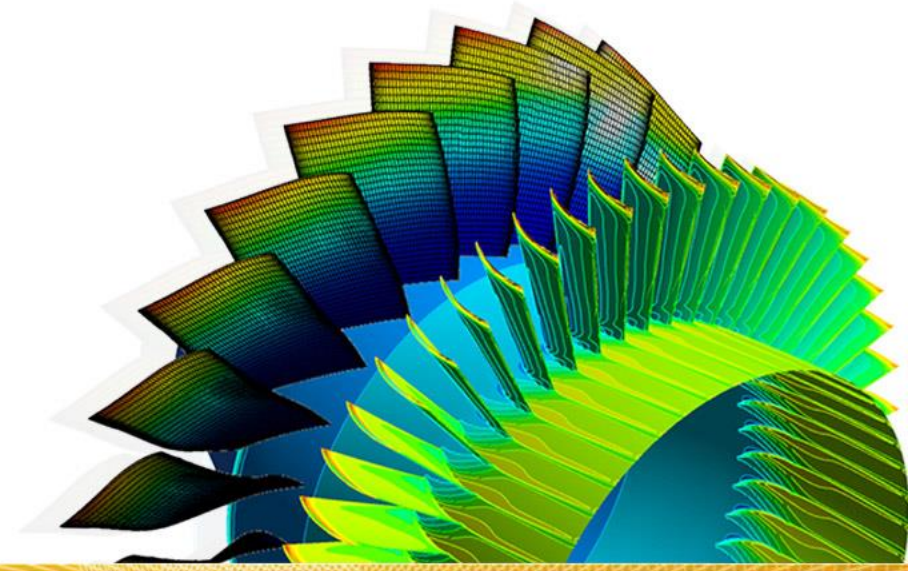
ANSYS Composite PrepPost 19.0

Module 11: Tips and Tricks



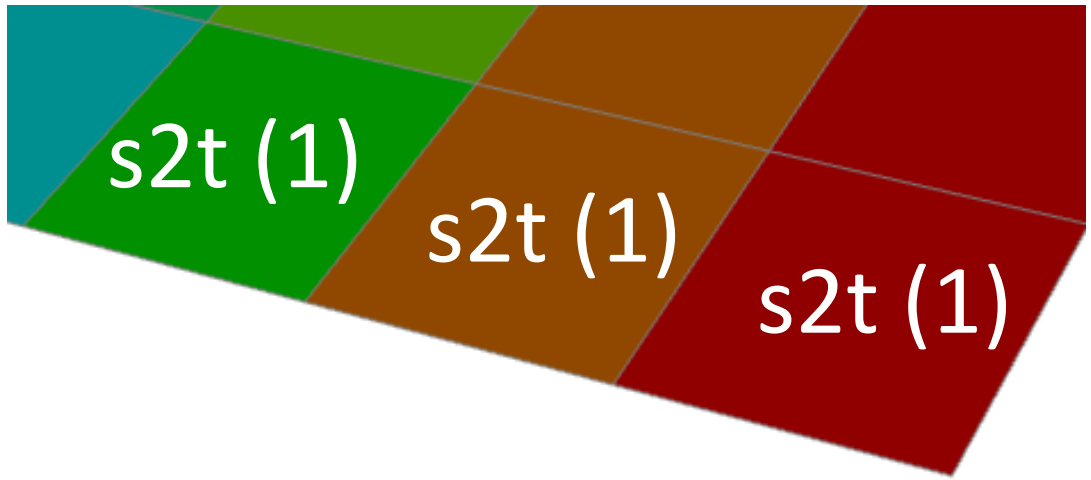
11. Ply Numbering and Sampling Points in ACP

