

LIVERMORE SOFTWARE TECHNOLOGY CORPORATION

LS-PrePost®

Metal Forming Simulation

Tutorial Manual – Trimming and Springback

Version 1.0

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Tutorial #T1 – Trimming of a decklid inner drawn panel

Interface Used: *Applications > Metal Forming*

Files required:

drawn.dynain.k (drawn part results)

mat_decklid.k (blank material properties)

trim.iges

Step 1

Note: LS-PrePost 2.4 dated April 14th, 2009 and later must be used for this tutorial. This tutorial focuses on the set-up process of drawn panel trimming simulation using the Metal Forming interface.

1. Load drawn part results and open Metal Forming Interface

launch LS-PrePost

File → Open → LS-Dyna Keyword

open “drawn.dynain.k”

File → Open → IGES File

open ‘trim.iges’

Shown in Figure 1 are drawn panel shape superimposed with trim curves, and drawn panel outline superimposed with trim curves.

Application → Metal Forming (or hit F11)

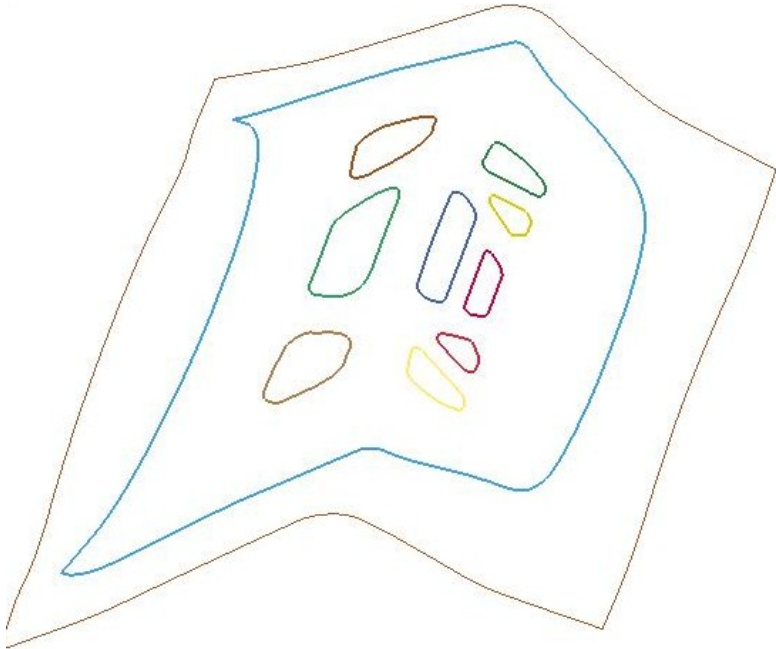
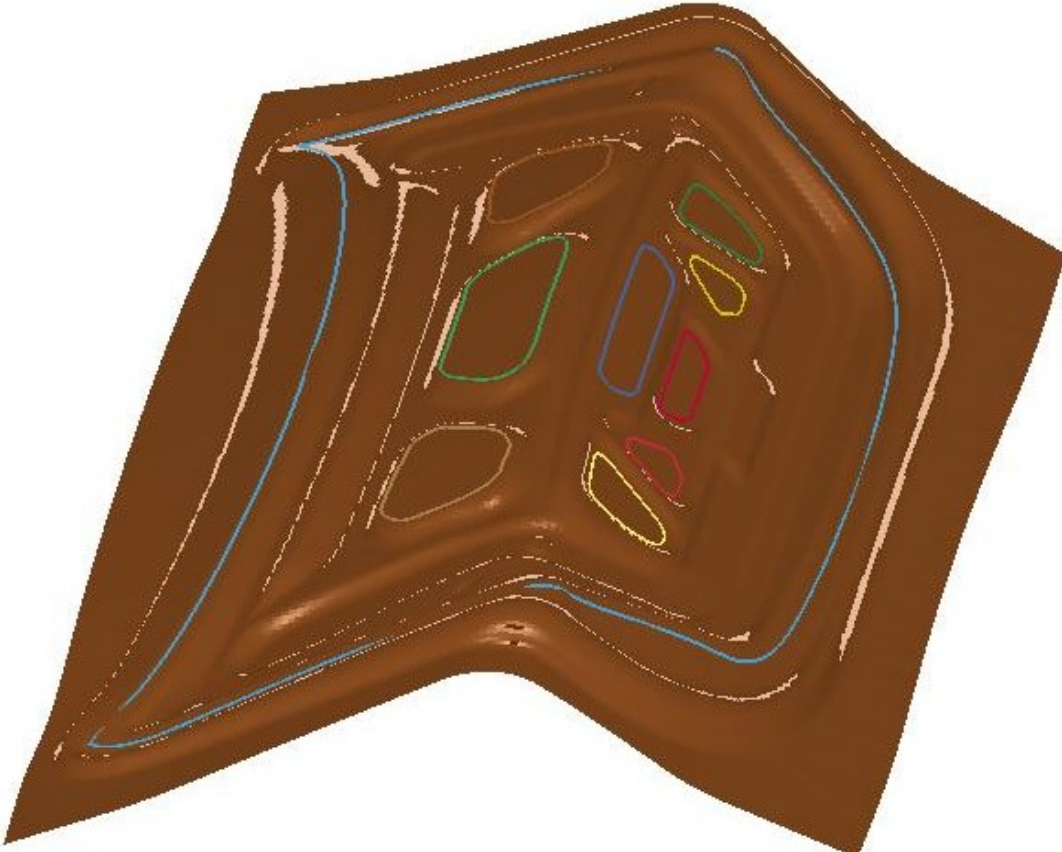


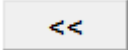
Figure 1

Step 2

2. Define Blank (refer to Figures 2 and 3)

click *Blank* in the side panel in Figure 2 (launches *Blank Assignment* Dialog in Figure 3)

select “5 Shell” from the right hand list

click 

select Element Formulation: 2:Belytschko-Tsay

(Note: To limit the file size in this tutorial, “2:Belytschko-Tsay” is selected here; however, choose 16:Fully Integrated Shell for draw and trimming simulation that also require a subsequent springback simulation)

enter Number of Integration: 5

(Note: To limit the file size in this tutorial, NIP of “5” is selected here; however, choose at least “7” NIP for draw and trimming simulation that also require a subsequent springback simulation)

enter Thickness: 0.9; must hit a carriage return.

click *MD* (launches *Material Database* Dialog shown in Figure 4)

