

LIVERMORE SOFTWARE TECHNOLOGY CORPORATION

LS-PrePost®

Metal Forming Simulation

Tutorial Manual – Gravity Loading

Version 1.0

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Table of Contents

Tutorial G1 – Gravity loading of a fender outer using One-Step Static	4
Tutorial G2 – Gravity loading of a fender outer using Implicit Dynamic	20
Tutorial G3 – Gravity loading of a B-pillar using One-Step Static	40
Tutorial G4 – Gravity loading of a B-pillar using Implicit Dynamic	56

Tutorial G1 – Gravity loading of a fender outer using One-Step Static

Interface Used: *Applications > Metal Forming*

Files required:

- tool.k (binder and punch mesh)
- blank.k (blank mesh)
- mat_fender.k (blank material property)

Page 1

Note: LS-PrePost 2.4 must be used for this tutorial. This tutorial focuses on the set-up process of a gravity loading analysis using the One-Step Implicit Static method within the Metal Forming interface. All components have been meshed previously.

1. Load meshed parts and open Metal Forming Interface

Launch LS-PrePost

File → Open → LS-Dyna Keyword

Open “blank.k”

File → Import → LS-Dyna Keyword

Open “tool.k”; select ‘Import NoOffset’ option

Application → Metal Forming

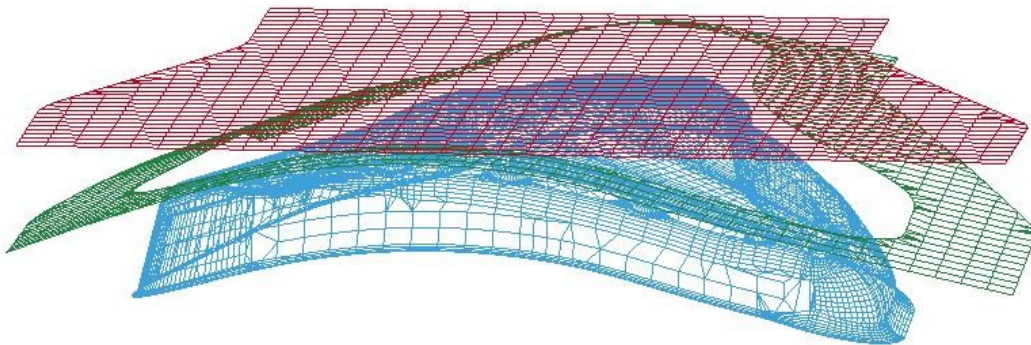


Figure 1

Page 2

2. Job Setup

click *Job Setup* in the side panel (launches Job Setup Dialog shown in Figure 2)

enter Project Name: gravity1

specify Master Folder

set Units: L:Millimeter, F:Newton

select Process Type:

click: *Apply*

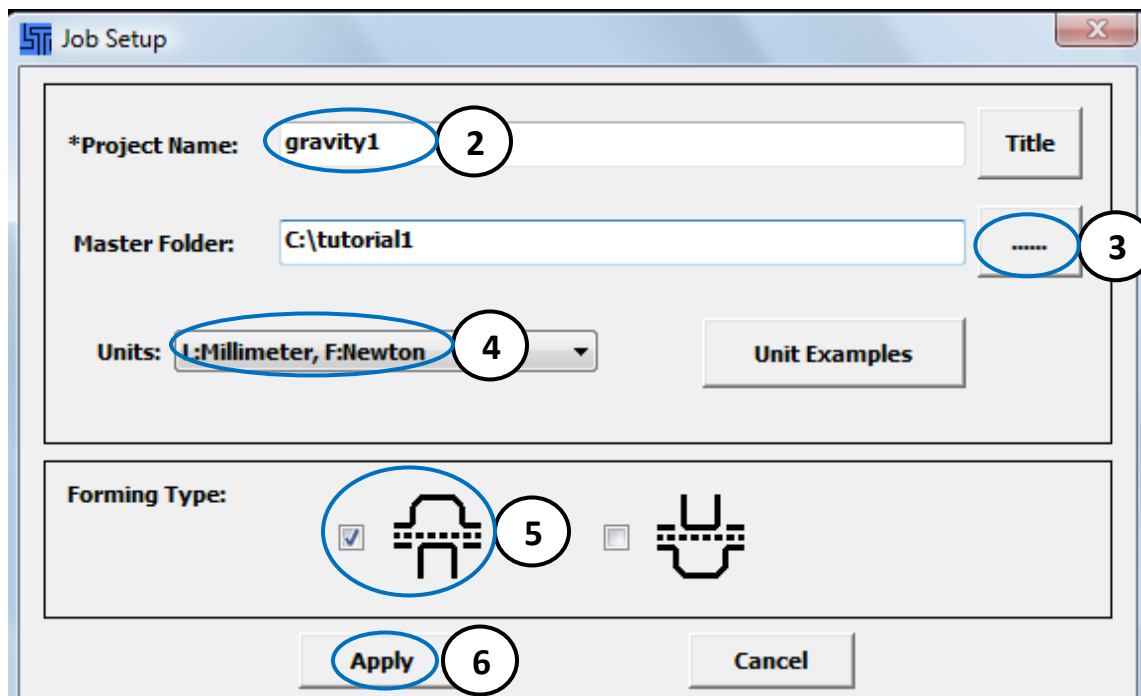
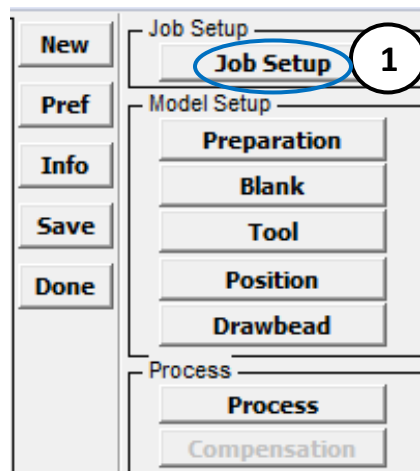


Figure 2

Page 3

3. Define Blank

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

select "1 Blank" from the right hand list

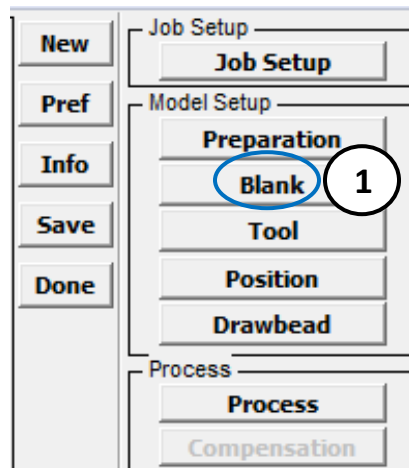
click <<

select Element Formulation: 2-Belytschko-Tsay

enter Number of Integration: 5

enter Thickness: 0.7; must hit carriage return.

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



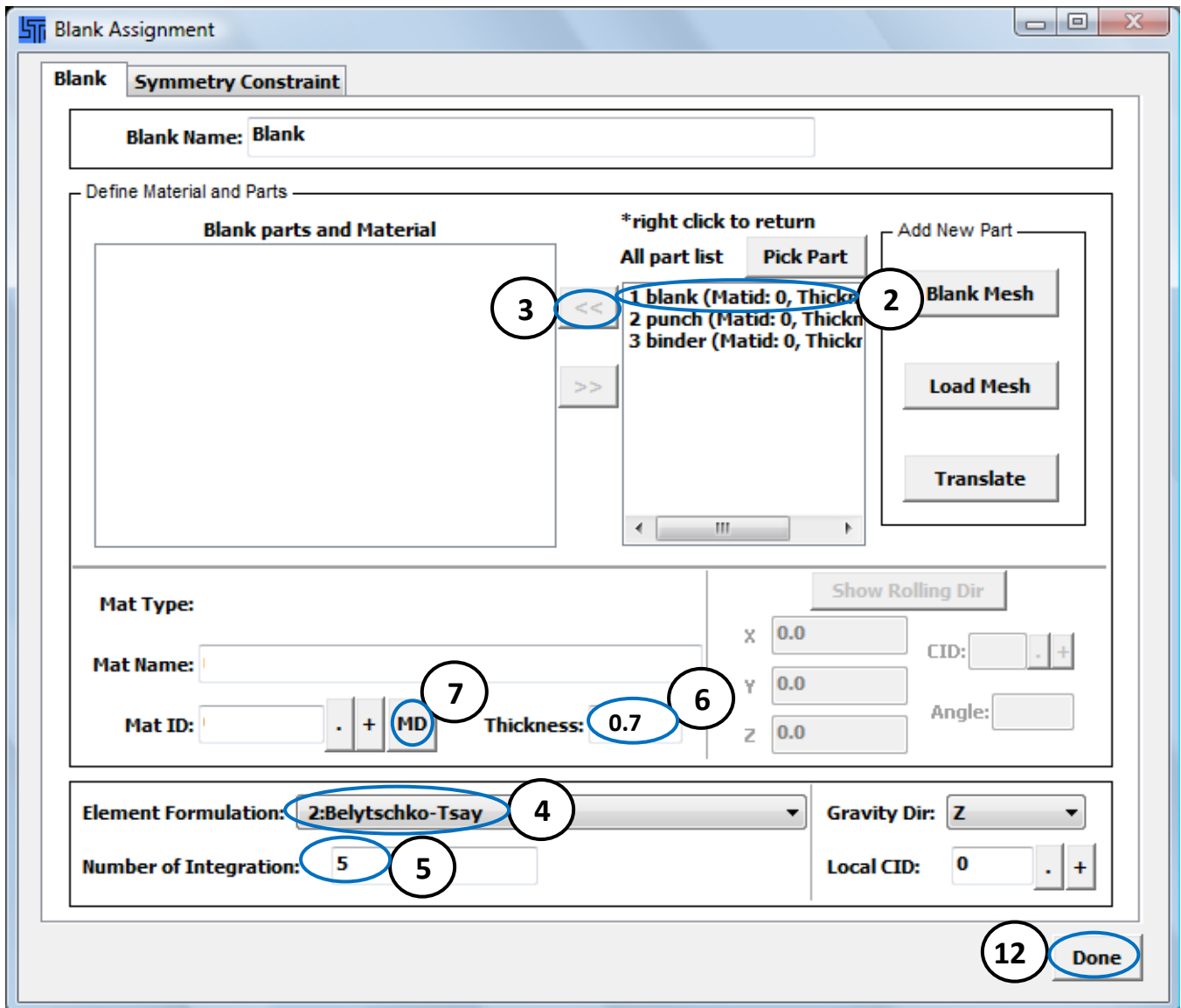



Figure 3

Page 4

4. Load material property for Blank

- click  to go to current working directory
- click "mat_fender.k"
- click *Preview*
- click *OK*
- click *Done* (Figure3)

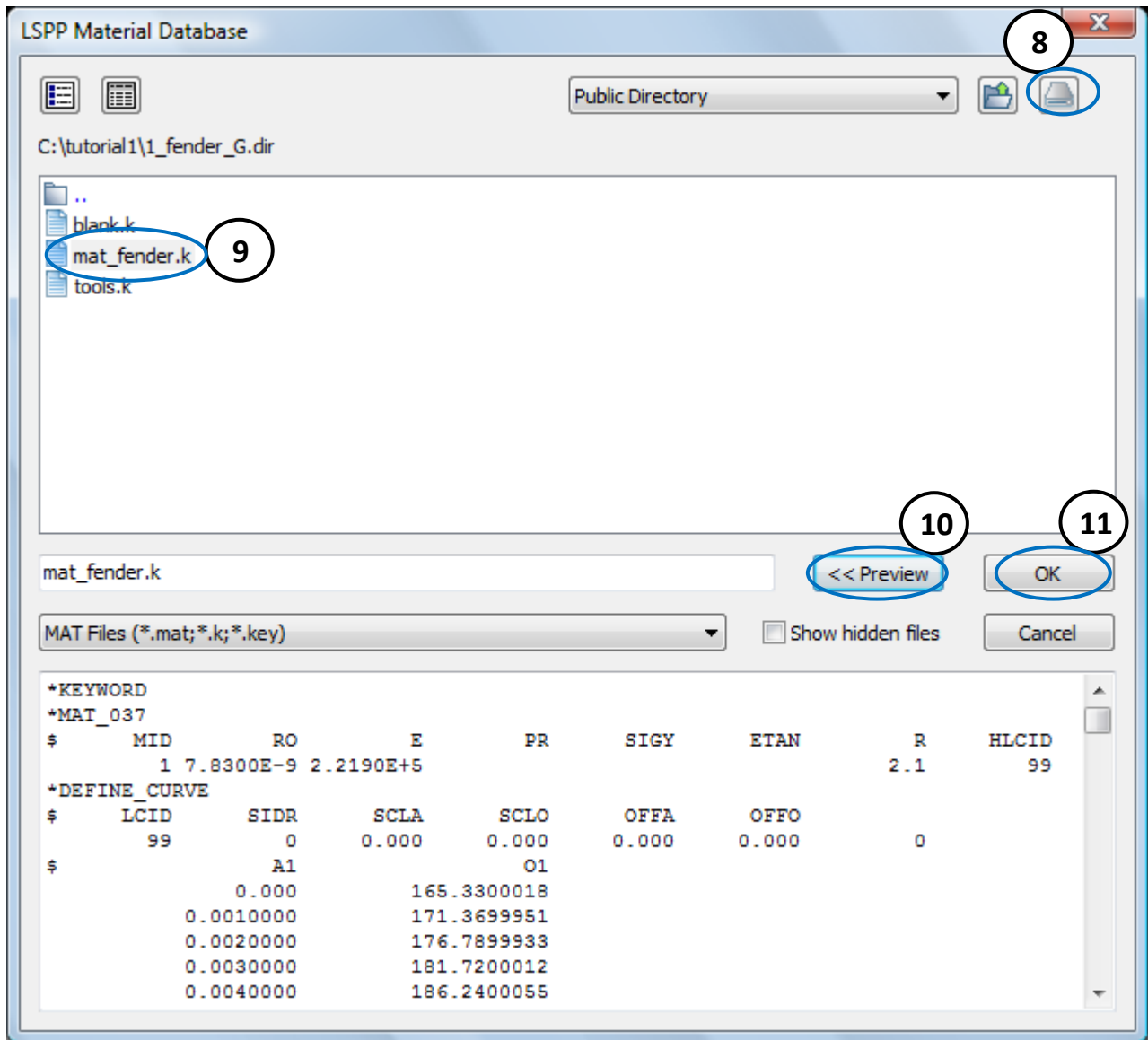


Figure 4

Page 5

5. Define Punch

Click *Tool* in the side panel (launches Tool Dialog shown in Figure 5)

select the Punch tab

enter Friction: 0.125

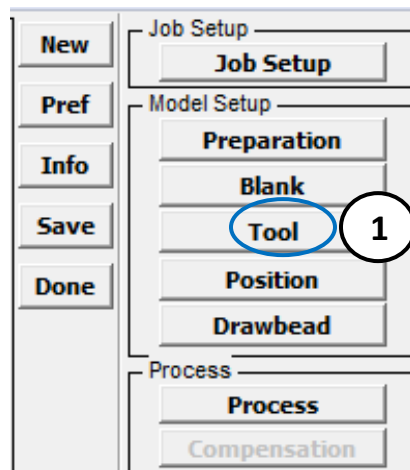
select "2 Punch" from the right hand list (All part list)

click <<

select Tool Position to Blank: Below

set Direction: Z

select Contact Type: Forming_Surface_To_Surface



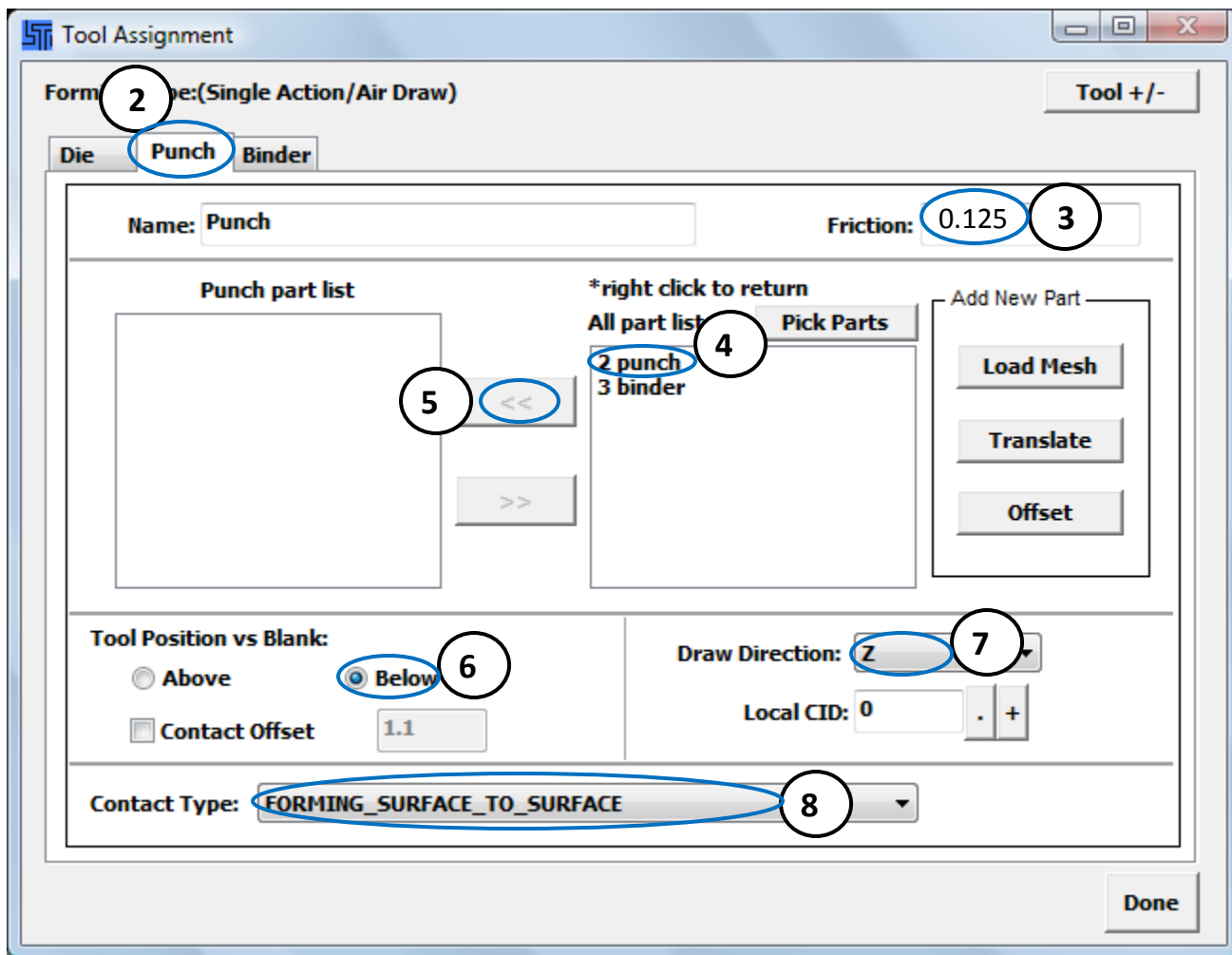


Figure 5

Page 6

6. Define Binder

- select the Binder tab
- enter Friction: 0.125
- select "3 Binder" from the right hand list (All part list)
- click <<
- select Tool Position to Blank: Below
- set Direction: Z
- select Contact Type: Forming_Surface_To_Surface

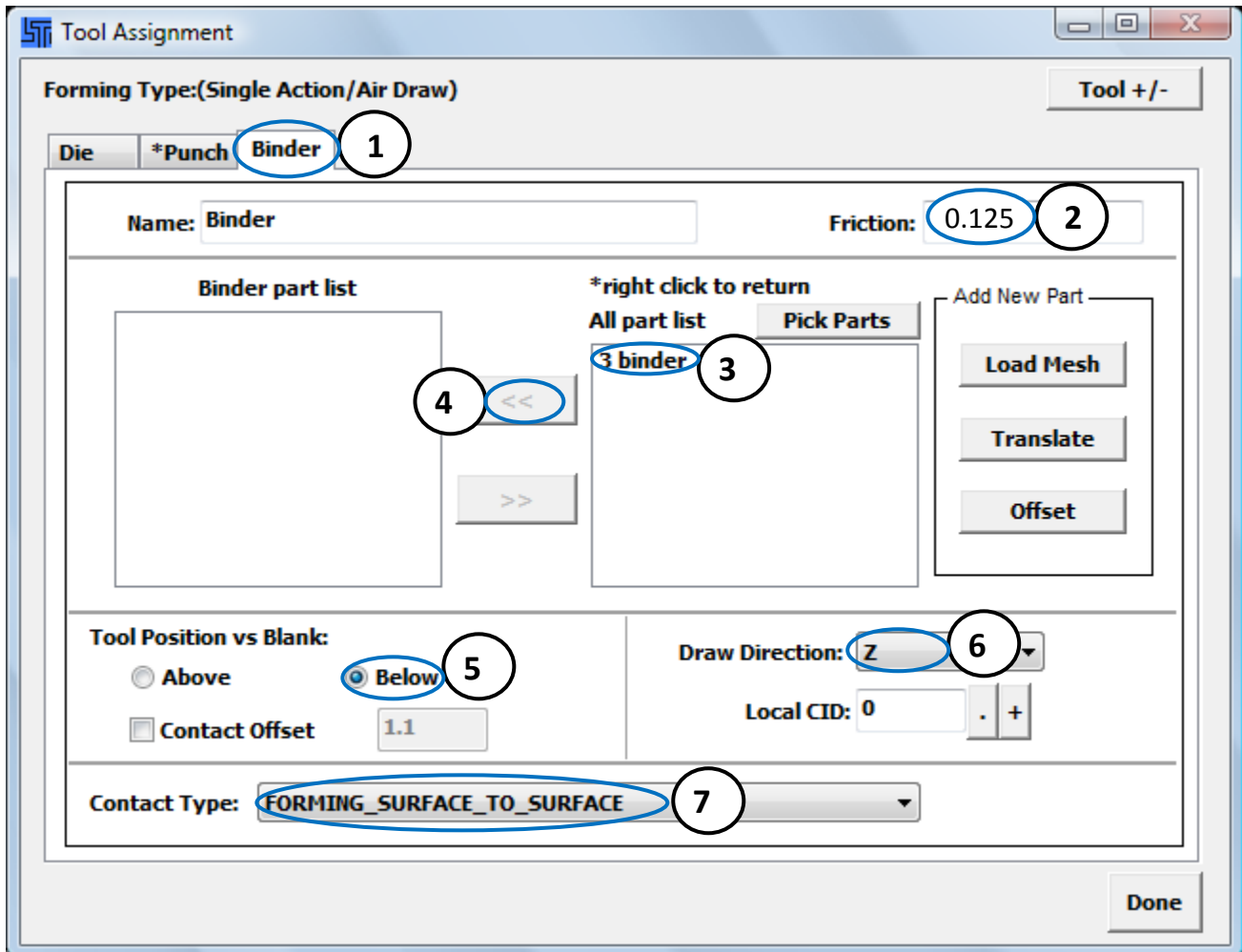


Figure 6

Page 7

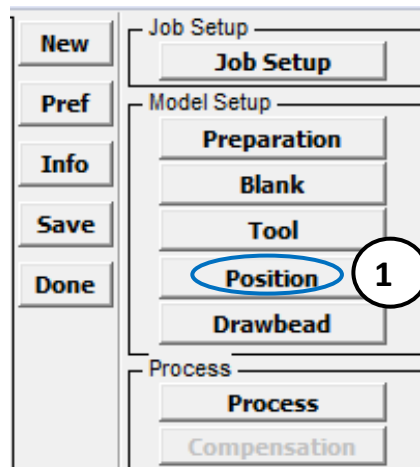
7. Position components

click *Position* in the side panel (launches Position Dialog shown in Figure 7)

