

# Neuerungen in LS-PrePost für das Pre- und Postprocessing von Composites

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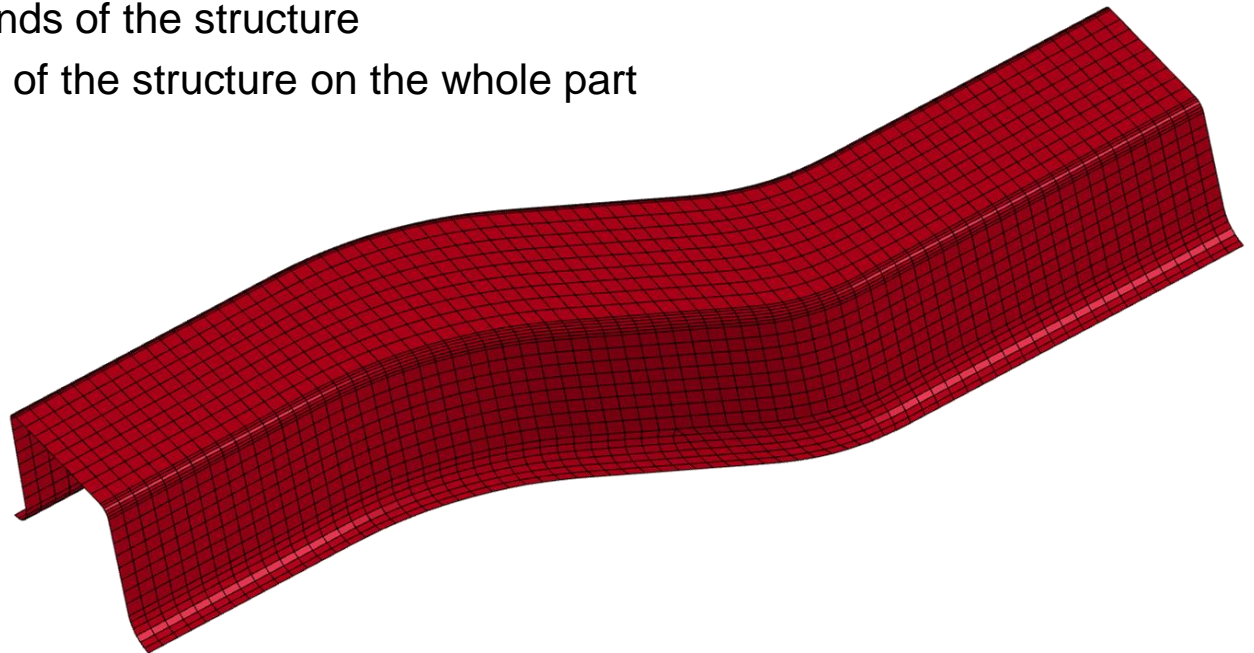
# Pre-Processing

# Example case

## ■ Definition of a composite structure for S-Rail

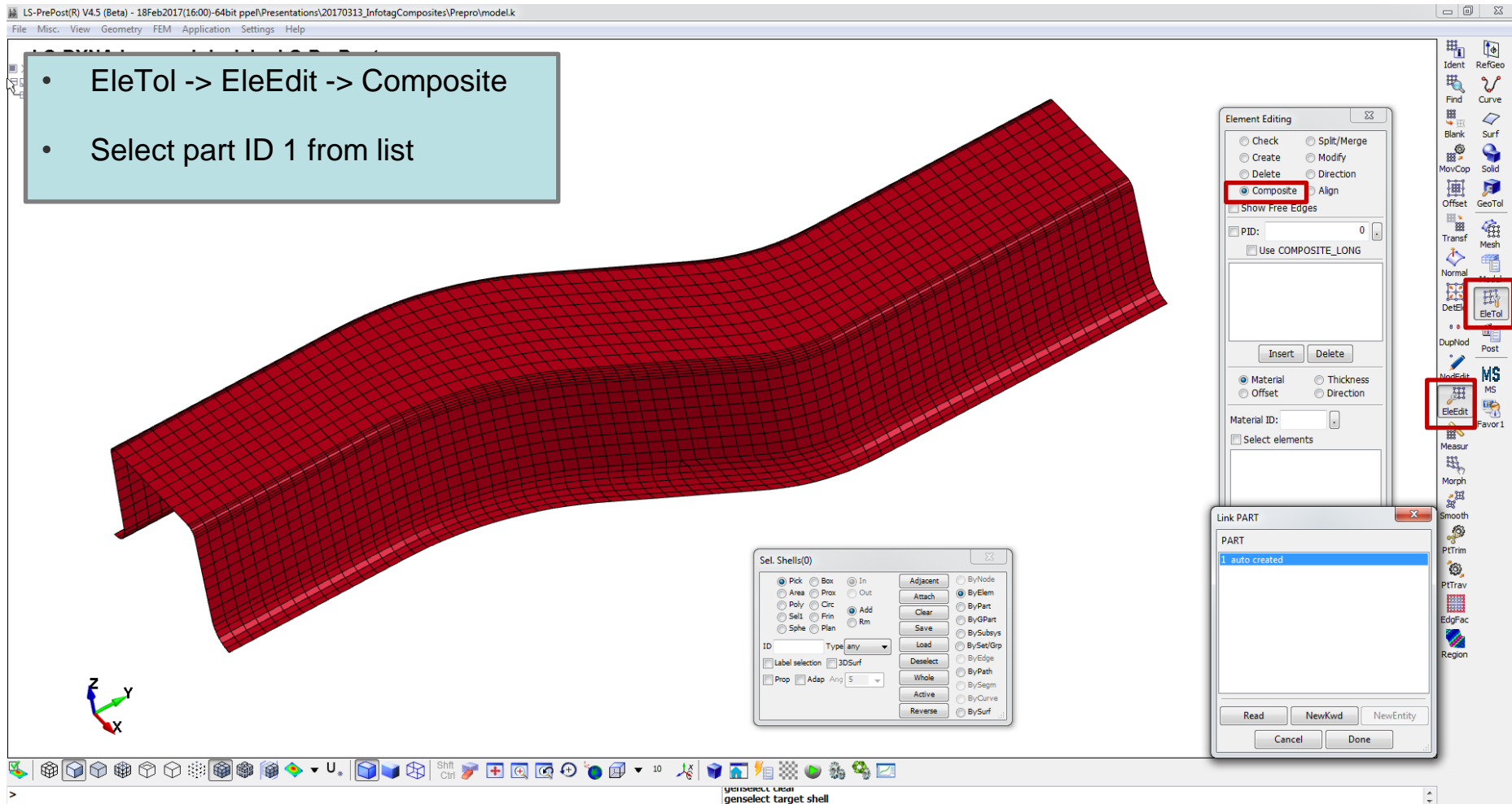
### ■ Lay-Up

- 0° whole part
- 45° whole part
- 90° only near the ends of the structure
- along the curvature of the structure on the whole part



# Composite Module

- EleTol -> EleEdit -> Composite
- Select part ID 1 from list



# Material assignment (1<sup>st</sup> ply)

- Insert Ply 1
- Choose material ID 1 for first ply
- Select all elements in the part
- Press „Apply“

The screenshot displays the LS-PrePost interface with a 3D model of a curved composite part. The part is rendered in red and is covered with a mesh. The 'Element Editing' dialog is open on the right side, showing 'ply 1' selected in the list. The 'Material ID' is set to '1'. The 'Sel. Shells(3485)' dialog is also open, with 'ByPart' selected. The status bar at the bottom indicates 'Select material ID from list' and 'elemedit composite material set 1'.