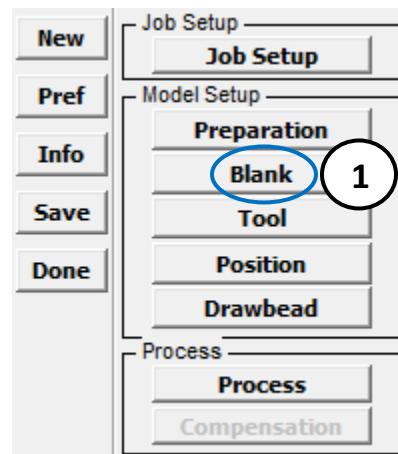


Figure 2

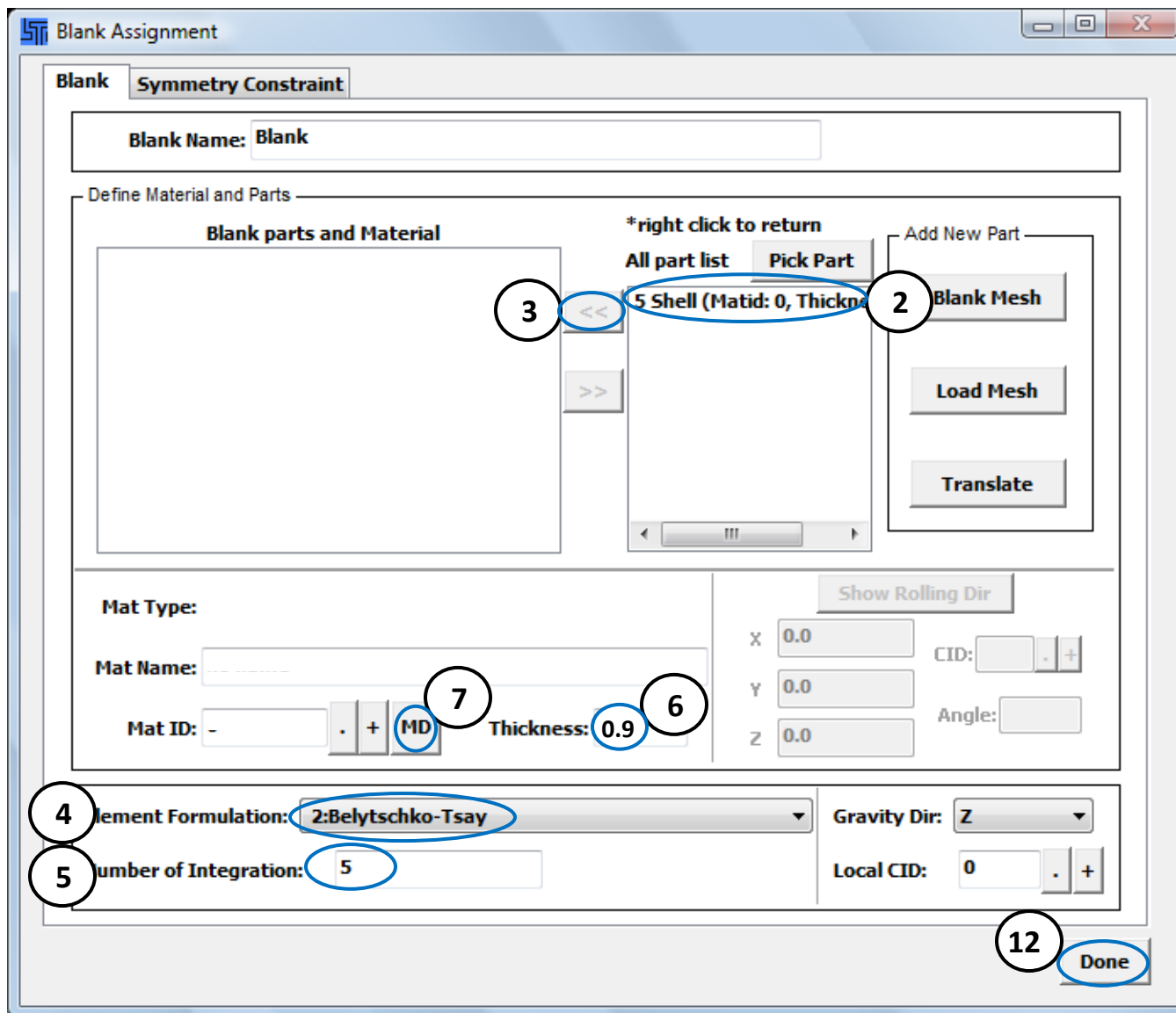



Figure 3

Step 3

3. Load material property for the blank (refer to Figure 4)

- click  to go to current working directory (Figure 4)
- click "mat_decklid.k"
- click *Preview*
- click *OK*
- click *Done* (Figure 5)

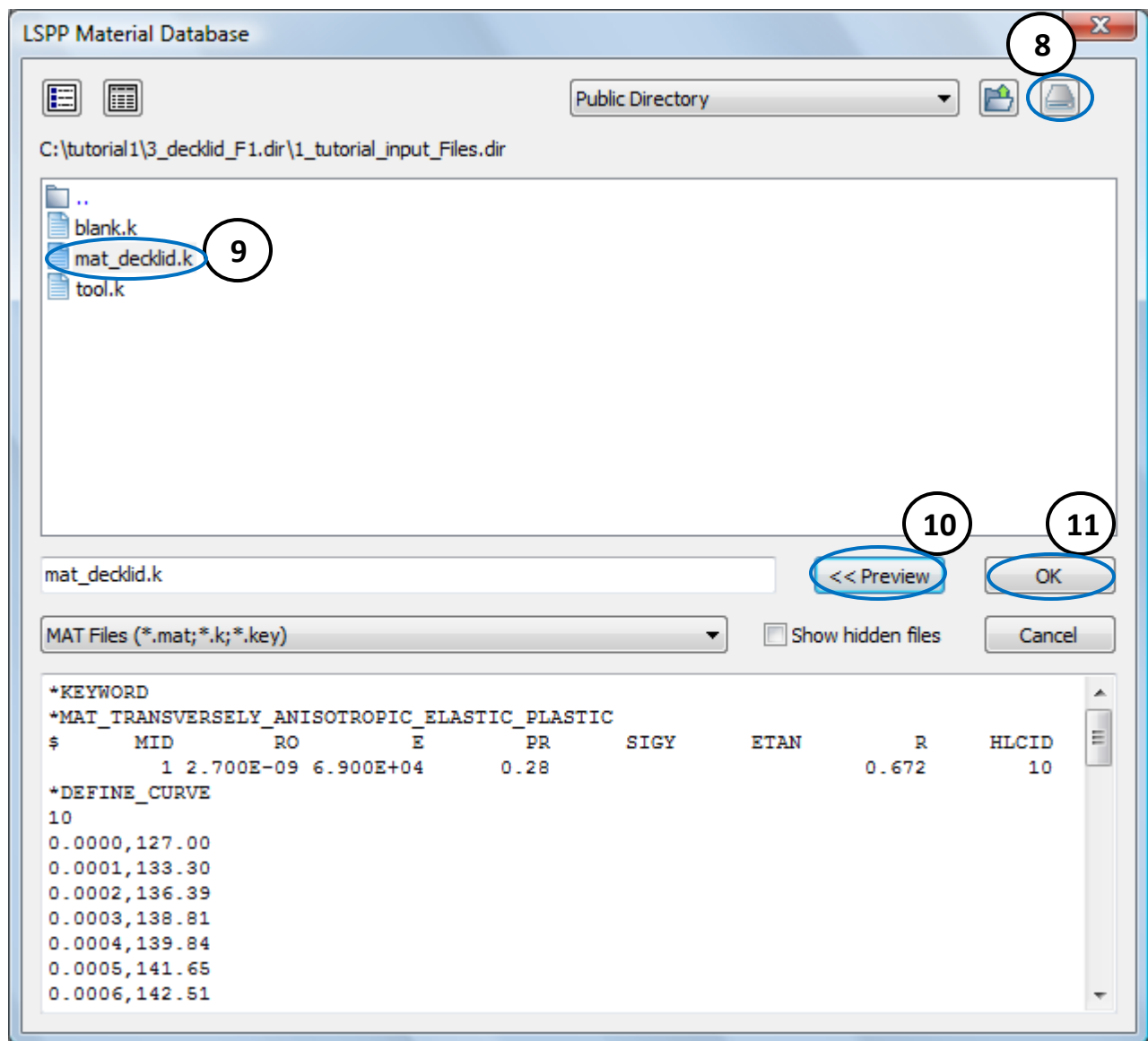


Figure 4

Step 4

4. Define Process (refer to Figures 5 through 7)

click *Process* in the side panel in Figure 5 (launches *Metal Forming Process* Dialog box as shown in Figure 6)

select Process Type: Trimming (Figure 6)

activate Trimline type: 3D

activate: pick seed node


pick a node which will not be trimmed away

click: *Create*

click: *All*

click 

click *Control* Tab (Figure 7)

click  (launches *Dyna Input Decks Trimming* Dialog in Figure 8)

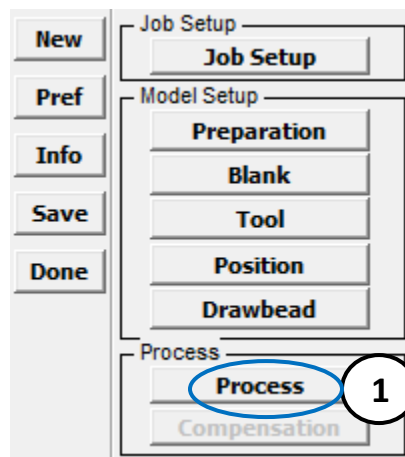


Figure 5

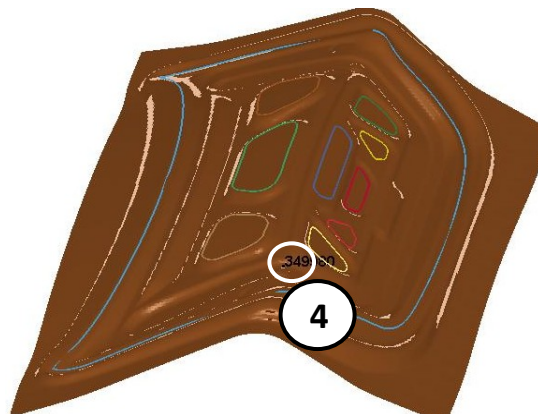
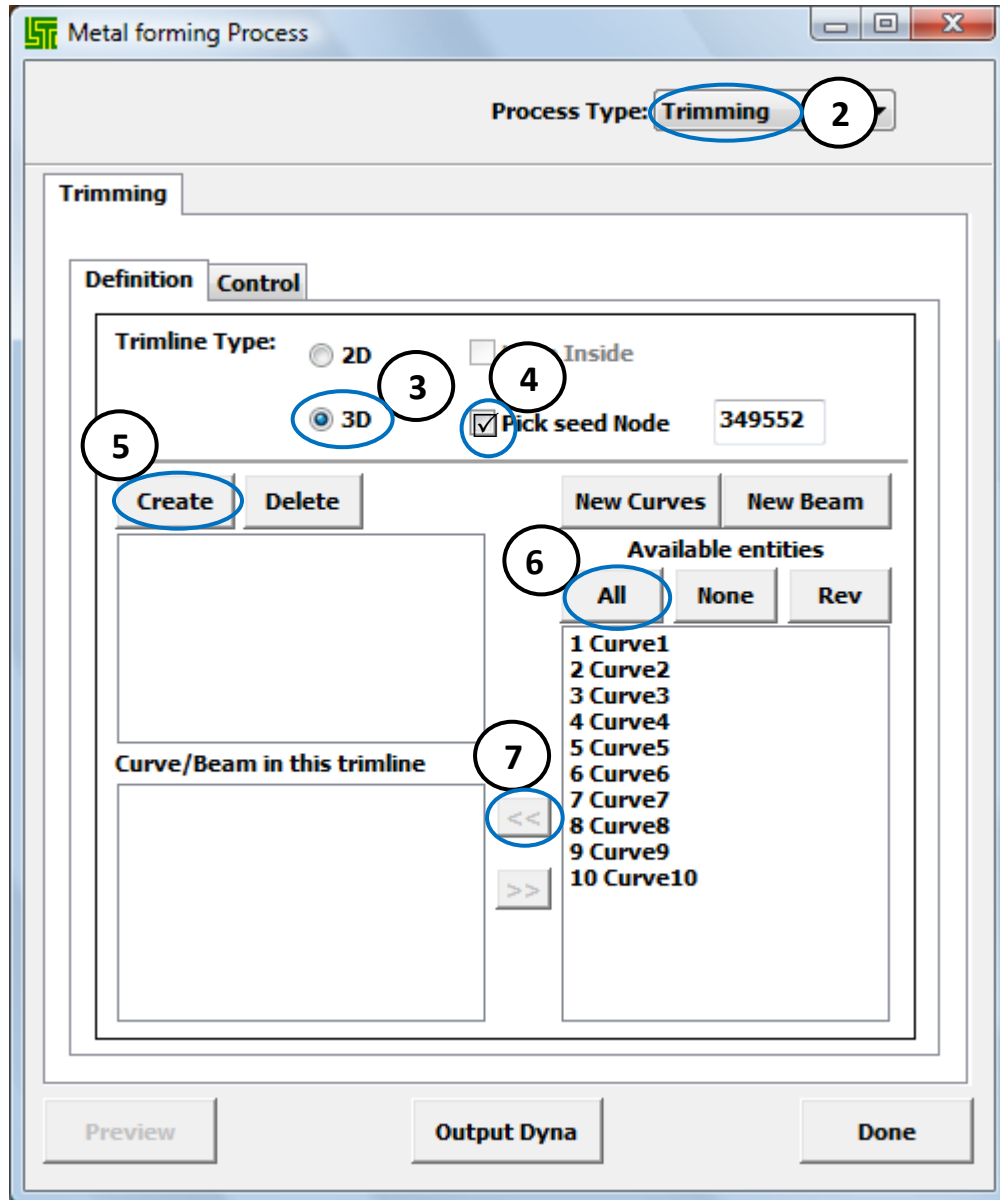