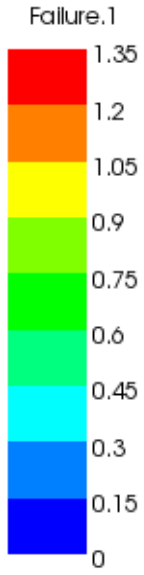
Agenda

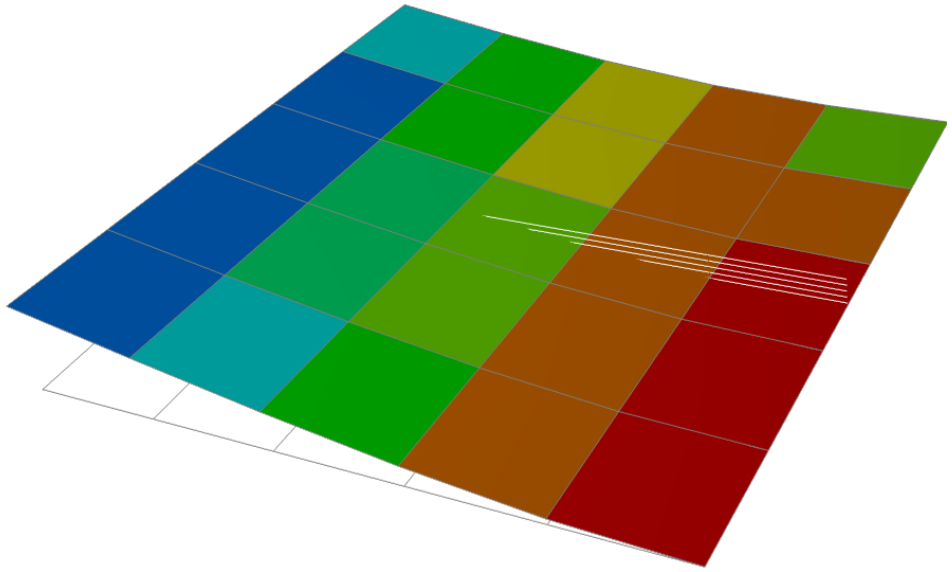
- The ply numbering concept in ANSYS Composite PrepPost
- From the overall view of evaluating all failure criteria through all layer to the layer specific postprocessing and the connection to the sampling points

11. Ply Numbering and Sampling Points in ACP

- ANSYS Composite PrepPost has the postprocessing capabilities to evaluate all selected failure criteria for all layers for each element and plot the worst value in a contour plot.
- The contour plot gives the failure criteria and the layer this failure criteria value belongs to.

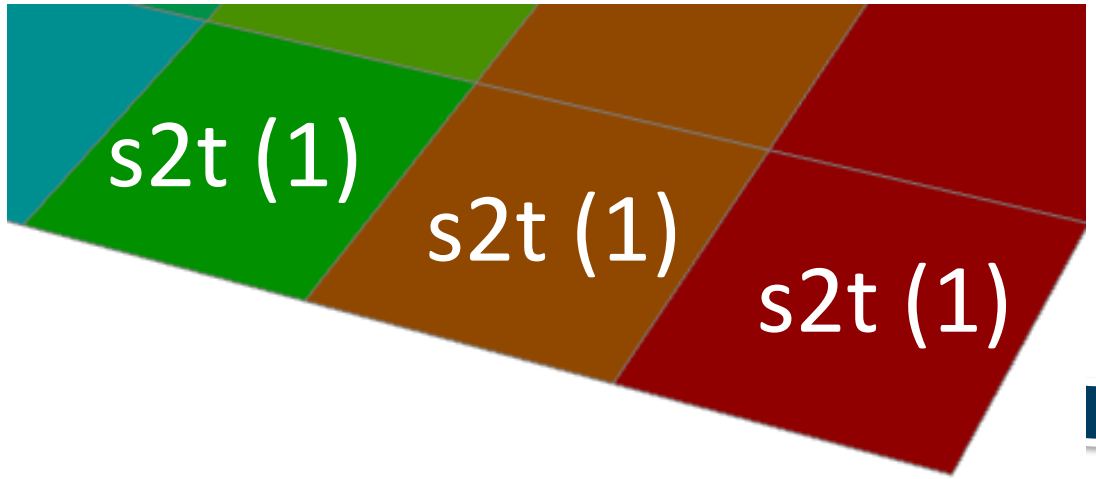






11. Ply Numbering and Sampling Points in ACP

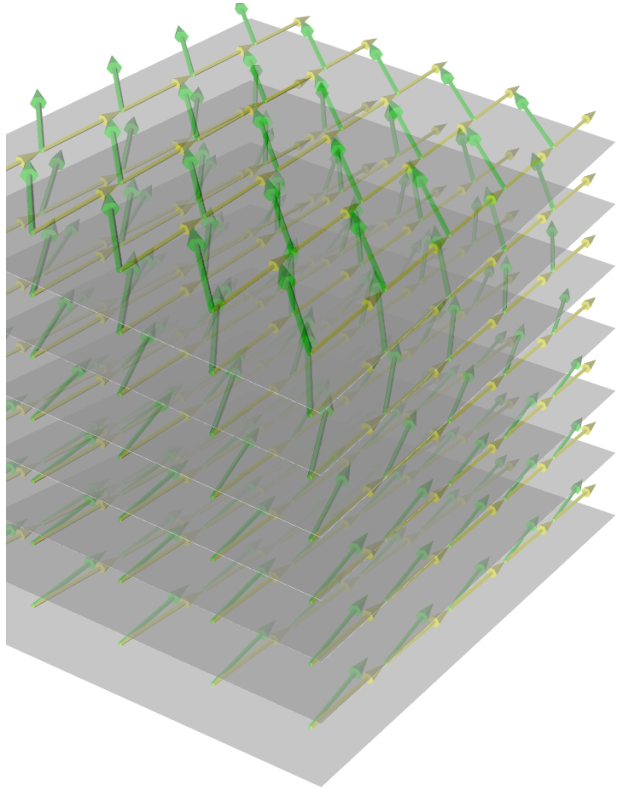
- But, what layer is layer number 1 (or 2,3,…)?
- Since multiple *Oriented Selection Sets* can be defined laying upon each other (ply drop offs,…) the layers should not be counted in the *Modeling Groups* section, the *Sampling Points* are the correct way to determine layer number 1 (or 2,3,…) in the model.