# Ply thickness (1<sup>st</sup> ply)

- Make sure all elements are still selected
- Choose „Thickness“
- Define thickness of ply as 0.5
- Press „Apply“

The screenshot displays the LS-PrePost interface with a 3D model of a curved structure. The 'Element Editing' dialog is open, showing the 'Thickness' property set to 0.5. The 'Sel. Shells(3485)' dialog is also open, showing selection options. The status bar at the bottom indicates 'Fringe total thickness for selected layers' and 'Normal Renderer'.

# Ply orientation (1<sup>st</sup> ply: global y-axis)

- Make sure all elements are still selected
- Choose „Direction“ and „Vector“
- Set global y-axis
- Press „Apply“ and „Accept“

LS-PrePost(R) V4.5 (Beta) - 18Feb2017(16:00)-64bit ppel\Presentations\20170313\_InfotagComposites\Prepro\model.k

File Misc View Geometry FEM Application Settings Help

Element Editing

- Check
- Split/Merge
- Create
- Modify
- Delete
- Direction
- Composite
- Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

ply 1

Insert Delete

- Material
- Thickness
- Direction
- Vector
- Rotate
- Map
- Smooth

Vector

X	Y	Z
0.	1.	0.

Angle: 5.

Rot - Rot +

Set BETA 0

Apply Reject Accept

Done

Shells(3485)

- Pick
- Area
- Poly
- Sel1
- Sph
- Plan

- Box
- Prism
- Add
- Fin
- Rm

- In
- Out
- Add
- Rm

ID: Type: any

Label selection 3DSurf

Adjacent

Attach

Clear

Save

Load

Deselect

Whole

Active

Reverse

ByNode

ByElem

ByPart

ByGPart

BySubsys

BySet/Grp

ByEdge

ByPath

BySegm

ByCurve

BySurf

element composite accept

elemedit composite direction vector 0.000000 1.000000 0.000000

Open Plot management interface

Normal Renderer

# Material definition (2<sup>nd</sup> ply)

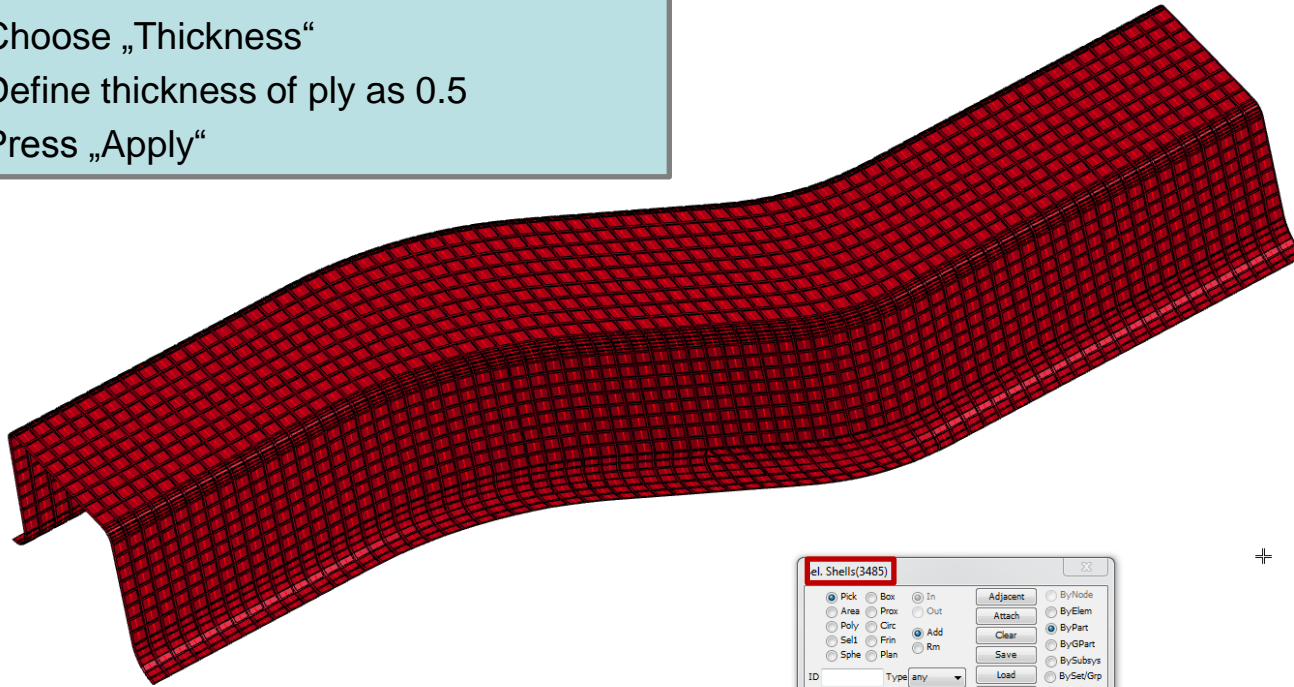
- Insert Ply 2
- Choose material ID 1
- Select all elements in the part
- Press „Apply“

The screenshot displays the LS-PrePost interface with a 3D model of a curved composite part. The 'Element Editing' dialog is open, showing 'ply 2' selected and 'Material ID: 1' chosen. The 'Shells(3485)' dialog is also open, showing selection options. The status bar at the bottom indicates 'Apply material ID to selected plies and elements'.



# Ply thickness (2<sup>nd</sup> ply)

- Make sure all elements are still selected
- Choose „Thickness“
- Define thickness of ply as 0.5
- Press „Apply“



Element Editing

Check  Split/Merge  
 Create  Modify  
 Delete  Direction  
 Composite  Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

ply 1  
ply 2

Insert Delete

Material  Thickness  Direction

Thickness: 0.5

Fringe Thickness  
 Thick display

Apply Reject Accept

Done

el. Shells(3485)

Pick  Box  In  Adjacent  ByNode  
 Area  Proxy  Out  Attach  ByElem  
 Poly  Circ  Add  Clear  ByPart  
 Sel1  Fin  Rm  Save  ByGPart  
 Sphc  Plan  Load  BySubsys  
 Label selection  3DSurf  Deselect  BySet/Grp  
 Reverse  ByEdge  
 Whole  ByPath  
 Active  BySigm  
 Reverse  ByCurve  
 BySurf

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File Misc. View Geometry FEM Application Settings Help

Apply thickness to selected plies and elements

element composite material set 1  
element composite thickness set 0.500000

Normal Renderer

# Ply orientation (2<sup>nd</sup> ply: 45° wrt 1<sup>st</sup> ply)

- Make sure all elements are still selected
- Choose „Direction“ and „Vector“
- Set global y-axis as starting point
- Press „Apply“ and „Accept“

The screenshot displays the LS-PrePost interface with a 3D model of a curved composite part. The model is composed of two plies, with the second ply oriented at 45 degrees relative to the first. The interface includes a menu bar, a toolbar, and several dialog boxes. The 'Element Editing' dialog is open, showing the 'Direction' and 'Vector' options selected. The 'Vector' dialog shows the X, Y, and Z components set to 0, 1, and 0 respectively. The 'Shells(3485)' dialog is also open, showing the 'Pick' and 'Add' options selected. The status bar at the bottom indicates the current element is 'element composite plyur 1' and the current edit is 'elemedit composite direction vector 0.000000 1.000000 0.000000'.