Figure 6

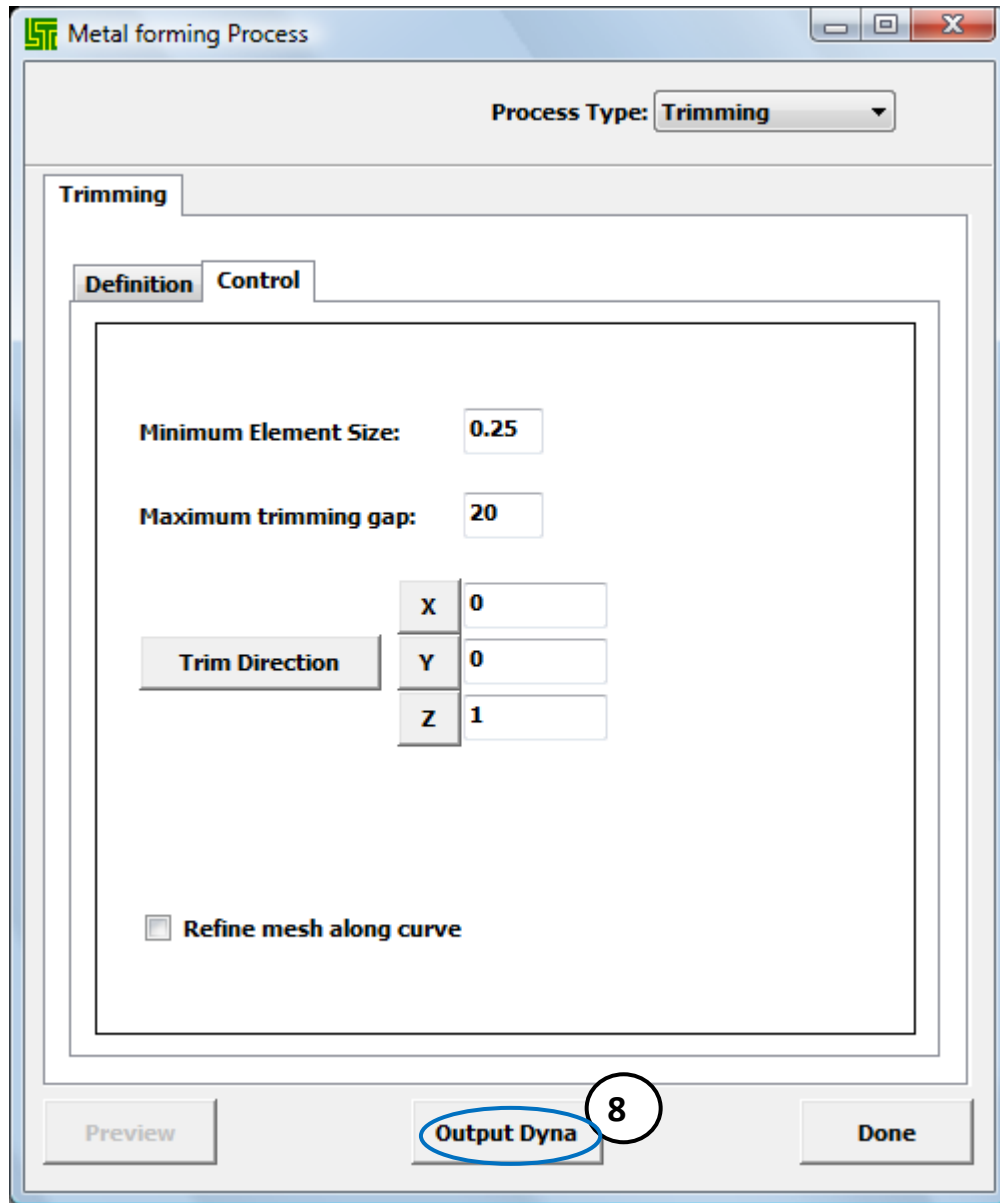


Figure 7

Step 5

5. Define Output Options (Figures 8 and 9)

click **Advanced...** (Figure 8)

set Blank File name: blank.k (Figure 9); hit a carriage return.

Set Dyna Input File name: sim.dyn; hit a carriage return.