Layer number 1 of this element is currently the most critical layer.

11. Ply Numbering and Sampling Points in ACP

- The model used here is a simple plate with 7 layers
- The layers are defined by 2 Oriented Selection Sets (OSS)



50° (Oriented Selection Set 1)

40° (Oriented Selection Set 1)

30° (Oriented Selection Set 1)

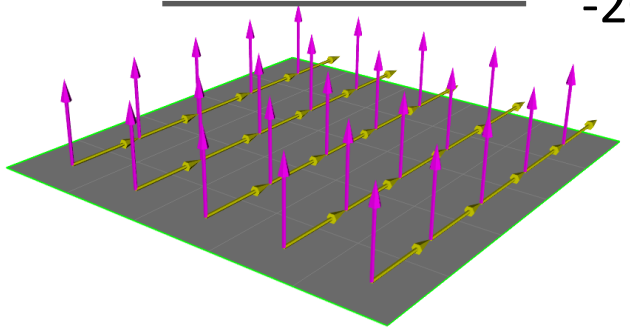
20° (Oriented Selection Set 1)

10° (Oriented Selection Set 1)

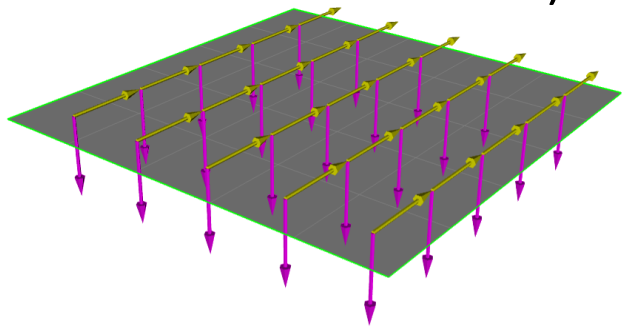
Element

-10° (Oriented Selection Set 2)

-20° (Oriented Selection Set 2)



(Oriented Selection Set 1)



(Oriented Selection Set 2)

