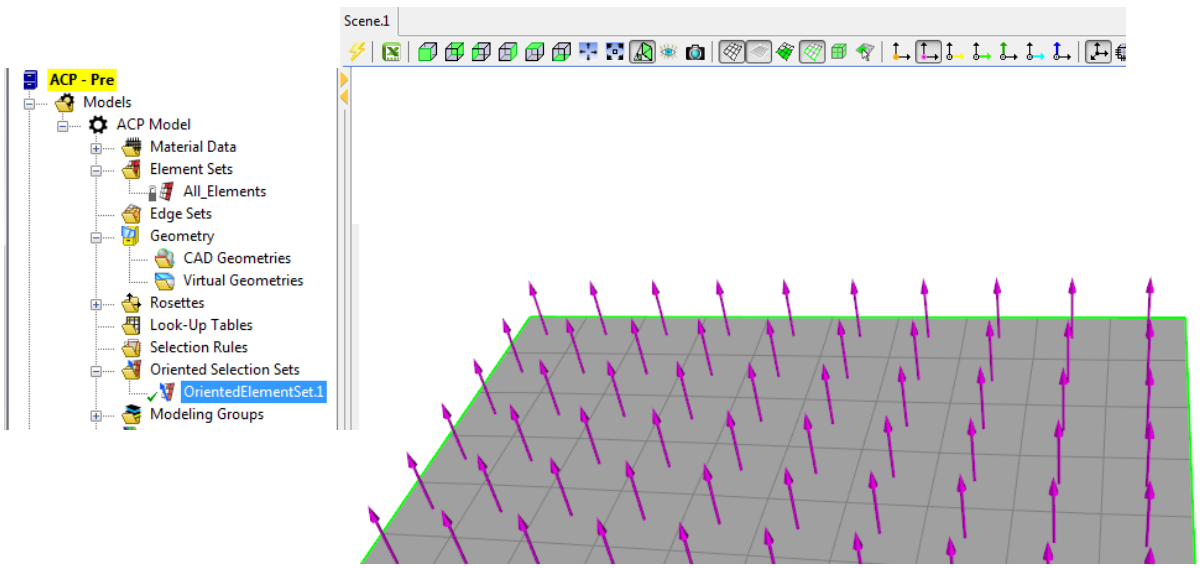


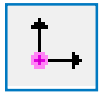


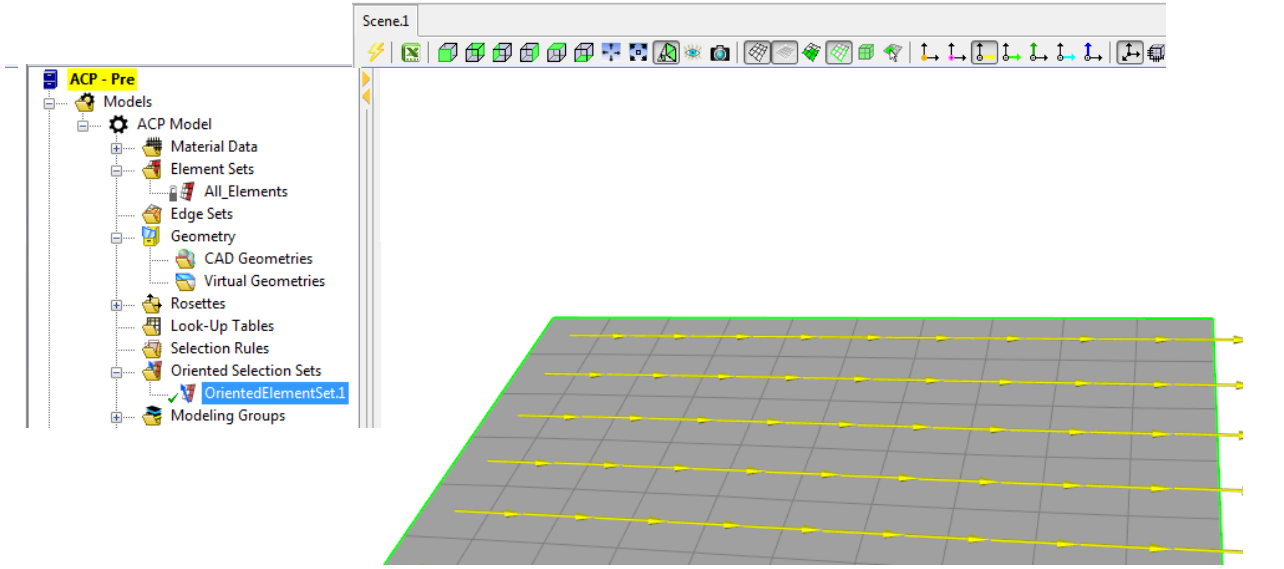
1. Select the rosette to define the reference direction (Click into the white area behind Rosette and select the rosette in the tree)

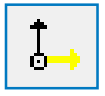
1. Introduction Workshop

Show Layup Direction and Reference Direction



- Click on the Show Orientations icon (magenta) in the scene toolbar 
- Select the oriented selection set in the tree. If orientations are not shown reselect oriented selection set