Element Editing

- Check
- Split/Merge
- Create
- Modify
- Delete
- Direction
- Composite
- Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

ply 1  
ply 2

Insert Delete

Material

Offset

Direction

Vector

Smooth

Thickness

Rotate

Map

Vector

X	Y	Z
0.	1.	0.

Angle: 5.

Rot - Rot +

Set BETA 0

Apply Reject Accept

Done

Shells(3485)

- Pick
- Area
- Poly
- Sel1
- Sph
- Plan
- Box
- Prism
- Circ
- Fin
- Rim
- In
- Out
- Add
- Rm

Adjacent

Attach

Clear

Save

Load

Deselect

Whole

Active

Reverse

ByNode

ByElem

ByPart

ByGPart

BySubsys

BySet/Grp

ByEdge

ByPath

BySegm

ByCurve

BySurf

Label selection 3DSurf

element composite plyur 1  
elemedit composite direction vector 0.000000 1.000000 0.000000

Normal Renderer

# Ply orientation (2<sup>nd</sup> ply: 45° wrt 1<sup>st</sup> ply)

- Make sure all elements are still selected
- Choose „Rotate“
- Input 45 degree and press „Rot +“
- Press „Apply“ and „Accept“

The screenshot shows the LS-PrePost software interface. The main window displays a 3D model of a curved composite structure with a red mesh. A black box highlights a section of the mesh. The 'Element Editing' dialog box is open, showing the 'Direction' and 'Rotate' options selected. The 'Angle' is set to 45 degrees, and the 'Rot +' button is highlighted. The 'Apply' and 'Accept' buttons are also highlighted. The 'Shells(3485)' dialog box is also visible, showing various selection options. The command line at the bottom shows the command: `element composite accept  
elemedit composite direction rotate 45.000000`

# Material definition (3<sup>rd</sup> ply)

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File Misc. View Geometry FEM Application Settings Help

LS-DYNA keyword deck by LS-PrePost

- Assembly 1
  - FEM Parts

Element Editing

- Check  Split/Merge
- Create  Modify
- Delete  Direction
- Composite  Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

ply 1  
ply 2  
ply 3

Insert Delete

Material  Thickness  
 Offset  Direction

Material ID: 1

Select elements

Apply Reject Accept

Done

Sel. Shells(735)

- Pick  Box  In  Adjacent  ByNode
- Area  Prox  Out  Attach  ByElem
- Poly  Circ  Add  ByPart
- Sel1  Frin  Rm  ByGPart
- Sphe  Plan  Save  BySubsys

Insert Ply 3

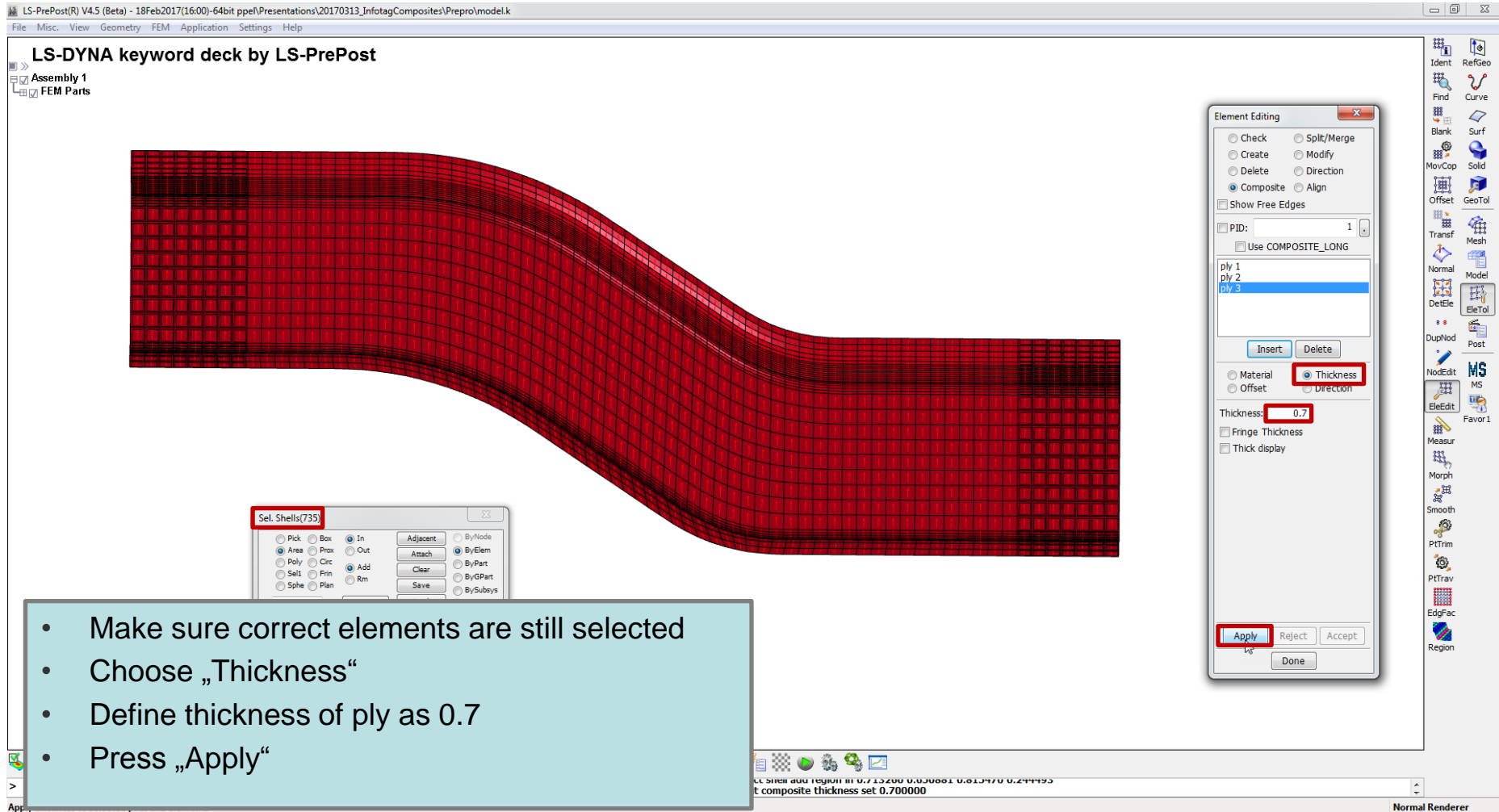
Choose material ID 1

Select elements in the part a 3rd ply is desired

Press „Apply“

Normal Renderer

# Ply thickness (3<sup>rd</sup> ply)



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File Misc. View Geometry FEM Application Settings Help

LS-DYNA keyword deck by LS-PrePost

Assembly 1  
FEM Parts

Element Editing

- Check
- Split/Merge
- Create
- Modify
- Delete
- Direction
- Composite
- Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

ply 1  
ply 2  
ply 3

Insert Delete

Material

Thickness

Offset

Direction

Thickness: 0.7

Fringe Thickness

Thick display

Apply Reject Accept

Done

Set Shells(735)

- Pick
- Box
- In
- Adjacent
- ByNode
- Area
- Prox
- Out
- Attach
- ByElem
- Poly
- Circ
- Add
- ByPart
- Sel1
- Frin
- Rm
- Save
- ByGPart
- Sphc
- Plan
- Rm
- BySubsys

- Make sure correct elements are still selected
- Choose „Thickness“
- Define thickness of ply as 0.7
- Press „Apply“

Normal Renderer

# Ply orientation (3<sup>rd</sup> ply: global x-axis)

The screenshot shows the LS-PrePost interface with a composite model. The main window displays a red mesh of a curved structure. Two dialog boxes are open: 'Set Shells(735)' and 'Element Editing'. The 'Element Editing' dialog is focused on the 'Direction' and 'Vector' options, with the 'X' column in the 'Vector' table set to 1.0, 0.0, and 0.0. A text box in the bottom left provides instructions for the process.