click **Done**

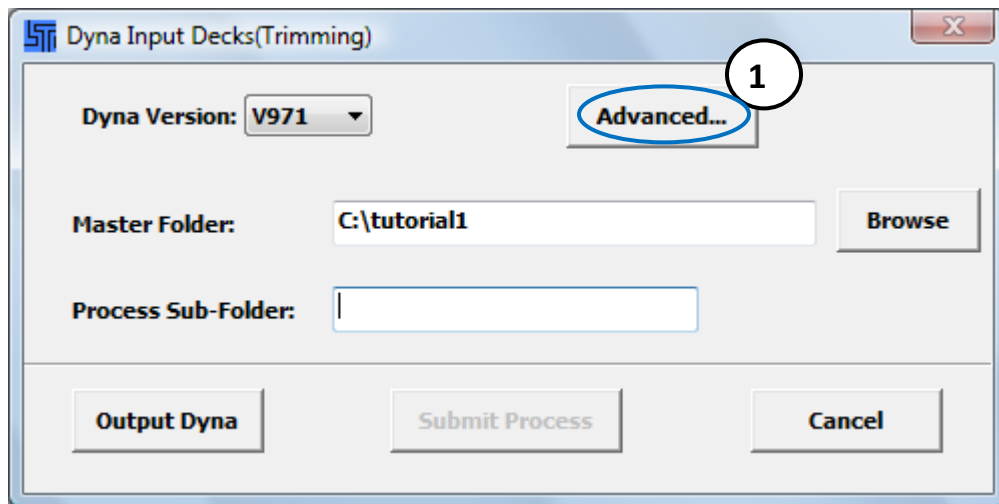


Figure 8

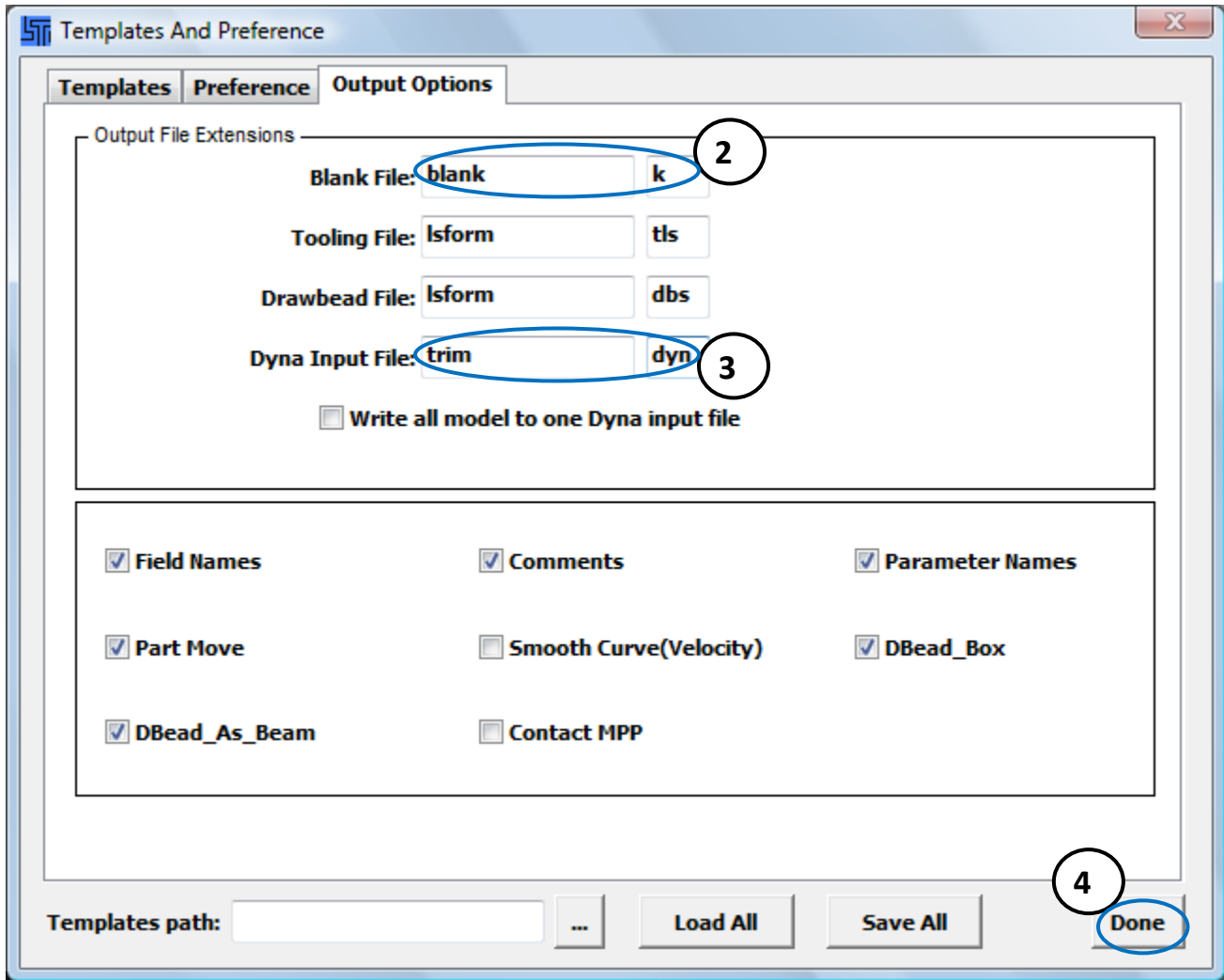


Figure 9

Step 6

6. Output LS-Dyna input decks (Figures 10)

In Dyna Input Decks (Trimming) Dialog

click *Browse* to specify a file folder for output files

click **Output Dyna**

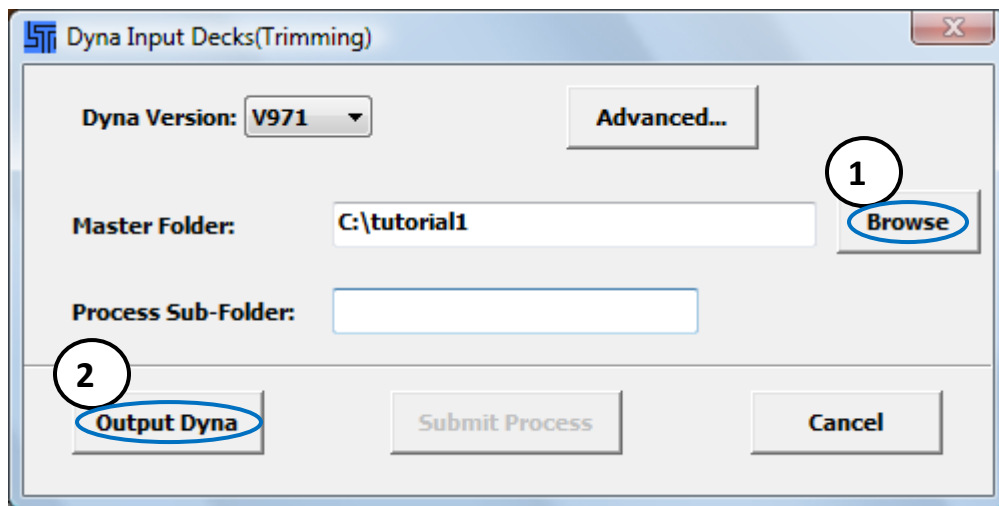


Figure 10

Step 7


7. Run LS-DYNA and processing results

Run LS-DYNA - C:\LSDYNA\program\ls971_s_R4.2_winx64_p.exe i=trim.dyn ncpu=2 memory=200M
The simulation takes about 28 seconds on a Xeon CPU 5150 @ 2.66GHz. The actual memory used was around 20 MW (million words), about 80 MB (megabytes).

Launch LS-PrePost

File → Open → LS-Dyna Binary Plot

Open "d3plot"

click  to move to the last state (Figure 10)

Shown in Figure 11 is the trimmed panel shape.



Figure 10



Figure 11

Tutorial #S1 – Springback of a decklid inner trimmed panel

Interface Used: *Applications > Metal Forming*

Files required:

trimmed.dynain.k (trimmed part results)

mat_decklid.k (blank material properties)

Step 1

Note: LS-PrePost 2.4 dated April 14th, 2009 and later must be used for this tutorial. This tutorial focuses on the set-up process of springback simulation using the Metal Forming interface.

1. Load trimmed part results and open Metal Forming Interface

launch LS-PrePost

File → Open → LS-Dyna Keyword

open “trimmed.dynain.k”

Shown in Figure 1 is the trimmed panel shape.

Application → Metal Forming (or hit F11)

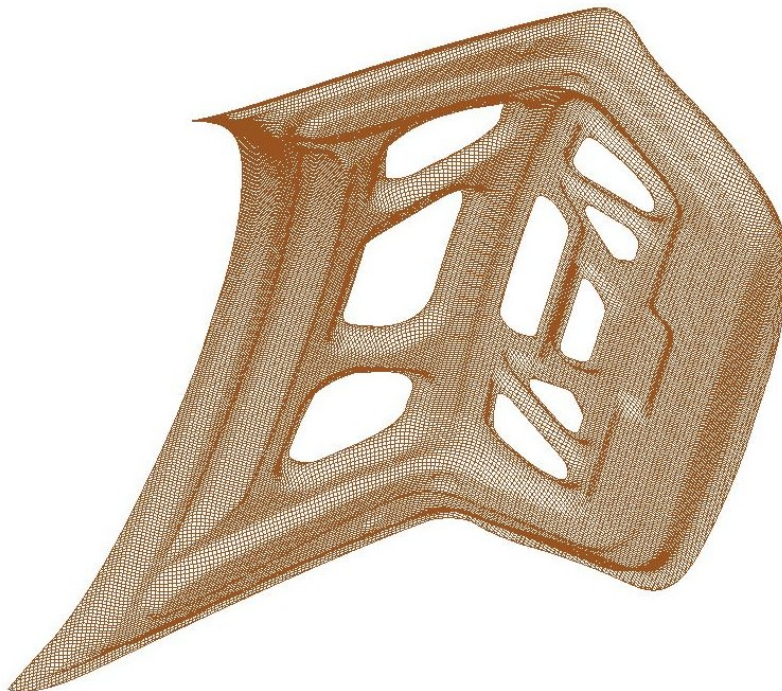


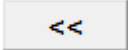
Figure 1

Step 2

2. Define Blank (refer to Figures 2 and 3)

click *Blank* in the side panel in Figure 2 (launches *Blank Assignment* Dialog in Figure 3)

select “5 Shell” from the right hand list

click 

select Element Formulation: 2:Belytschko-Tsay

(Note: To limit the file size in this tutorial, “2:Belytschko-Tsay” is selected here; however, always choose 16:Fully Integrated Shell for springback simulation as well as the preceding draw and trimming simulation)

enter Number of Integration: 5

(Note: To limit the file size in this tutorial, NIP of “5” is selected here; however, always choose at least “7” NIP for springback simulation as well as the preceding draw and trimming simulation)

enter Thickness: 0.9; must hit a carriage return.

click *MD* (launches *Material Database* Dialog shown in Figure 4)