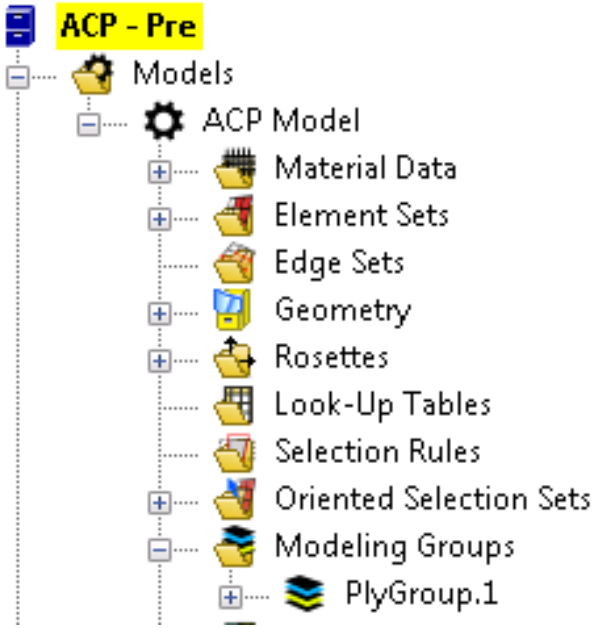
- Click on the Show Reference Direction icon (yellow) in the scene toolbar 
- Select the oriented selection set in the tree. If directions are not shown reselect oriented selection set

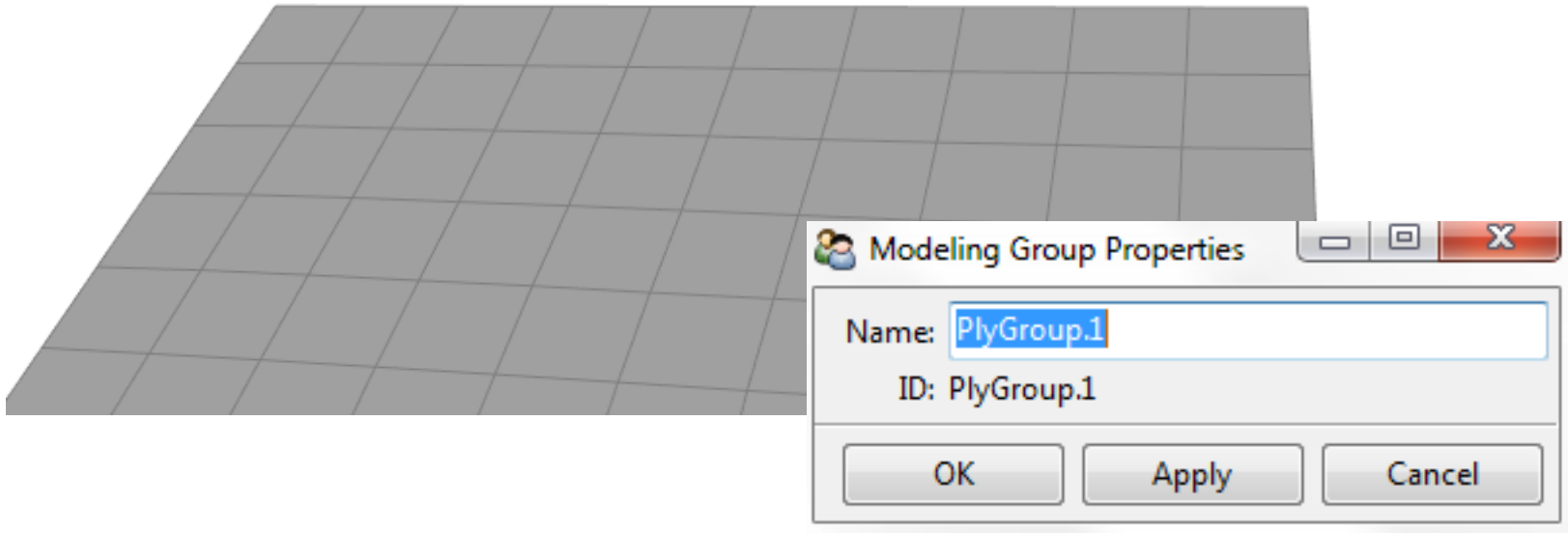
1. Introduction Workshop

Creating the Composite Layup

- Now we can start defining the composite layup
- Therefore we just need to select the oriented selection set which includes information about the layup area and direction as well as the reference direction for the fiber angles