activate Blank only as a movable tool

click *Auto Position*

click *Done*



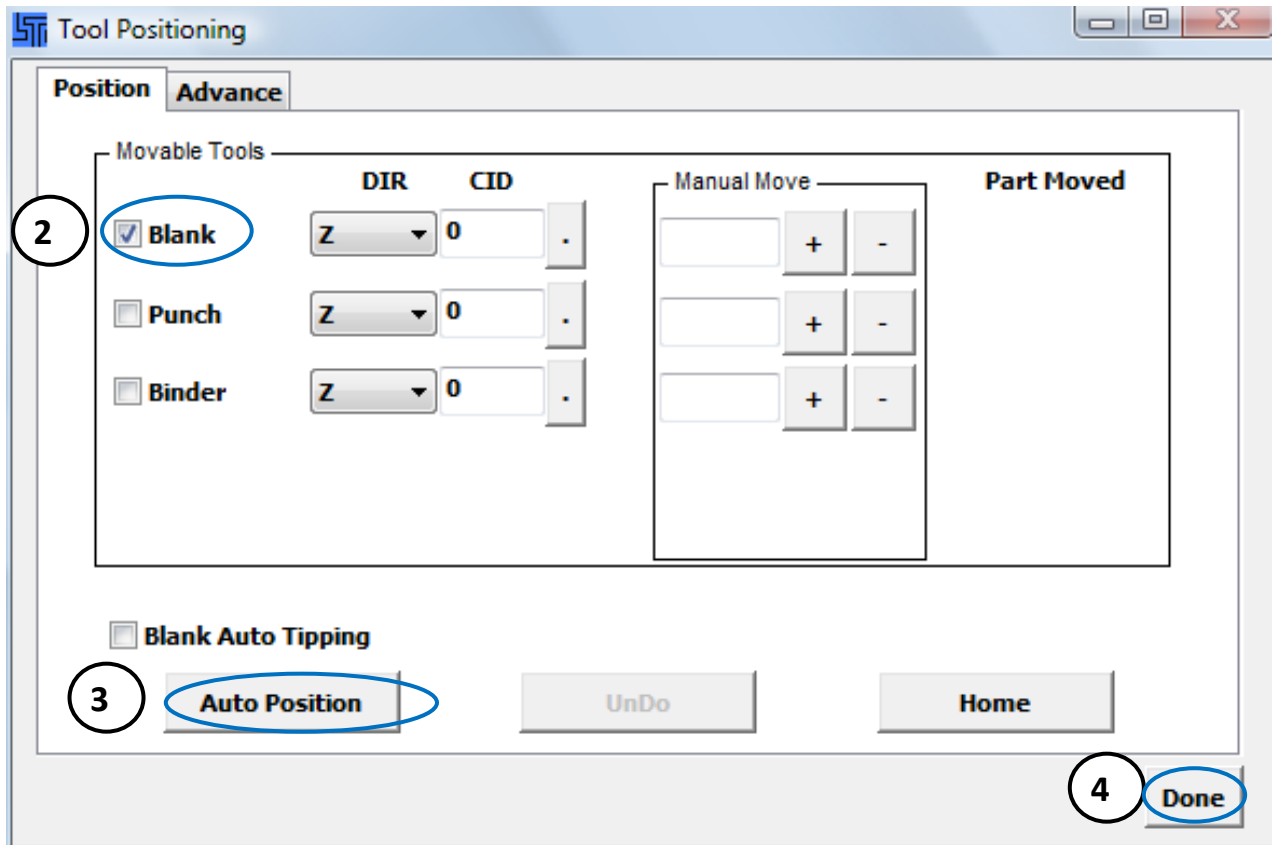


Figure 7

Page 8**8. Define Process**

click *Process* in the side panel (launches Process Dialog shown in Figure 8)

select Process Type as: Gravity

activate Punch and Binder as Active Tools

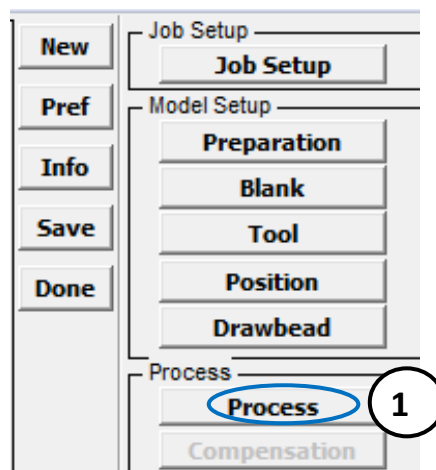
select the Control tab within the Gravity tab (Figure 9)

select One Step Static

enter Termination Time: 0.5

activate Blank

click *Output Dyna* (launches Dyna Input Decks Gravity dialog in Figure 10)



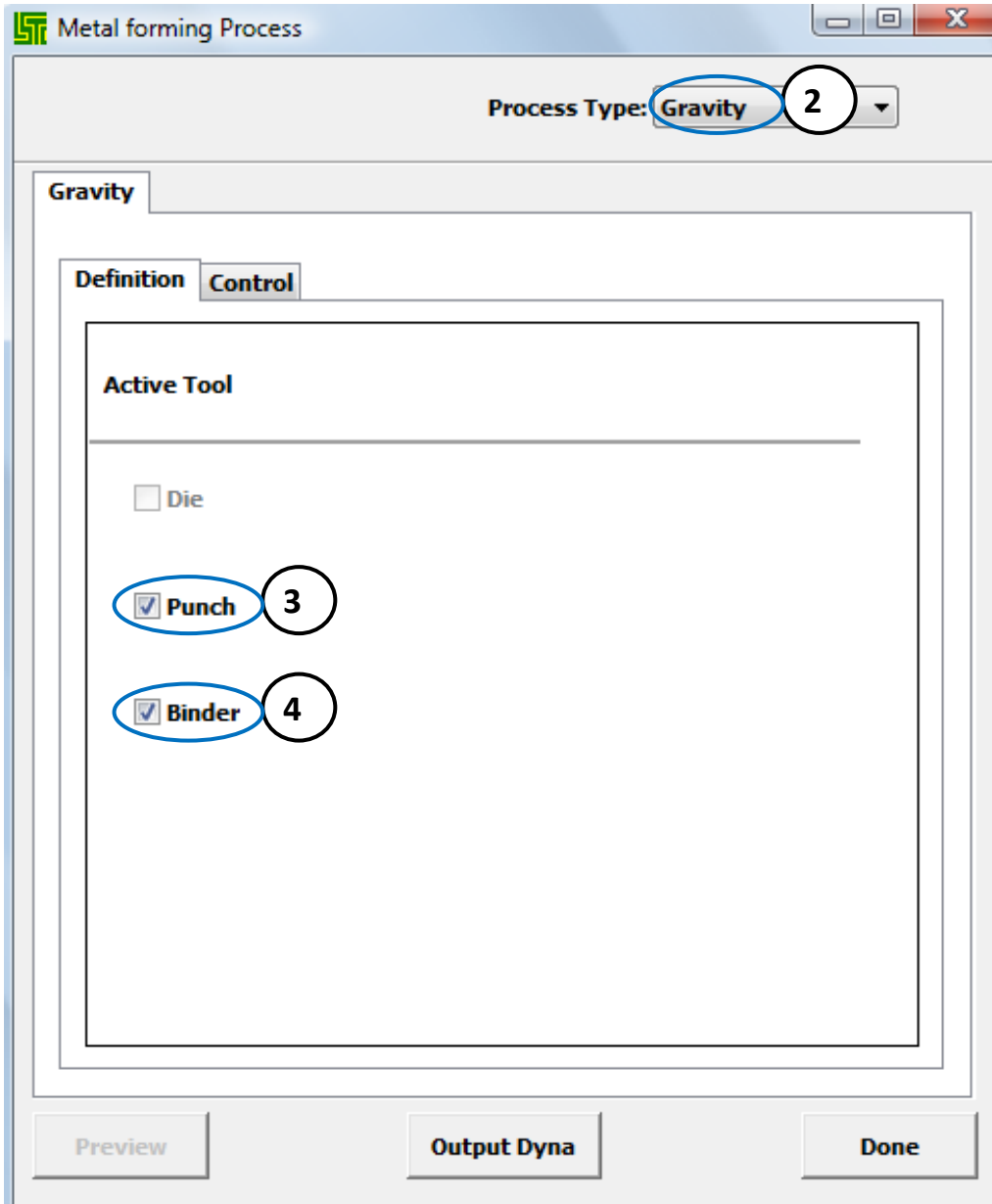


Figure 8

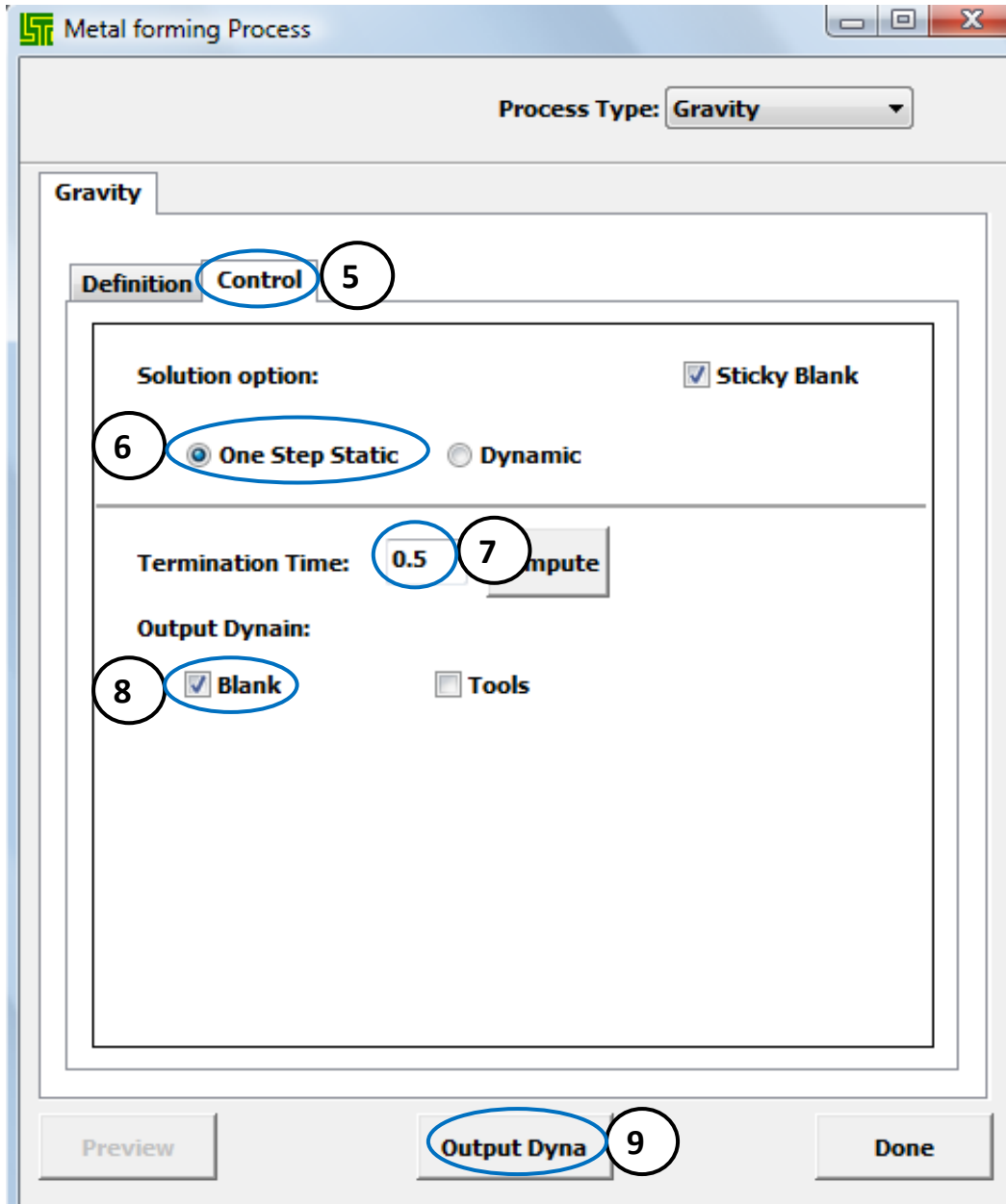


Figure 9

Page 99. Define Process (*continued...*)

Refer to Figure 10

click *Advanced* in the Dyna Input Decks(Gravity) dialog

select the Output Options tab under the Templates and Preference tab (Figure 10)

enter Blank File: blank.k; hit a carriage return to make the change to take effect.

enter Tooling File: tools.k; hit a carriage return to make the change to take effect.

enter Dyna Input File: fenderg.dyn; hit a carriage return to make the change to take effect.

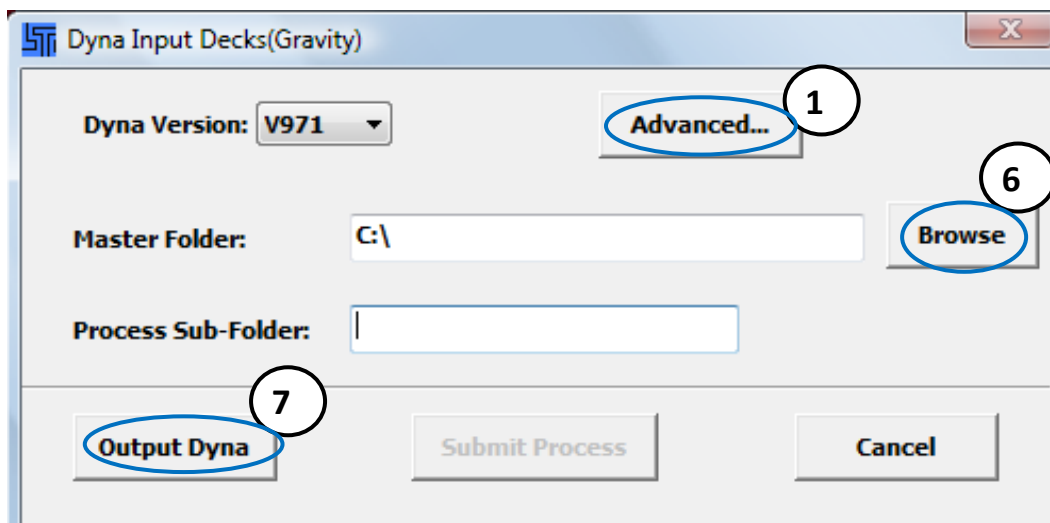
click *Done*

click *Browse* and specify a directory for the input file, in the Dyna Input Decks(Gravity) dialog

click *Output Dyna*

Save project file, File → Save Project As...

Close this LS-PrePost session.



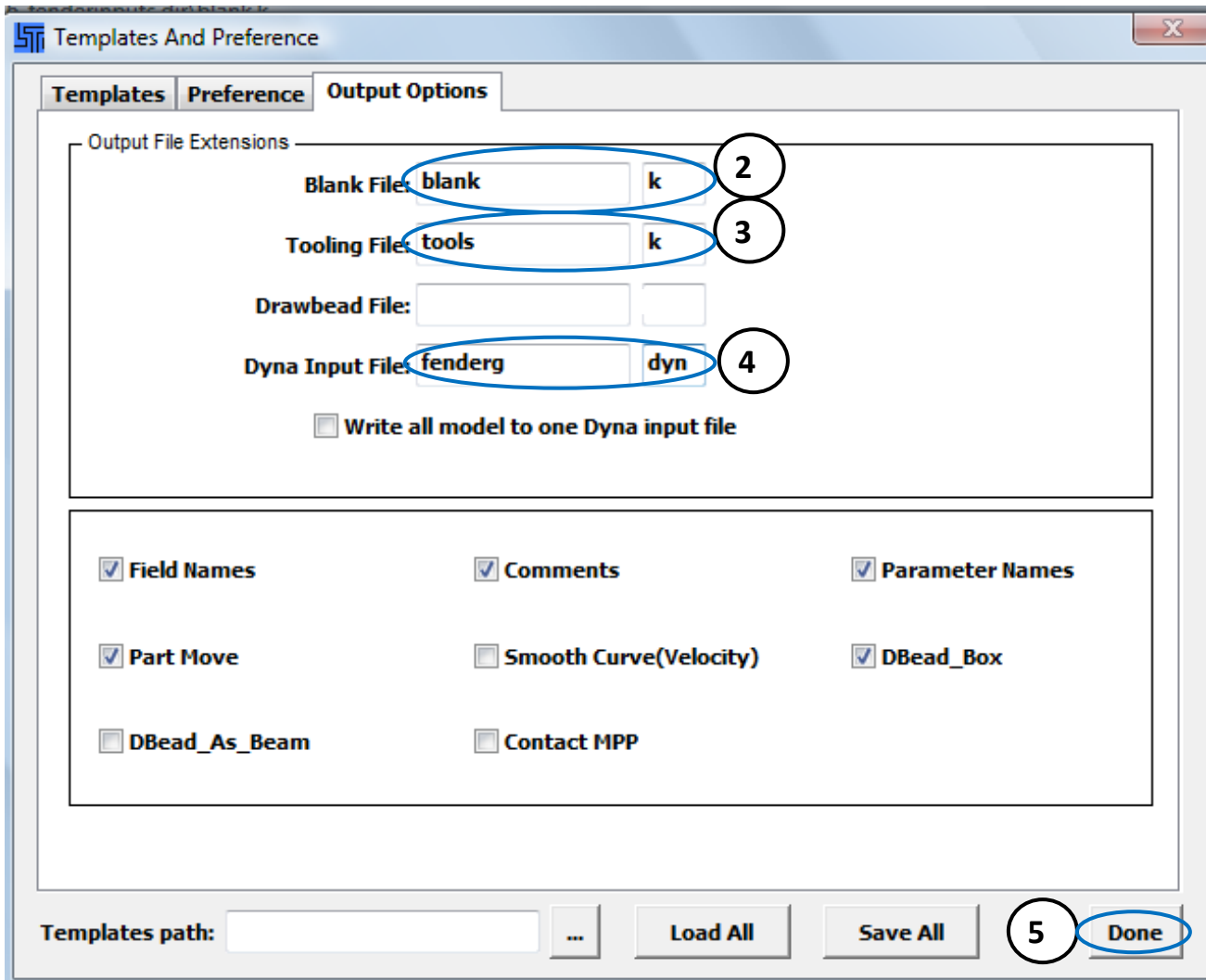


Figure 10

Page 10

9. Execute LS-DYNA and process results


Run LS-DYNA with command: ls971_d_R3.2.1_win32_p.exe i=fenderg.dyn memory=5M ncpu=2
 This job should take less than 3 minutes on a Xeon machine with 2-CPU SMP version of LS-DYNA, requiring about 4.5 million words of memory (4.5MW).

Launch LS-PrePost

File → Open → LS-Dyna Binary Plot

Open “d3plot”

select all parts by ‘SelPar’ as shown in Figure 11

click on  to move to the last state; shown in Figure 12 is the final deformed shape of the blank

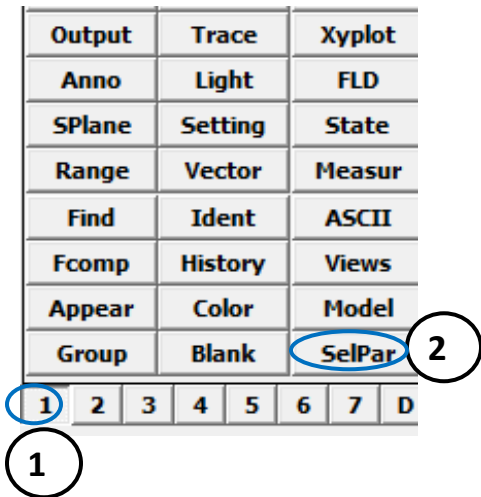


Figure 11

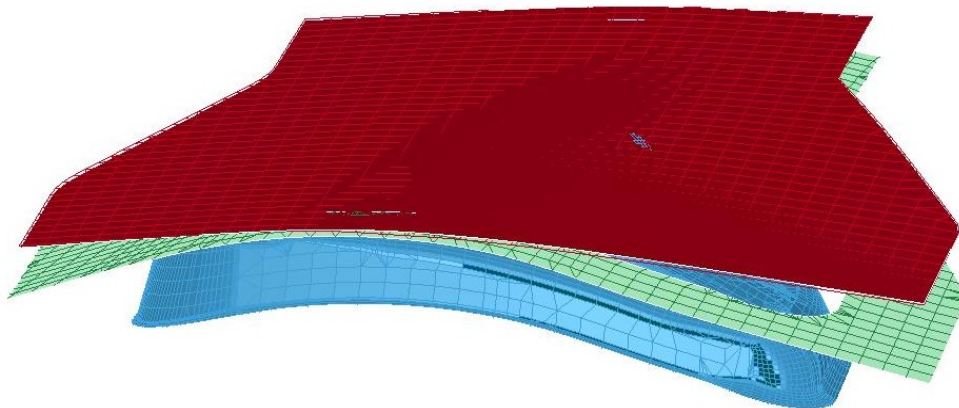


Figure 12

Tutorial G2 – Gravity loading of a fender outer using Implicit Dynamic

Interface Used: *Applications > Metal Forming*

Files required:

- tool.k (binder and punch mesh)
- blank.k (blank mesh)
- mat_fender.k (blank material property)
- lspp_smf_temp_gr.temp – keyword template file used in Implicit Dynamic.

Page 1

Note: LS-PrePost 2.4 must be used for this tutorial. This tutorial focuses on the set-up process of a gravity loading analysis using the Implicit Dynamic method within the Metal Forming interface. All components have been meshed previously.

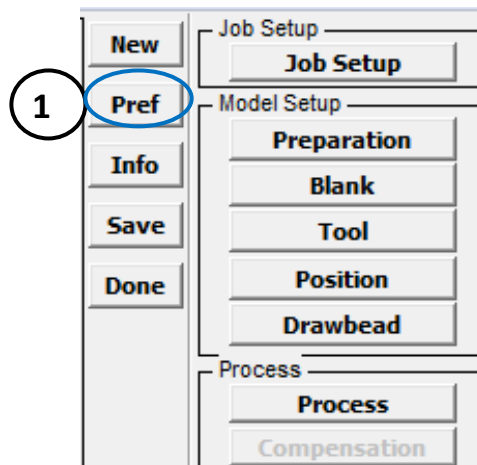
1. Define Templates

click *Pref* in the side panel (launches Templates and Preference Dialog in Figure 1)

select *Gravity* tab under the Templates and Preference tab

click *load* to load the template file: lspp_smf_temp_gr.temp

click: *Done*



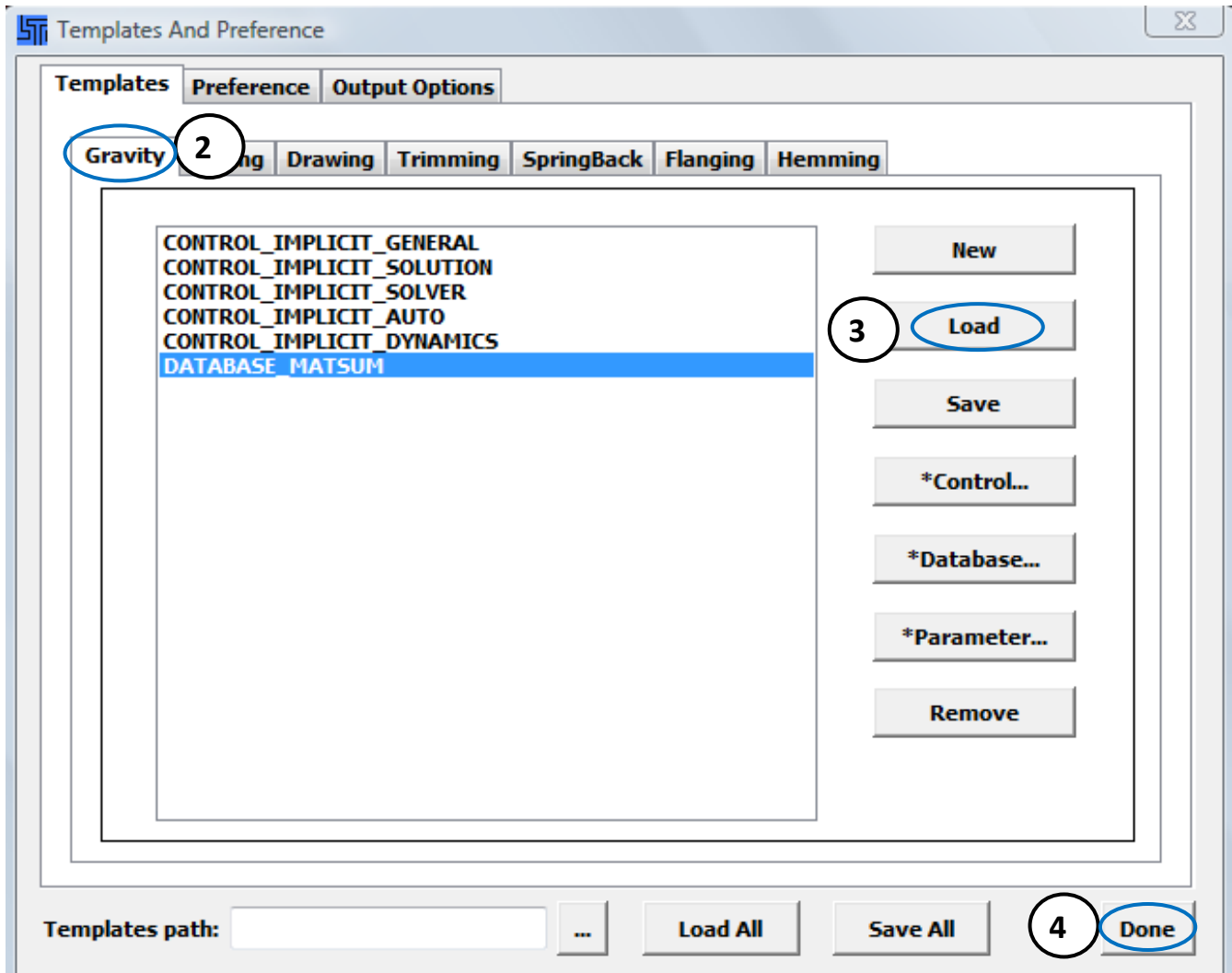


Figure 1

Page 2

2. Load meshed parts and open Metal Forming Interface

Launch LS-PrePost

File → Open → LS-Dyna Keyword

Open "blank.k"