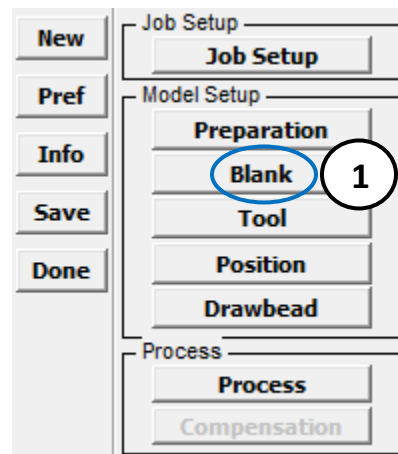


Figure 2

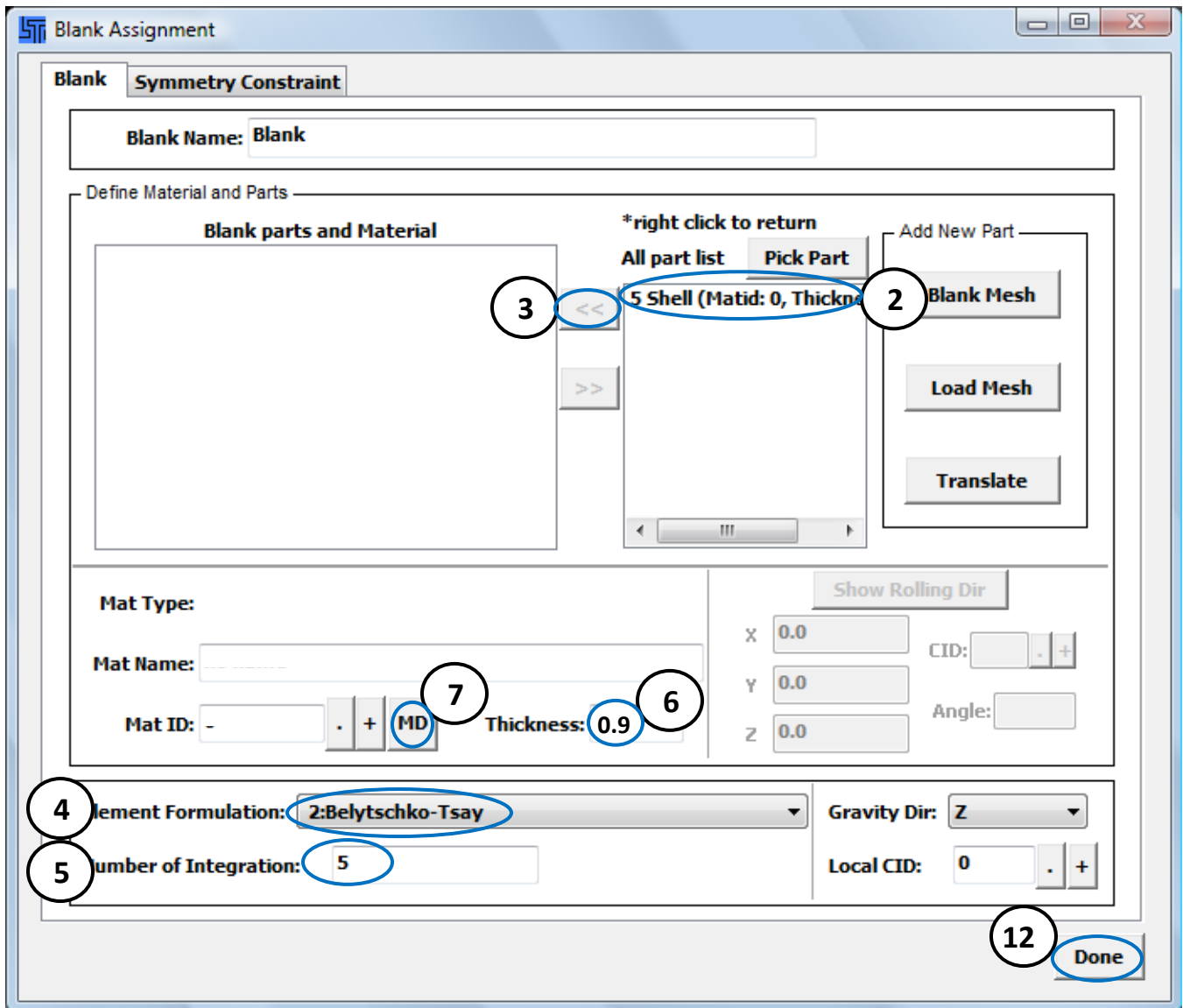



Figure 3

Step 3

3. Load material property for the blank (refer to Figure 4)

- click  to go to current working directory (Figure 4)
- click "mat_decklid.k"
- click *Preview*
- click *OK*
- click *Done* (Figure 5)

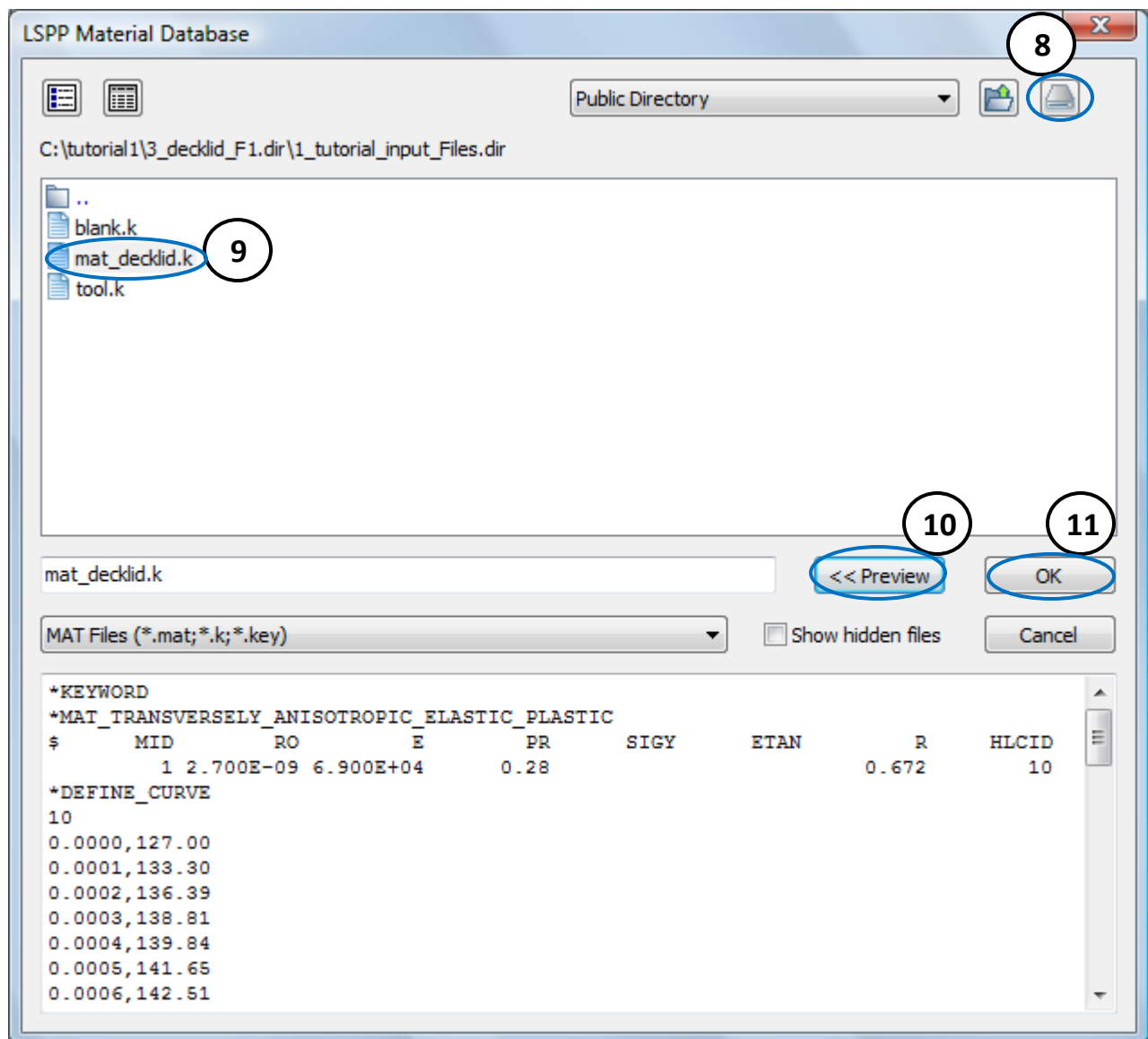


Figure 4

Step 4

4. Define Process (refer to Figures 5 through 9)

click *Process* in the side panel in Figure 5 (launches *Metal Forming Process* Dialog box as shown in Figure 7)

click to position the trimmed panel in top view (Figure 5)

select Process Type: Springback (Figure 7)

click *Definition* tab

activate **Constrained**

click

click left mouse button to pick three nodes in the sequence shown (Figure 8)

(Note: Three constrained nodes should form a right triangle, with 2nd node along the x-axis)

click right mouse button to return to *Metal Forming Process* Dialog box

highlight three nodes in the box to show nodal locations on the panel in the main graphics window

click *Control* Tab

click **Coarsen** (Figure 9)

click **Box**

click **Check Shell**

click (launches *Dyna Input Decks Springback* Dialog in Figure 10)