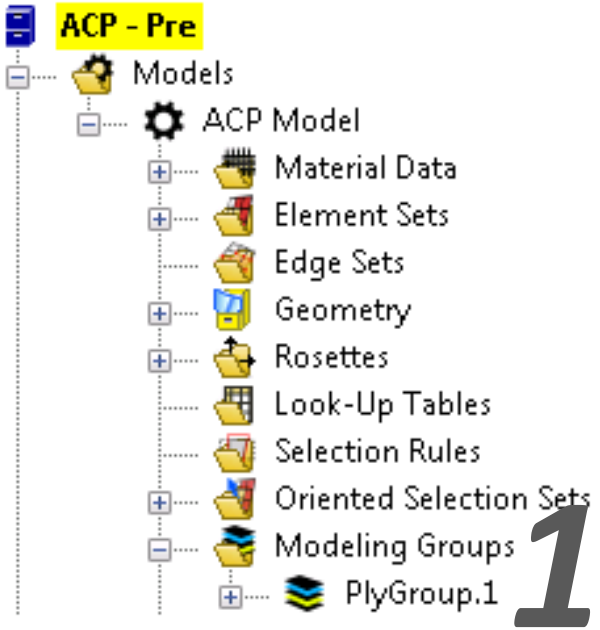
1. Introduction Workshop

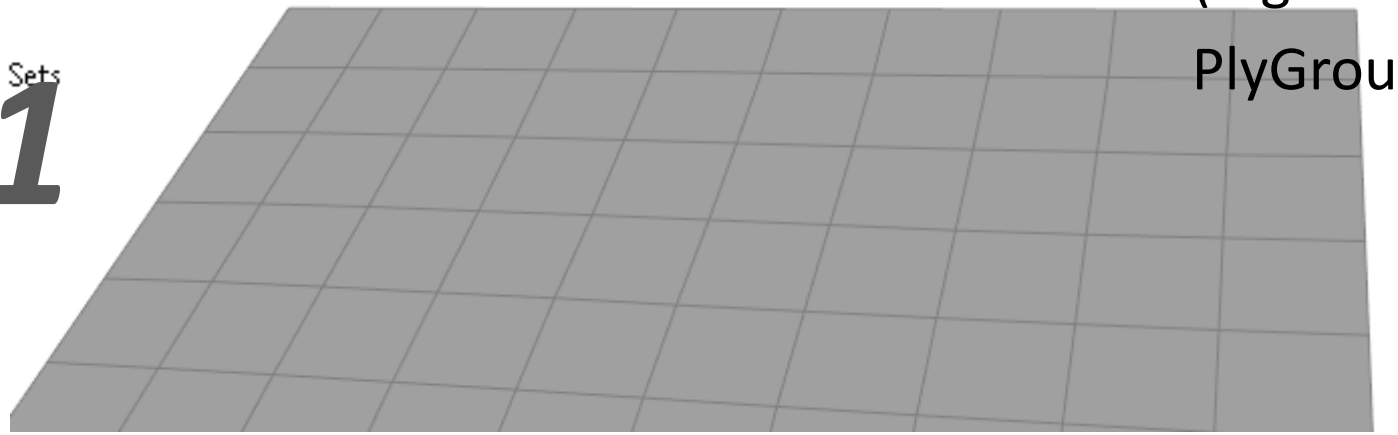




1. Create a new ply group (ply groups are used to organize your composite layups when you work with more complex parts) (Right mouse button on Modeling Groups → Create Modeling Group)