- Make sure correct elements are still selected
- Choose „Direction“ and „Vector“
- Set global x-axis
- Press „Apply“ and „Accept“

Element Editing dialog details:  
PID: 1  
Use COMPOSITE\_LONG:   
ply 1  
ply 2  
ply 3  
Material:  Thickness:   
 Direction  
 Vector:  Rotate:  Map  
Vector table:  

X	Y	Z
1.	0.	0.

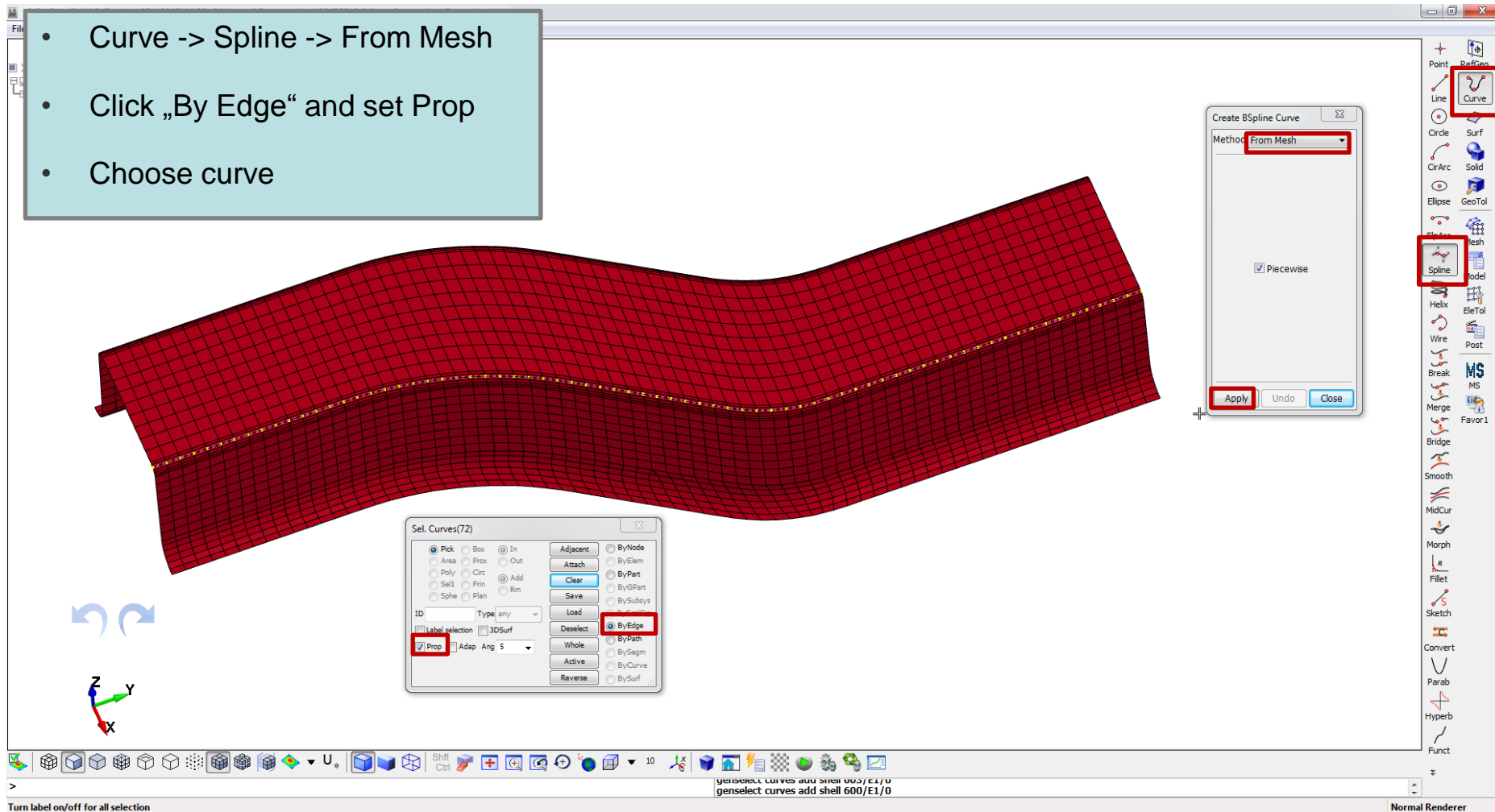
  
Angle: 45  
Set BETA: 0  
Buttons: Apply, Reject, Accept, Done

Set Shells(735) dialog details:  
Pick:  Box:  In:  Adjacent:  ByNode:   
Area:  Prox:  Out:  Attach:  ByElem:   
Poly:  Circ:  Add:  ByPart:   
Sel1:  Frin:  Clear:  ByGPart:   
Sphc:  Plan:  Rm:  Save:  BySubsys:

Command line: element composite direction vector 1.000000 0.000000 0.000000

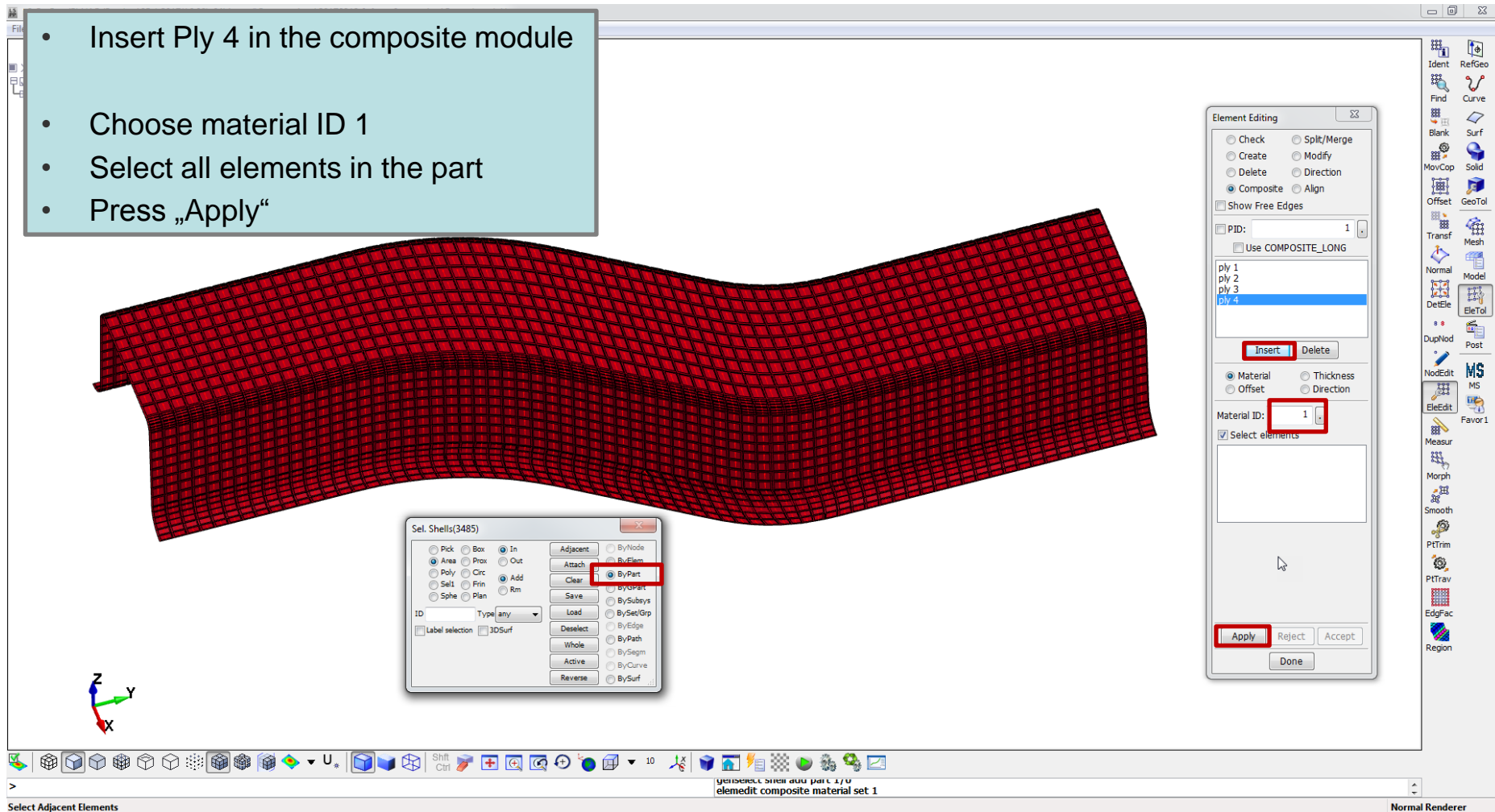
# Define curve for orientation of 4<sup>th</sup> ply

- Curve -> Spline -> From Mesh
- Click „By Edge“ and set Prop
- Choose curve



# Material definition (4<sup>th</sup> ply)

- Insert Ply 4 in the composite module
- Choose material ID 1
- Select all elements in the part
- Press „Apply“



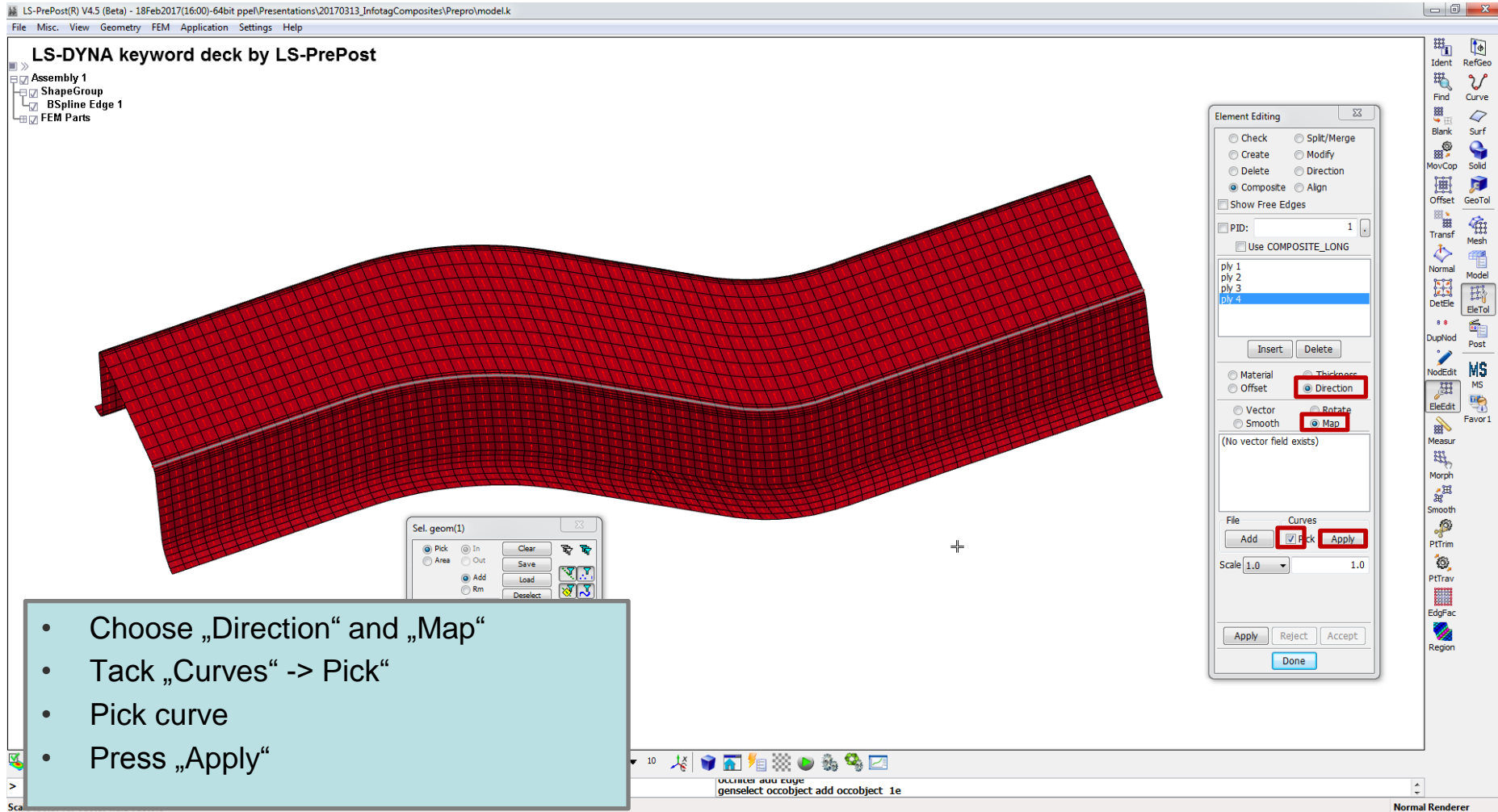


# Ply thickness (4<sup>th</sup> ply)

- Make sure all elements are still selected
- Choose „Thickness“
- Define thickness of ply as 0.25
- Press „Apply“

The screenshot displays the LS-PrePost interface with a 3D model of a composite shell. The shell is rendered with a red mesh. The 'Element Editing' dialog is open, showing the 'Thickness' property set to 0.25 for the 4th ply. The 'Sel. Shells(3485)' dialog is also open, showing selection options. The status bar at the bottom indicates 'element composite thickness set 0.25000' and 'element composite plydir 1'.