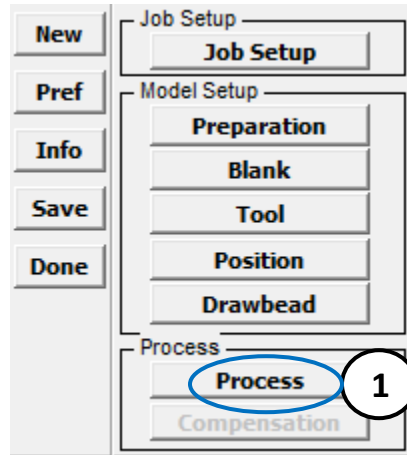


Figure 5



Figure 6

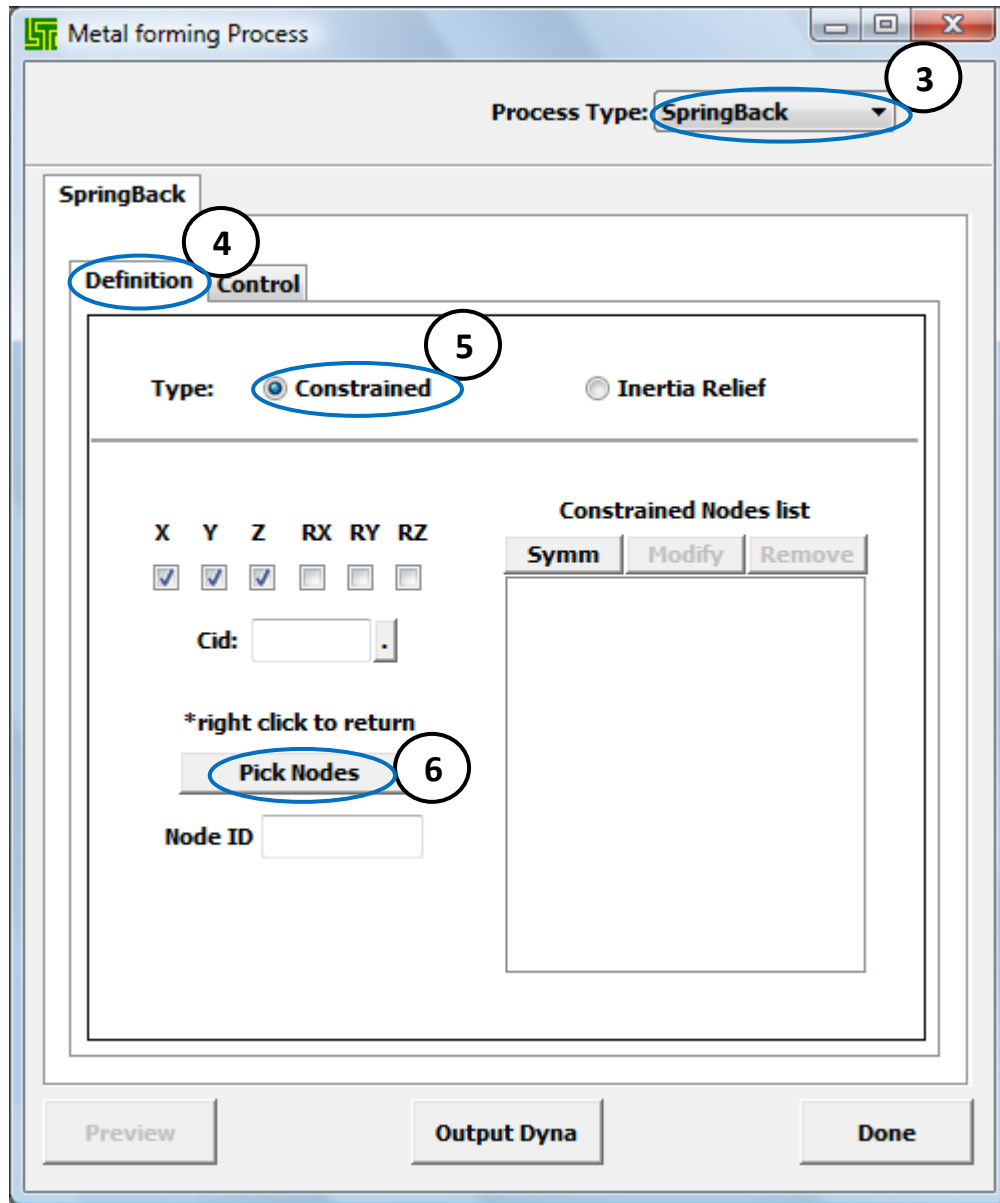


Figure 7

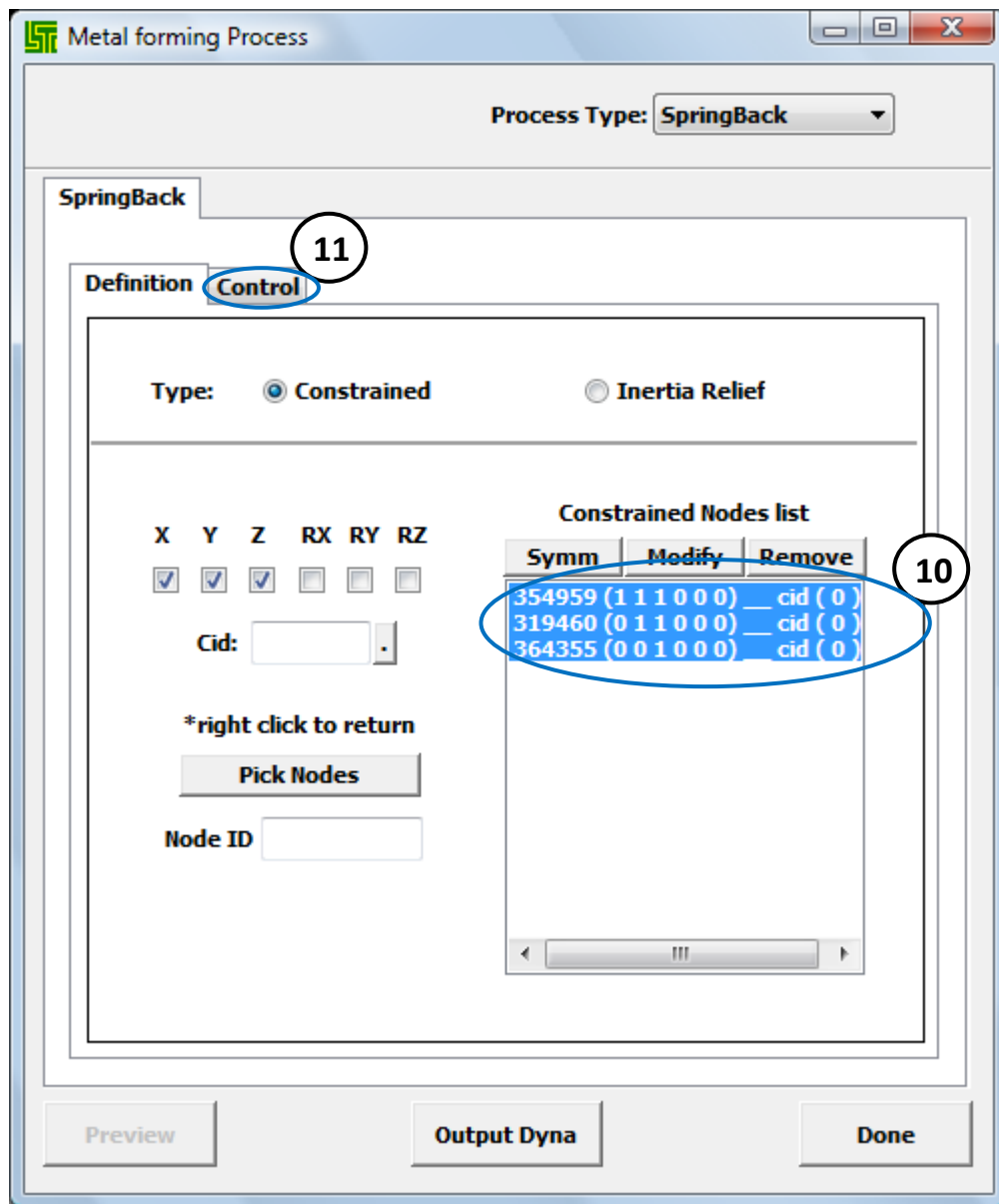
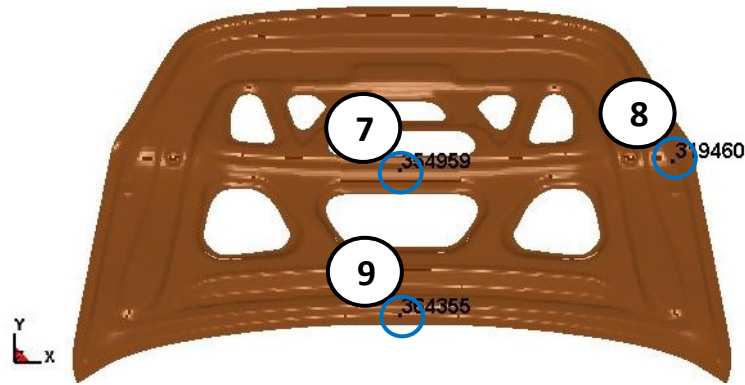


Figure 8

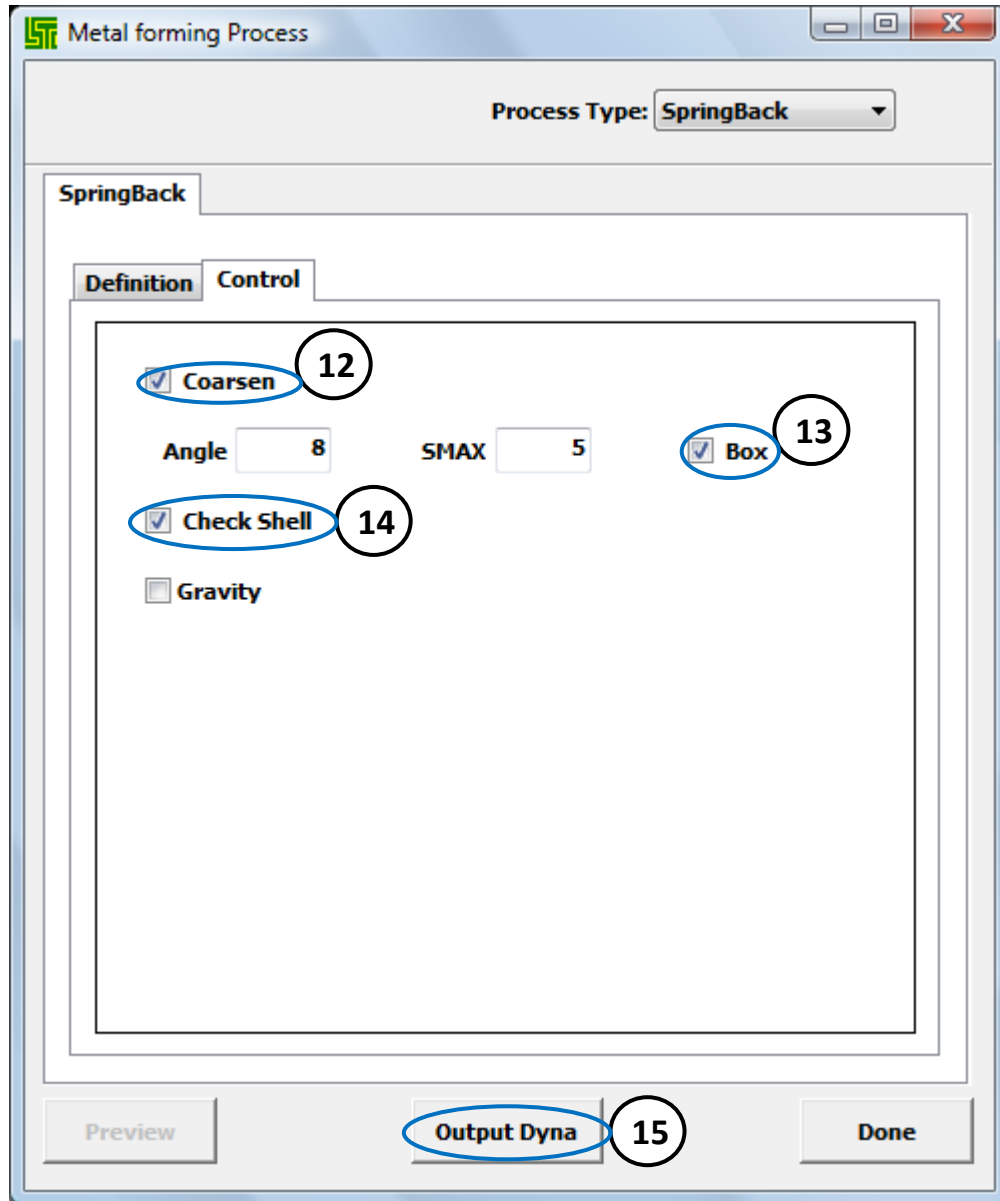


Figure 9

Step 5

5. Define Output Options (Figures 10 and 11)

click **Advanced...** (Figure 10)

set Blank File name: blank.k (Figure 11); hit a carriage return.