File → Import → LS-Dyna Keyword

Open "tool.k"; select 'Import NoOffset' option

Application → Metal Forming

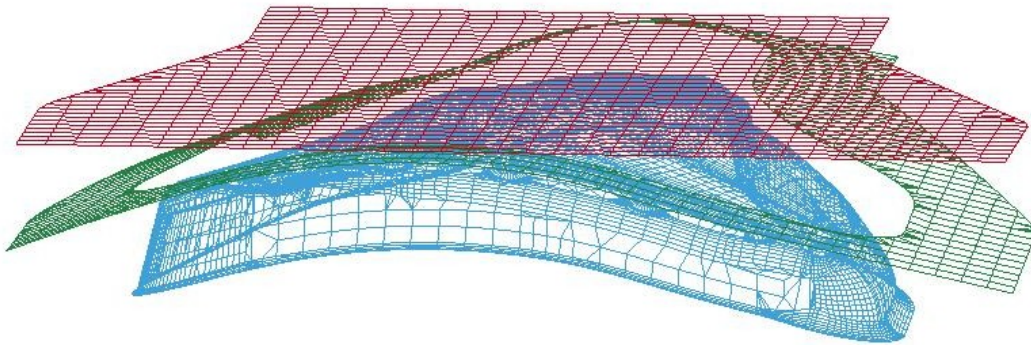


Figure 2

Page 3

3. Job Setup

click *Job Setup* in the side panel (launches Job Setup Dialog shown in Figure 3)

enter Project Name: gravity1

specify Master Folder

set Units: L:Millimeter, F:Newton

select Process Type: 

click: *Apply*

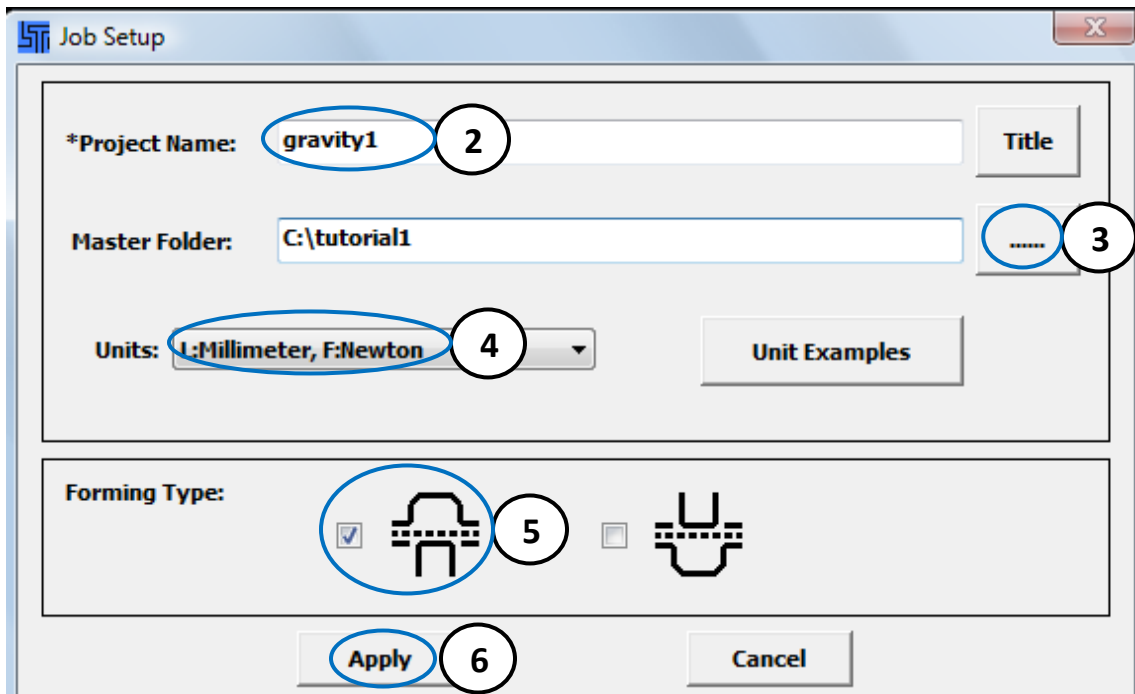
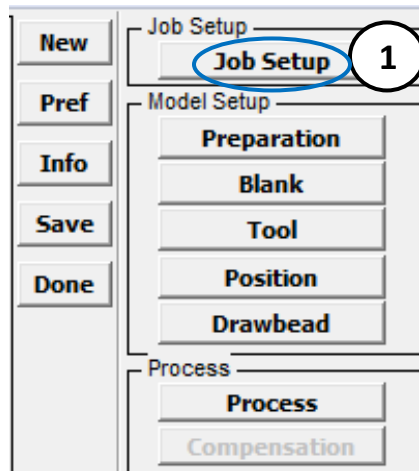


Figure 3

Page 4

4. Define Blank

click *Blank* in the side panel (launches Blank Dialog shown in Figure 4)

select "1 Blank" from the right hand list

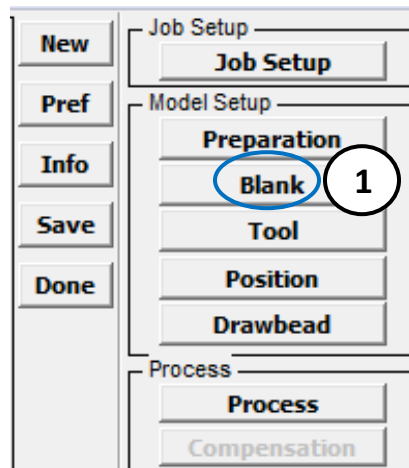
click <<

select Element Formulation: 2-Belytschko-Tsay

enter Number of Integration: 5

enter Thickness: 0.7; must hit carriage return.

click *MD* (launches Material Database Dialog shown in Figure 5)



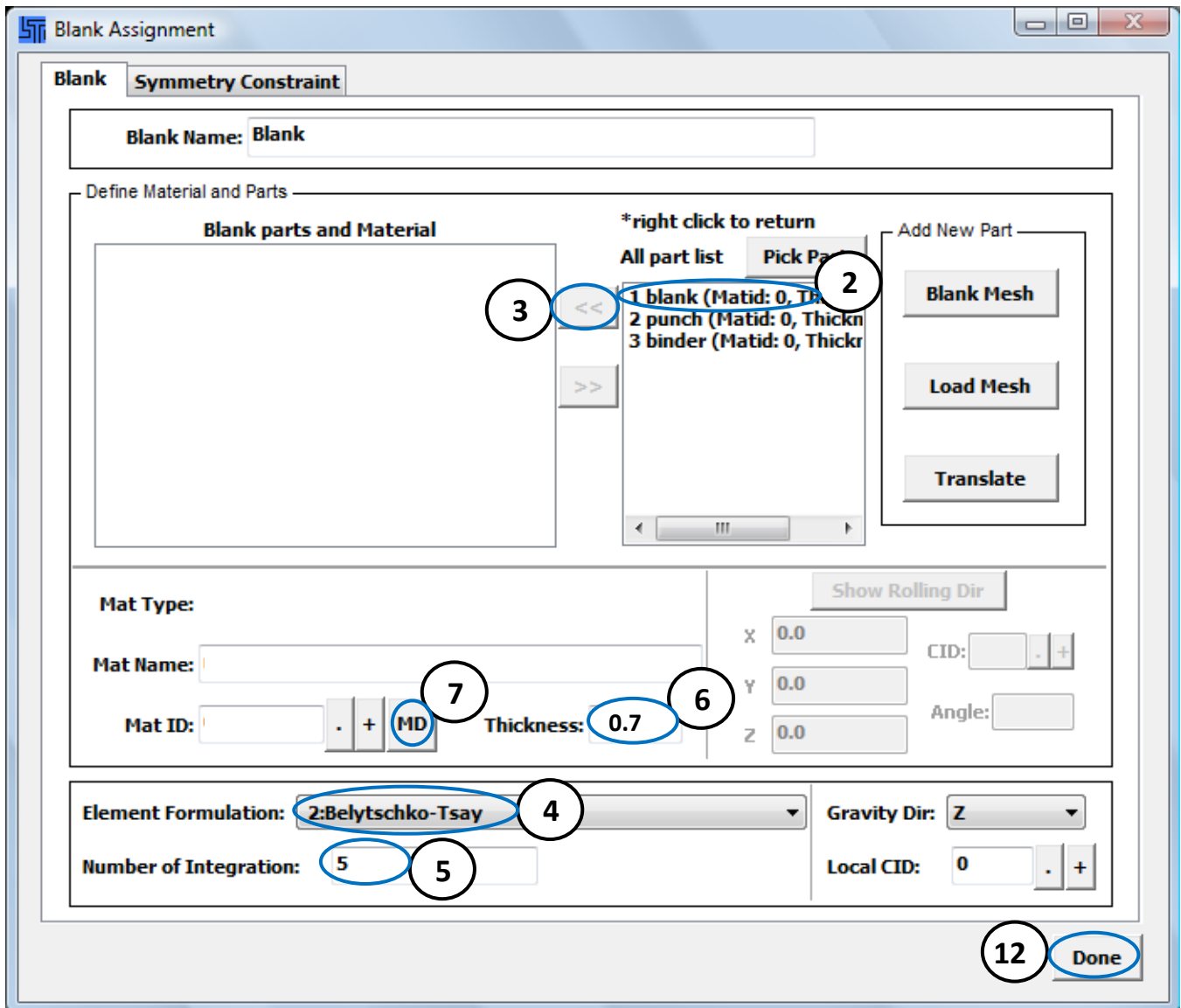



Figure 4

Page 5

5. Load material property for Blank

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

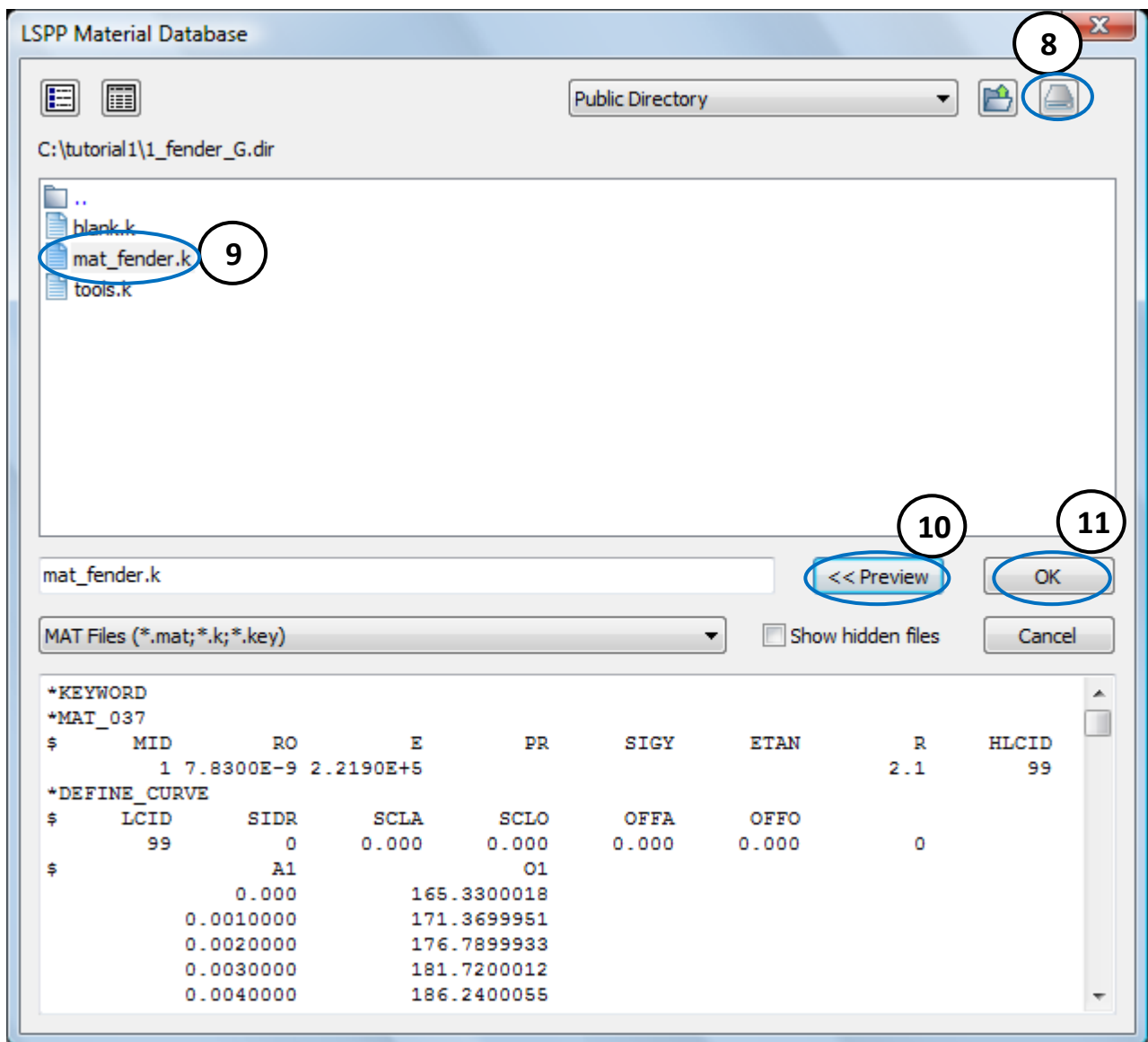


Figure 5

Page 6

6. Define Punch

Click *Tool* in the side panel (launches Tool Dialog shown in Figure 6)

select the Punch tab

enter Friction: 0.125

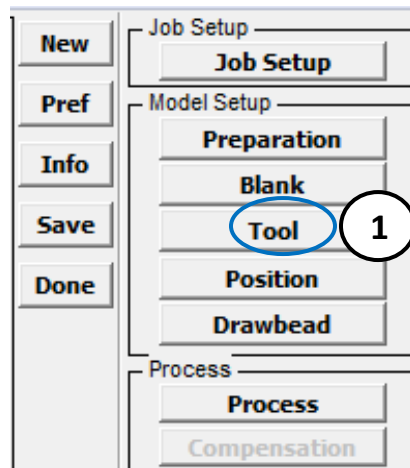
select "2 Punch" from the right hand list (All part list)

click <<

select Tool Position to Blank: Below

set Direction: Z

select Contact Type: Forming_Surface_To_Surface



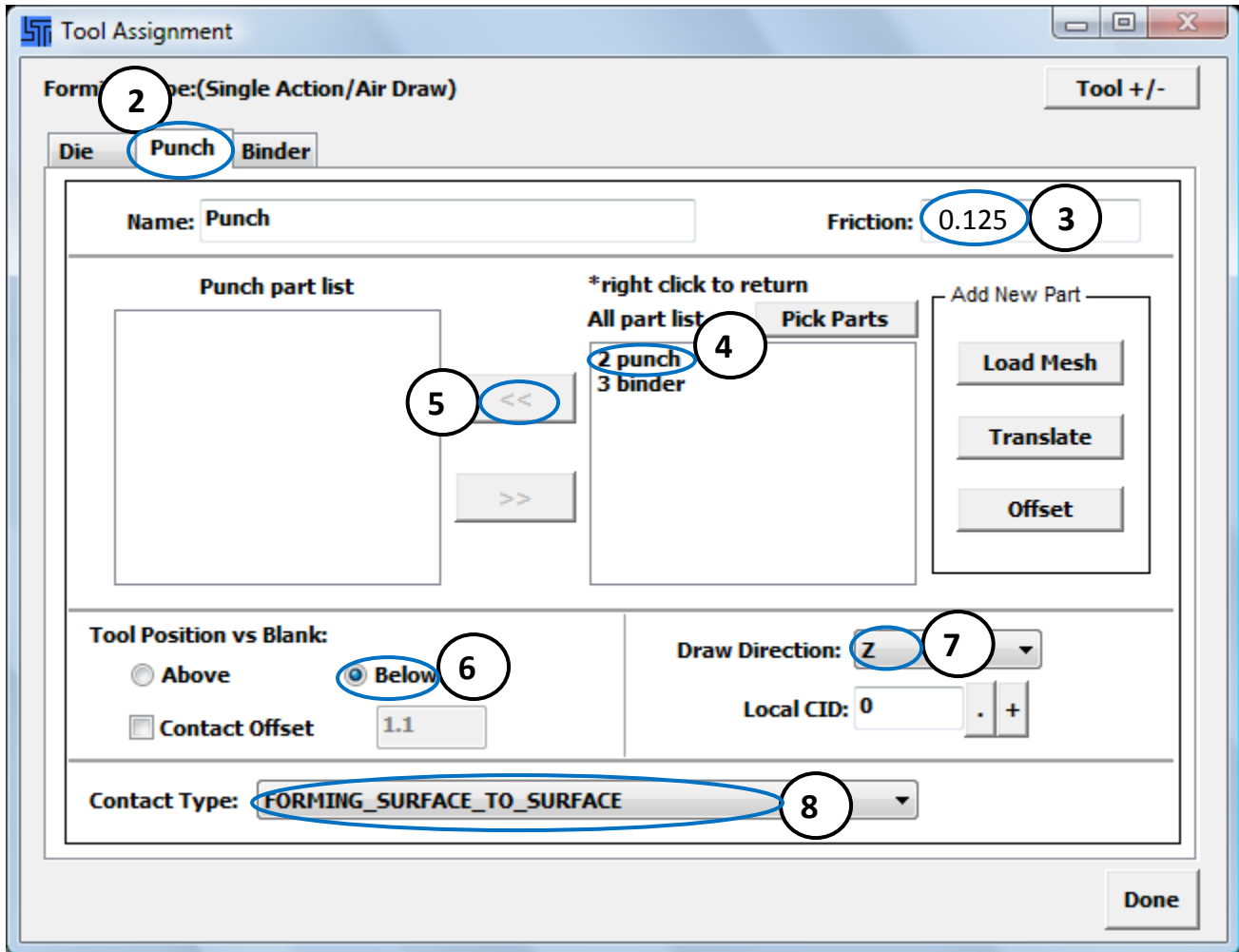


Figure 6

Page 7

7. Define Binder

- select the Binder tab
- enter Friction: 0.125
- select "3 Binder" from the right hand list (All part list)
- click <<
- select Tool Position to Blank: Below
- set Direction: Z
- select Contact Type: Forming_Surface_To_Surface

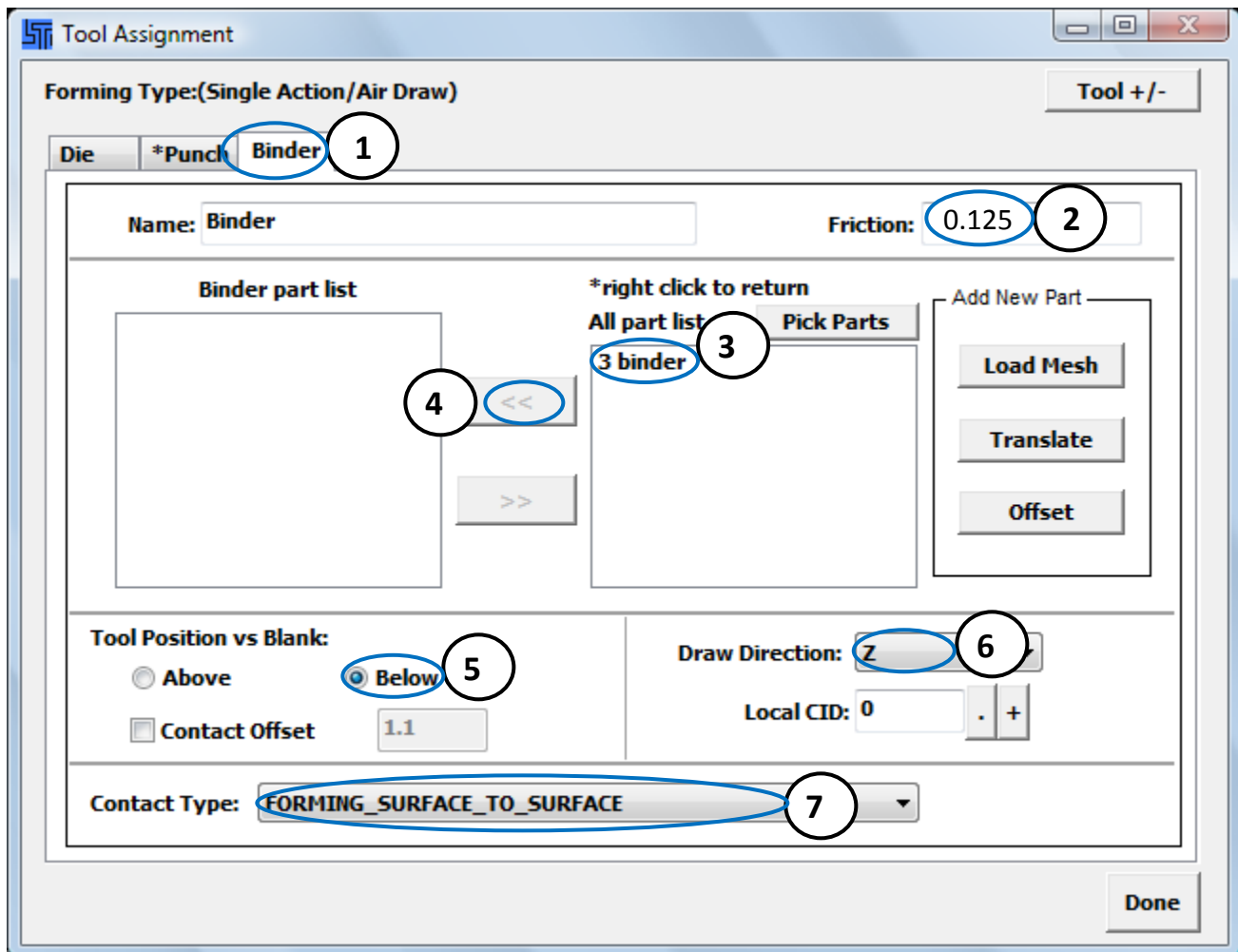


Figure 7

Page 8

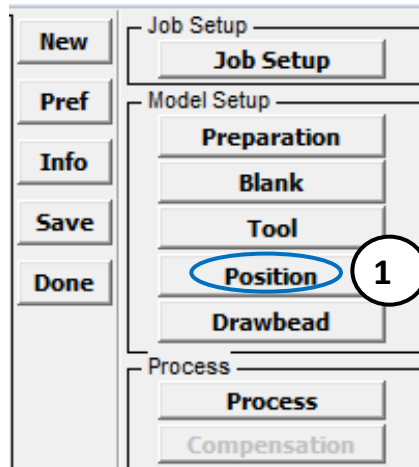
8. Position components

click *Position* in the side panel (launches Position Dialog shown in Figure 8)