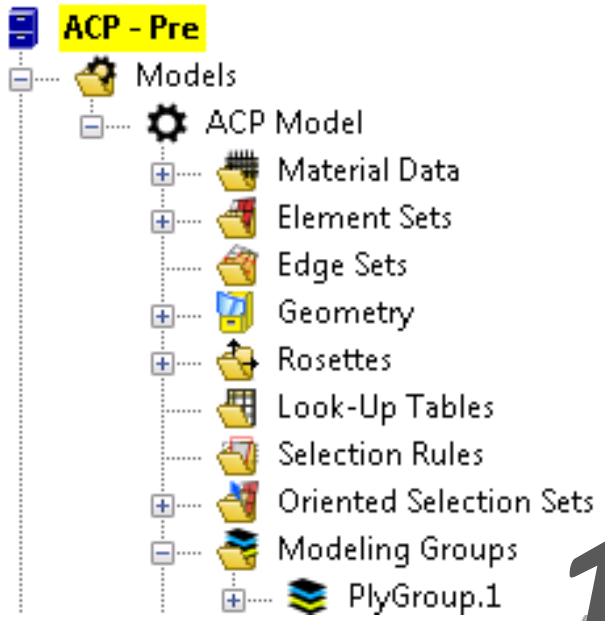
1. Introduction Workshop

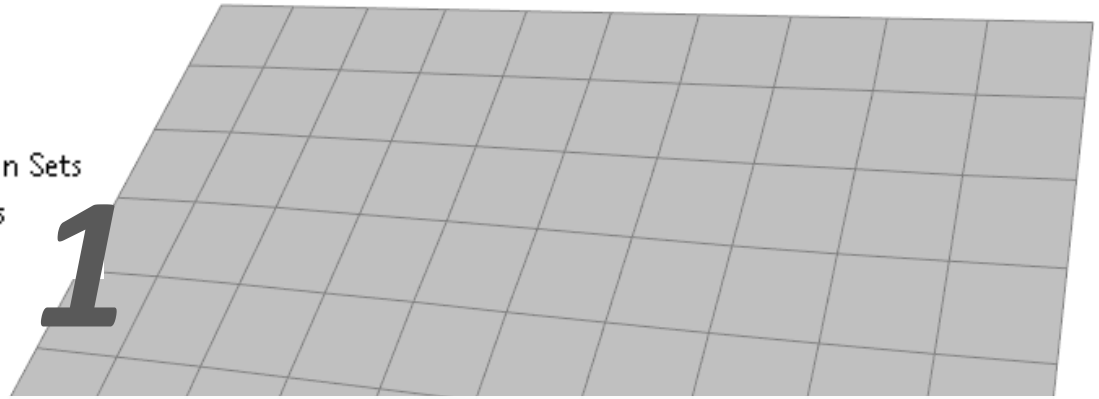


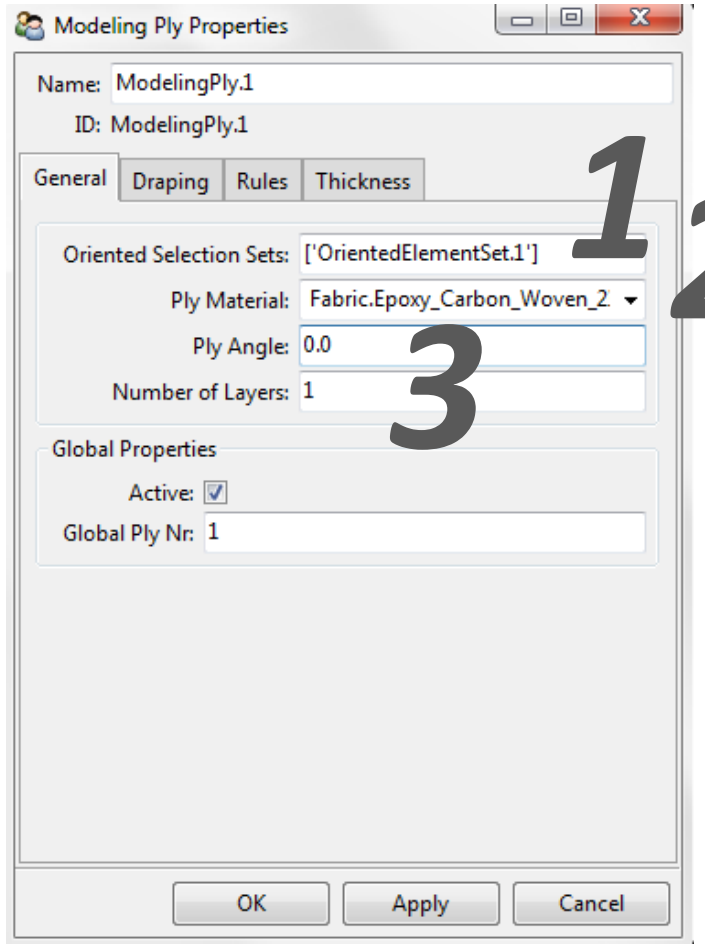


1. Create a new ply which will be the first ply we define for our composite layup (Right mouse button on PlyGroup.1 → Create Ply)

1. Introduction Workshop





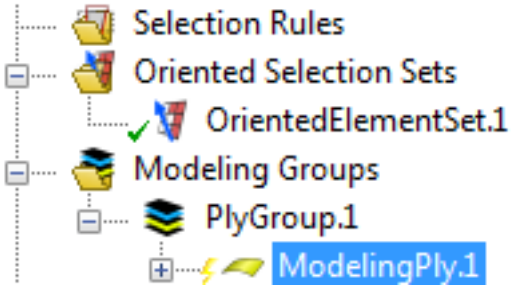


1. Select the oriented selection set we want to place this layer on
2. Select the fabric you want to lay down (In this example we have just one fabric)
3. The ply angle specifies the angle to the fabric according to the reference direction, we will leave it to zero for now

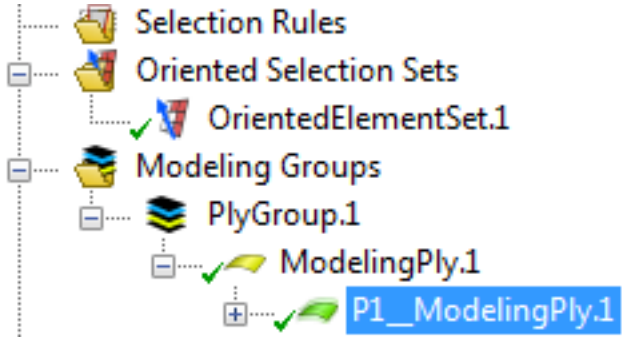
1. Introduction Workshop

Update

- Remember to update your model. The update will create the layer we defined
- You can define multiple layers without updating but will see the layers not before you update your model