Set Dyna Input File name: spbk.dyn; hit a carriage return.

click **Done**

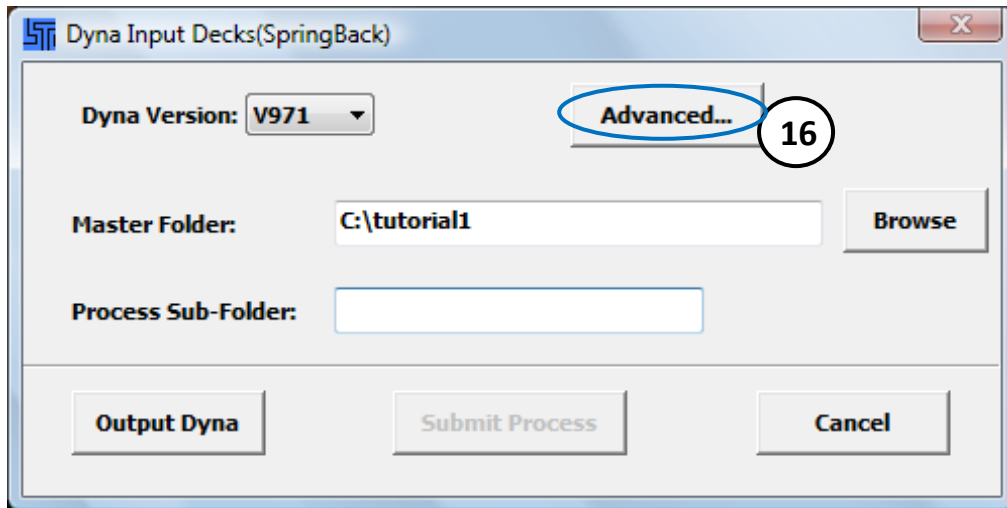


Figure 10

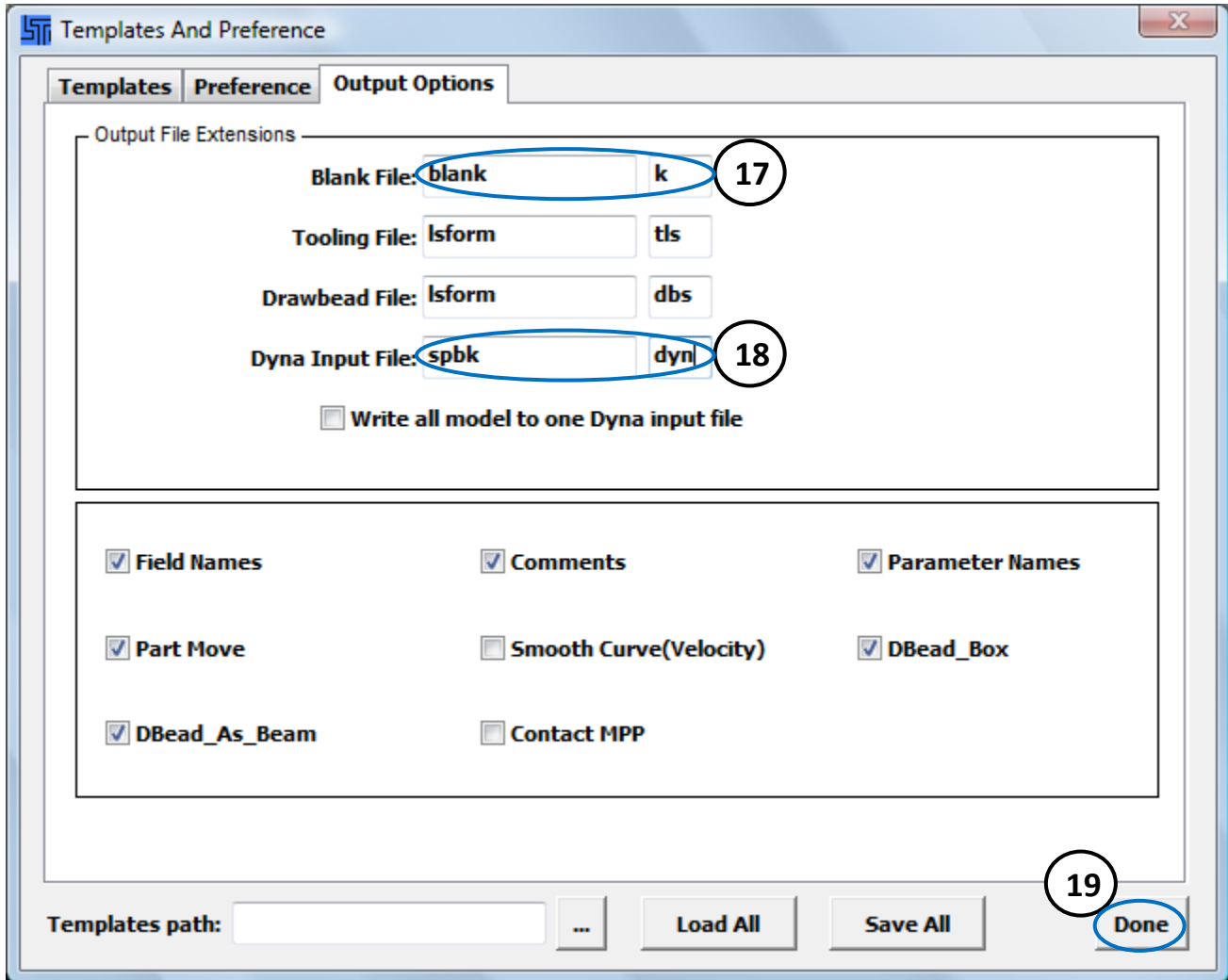


Figure 11

Step 6

6. Output LS-Dyna input decks (Figures 12)

In Dyna Input Decks (SpringBack) Dialog

click *Browse* to specify a file folder for output files

click **Output Dyna**

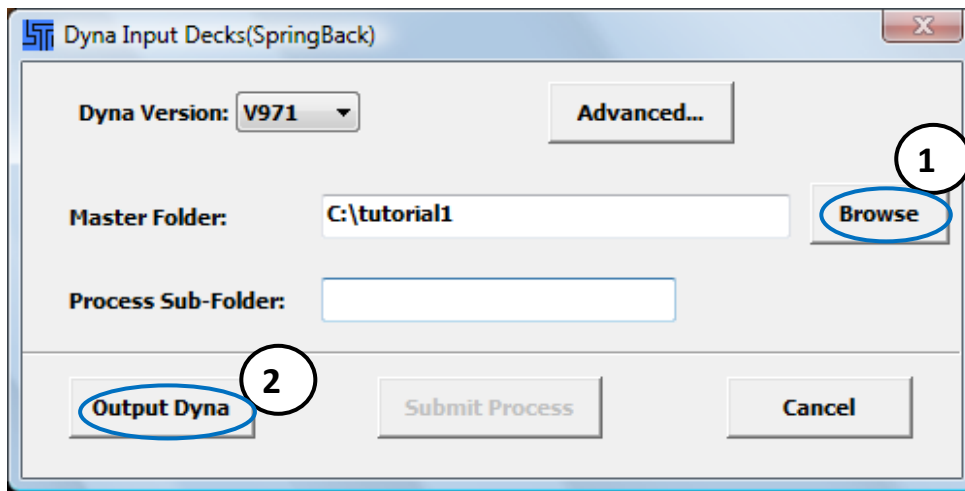


Figure 12

Step 7


7. Run LS-DYNA and processing results

Run LS-DYNA - C:\LSDYNA\program\ls971_d_R4.2_winx64_p.exe i=spbk.dyn ncpu=2 memory=160M
The simulation takes about 11 minutes on a Xeon CPU 5150 @ 2.66GHz. The actual memory used was around 83 MW (million words), about 640 MB (megabytes).

Launch LS-PrePost

File → Open → LS-Dyna Binary Plot

Open "d3plot"

click  to move to the last state (Figure 13)

Shown in Figure 14 is the sprungback panel shape.