activate Blank only as a movable tool

click *Auto Position*

click *Done*



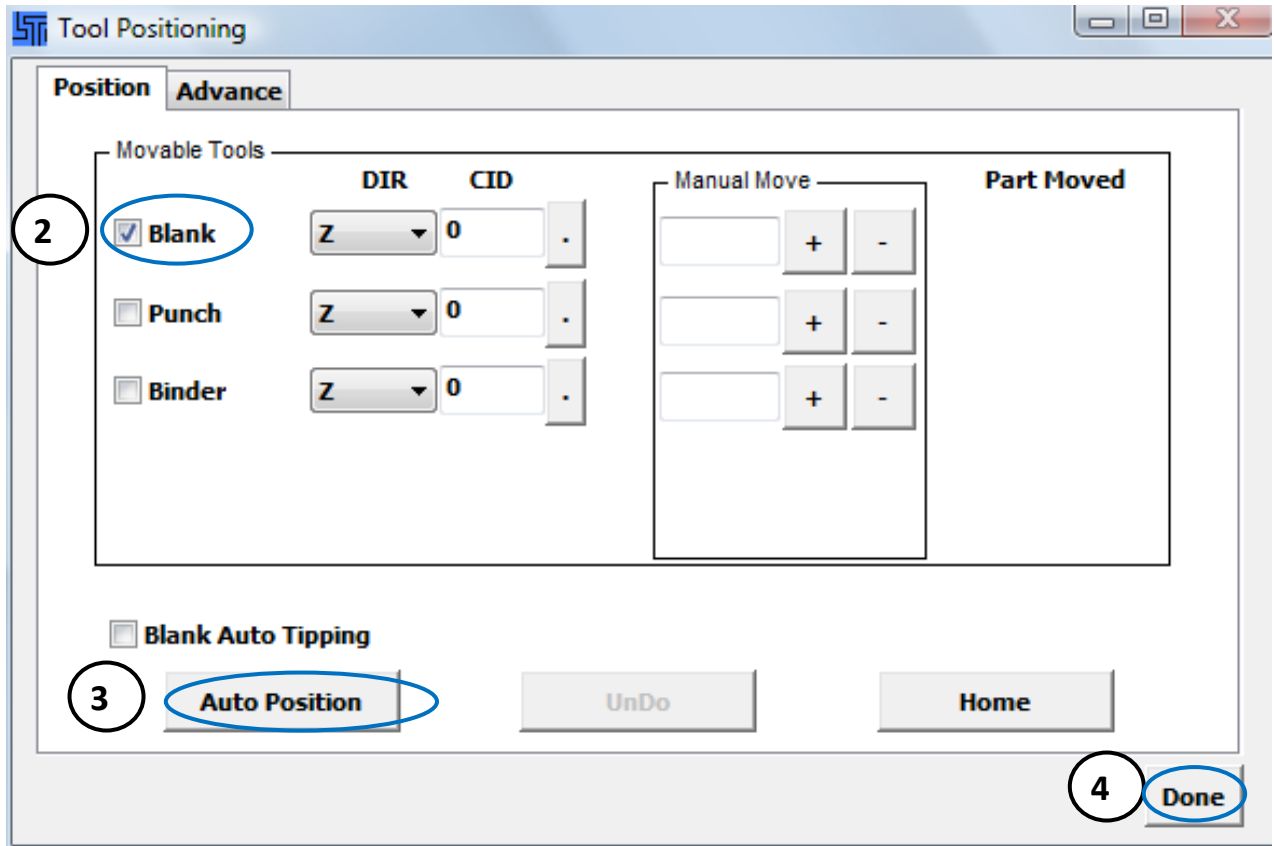


Figure 8

Page 9

9. Define Process

click *Process* in the side panel (launches Process Dialog shown in Figure 9)

select Process Type as: Gravity

activate Punch and Binder as Active Tools

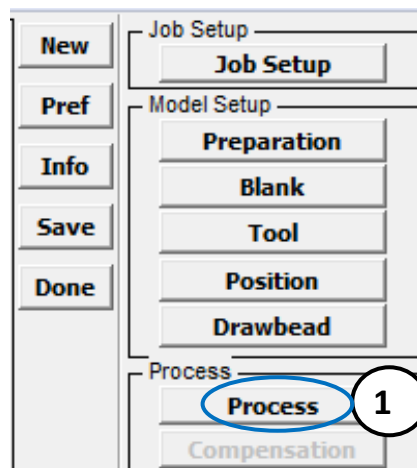
select the Control tab within the Gravity tab (Figure 10)

select Dynamic

enter Termination Time: 3.0

activate Blank

click *Output Dyna* (launches Dyna Input Decks Gravity dialog in Figure 11)



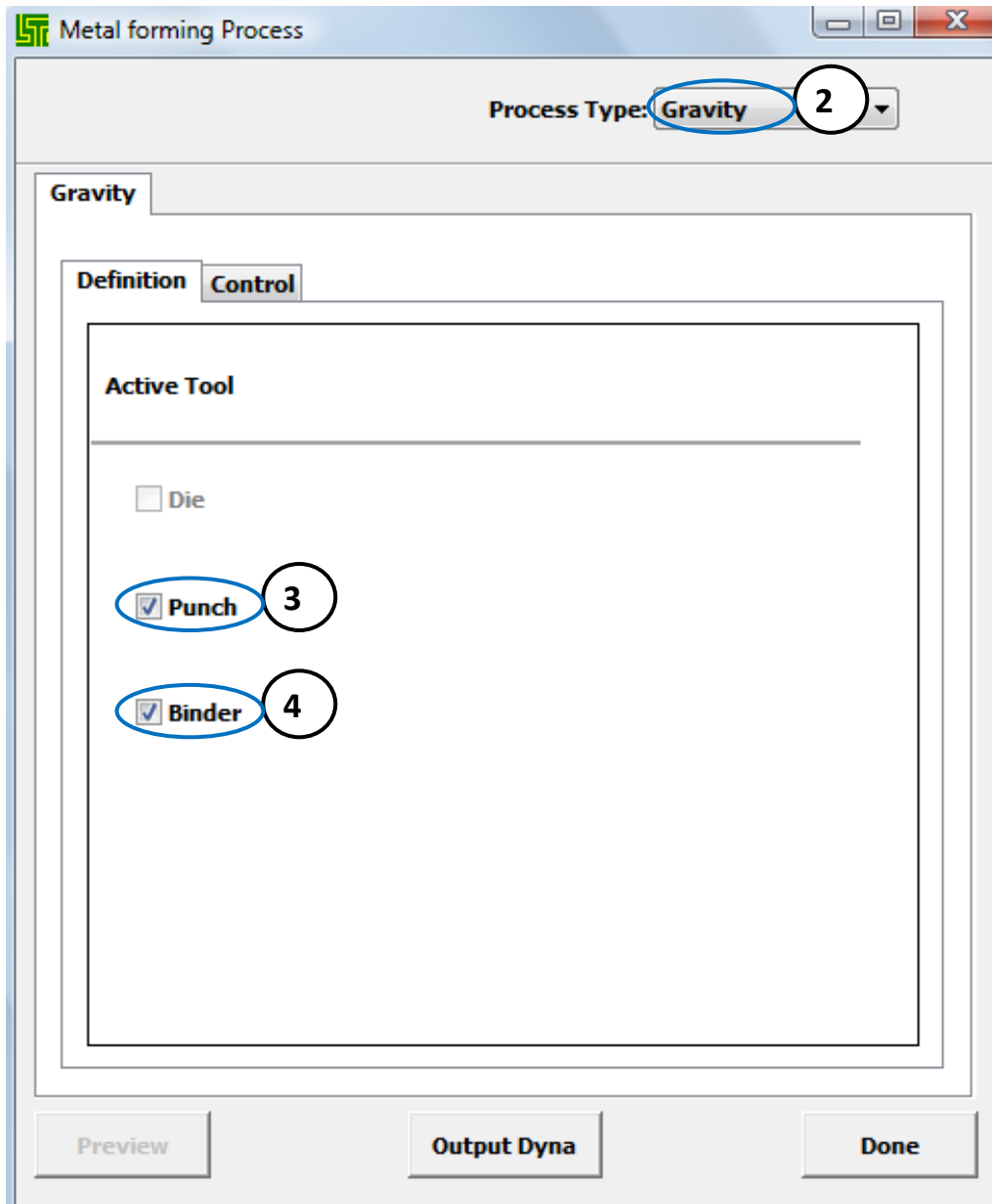


Figure 9

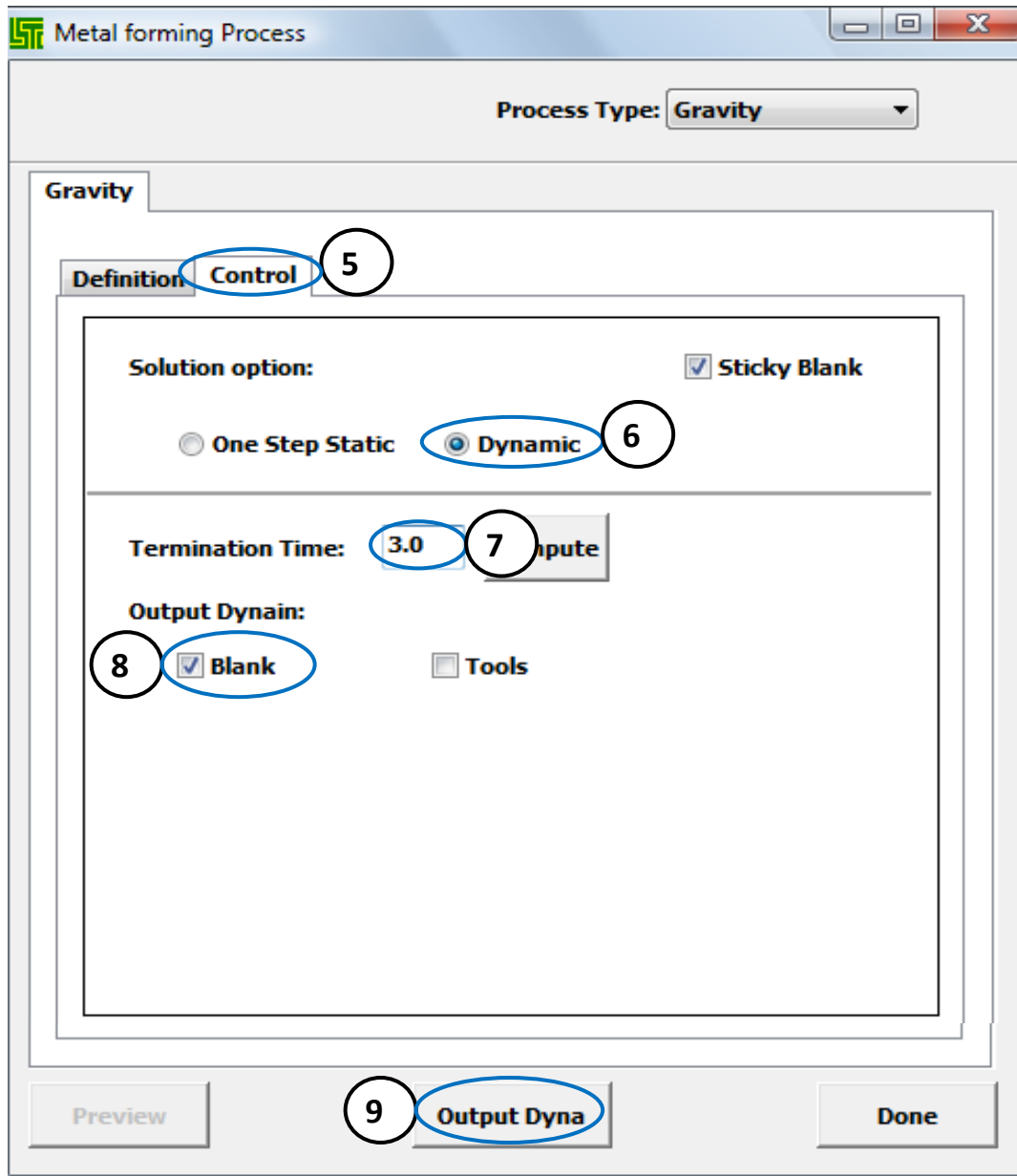


Figure 10

Page 1010. Define Process (*continued...*)

Refer to Figure 11

click *Advanced* in the Dyna Input Decks(Gravity) dialog

select the Output Options tab under the Templates and Preference tab (Figure 11)

enter Blank File: blank.k; hit a carriage return to make the change to take effect.

enter Tooling File: tools.k; hit a carriage return to make the change to take effect.

enter Dyna Input File: fenderg.dyn; hit a carriage return to make the change to take effect.

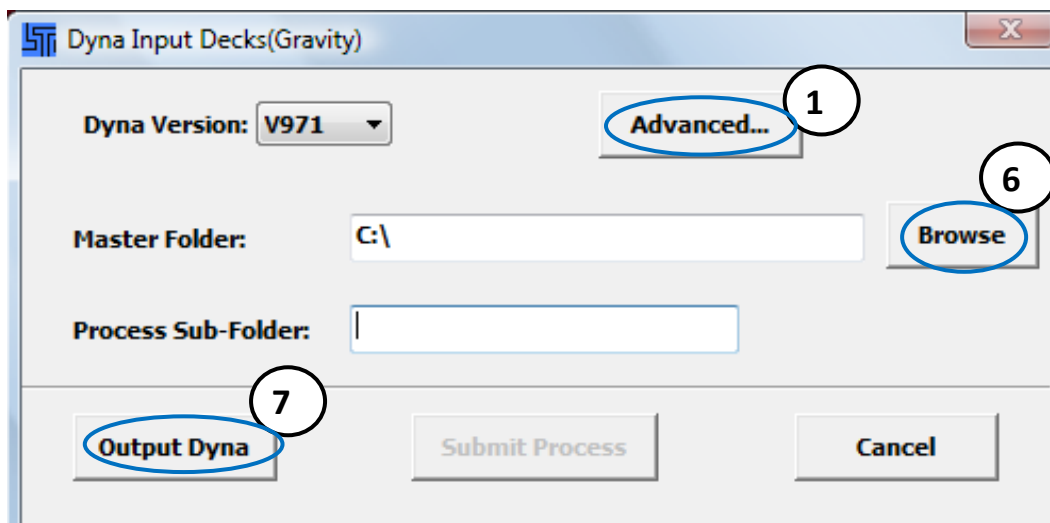
click *Done*

click *Browse* and specify a directory for the input file, in the Dyna Input Decks(Gravity) dialog

click *Output Dyna*

Save project file, File → Save Project As...

Close this LS-PrePost session.



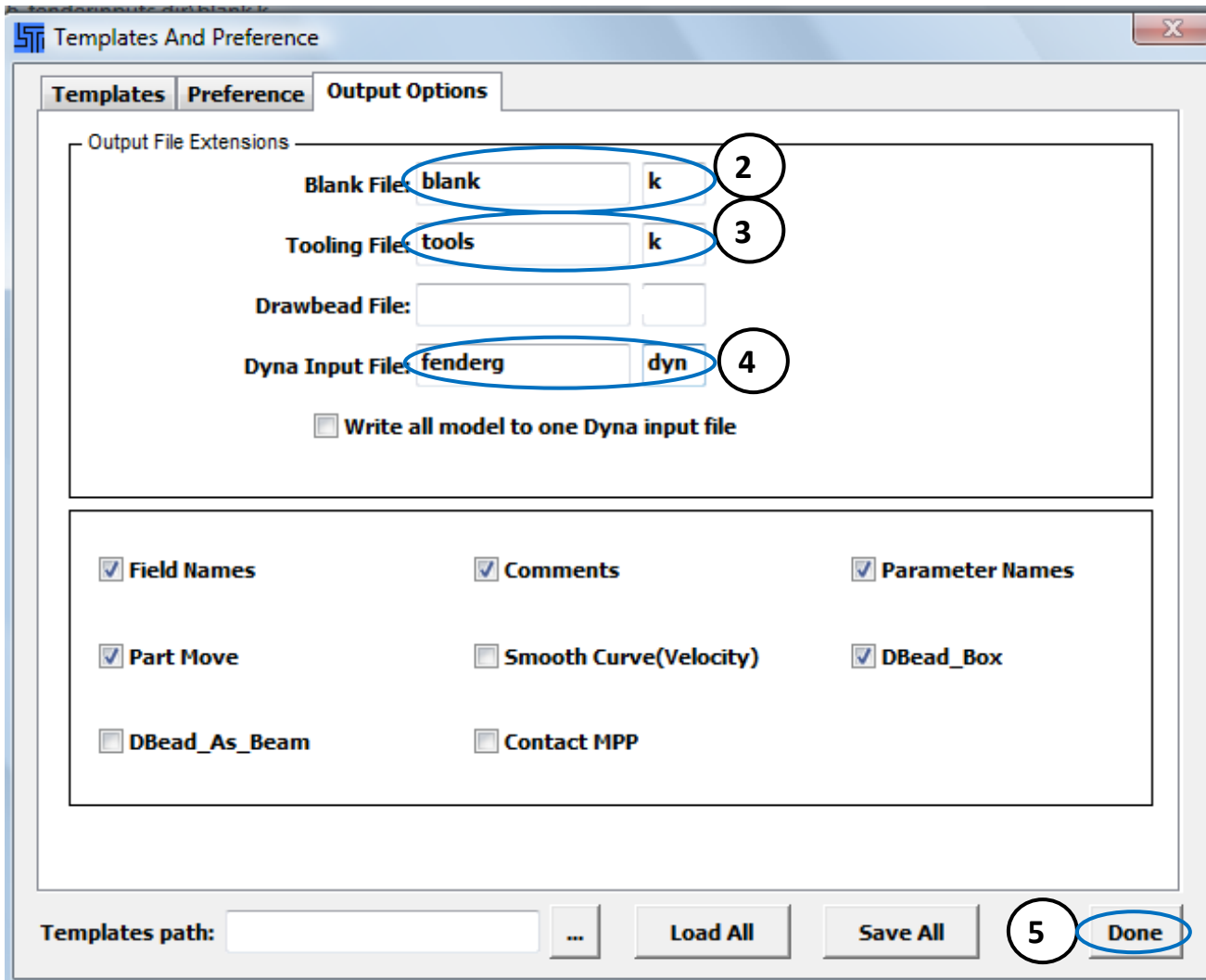


Figure 11

Page 11

11. Execute LS-DYNA and process results

Run LS-DYNA with memory=9M ncpu=2

It should take less than 2.5 minutes on a Xeon machine with 2-CPU SMP version of LS-DYNA, requiring about 9.0 million words of memory (9.0MW).

Launch LS-PrePost

File → Open → LS-Dyna Binary Plot

Open "d3plot"

Refer to Figure 12

select all parts by 'SelPar' as shown in Figure 12

click on  to move to the last state

Shown in Figure 13 is the final deformed shape of the blank

Refer to Figure 14

click *page 1*

click *ASCII*

click *MATSUM*

click *load*

click *1* under Mat id

highlight *1-Internal Energy, 2-Kinetic Energy, 3-Hourglass Energy*

click *plot*

Shown in Figure 15 is the energy history plot of the blank.

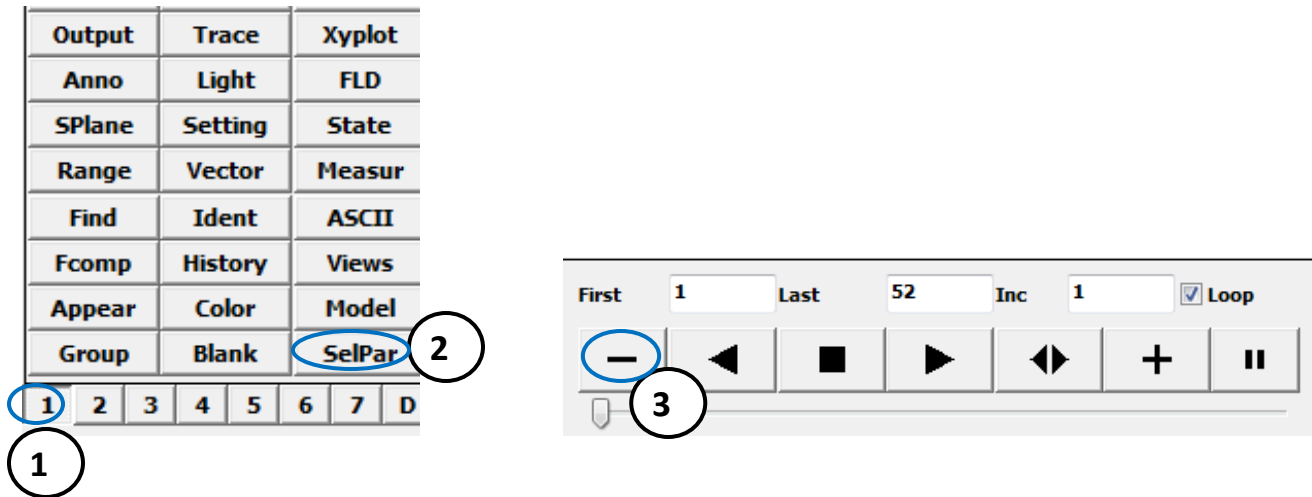


Figure 12

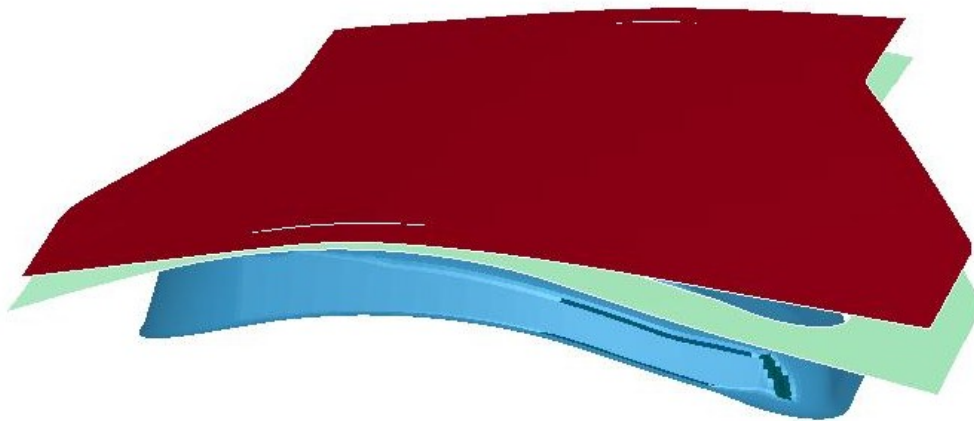


Figure 13 Blank deformed geometry

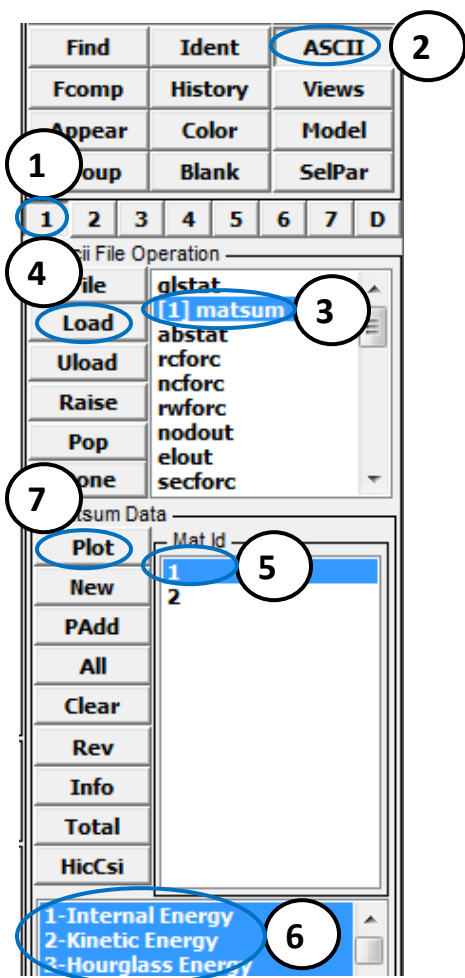


Figure 14

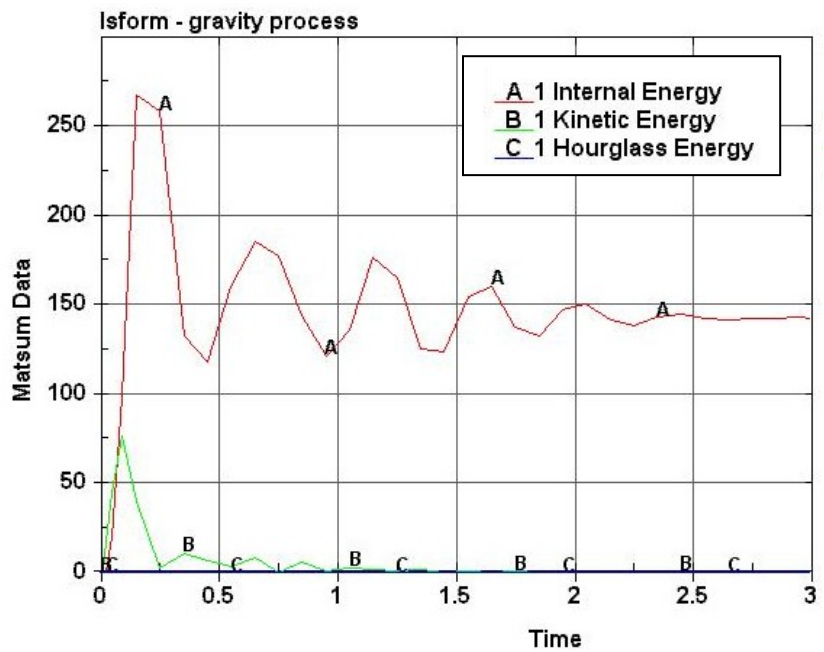


Figure 15

Tutorial G3 – Gravity loading of a B-pillar using One-Step Static

Interface Used: *Applications > Metal Forming*

Files required:

- tool.k (binder and punch mesh)
- blank.k (blank mesh)
- mat_bplr.k (blank material property)

Page 1

Note: LS-PrePost 2.4 must be used for this tutorial. This tutorial focuses on the set-up process of a gravity loading analysis using the One-Step Implicit Static method within the Metal Forming interface. All components have been meshed previously.