Update Required



Model Updated

1. Introduction Workshop

Modeling Plies

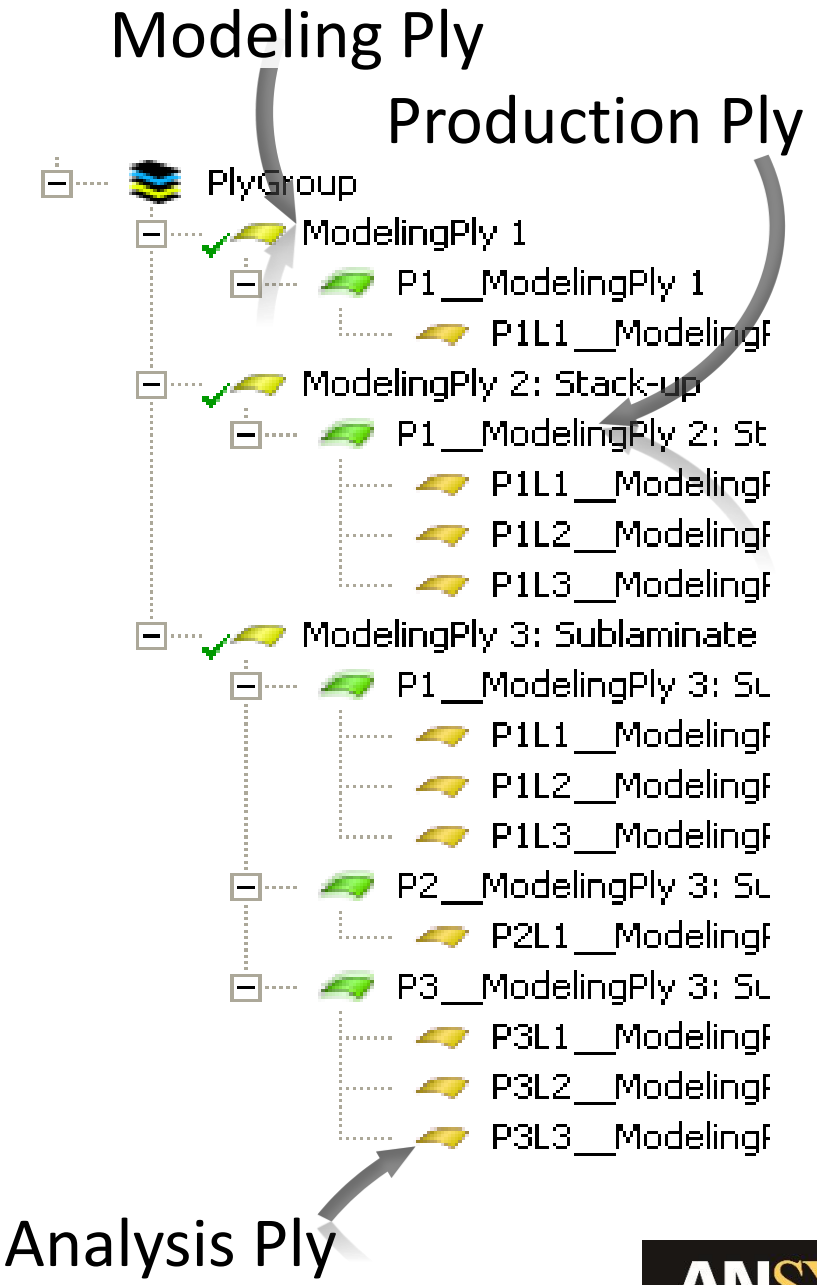
Plies are defined at the Modeling Ply level in ANSYS Composite PrepPost. Fabric selection, oriented selection sets and draping is defined on the Modeling Ply level.

Production Plies

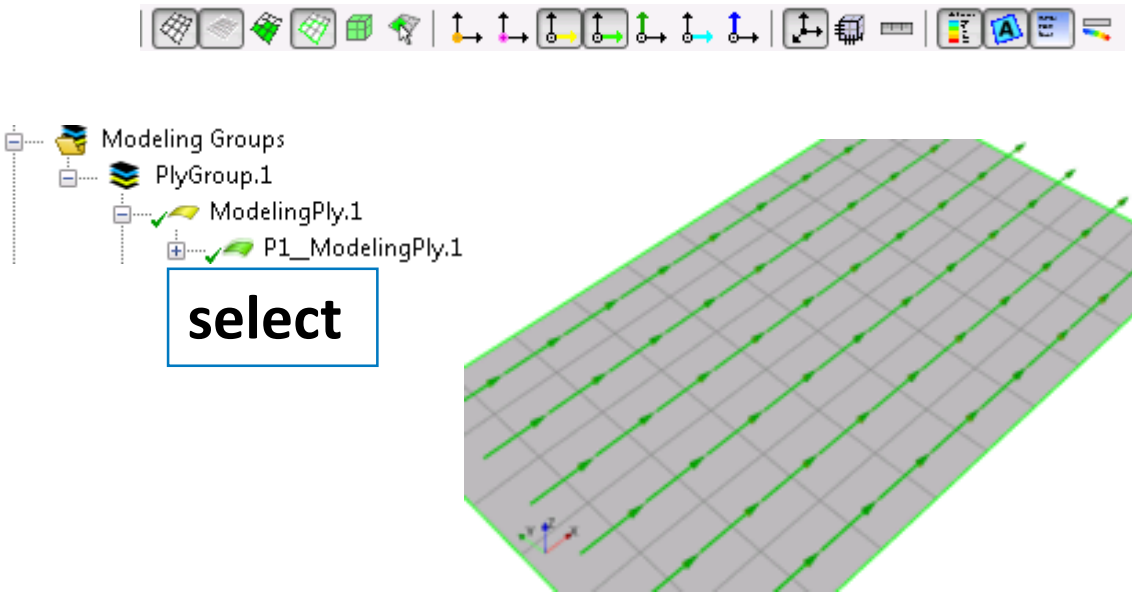
The production ply level describes plies as they are used in manufacturing. Stackups will be seen at the production ply level.