Figure 13



Figure 14

1) Springback displacement contour plot

click , Figure 15

click 

highlight: Z-displacement

shown in Figure 16 is the springback contour in Z-direction

highlight: resultant displacement

shown in Figure 17 is the resultant springback contour

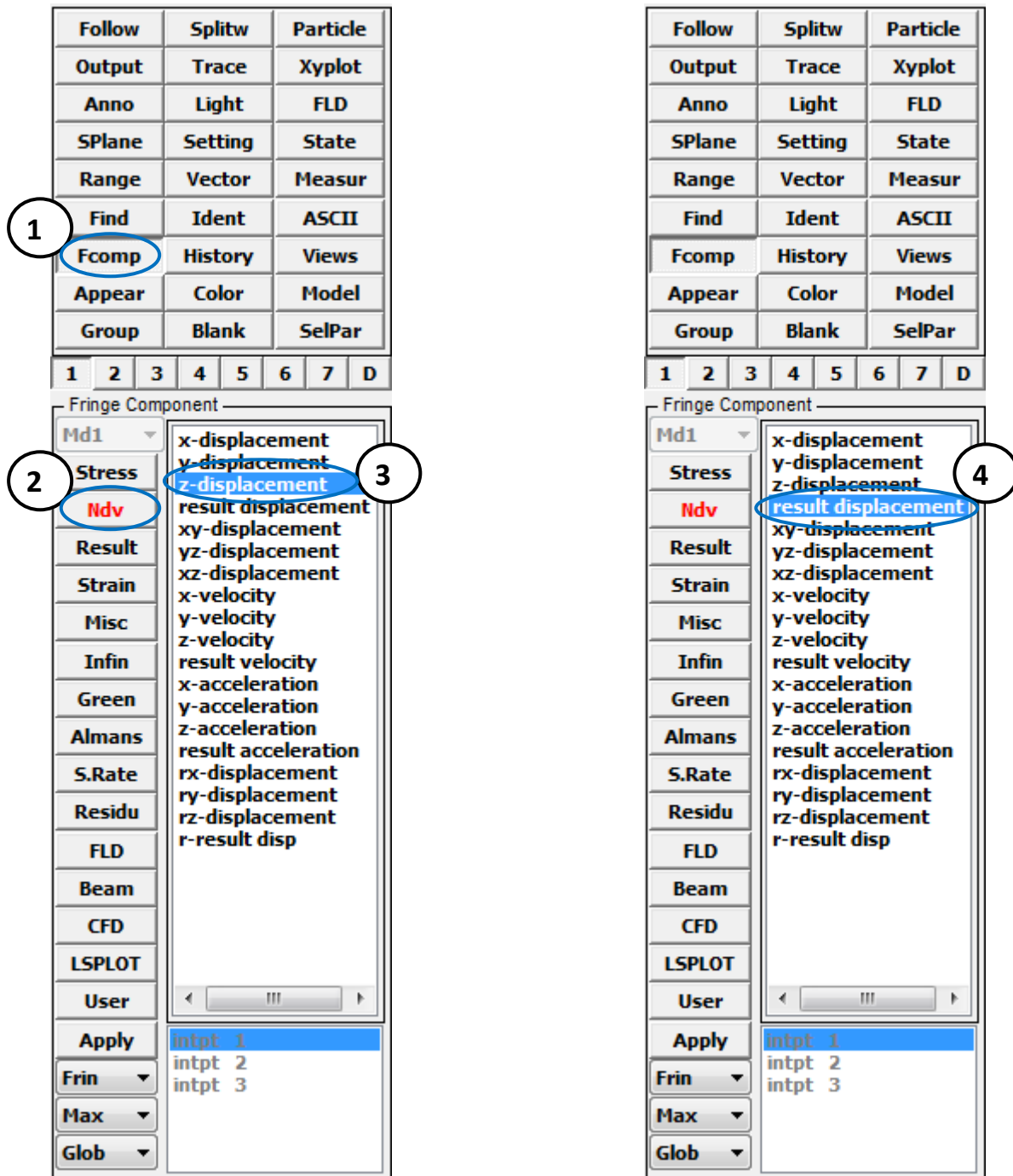


Figure 15

Isform - SpringBack process
Time = 1
Contours of Z-displacement
min=-0.937836, at node# 350327
max=6.22169, at node# 371953

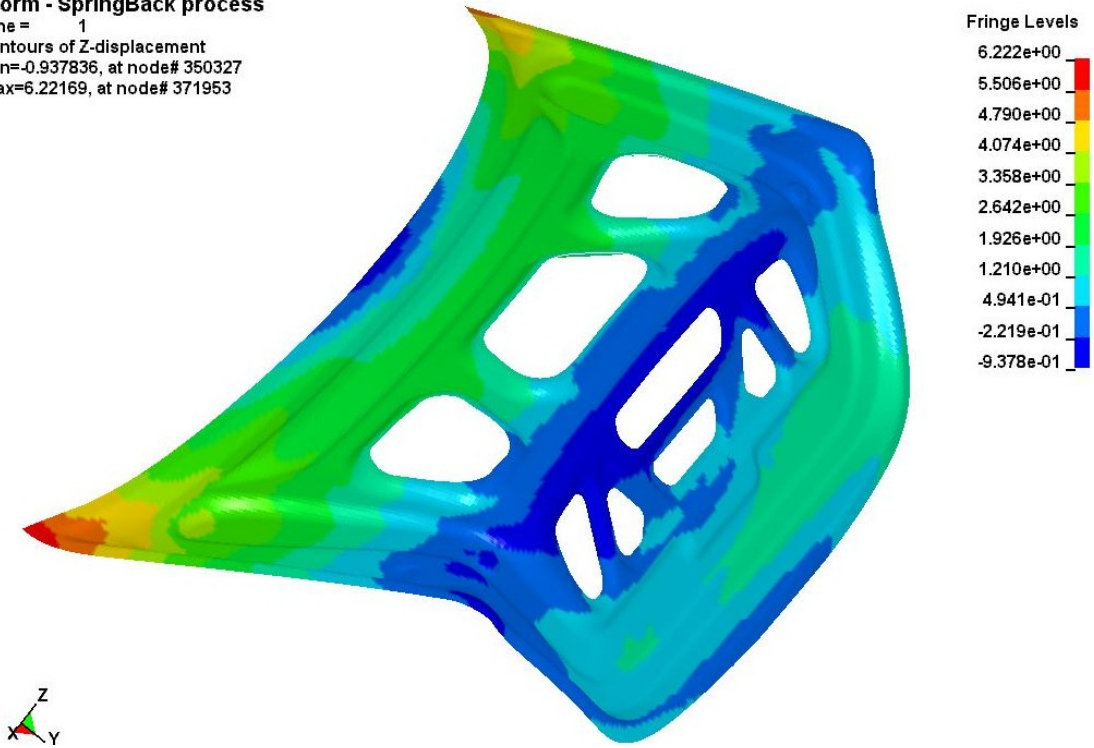


Figure 16

Isform - SpringBack process
Time = 1
Contours of Resultant Displacement
min=0, at node# 354959
max=6.55503, at node# 371953

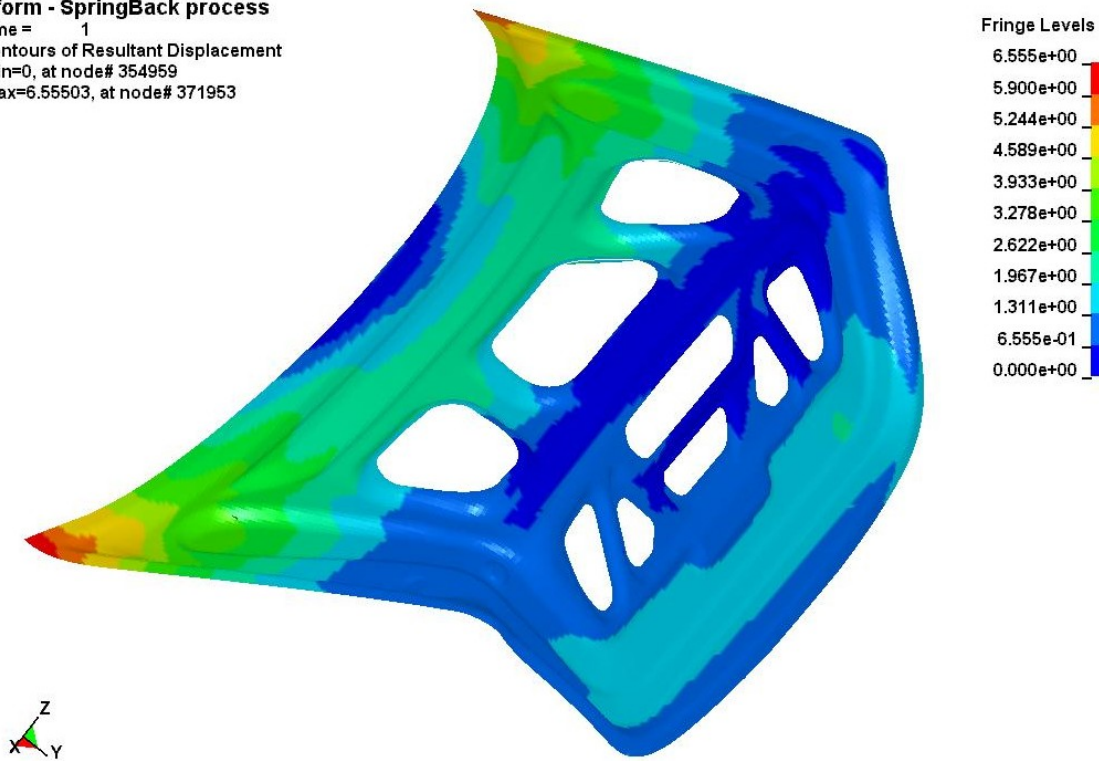


Figure 17