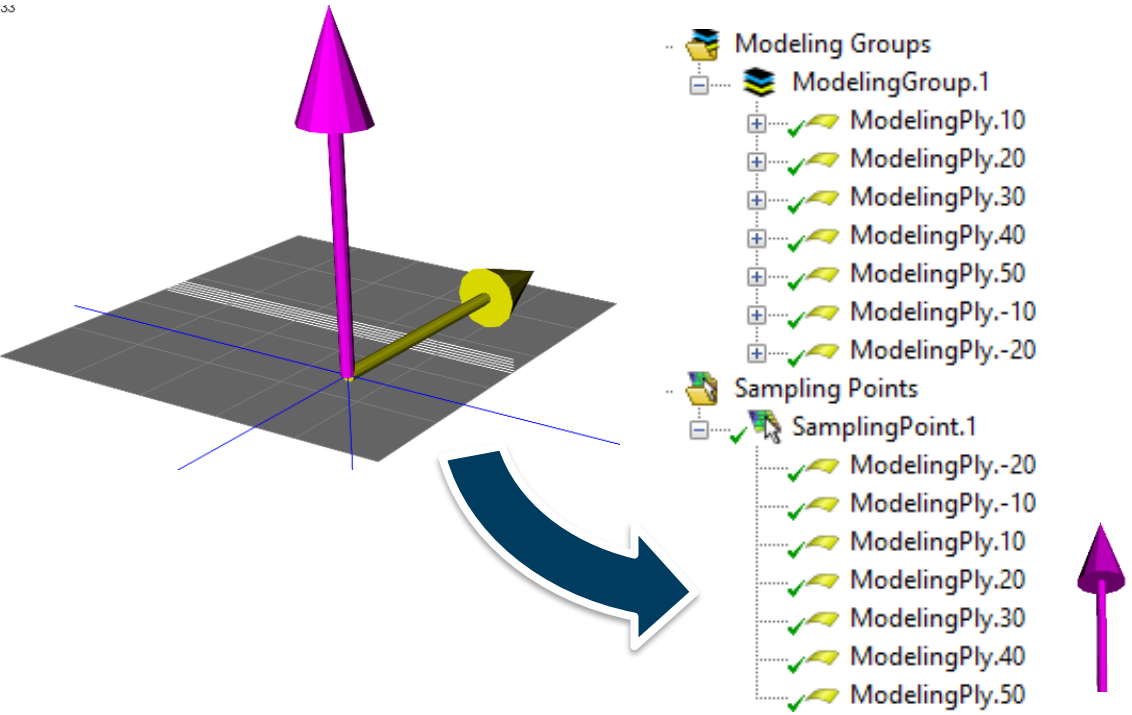
Displays the orientation of the OSS

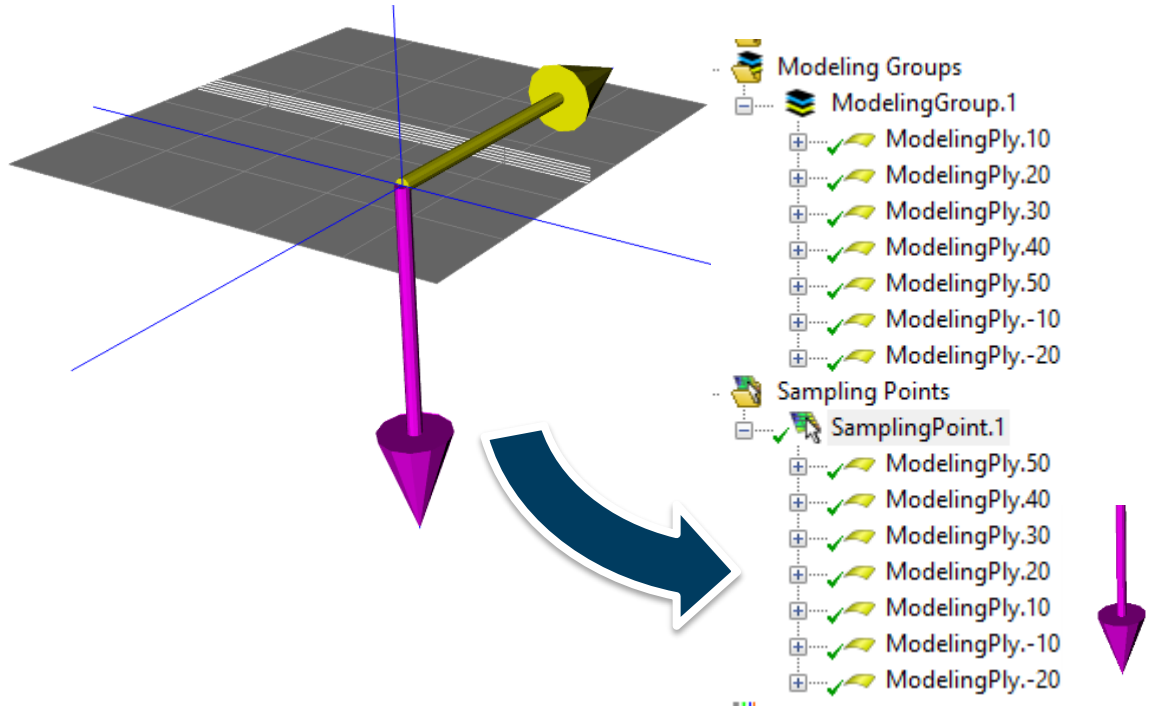
Displays the reference direction of the OSS

Displays the fiber direction

11. Ply Numbering and Sampling Points in ACP

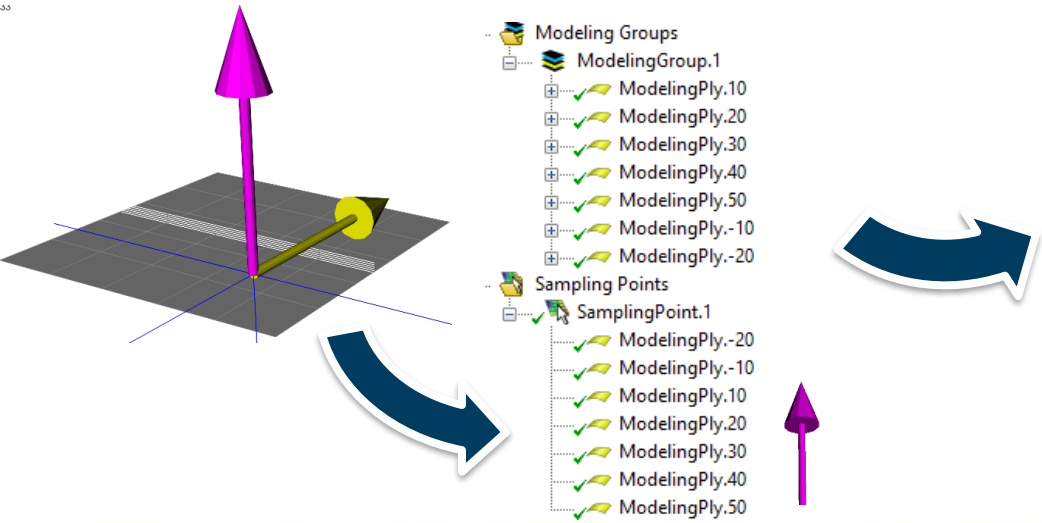
- When adding a *Sampling Point* ANSYS Composite PrepPost is asking for a sampling direction.
- This direction defines how the layers are listed in the tree under the sampling point.