1. Load meshed parts and open Metal Forming Interface

Launch LS-PrePost

File → Open → LS-Dyna Keyword

Open “tool.k”

File → Import → LS-Dyna Keyword

Open “blank.k”; select ‘Import Offset’ option

Application → Metal Forming

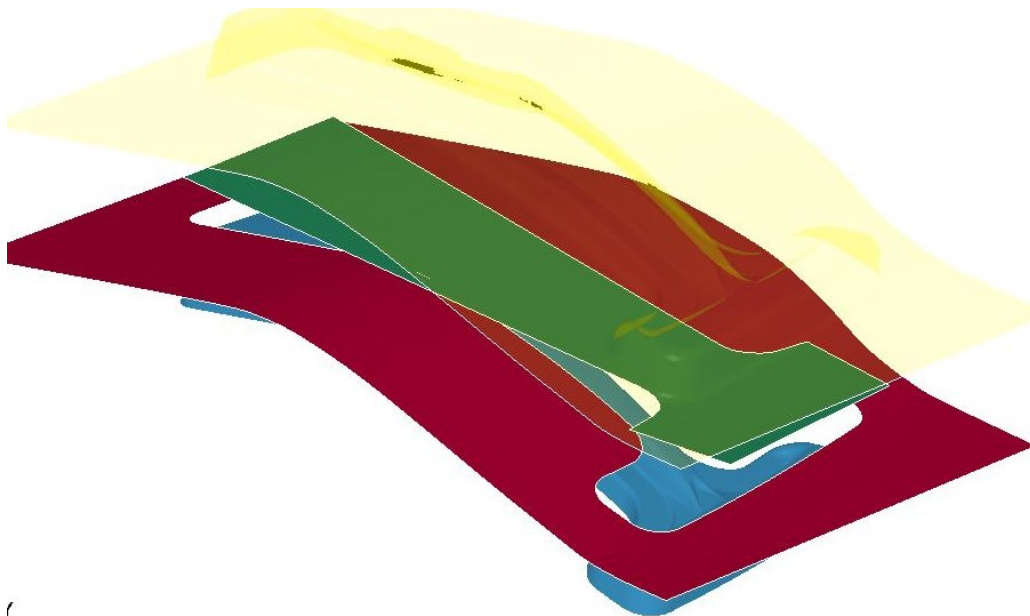


Figure 1

Page 2

2. Job Setup

click *Job Setup* in the side panel (launches Job Setup Dialog shown in Figure 2)

enter Project Name: gravity1

specify Master Folder

set Units: L:Millimeter, F:Newton

select Process Type:



click: *Apply*

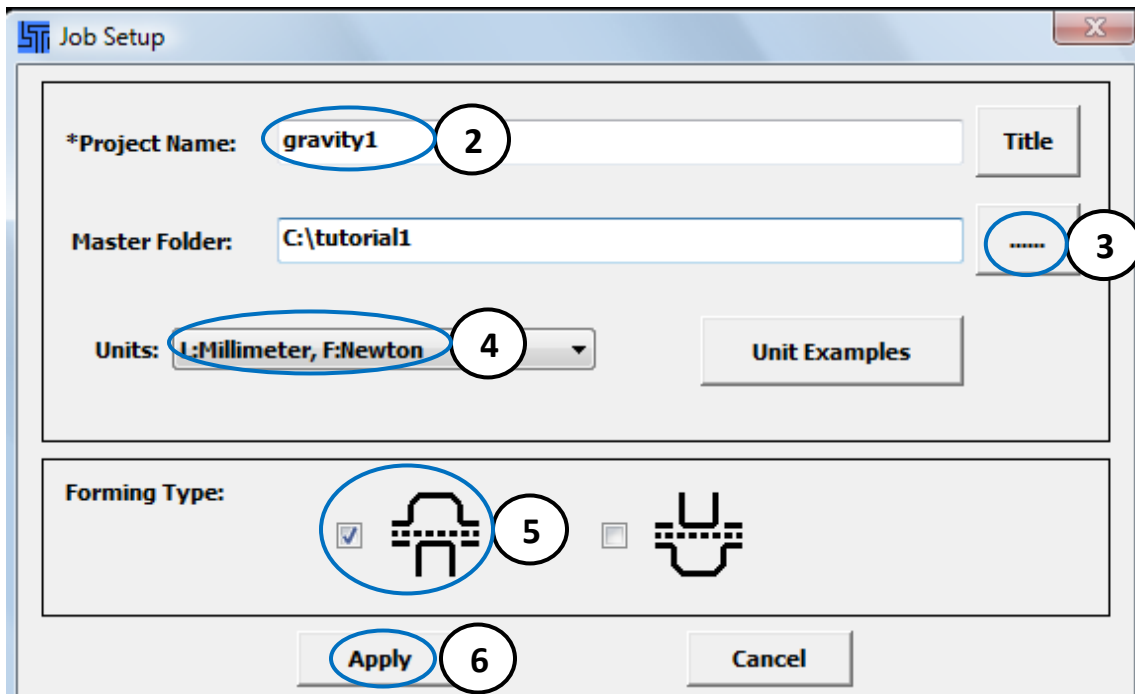
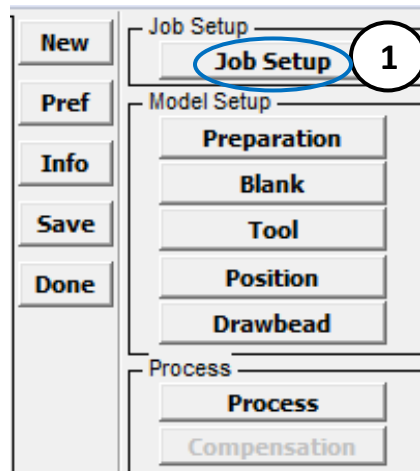


Figure 2

Page 3

3. Define Blank

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

select "14 Blank14" from the right hand list

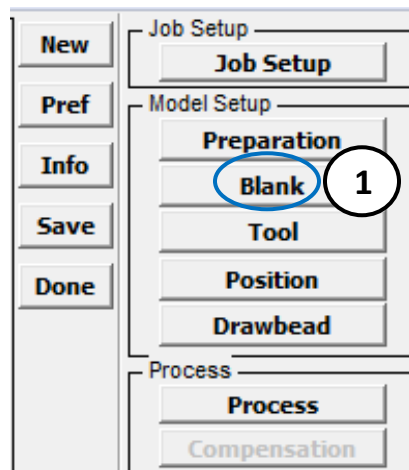
click <<

select Element Formulation: 2-Belytschko-Tsay

enter Number of Integration: 5

enter Thickness: 1.95; must hit carriage return.

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



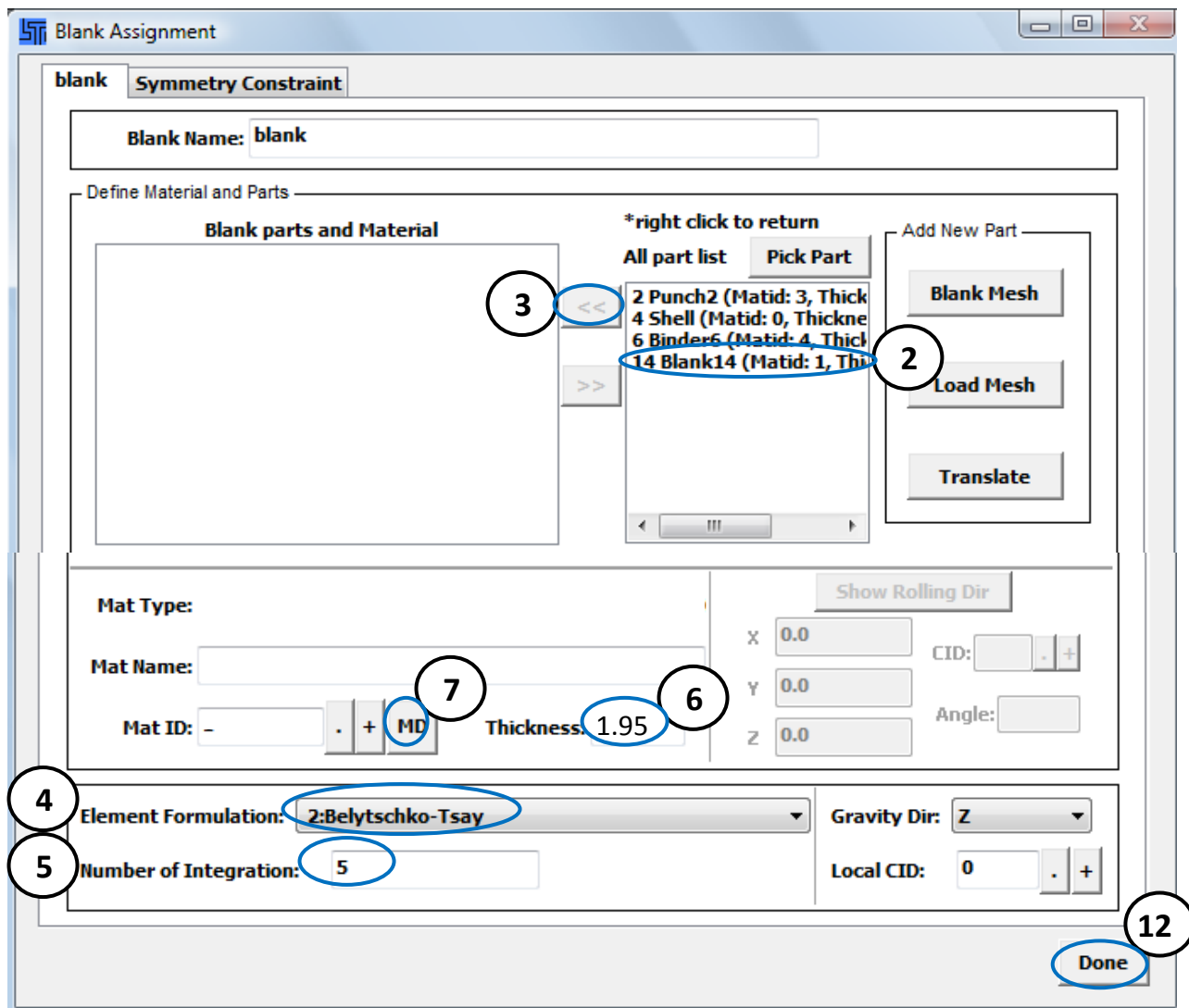



Figure 3

Page 4

4. Load material property for Blank

- click  to go to current working directory
- click "mat_bplr.k"
- click *Preview*
- click *OK*
- click *Done* (Figure3)

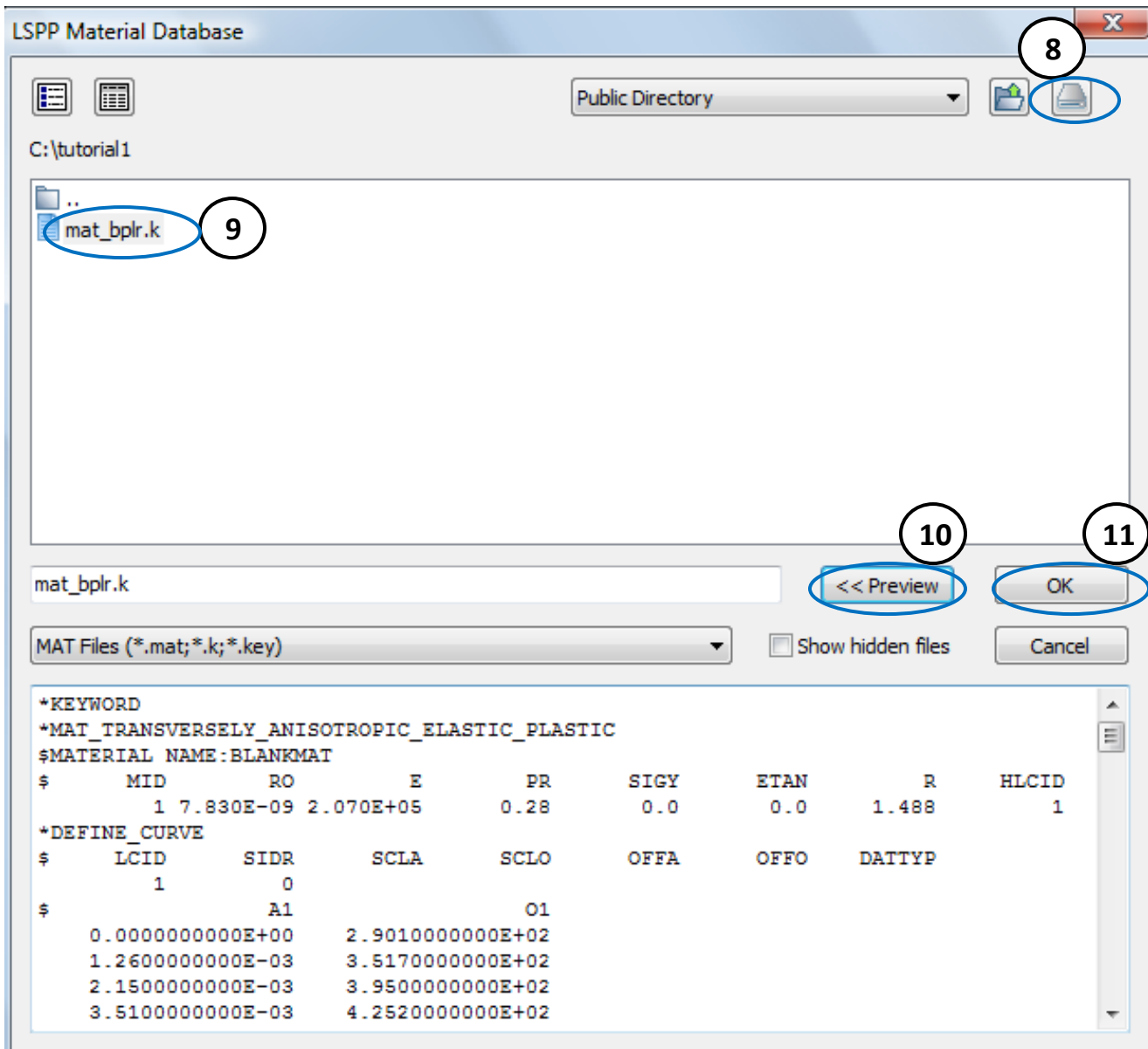


Figure 4

Page 5

5. Define Punch

Click *Tool* in the side panel (launches Tool Dialog shown in Figure 5)

select the Punch tab

enter Friction: 0.125

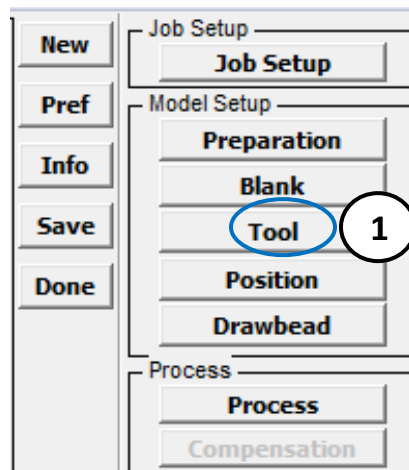
select "2 Punch2" from the right hand list (All part list)

click <<

select Tool Position to Blank: ☉ Below

set Direction: Z

select Contact Type: Forming_Surface_To_Surface



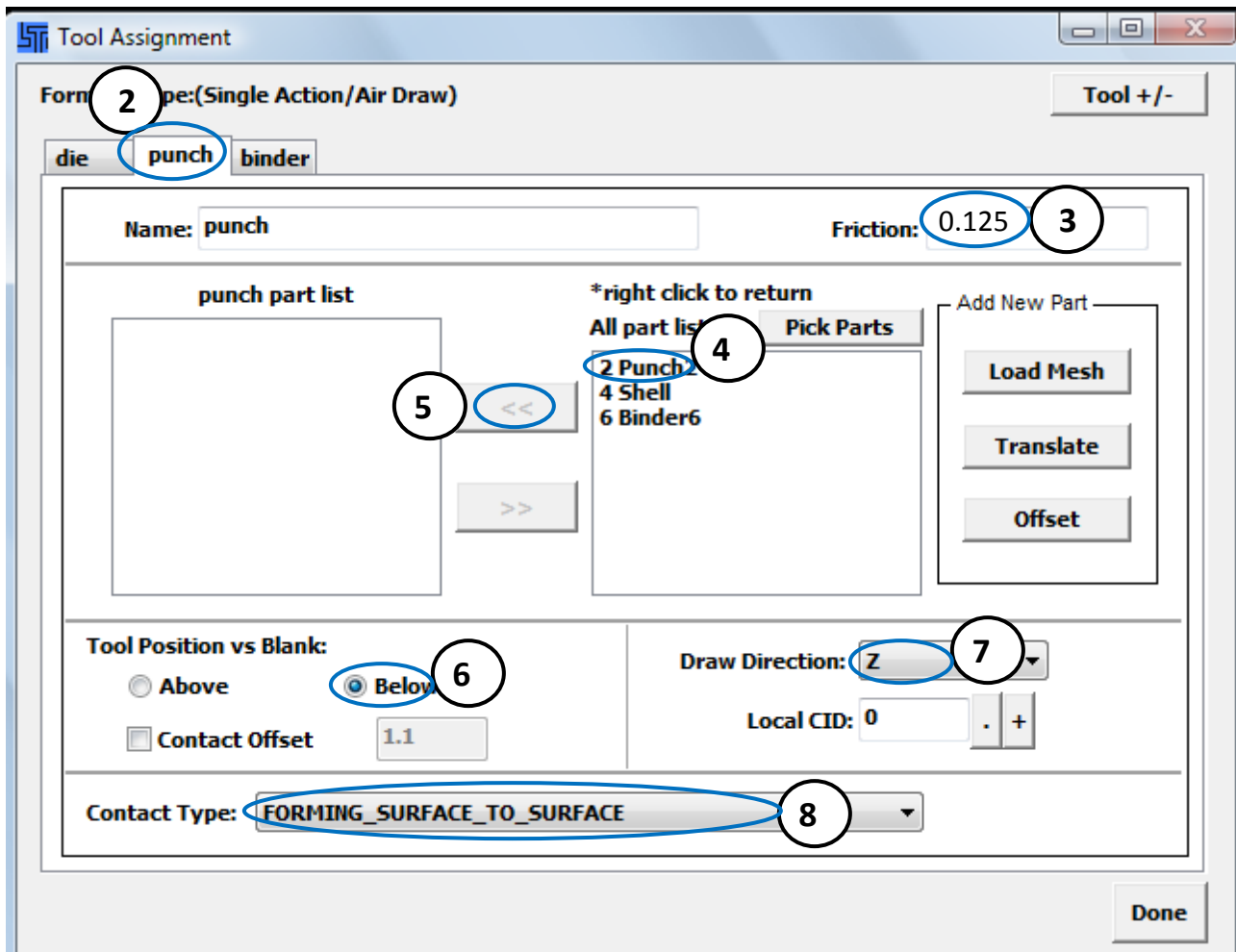


Figure 5

Page 6

6. Define Binder

- select the Binder tab
- enter Friction: 0.125
- select "6 Binder6" from the right hand list (All part list)
- click <<
- select Tool Position to Blank: Below
- set Direction: Z
- select Contact Type: Forming_ Surface_To_Surface

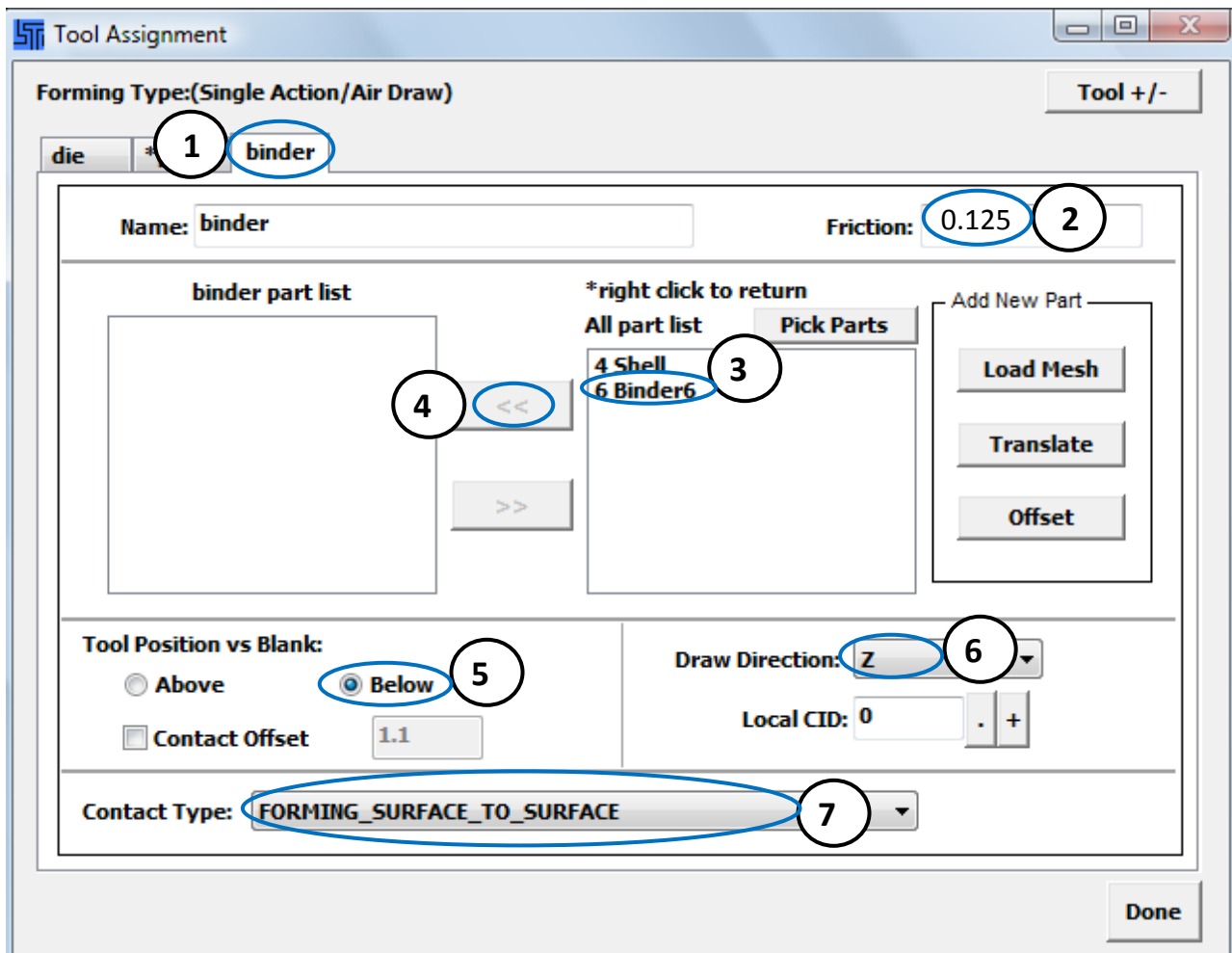


Figure 6

Page 7

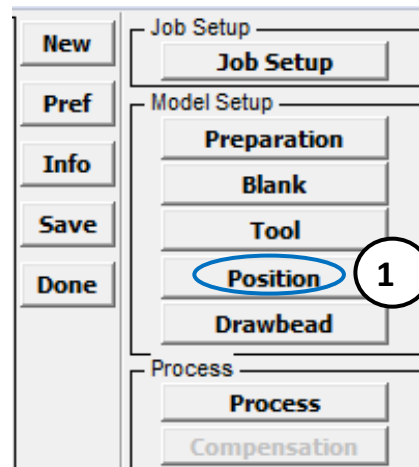
7. Position components

click *Position* in the side panel (launches Position Dialog shown in Figure 7)