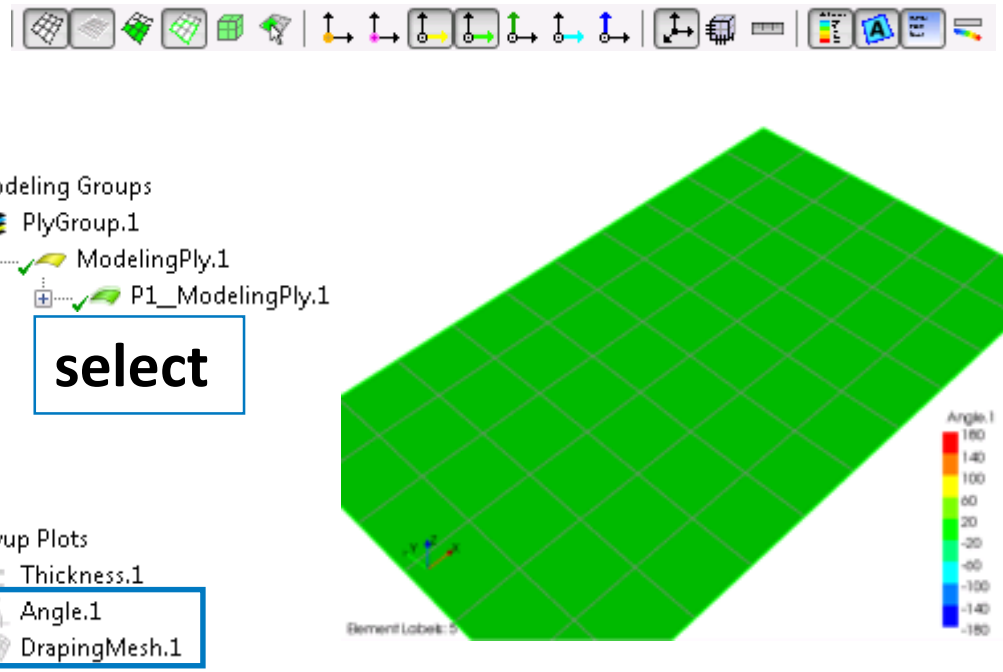
Analysis Plies

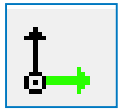
At this level all analysis plies are shown as used in the simulation and available for postprocessing.



1. Introduction Workshop





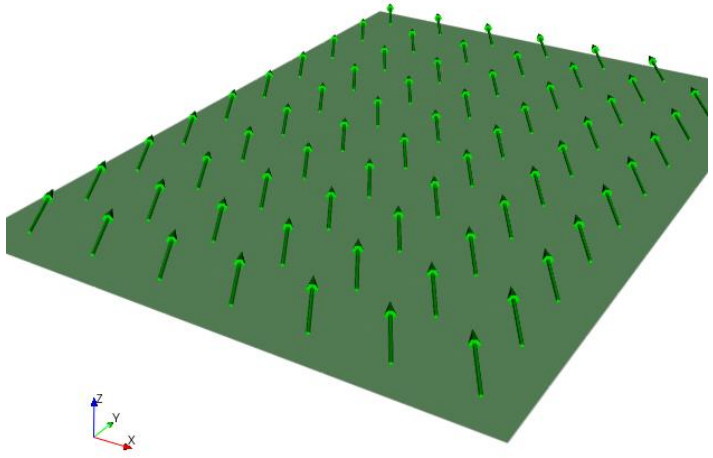
- Click on the Show Fiber Directions icon (light green) in the scene toolbar 
- Select the analysis ply we just created to see the fiber directions of this ply

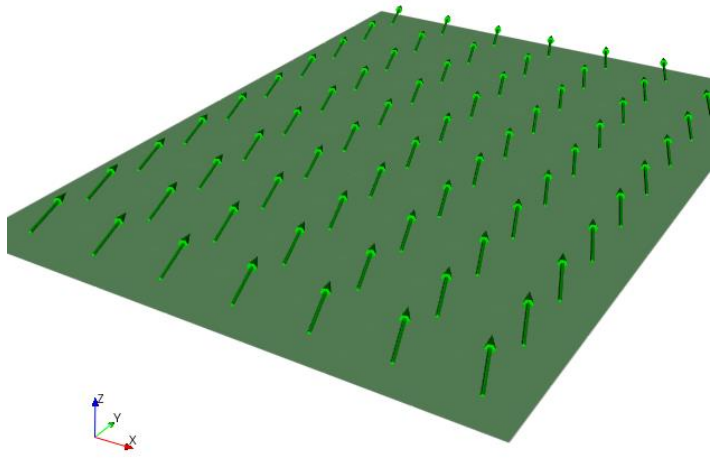
- Use **Layup plots / Angle.1** -> Right Mouse Button -> **Show** to additionally show Angles by contour plot

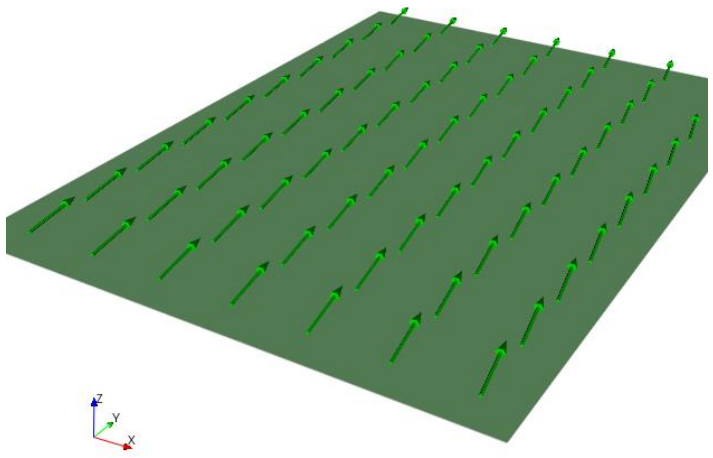
1. Introduction Workshop

Different Fiber Angles

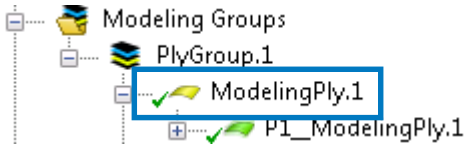
- We can modify the fiber angles of the layer we defined and check the fiber angles visually in ANSYS Composite PrepPost