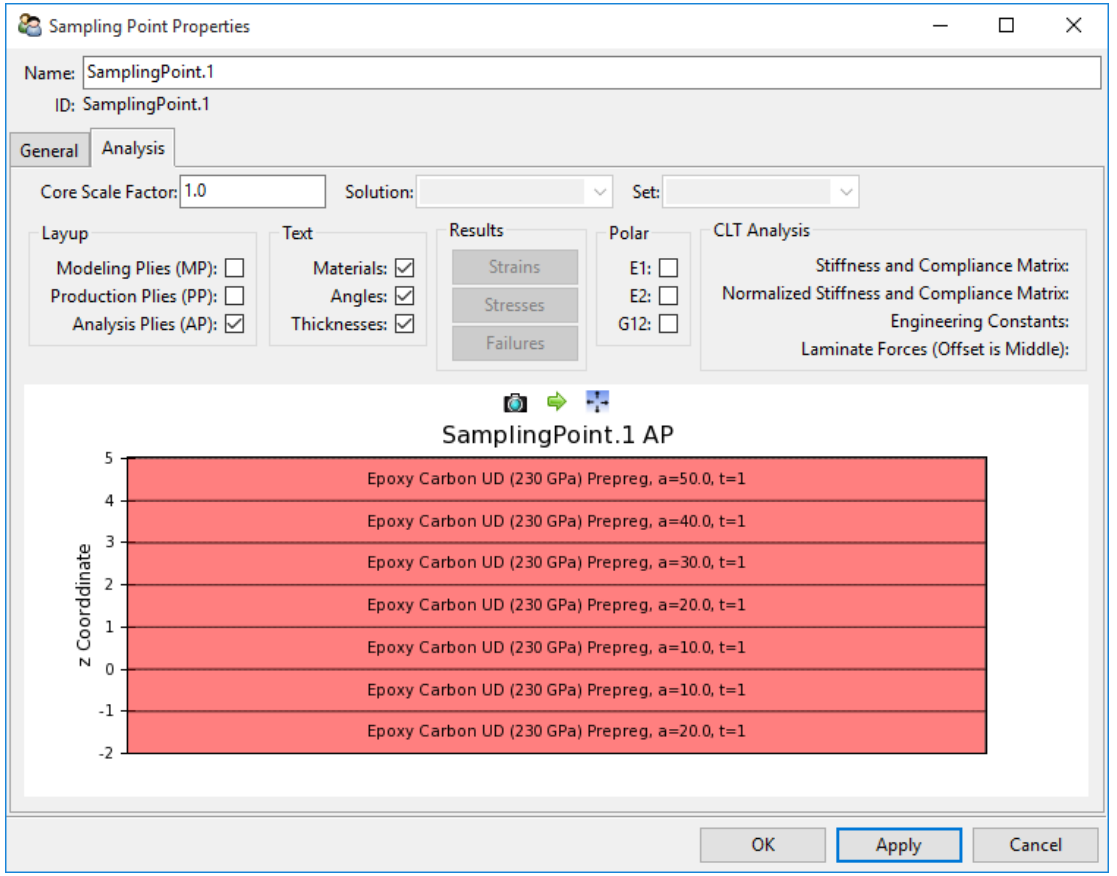




11. Ply Numbering and Sampling Points in ACP

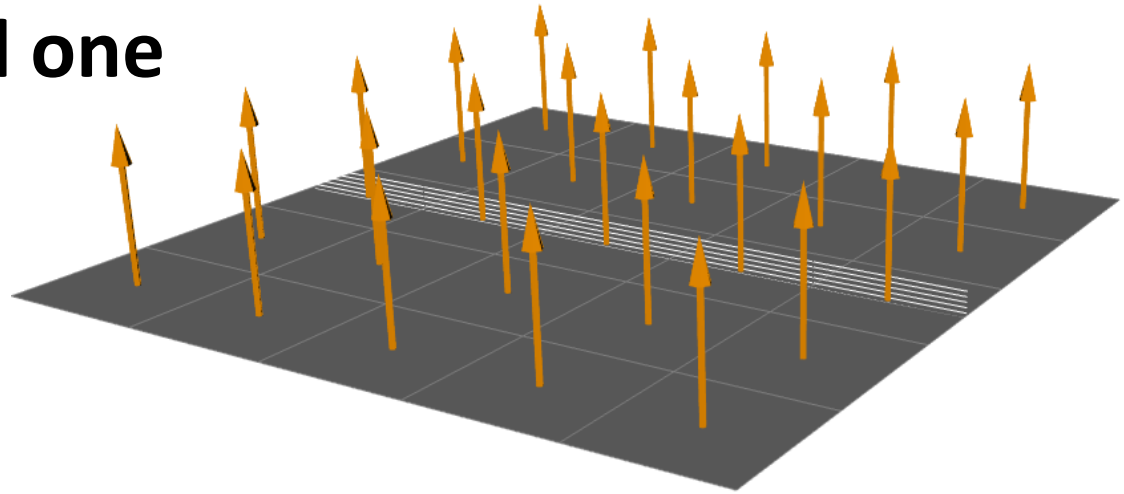
The sampling direction also has an influence on the lay-up shown under the A*nalysis* tab in the sampling point. It defines the positive z-direction in the lay-up visualization.