# Ply orientation (4<sup>th</sup> ply: along curve)



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File Misc View Geometry FEM Application Settings Help

LS-DYNA keyword deck by LS-PrePost

- Assembly 1
  - ShapeGroup
    - BSpline Edge 1
    - FEM Parts

Element Editing

- Check
- Split/Merge
- Create
- Modify
- Delete
- Direction
- Composite
- Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

- ply 1
- ply 2
- ply 3
- ply 4**

Insert Delete

- Material
- Offset
- Direction
- Vector
- Smooth
- Thickness
- Rotate
- Map

(No vector field exists)

File Curves

Add  Pick Apply

Scale 1.0 1.0

Apply Reject Accept

Done

Sel. geom(1)

- Pick
- Area
- In
- Out
- Add
- Rm
- Clear
- Save
- Load
- Deselect

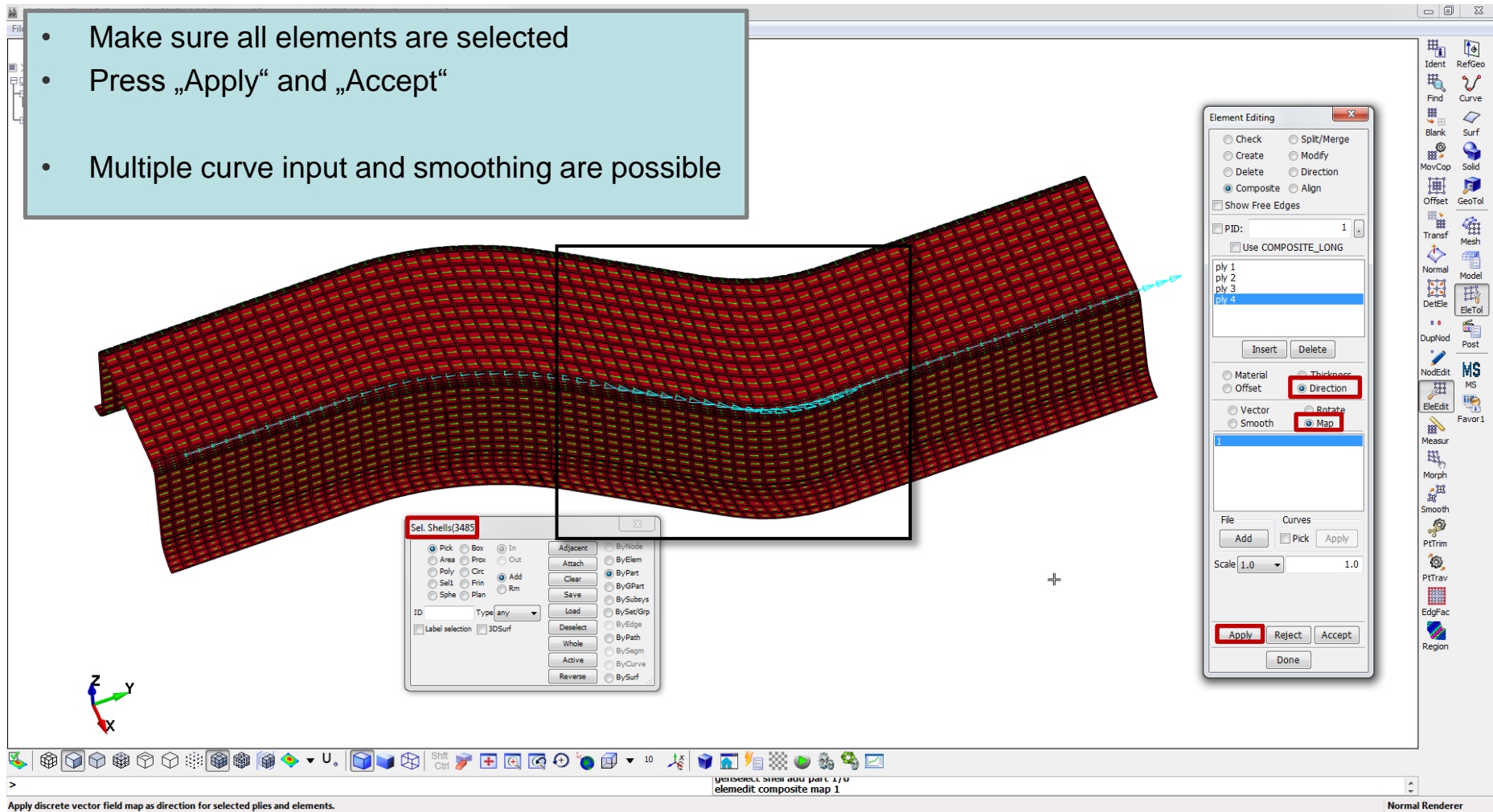
- Choose „Direction“ and „Map“
- Tack „Curves“ -> Pick“
- Pick curve
- Press „Apply“

10 10/11/17 14:08:49 genselect occobject add occobject 1e

Normal Renderer

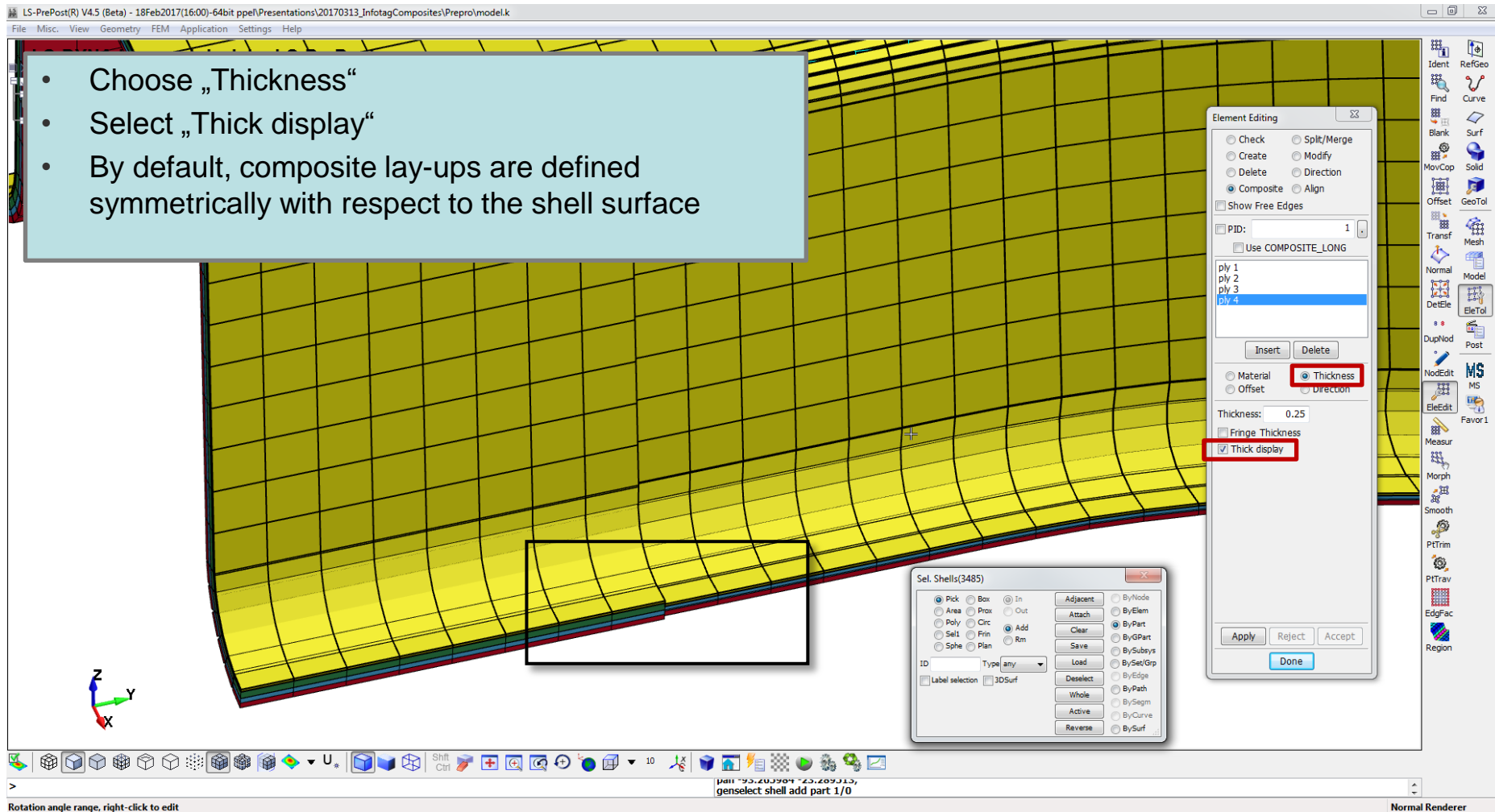
# Ply orientation (4<sup>th</sup> ply: along curve)