activate Blank only as a movable tool

click *Auto Position*

click *Done*



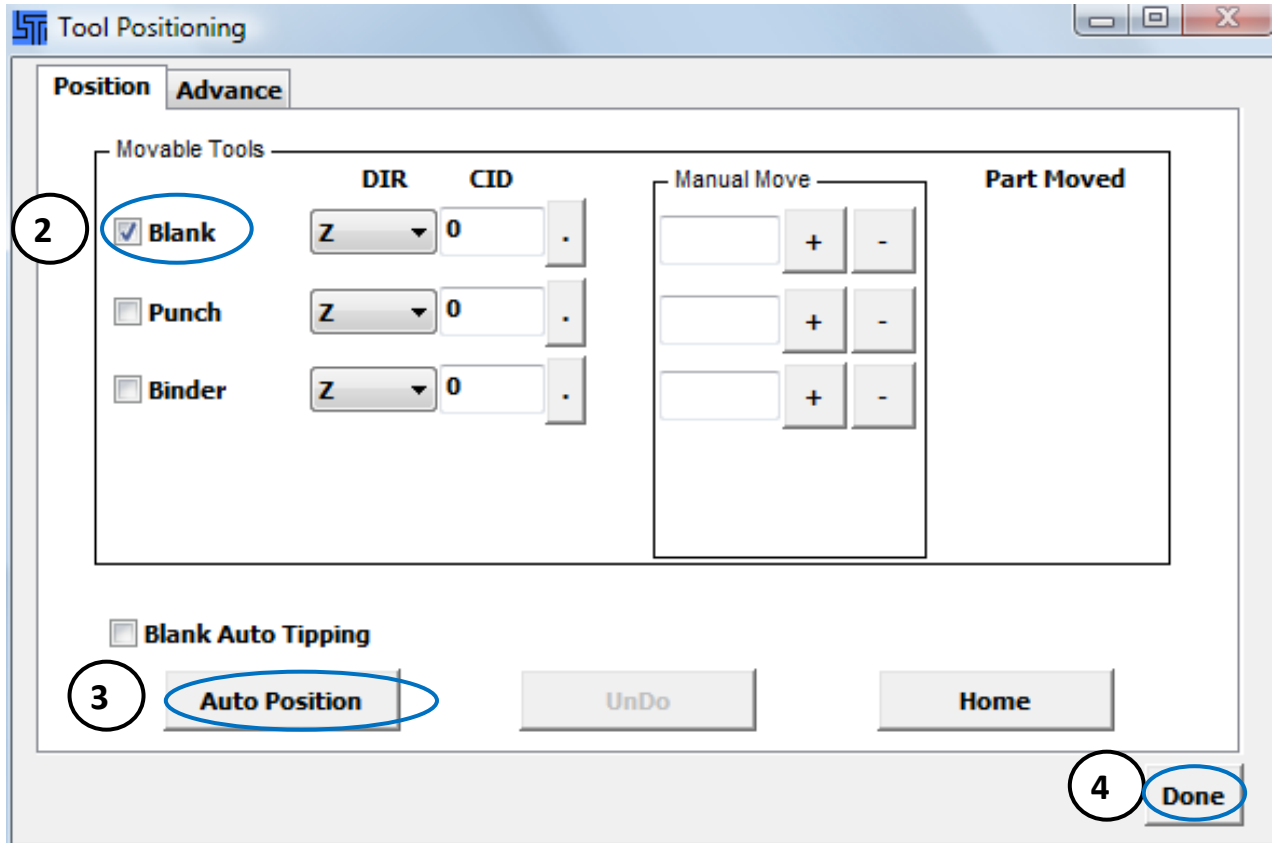


Figure 7

Page 8**8. Define Process**

click *Process* in the side panel (launches Process Dialog shown in Figure 8)

select Process Type as: Gravity

activate Punch and Binder as Active Tools

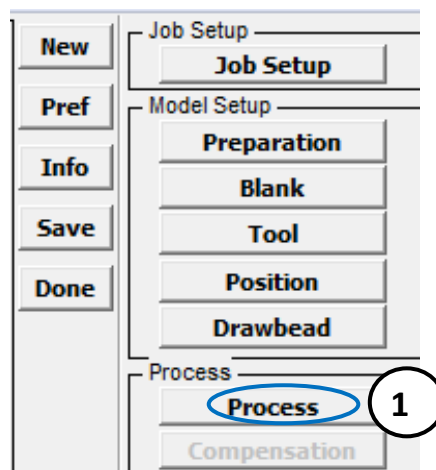
select the Control tab within the Gravity tab (Figure 9)

select One Step Static

enter Termination Time: 0.5

activate Blank

click *Output Dyna* (launches Dyna Input Decks Gravity dialog in Figure 10)



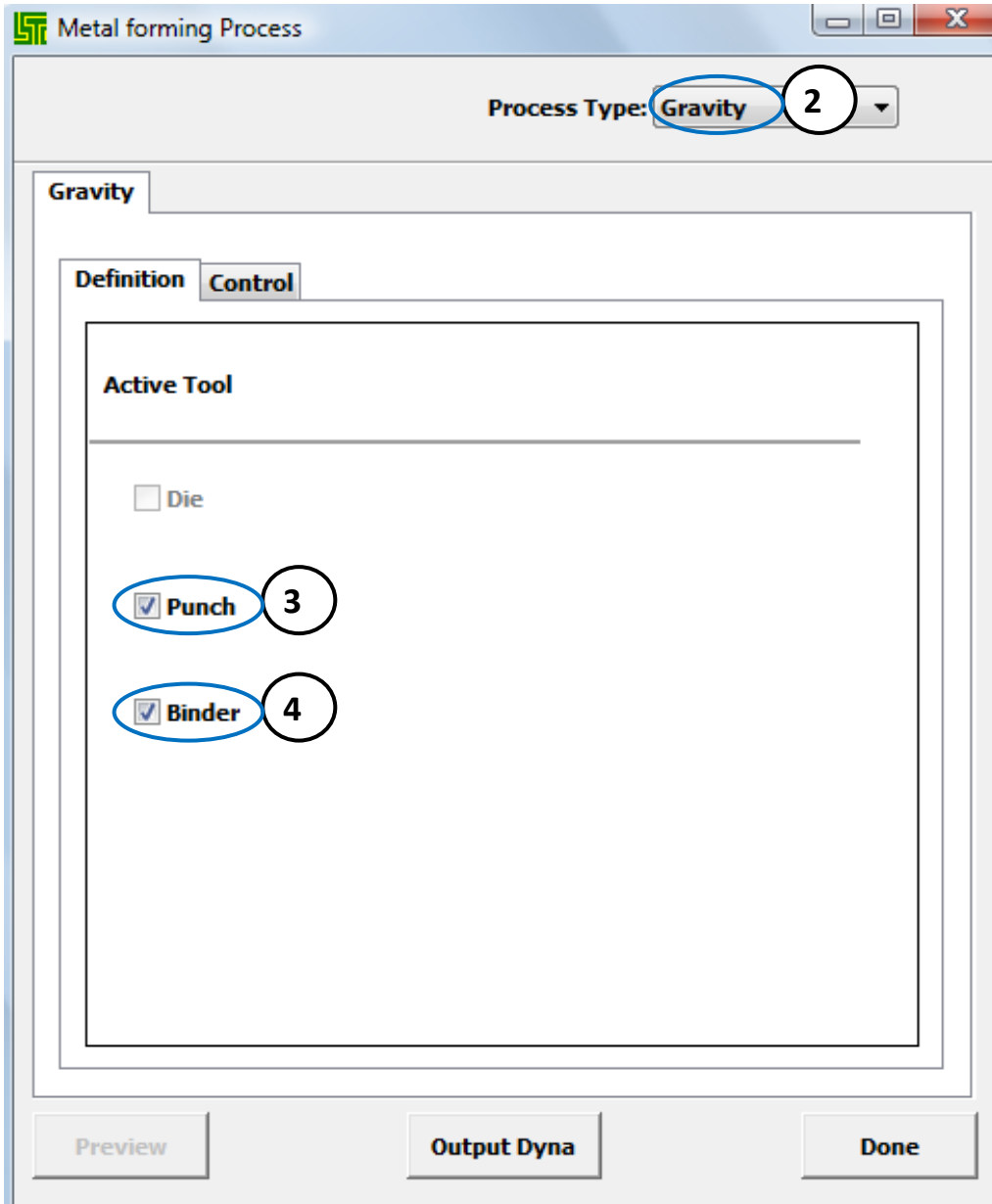


Figure 8

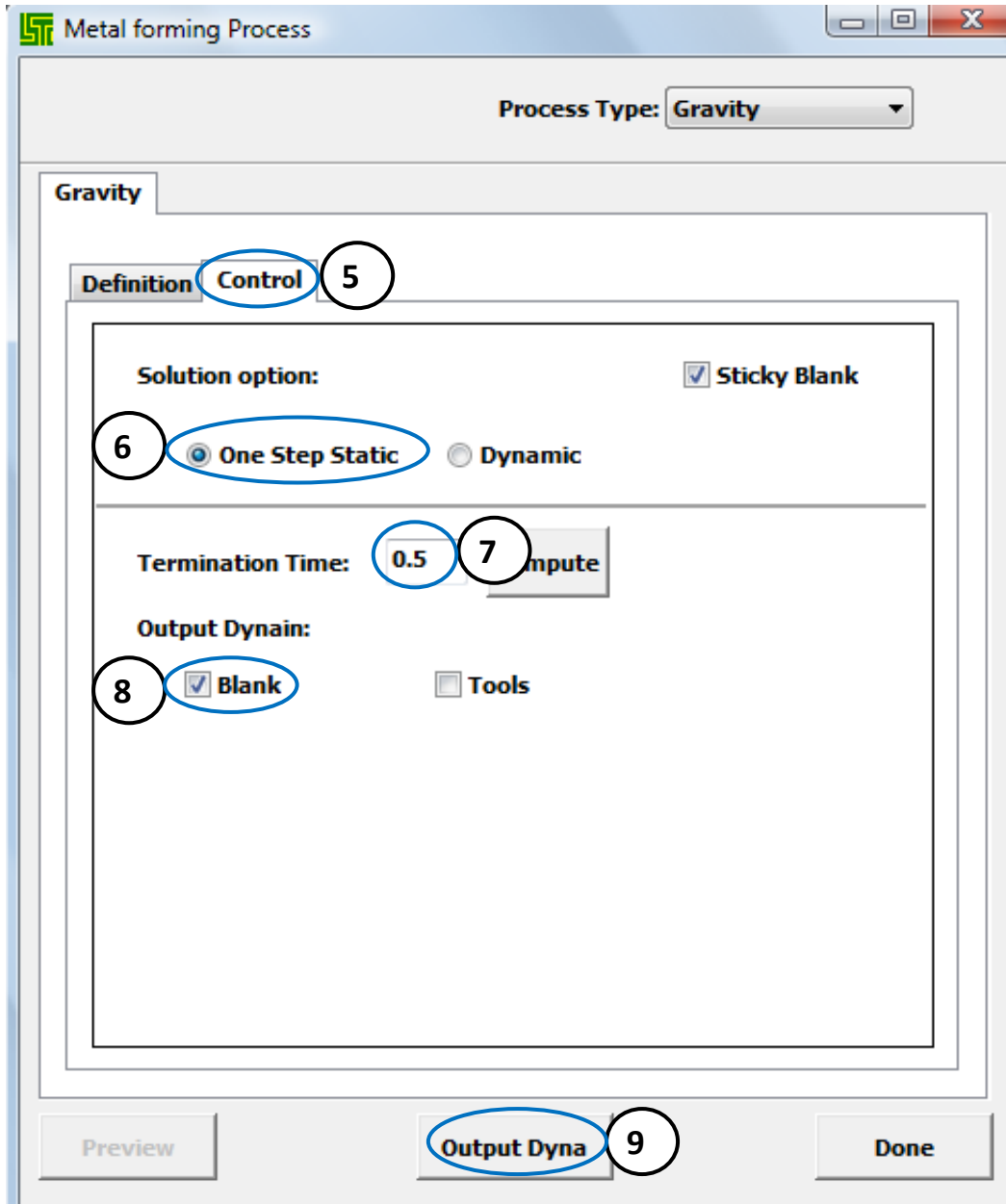


Figure 9

Page 99. Define Process (*continued...*)

Refer to Figure 10

click *Advanced* in the Dyna Input Decks(Gravity) dialog

select the Output Options tab under the Templates and Preference tab (Figure 10)

enter Blank File: blank.k; hit a carriage return to make the change to take effect.

enter Tooling File: tools.k; hit a carriage return to make the change to take effect.

enter Dyna Input File: bplrg.dyn; hit a carriage return to make the change to take effect.

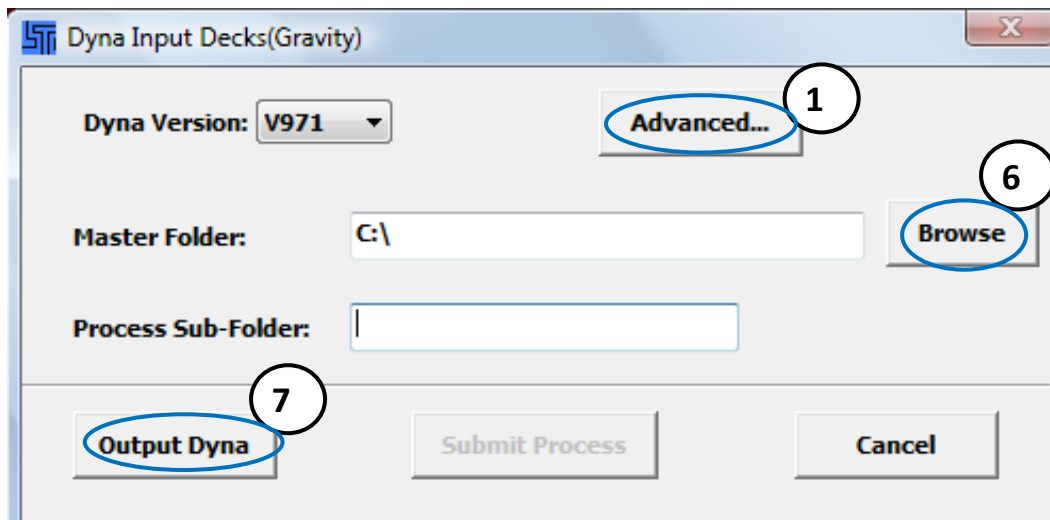
click *Done*

click *Browse* and specify a directory for the input file, in the Dyna Input Decks(Gravity) dialog

click *Output Dyna*

Save project file, File → Save Project As...

Close this LS-PrePost session.



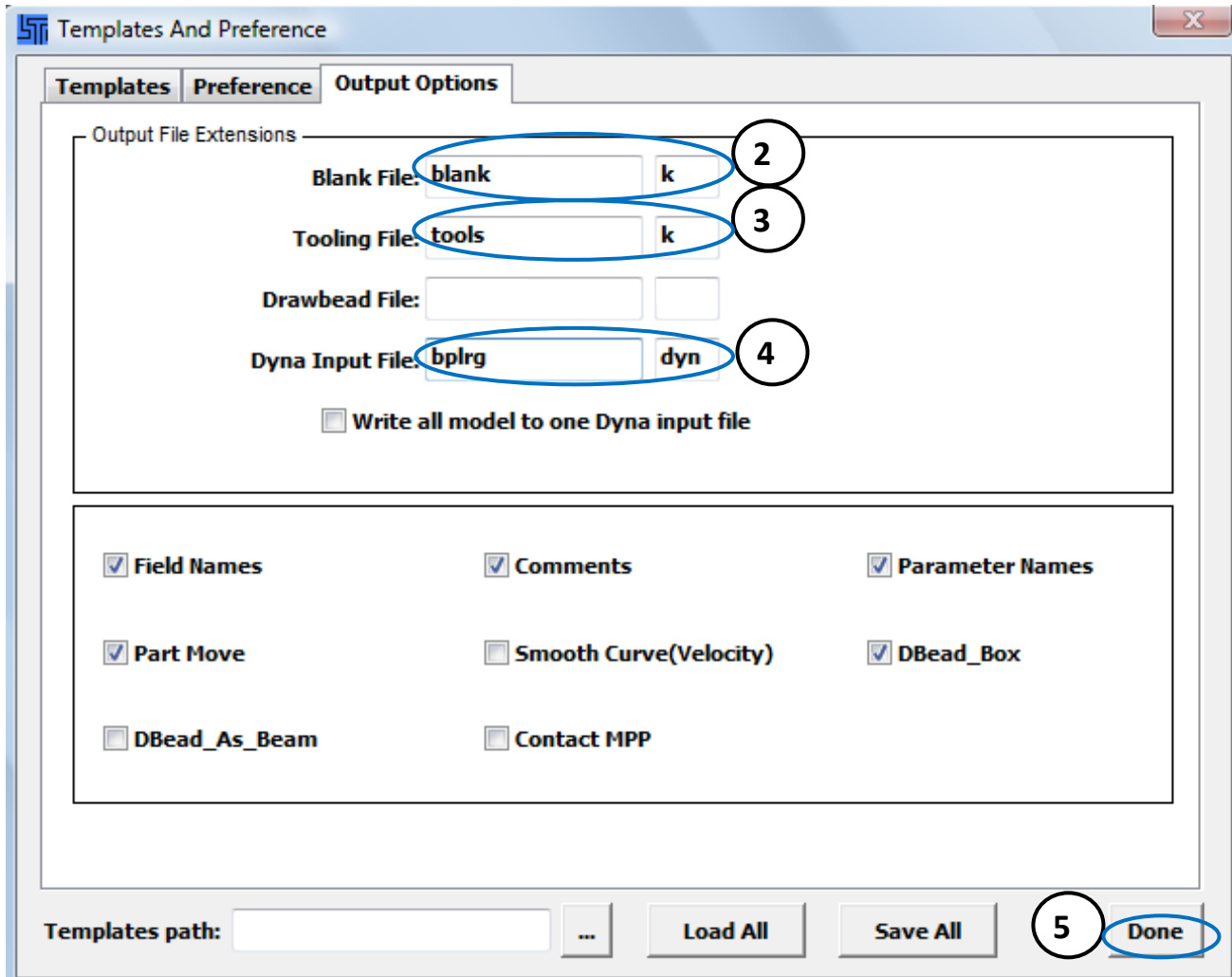


Figure 10

Page 10

9. Execute LS-DYNA and process results

Run LS-DYNA with command: ls971_d_R3.2.1_win32_p.exe i=bplrg.dyn memory=7M ncpu=2
 This job should take about 1.5 minutes on a Xeon machine with 2-CPU SMP version of LS-DYNA, requiring about 7.0 million words of memory (7.0MW).

Launch LS-PrePost
 File → Open → LS-Dyna Binary Plot
 Open “d3plot”

select all parts by ‘SelPar’ as shown in Figure 11

click on  to move to the last state; shown in Figure 12 is the final deformed shape of the blank

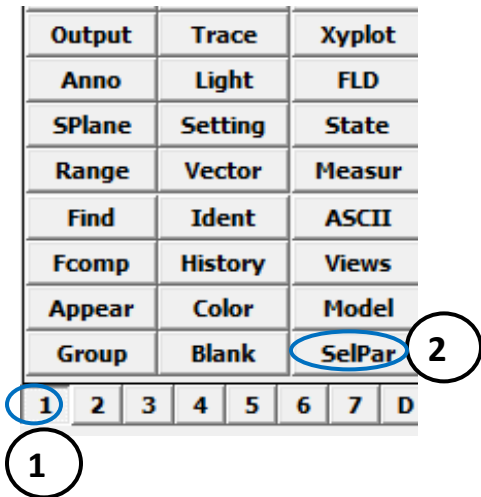


Figure 11

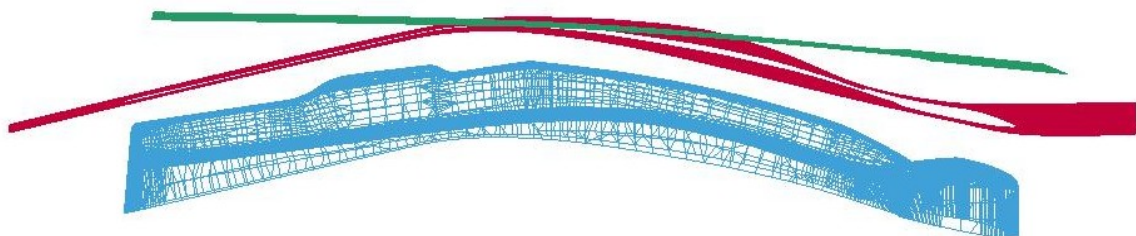


Figure 12

Tutorial G4 – Gravity loading of a B-pillar using Implicit Dynamic

Interface Used: *Applications > Metal Forming*

Files required:

- tool.k (binder and punch mesh)
- blank.k (blank mesh)
- mat_bplr.k (blank material property)
- lspp_smf_temp_gr.temp – keyword template file used in Implicit Dynamic.

Page 1

Note: LS-PrePost 2.4 must be used for this tutorial. This tutorial focuses on the set-up process of a gravity loading analysis using the Implicit Dynamic method within the Metal Forming interface. All components have been meshed previously.