11. Ply Numbering and Sampling Points in ACP

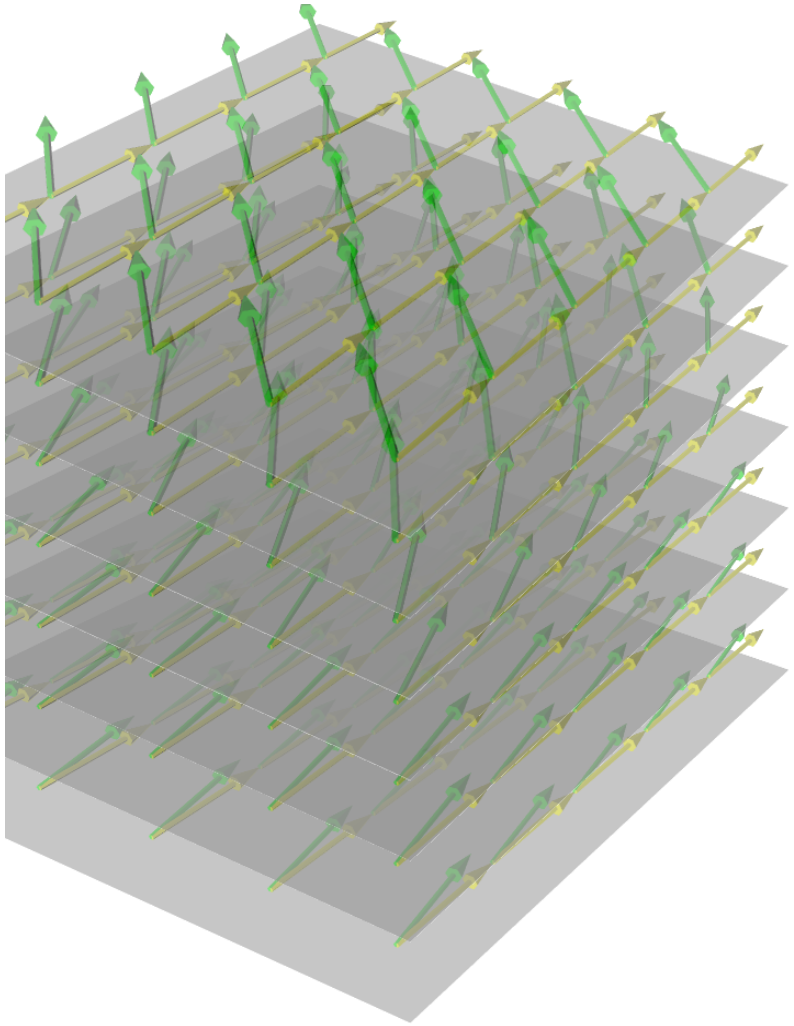
- The layer numbering in failure plots is based on the element normal direction.
- **Imagine to shoot through the element in element normal direction, the first layer you hit is layer 1, the second one is layer 2,…**