- Make sure all elements are selected
- Press „Apply“ and „Accept“
- Multiple curve input and smoothing are possible



# Check composite lay-up

- Choose „Thickness“
- Select „Thick display“
- By default, composite lay-ups are defined symmetrically with respect to the shell surface



# Align lay-up to lower surface

- Choose all plies
- Select all elements
- Open Offset menu
- Click „Flat lower“
- Press „Apply“

The screenshot displays the LS-PrePost interface with a 3D model of a curved composite structure. A yellow grid represents the lay-up. The 'Element Editing' dialog is open, showing the 'Offset' option selected under 'Abs. value', with 'Flat lower' chosen. The 'Sel. Shells(3485)' dialog is also open, showing various selection options. A status bar at the bottom indicates 'Apply offset to selected elements'.

LS-PrePost(R) V4.5 (Beta) - 18Feb2017(16:00)-64bit ppel\Presentation\20170313\_InfotagComposites\Prepro\model.k  
File Misc View Geometry FEM Application Settings Help

Element Editing

- Check
- Split/Merge
- Create
- Modify
- Delete
- Direction
- Composite
- Align

Show Free Edges

PID: 1

Use COMPOSITE\_LONG

- ply 1
- ply 2
- ply 3
- ply 4

Insert Delete

Material Thickness

Offset Direction

Abs. value

- Flat lower
- Flat upper

Apply Reject Accept Done

Sel. Shells(3485)

- Pick
- Area
- Poly
- Selt
- Sphe
- Box
- Prox
- Circ
- Frin
- Plan
- In
- Out
- Add
- Rm

Adjacent Attach Clear Load Deselect Whole Active Reverse

ByNode ByElem ByPart BySubsys BySec/Grp ByEdge ByPath BySegm ByCurve BySurf

ID: Type: any

Label selection 3DSurf

Apply offset to selected elements

element composite: ply 1 2 3 4  
element composite offset nloc -1

Normal Renderer

# Keyword

- By saving the keyword file, LS-PrePost will generate a list of **\*ELEMENT\_SHELL\_COMPOSITE\_OFFSET**

```
$#      eid      pid      n1      n2      n3      n4      n5      n6      n7      n8
...      1        1        78      156      80      79      0        0        0        0
$#      offset
...      0.975
$#      mid1     thick1      b1      unused      mid2     thick2      b2
...      1        0.5 -90.69652      1        0.5 -45.69652
...      1        0.7  179.3045      1        0.25 -90.67136
...
...      17        1        62      172      171      63      0        0        0        0
...      0.625
...      1        0.5 -100.2107      1        0.5 -55.21067
...      0        0.0      0.0      1        0.25 -106.1234
```

- **LS-DYNA interpretation of „zero“ integration points**
  - integration points are not considered during calculation
  - zero data are written to d3plot for integration points
- **Integration point number in Post-Processing consequently coincides with Ply-Id defined in the composite module**



# Post-Processing

# Visualization of fiber orientations

LS-PrePost(R) V4.5 (Beta) - 18Feb2017(16:00)-64bit 0313\_InfotagComposites(VectorPlot)\VectorPlot\ORIG\_3IP.d3plot

File Misc. View Geometry FEM Application Settings Help

LS-DYNA keyword deck by LS-PrePost  
Time = 0.00049952, #nodes=27671, #elem=26944

Post

Animate

Eigen First: 1 Last: 3 Inc: 1 Time: 0.0004995 State: 2

Animate

30 S F

Vector Plot

Hist. var. cosine

S1  S2  S3

X  Y  Z

H.Var X H.Var Y H.Var Z

0 0 0

Int. Pt. 1

Vector Range

Min: 0

Max: 0

Dynamic  Static

User  Show

SF: 1.0 1.0

Hidden line vector off

Keep vector display

Display highlighted node vel.