1. Define and Modify Templates

click *Pref* in the side panel (launches Templates and Preference Dialog)

select *Gravity* tab under the Templates and Preference tab

click *load* to load the template file: lspp_smf_temp_gr.temp

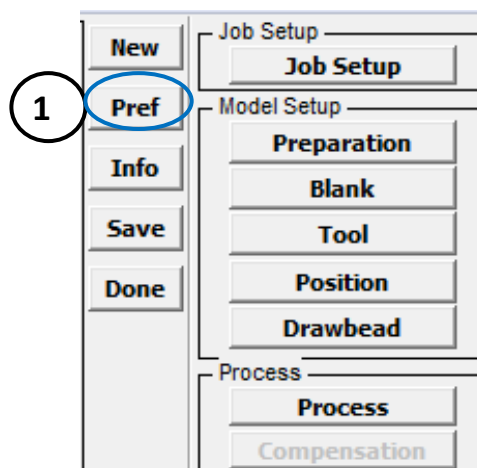
click “Control_Implicit_Auto” (launches Keyword Input Dialog)

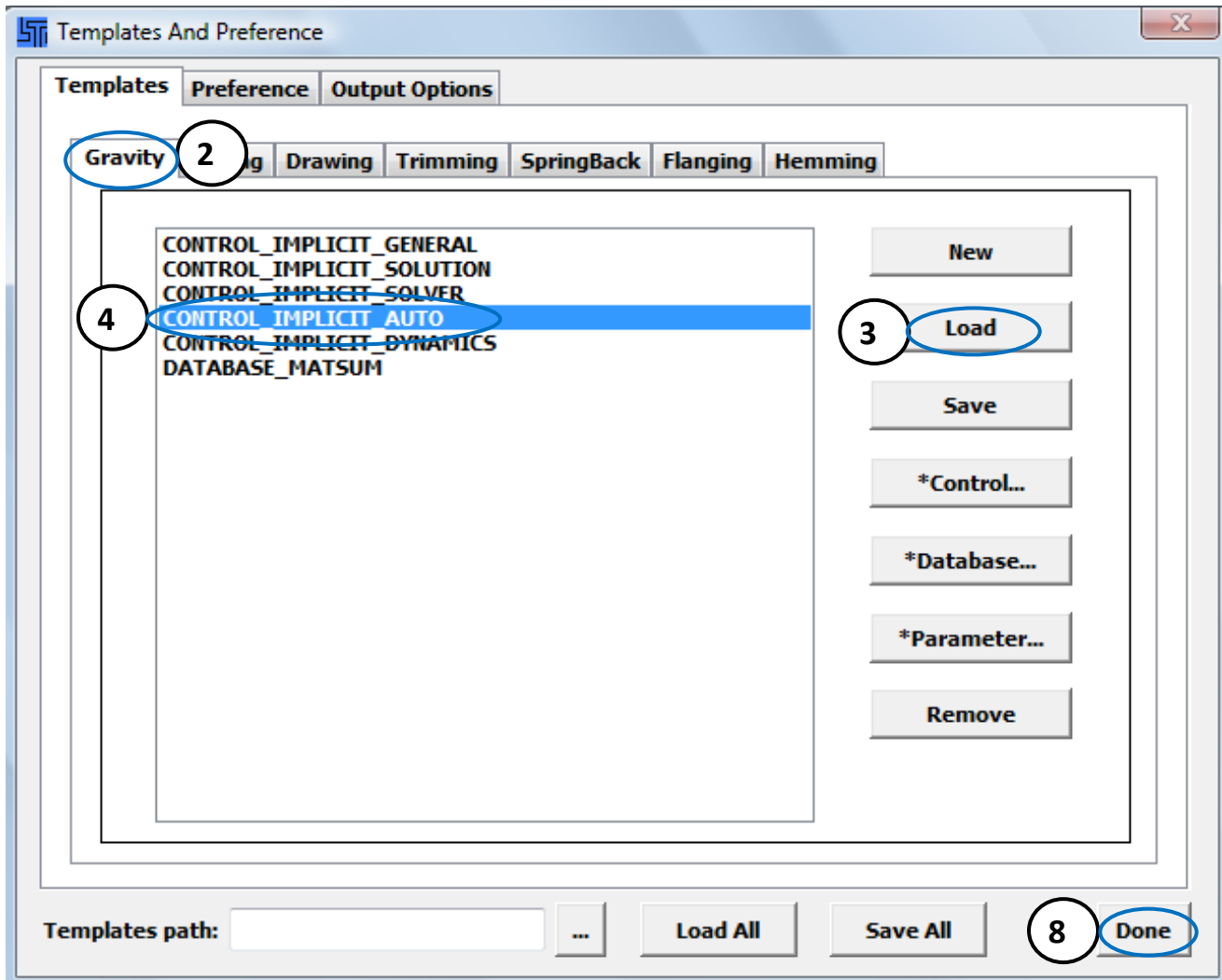
change DTMAX to 0.01

click *Accept*

click *Done*

click *Done* in Templates and Preference Dialog





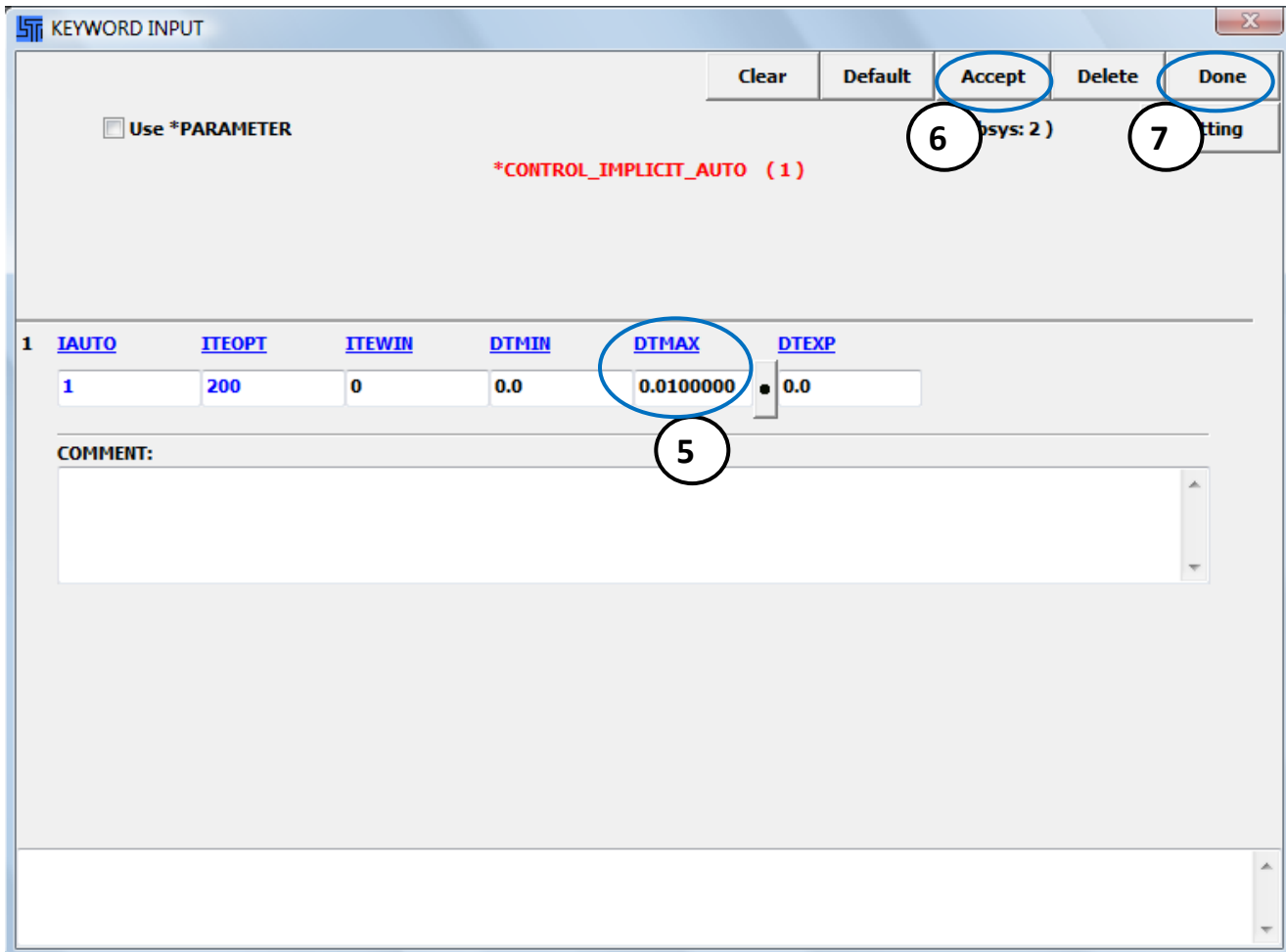


Figure 1

Page 2

2. Load meshed parts and open Metal Forming Interface

Launch LS-PrePost

File → Open → LS-Dyna Keyword

Open "tool.k"

File → Import → LS-Dyna Keyword

Open "blank.k"; select 'Import Offset' option

Application → Metal Forming

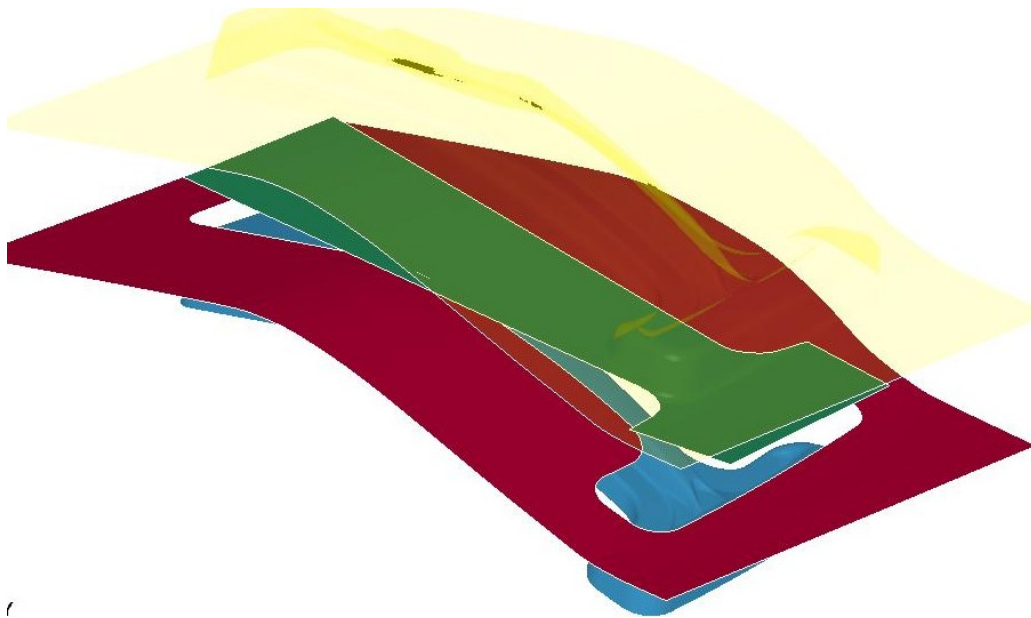


Figure 2

Page 3

3. Job Setup

click *Job Setup* in the side panel (launches Job Setup Dialog shown in Figure 3)

enter Project Name: gravity1

specify Master Folder

set Units: L:Millimeter, F:Newton

select Process Type:

click: *Apply*

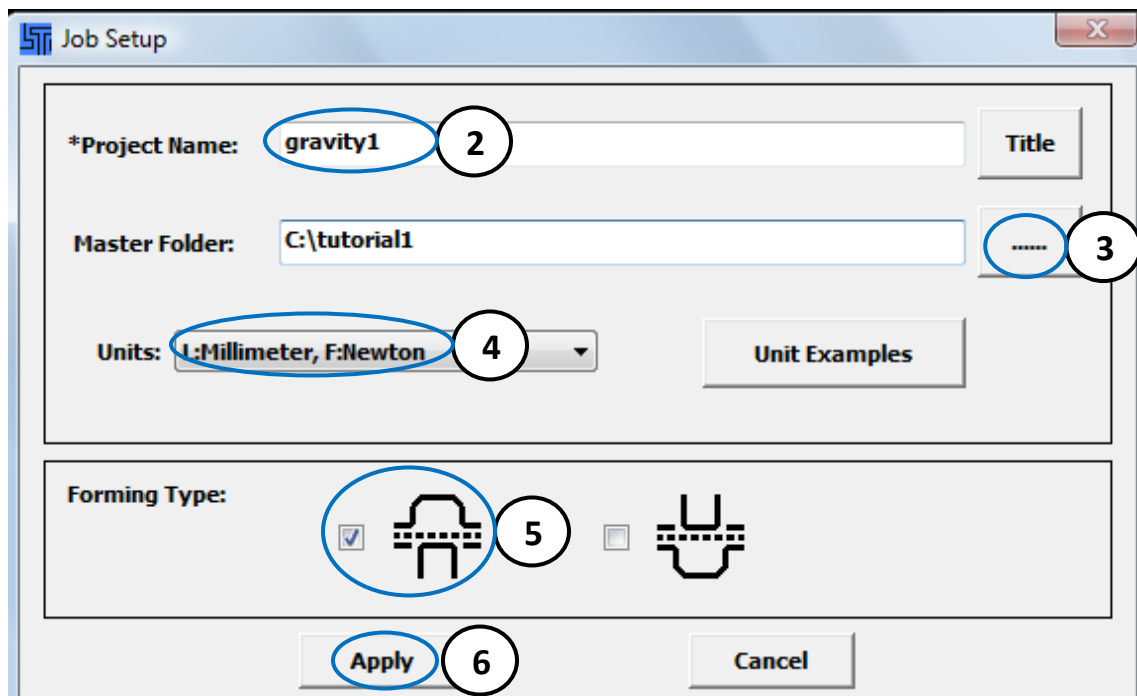
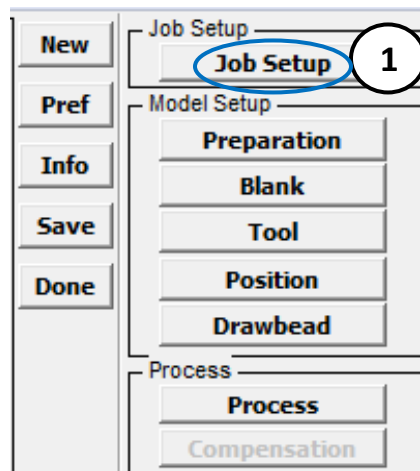


Figure 3

Page 4

4. Define Blank

click *Blank* in the side panel (launches Blank Dialog shown in Figure 4)

select "14 Blank14" from the right hand list

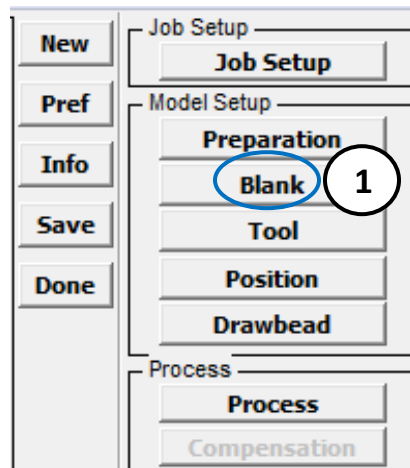
click <<

select Element Formulation: 2-Belytschko-Tsay

enter Number of Integration: 5

enter Thickness: 1.95; must hit carriage return.

click *MD* (launches Material Database Dialog shown in Figure 5)



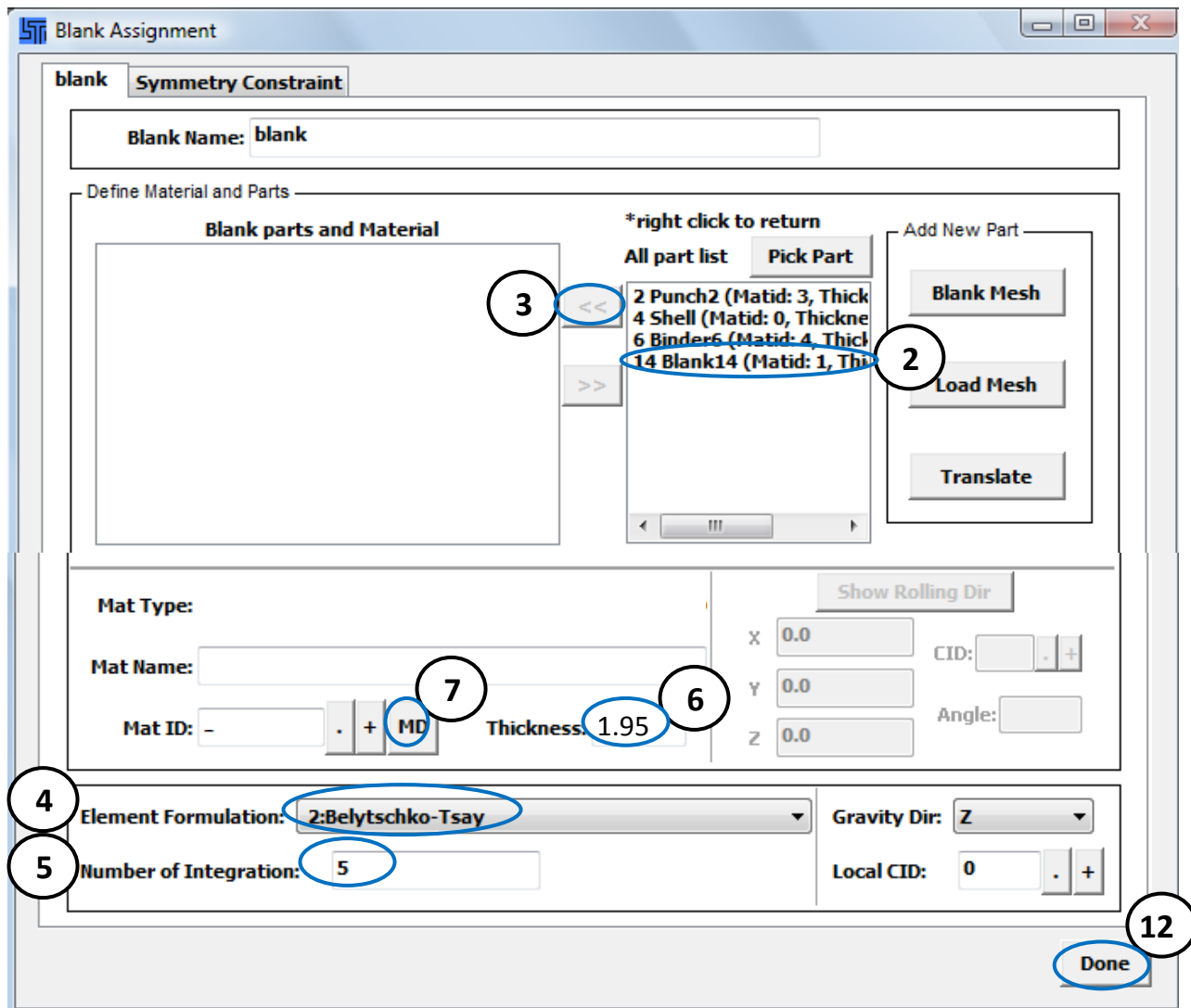



Figure 4

Page 5

5. Load material property for Blank

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

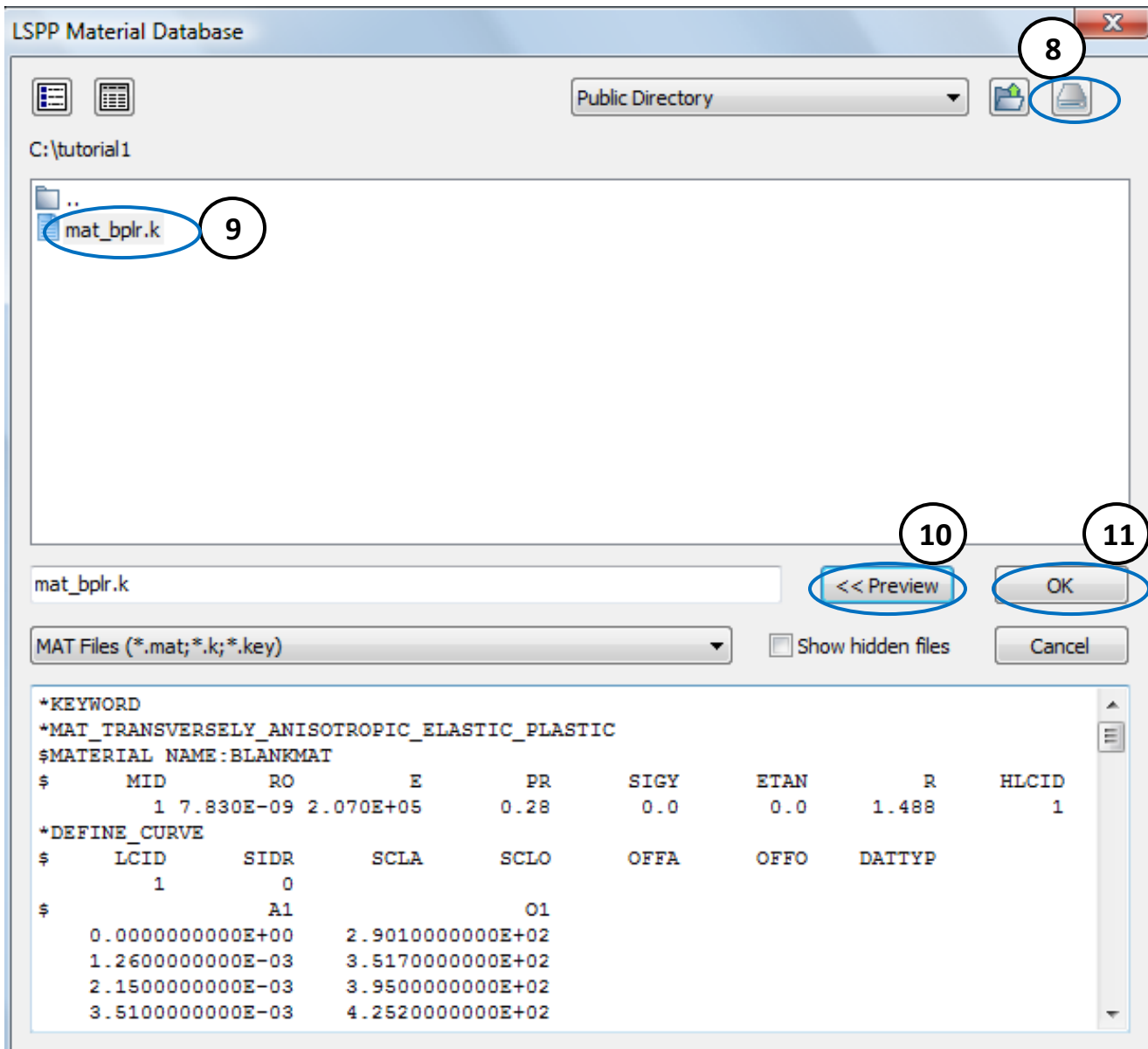


Figure 5

Page 6

6. Define Punch

Click *Tool* in the side panel (launches Tool Dialog shown in Figure 6)

select the Punch tab

enter Friction: 0.125

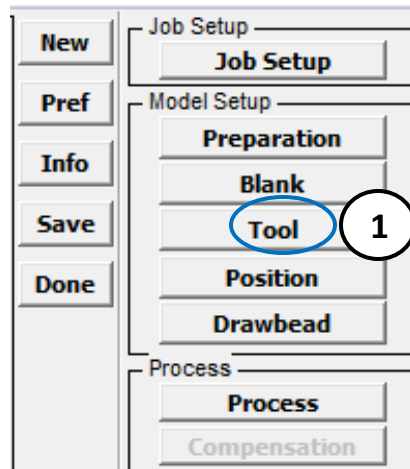
select "2 Punch2" from the right hand list (All part list)

click <<

select Tool Position to Blank: Below

set Direction: Z

select Contact Type: Forming_Surface_To_Surface



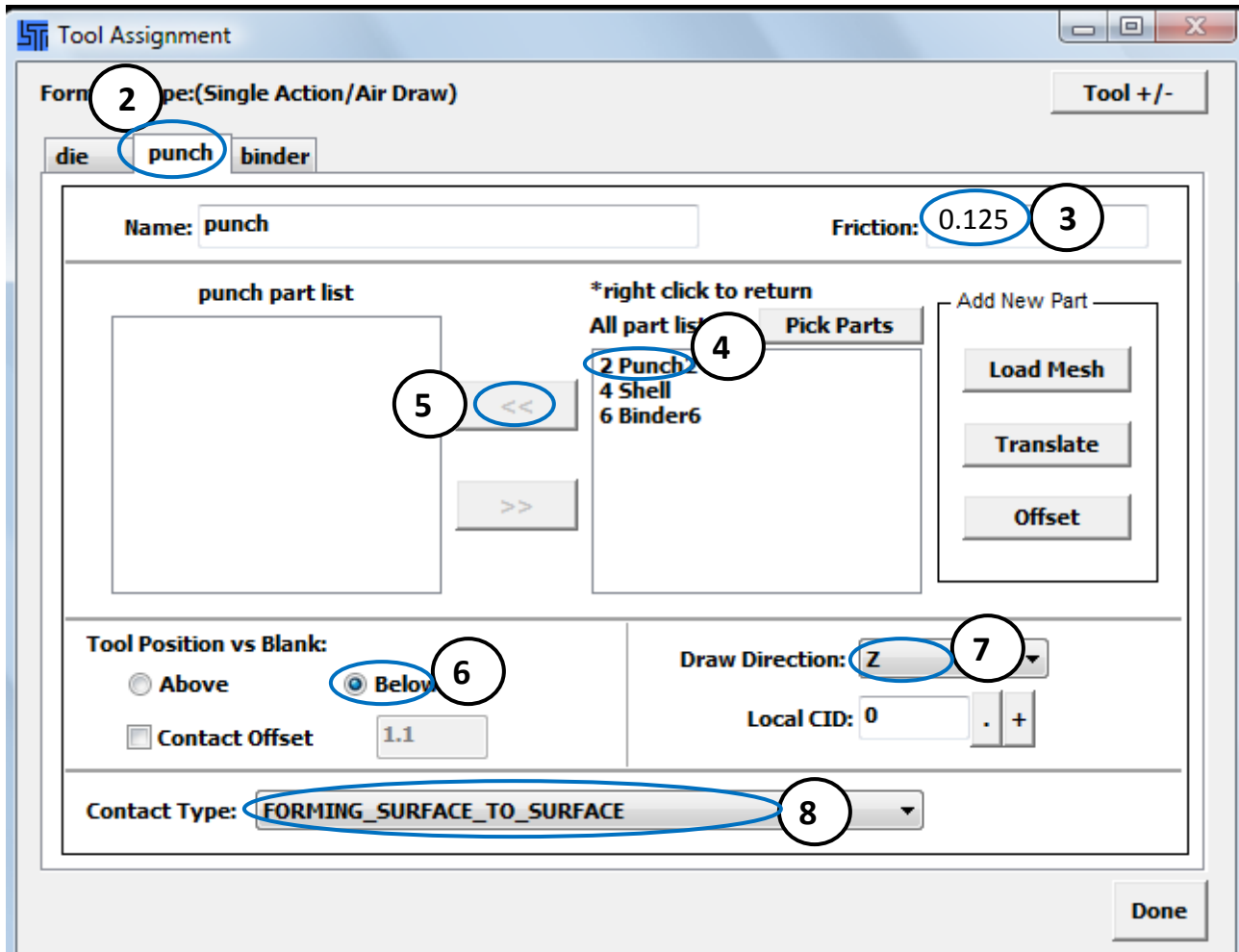


Figure 6

Page 7

7. Define Binder

- select the Binder tab
- enter Friction: 0.125
- select "6 Binder6" from the right hand list (All part list)
- click <<
- select Tool Position to Blank: Below
- set Direction: Z
- select Contact Type: Forming_ Surface_To_Surface