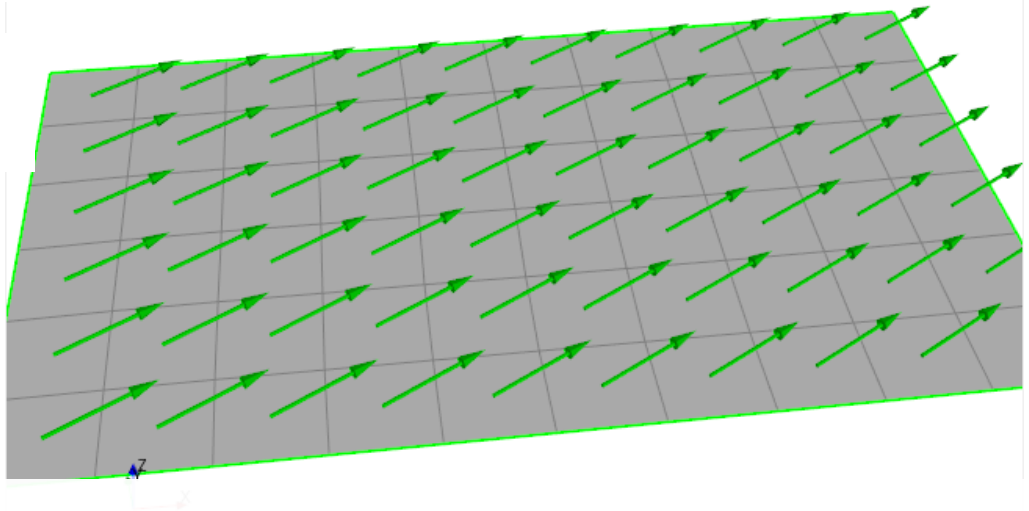


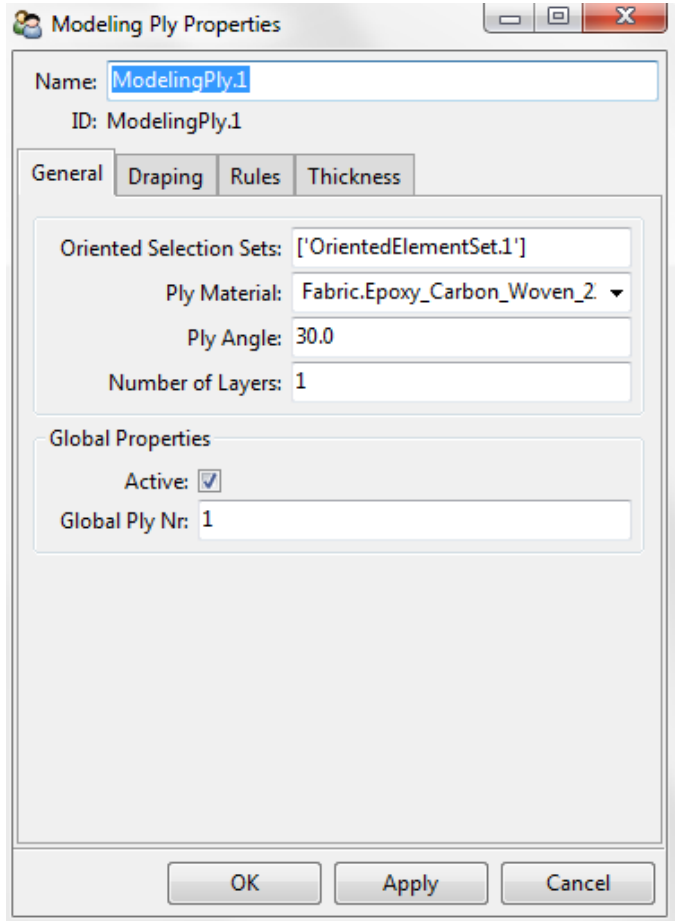




1. Introduction Workshop



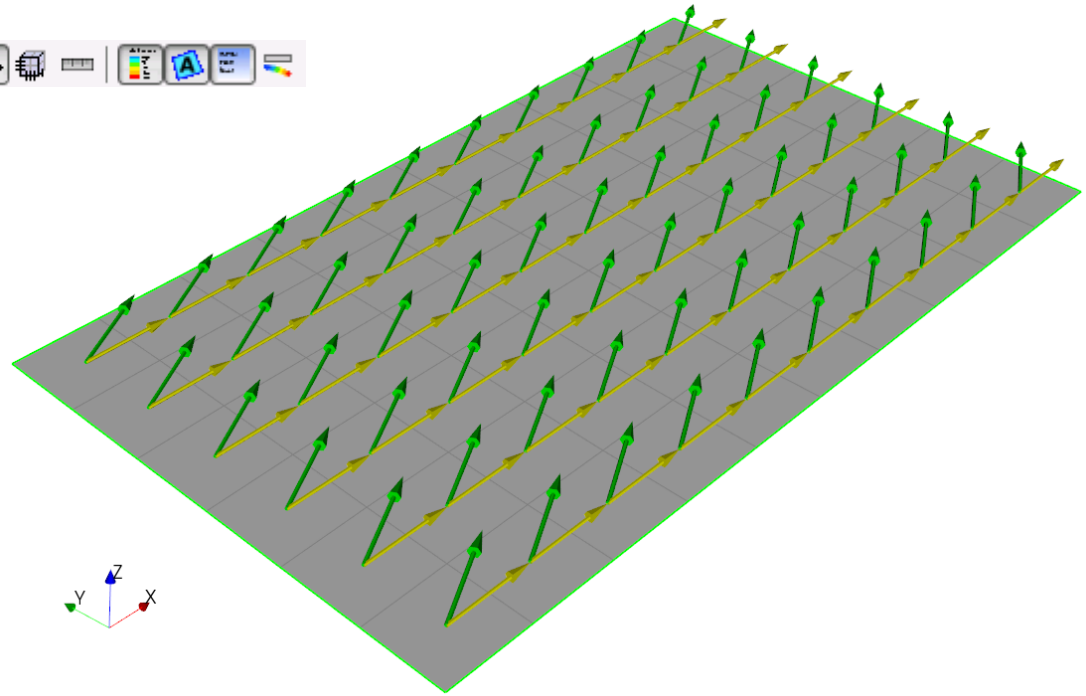




1. Edit the properties of the modeling ply we created before (Right mouse button on ModelingPly.1 → Properties)
2. Change the ply angle to 30°

1. Introduction Workshop

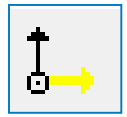
Show Fiber Direction



- Show Fiber Directions should be selected

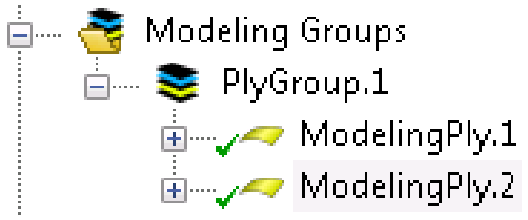
- Select the analysis ply we just modified to see the 30° fiber directions

- You can combine different direction displays by additionally activating from toolbar