Whole  Part

Area  El/Node

Apply Clear Done

Post

Vector

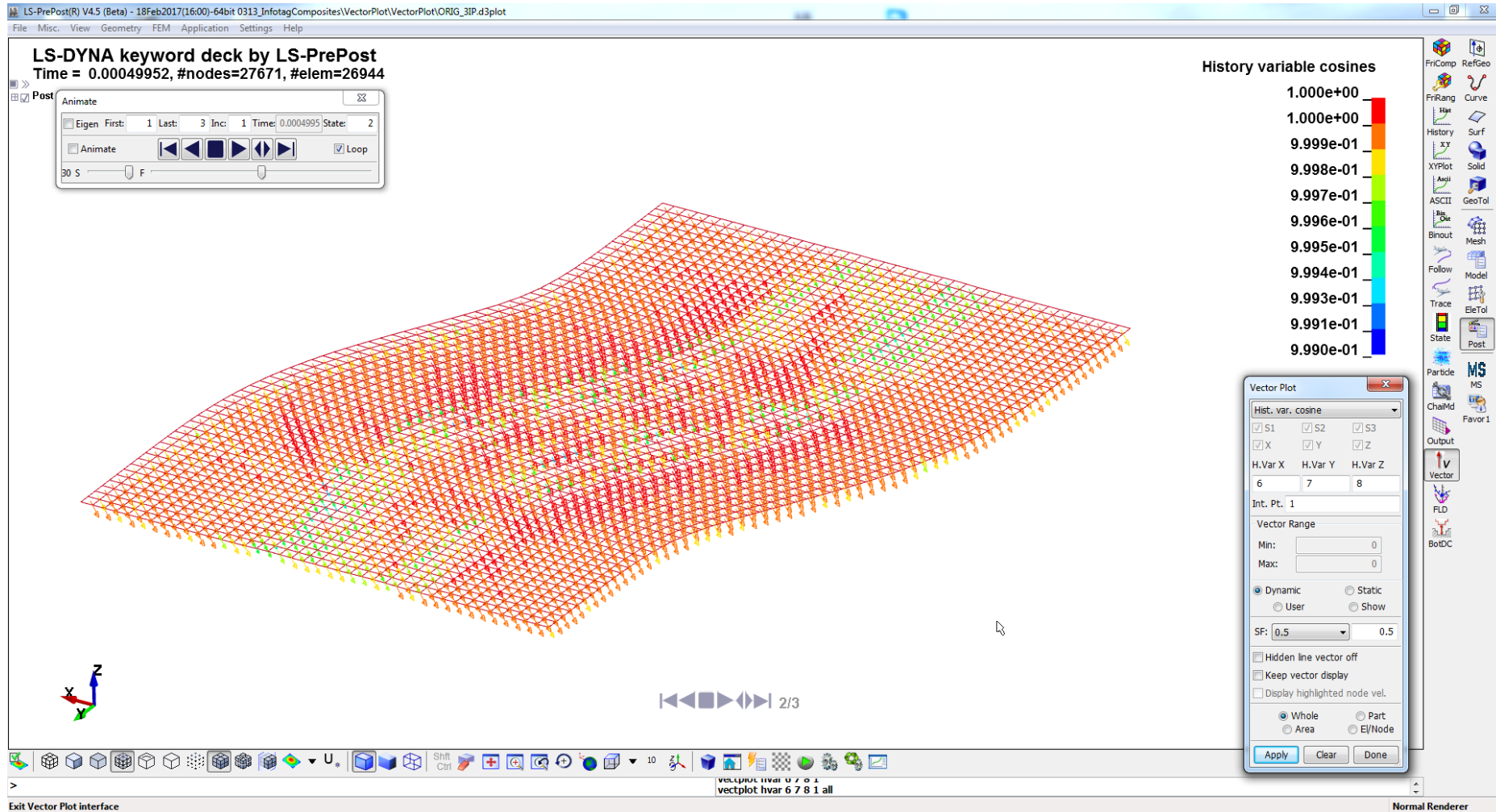
Apply vector plot

clearvect;

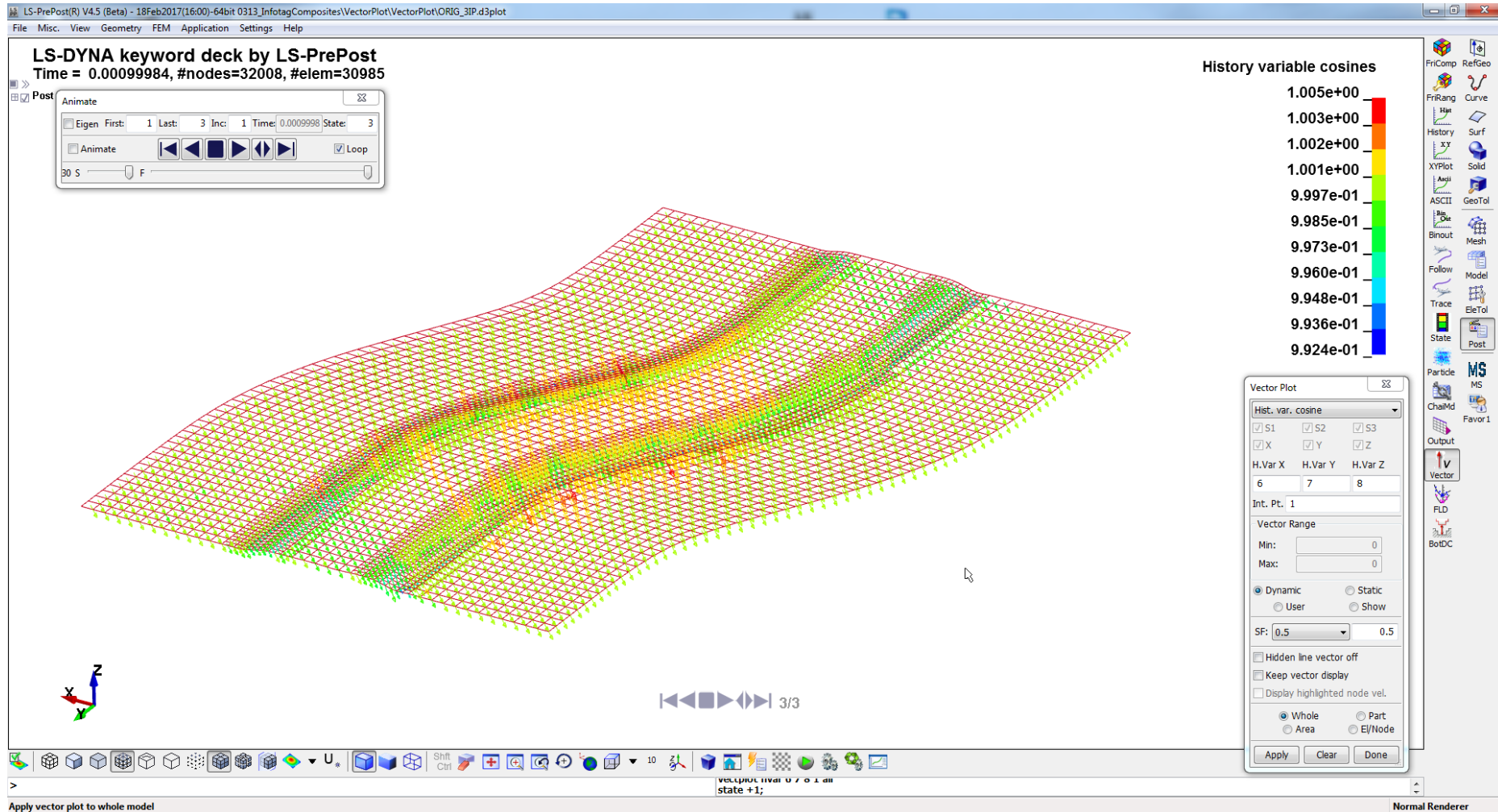
- Choose Post -> Vector -> Hist var. cosine
- Select position of history variables
- „Apply“



# Visualization of fiber orientations

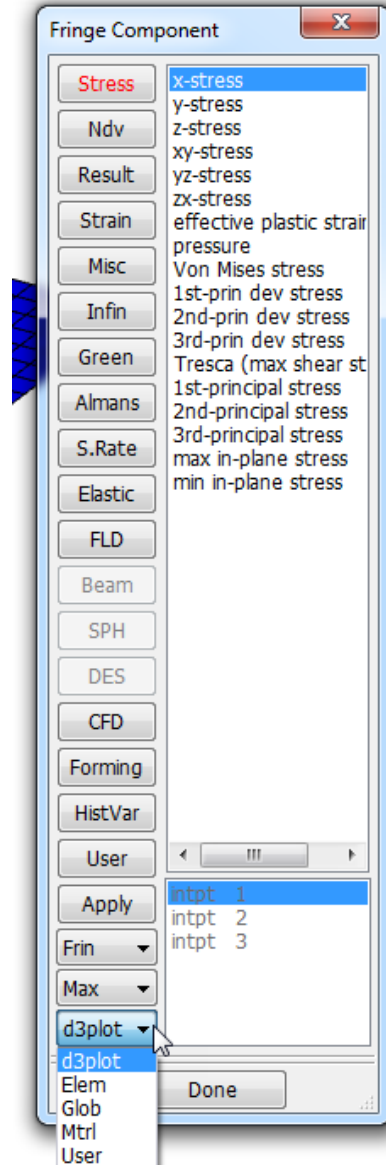


# Visualization of fiber orientations



# Stress output

- For fringe plot, new option for stress and strain output for non-isotropic materials can be used
- To be reasonably defined, keyword has to be loaded into LS-PrePost





# Outlook

# Application based input

- **New feature: Application explorer**
- **Model generation without explicit keyword definition**
- **Implemented for ICFD solver in LS-PrePost 4.5**
- **Further application in preparation:**
  - implicit
  - thermal
  - ...
- **We are open for suggestions!**

Thank you  
for your attention!