Displays the element normals

11. Ply Numbering and Sampling Points in ACP

- For the plate example this leaves us with



Layer 7 – Ply Angle = 50 deg

Layer 6

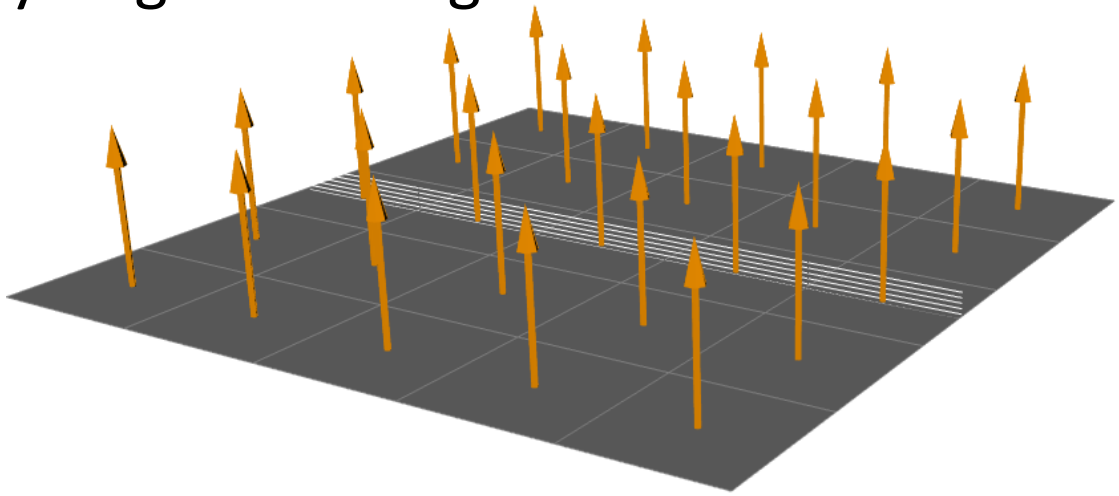
Layer 5

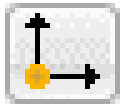
Layer 4

Layer 3

Layer 2

Layer 1 – Ply Angle = -20 deg

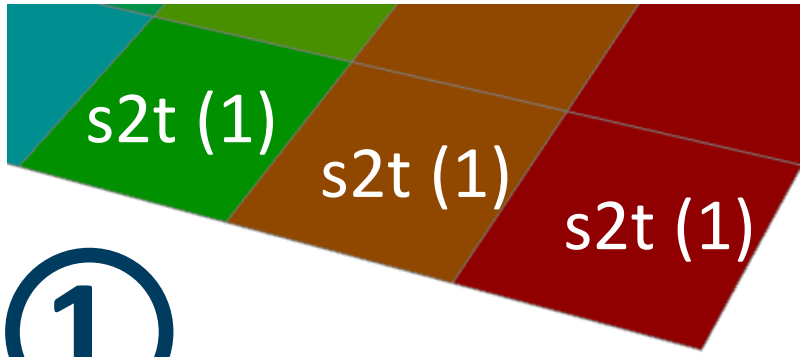




The orange arrows displays the element normals

11. Ply Numbering and Sampling Points in ACP

- Back to the contour plot. Layer number 1 can now be found using the sampling points.

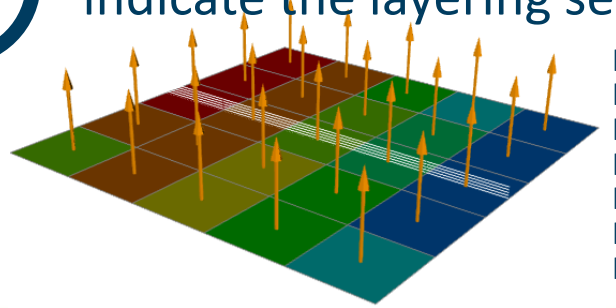


1

Layer number 1 is critical.

2

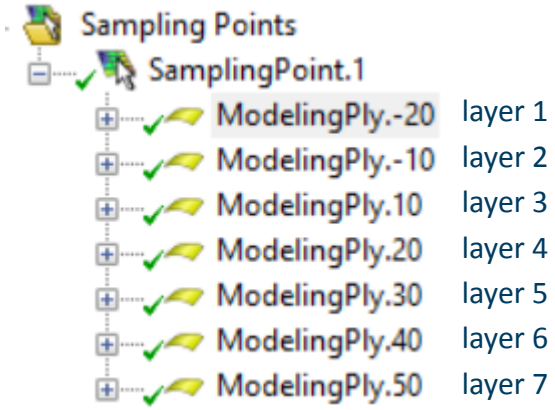
The orange element orientations indicate the layering sequence



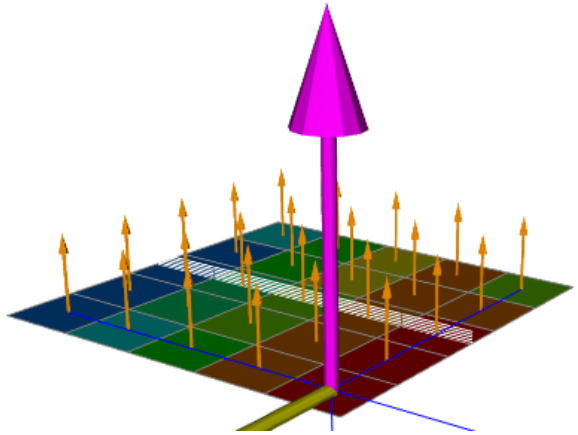
layer 7
layer 6
layer 5
layer 4
layer 3
layer 2
layer 1

3

By aligning the sampling direction of a sampling point with the element normal we can find the layer in the tree