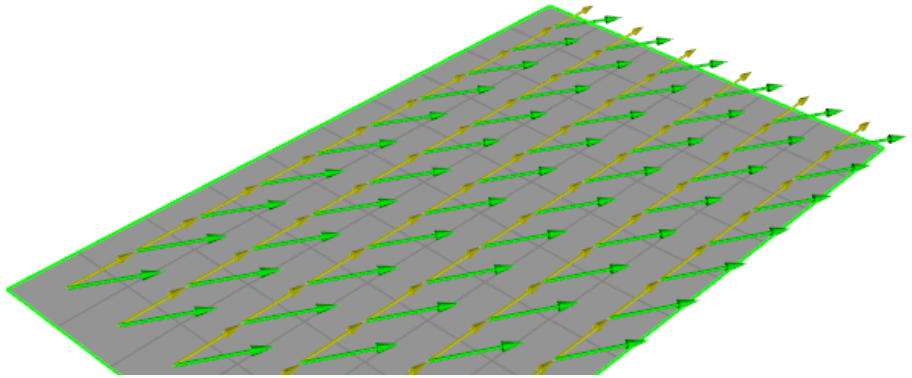


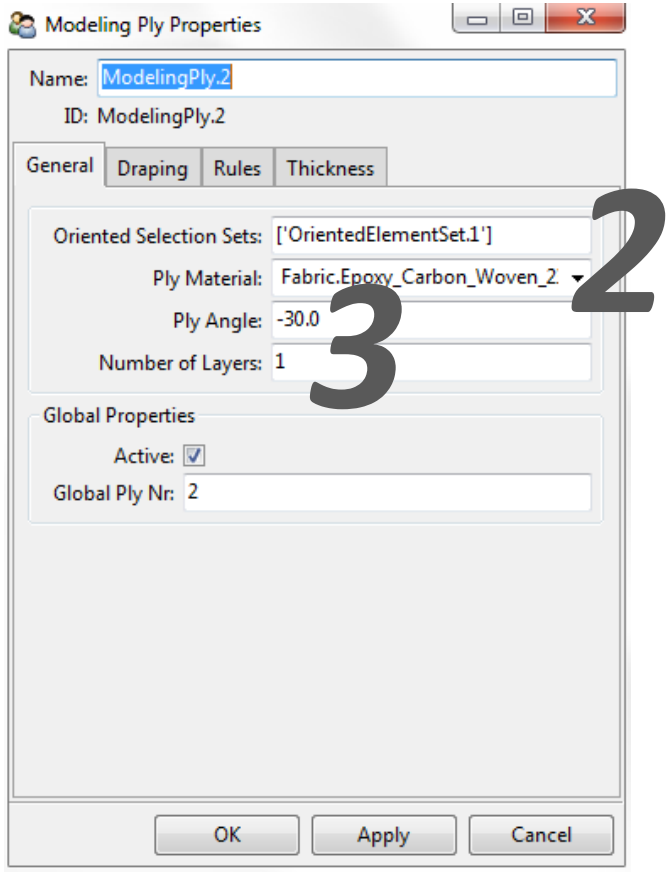
- Add display of reference direction (0°, yellow) to better recognize angle

1. Introduction Workshop



1





2

3

1. Create a new -30° layer. Therefore select the ModelingPly.1 and click right mouse button. You can now choose to create a ply before or after the selected ply. Create a new ply after the selected one.
2. Select the oriented selection set and the fabric we used before
3. Define a ply angle of -30°

1. Introduction Workshop

Composite Layup

- Create a (30°,-30°,0°,-30°,30°) layup for the plate and check the fiber angles of the different plies by selecting in the tree