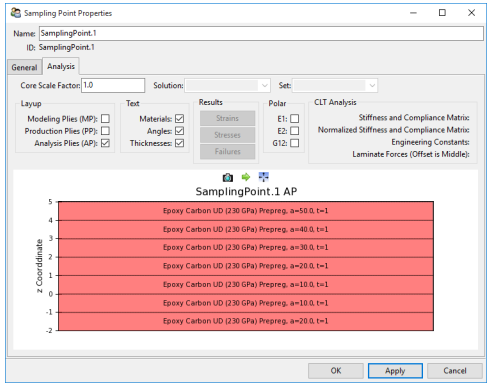


layer 1
layer 2
layer 3
layer 4
layer 5
layer 6
layer 7



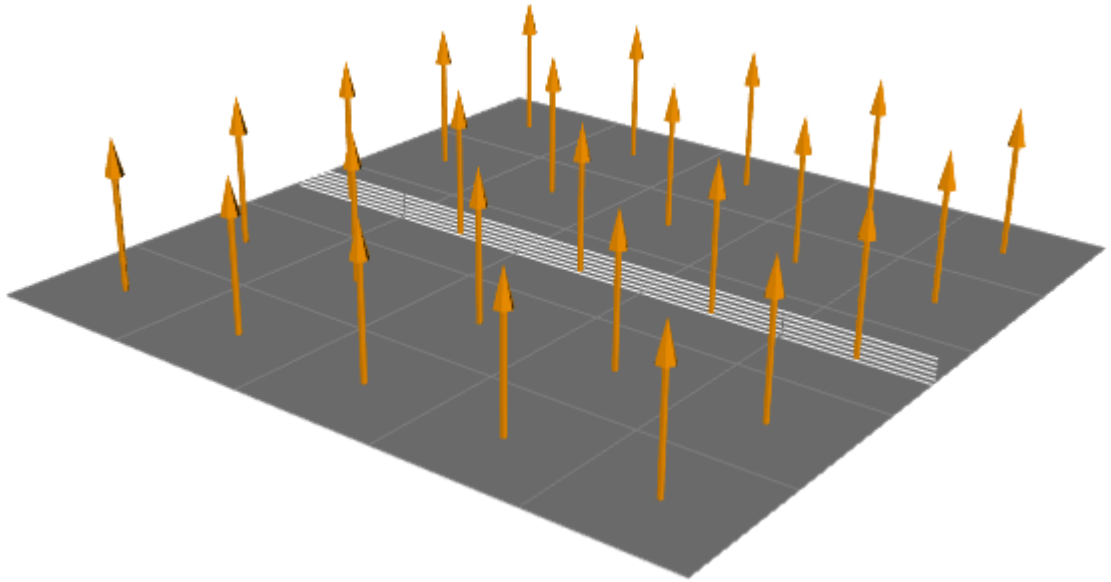
4

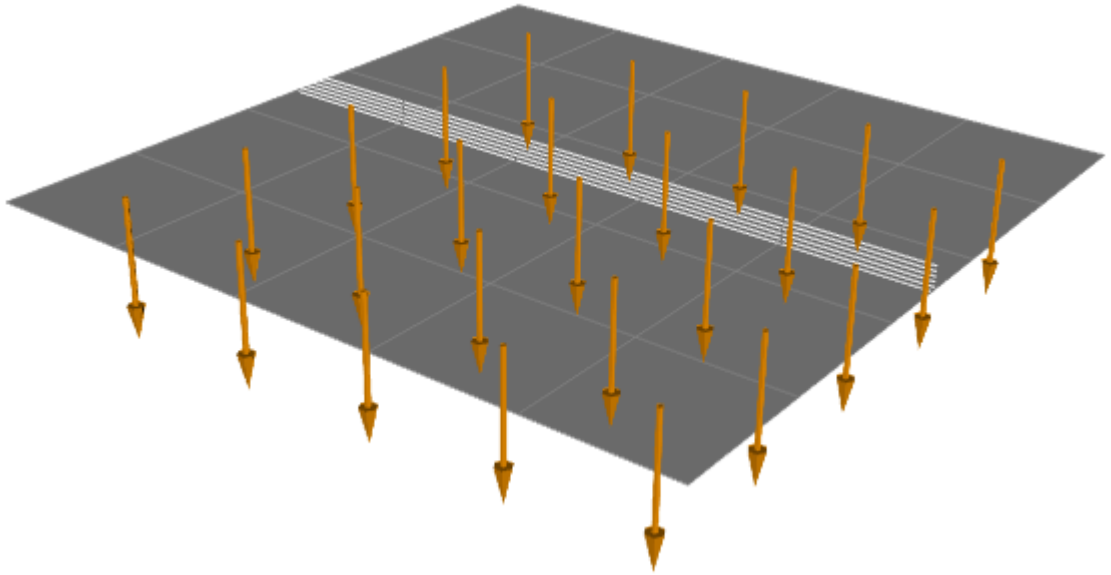
You can also check the lay-up sequence in the analysis tab.



11. Ply Numbering and Sampling Points in ACP

- Switching the element normal direction will not affect the lay-up of the composite. This is ensured with the lay-up direction being defined in the oriented selection sets in global coordinate directions.





Element normal direction used before

Flipped element normal direction

11. Ply Numbering and Sampling Points in ACP

- However, the lay-up numbering will be affected since this is defined in the element normal direction.
- The critical layer is still the same layer, but due to flipping the element direction this layer is now layer number 7.