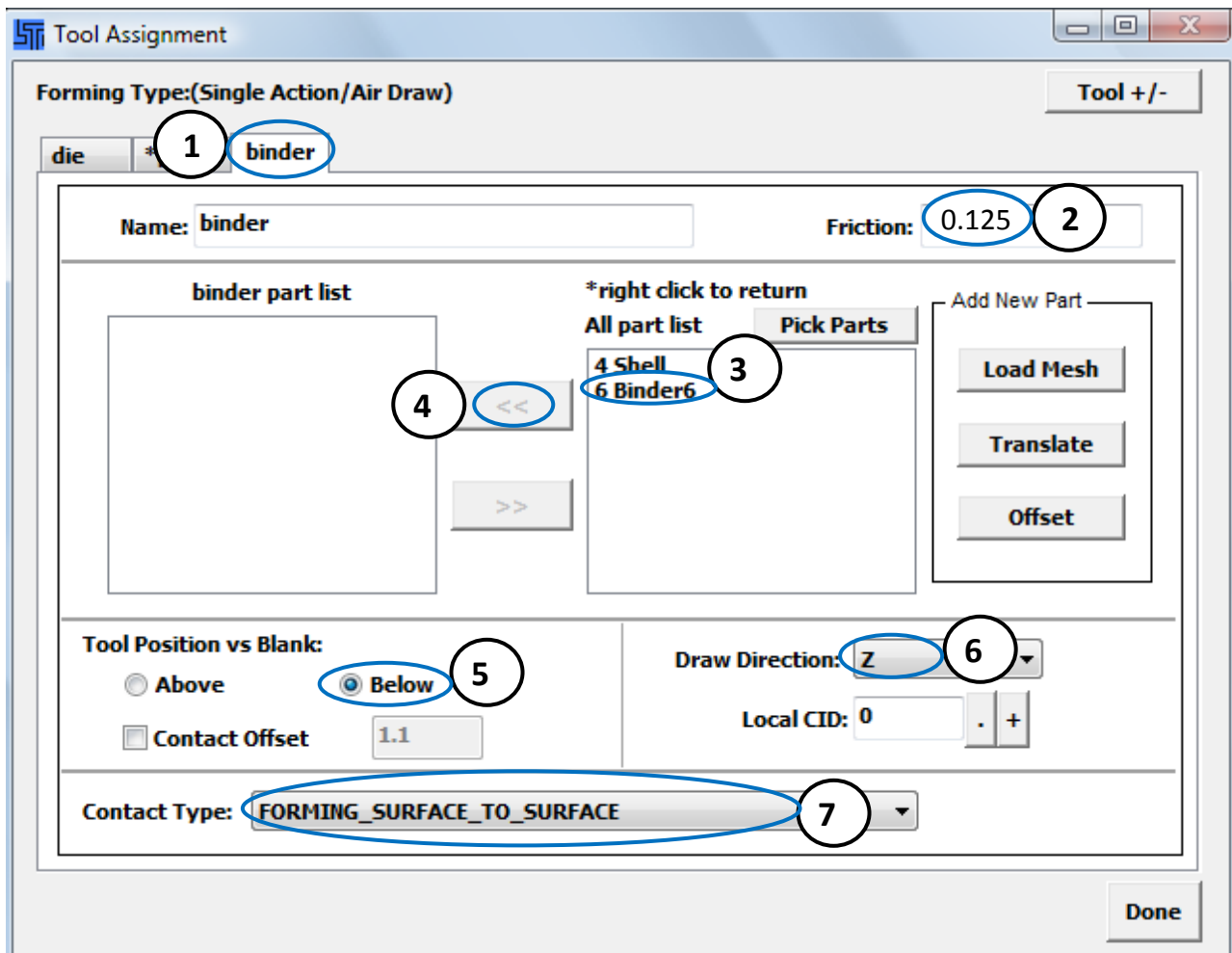


Figure 7

Page 8

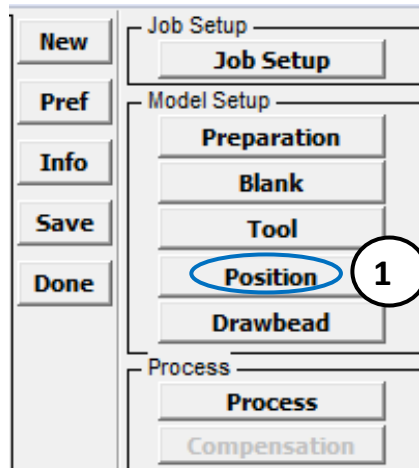
8. Position components

click *Position* in the side panel (launches Position Dialog shown in Figure 8)

activate Blank only as a movable tool

click *Auto Position*

click *Done*



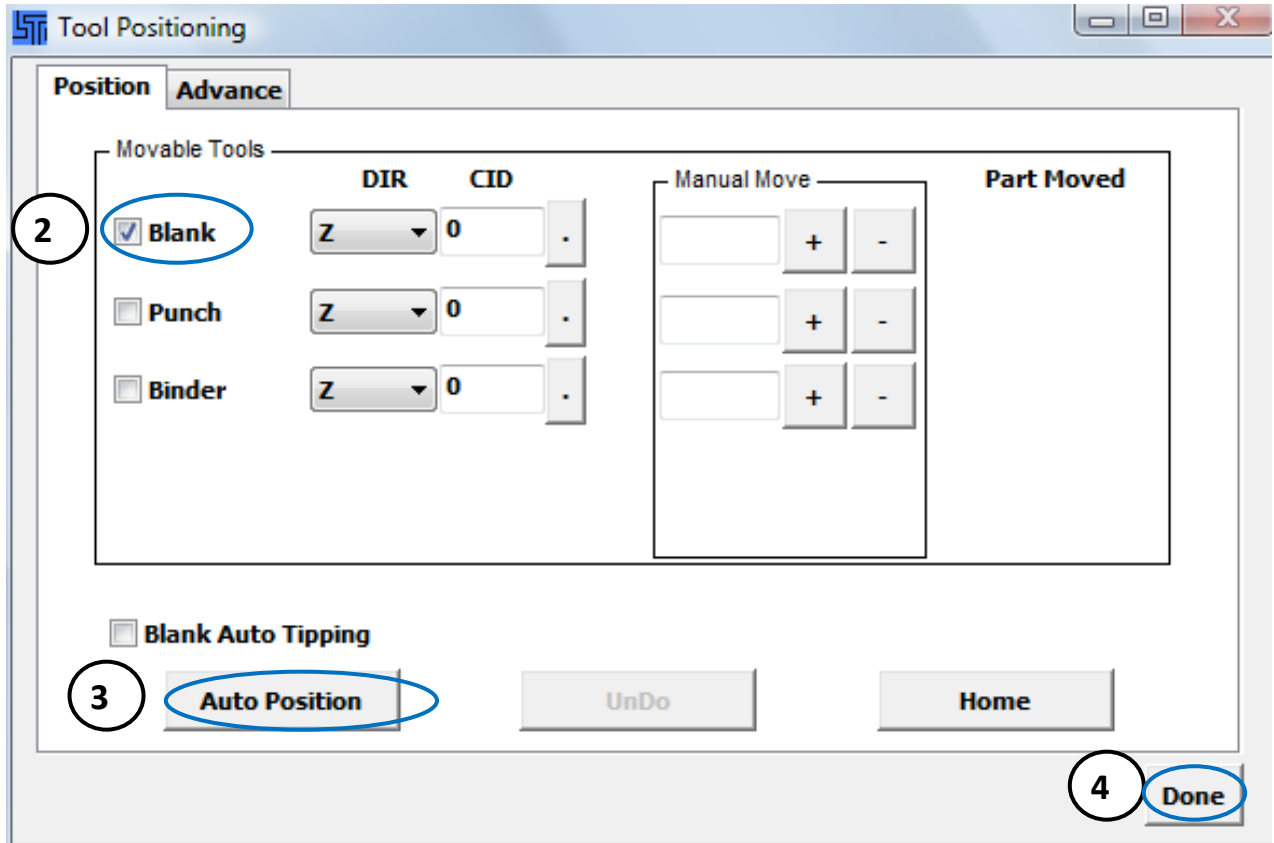


Figure 8

Page 9

9. Define Process

click *Process* in the side panel (launches Process Dialog shown in Figure 9)

select Process Type as: Gravity

activate Punch and Binder as Active Tools

select the Control tab within the Gravity tab (Figure 10)

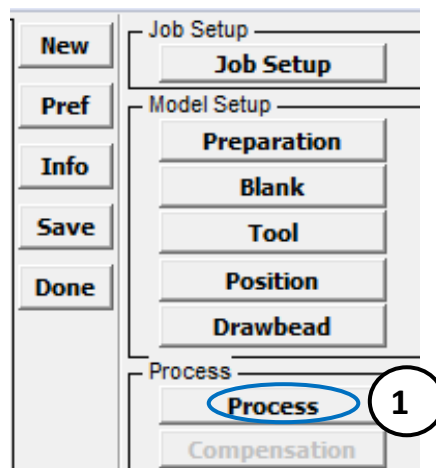
deactivate Sticky Blank

select Dynamic

enter Termination Time: 2.0

activate Blank

click *Output Dyna* (launches Dyna Input Decks Gravity dialog in Figure 11)



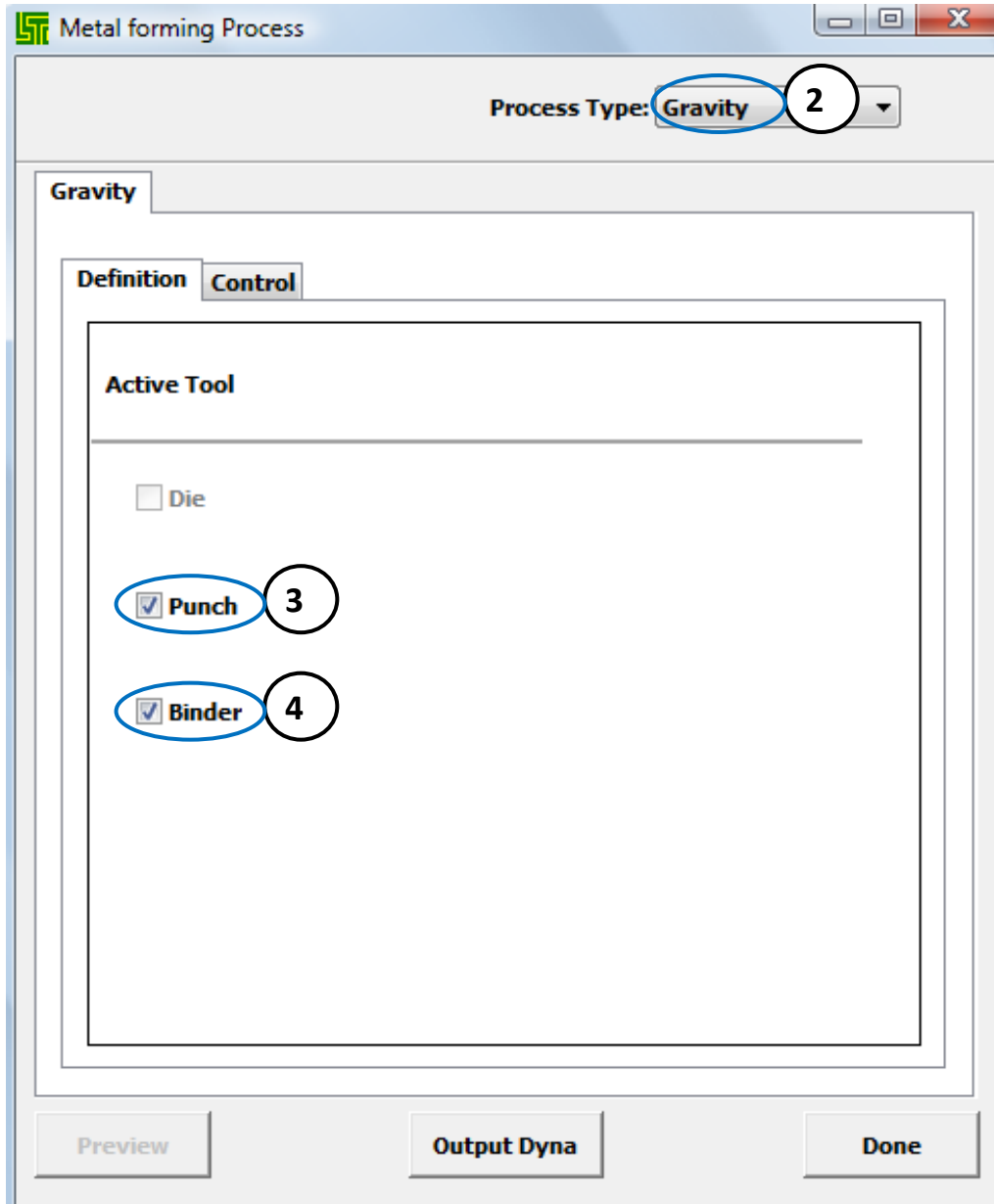


Figure 9

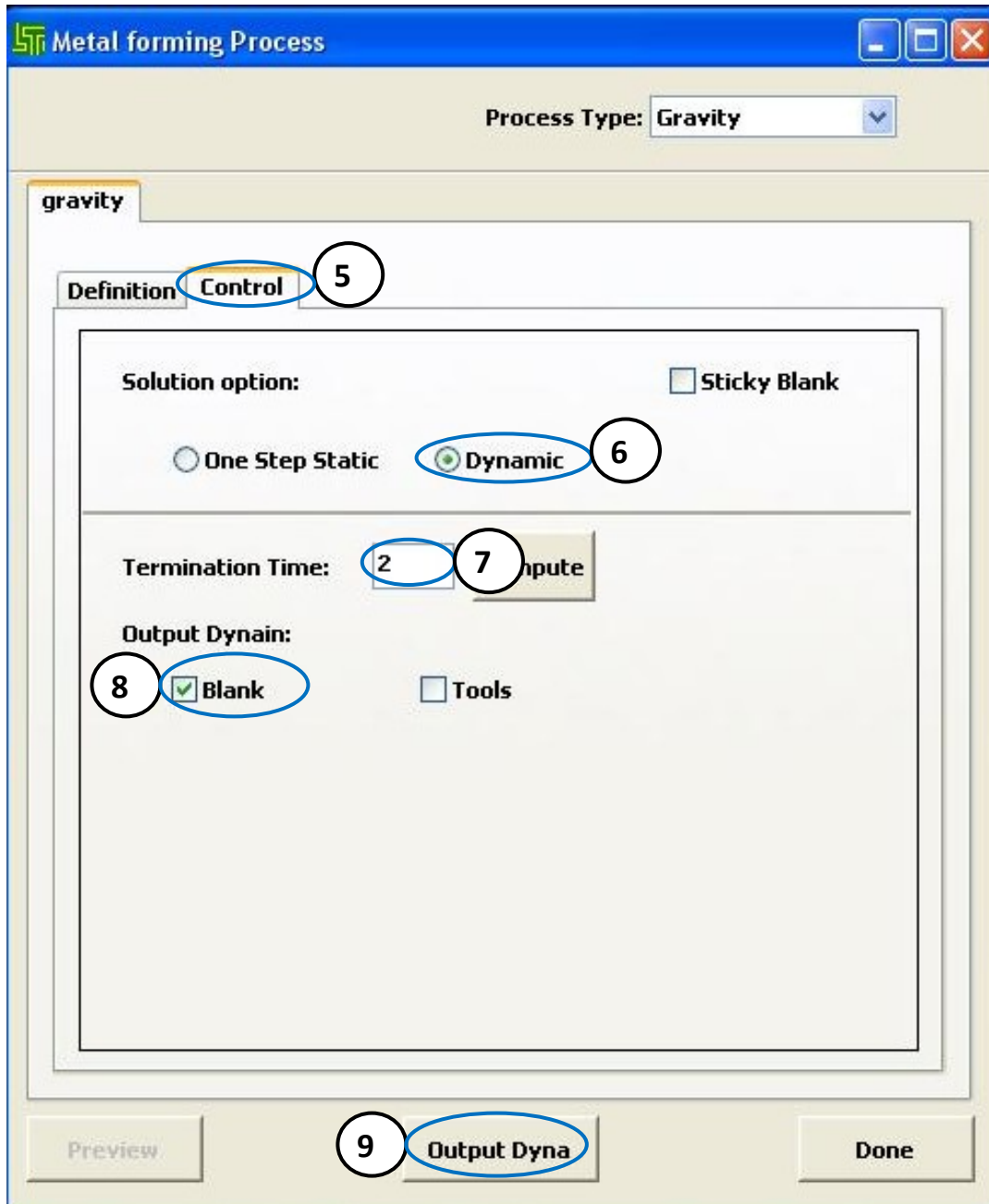


Figure 10

Page 1010. Define Process (*continued...*)

Refer to Figure 11

click *Advanced* in the Dyna Input Decks(Gravity) dialog

select the Output Options tab under the Templates and Preference tab (Figure 11)

enter Blank File: blank.k; hit a carriage return to make the change to take effect.

enter Tooling File: tools.k; hit a carriage return to make the change to take effect.

enter Dyna Input File: bplrg.dyn; hit a carriage return to make the change to take effect.

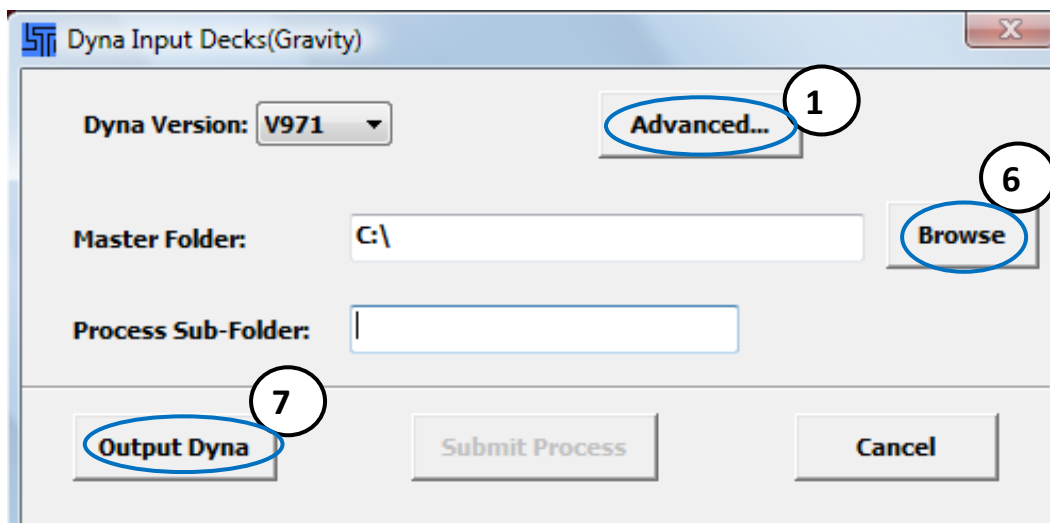
click *Done*

click *Browse* and specify a directory for the input file, in the Dyna Input Decks(Gravity) dialog

click *Output Dyna*

Save project file, File → Save Project As...

Close this LS-PrePost session.



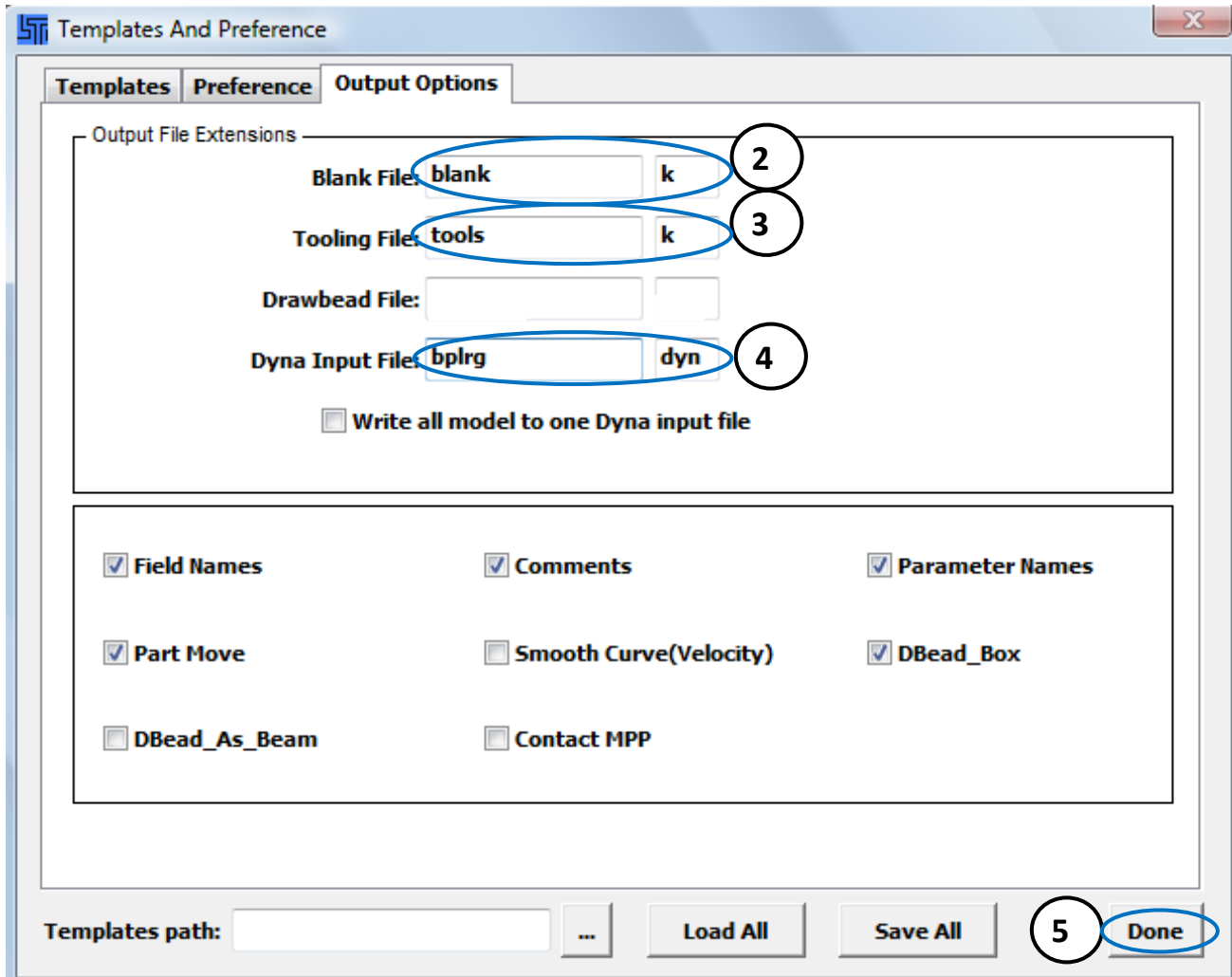


Figure 11

Page 11

11. Execute LS-DYNA and process results

Run LS-DYNA with memory=9.5M ncpu=2

It should take about 6.0 minutes on a Xeon machine with 2-CPU SMP version of LS-DYNA, requiring about 9.5 million words of memory (9.0MW).

Launch LS-PrePost

File → Open → LS-Dyna Binary Plot

Open "d3plot"

Refer to Figure 12

select all parts by 'SelPar' as shown in Figure 12

click on  to move to the last state

Shown in Figures 13 and 14 are the initial and final deformed shapes of the blank

Refer to Figure 15

click *page 1*

click *ASCII*

click *MATSUM*

click *load*

click *1* under Mat id

highlight *1-Internal Energy, 2-Kinetic Energy, 3-Hourglass Energy*

click *plot*

Shown in Figure 16 is the energy history plot of the blank.

Output	Trace	Xyplot
Anno	Light	FLD
SPlane	Setting	State
Range	Vector	Measur
Find	Ident	ASCII
Fcomp	History	Views
Appear	Color	Model
Group	Blank	SelPar

1 2 3 4 5 6 7 D



Figure 12

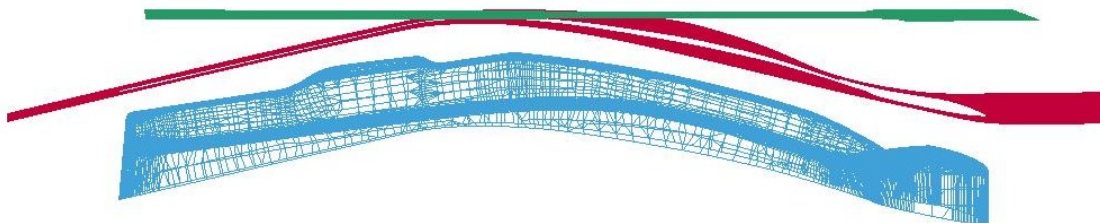


Figure 13 Initial blank position and shape

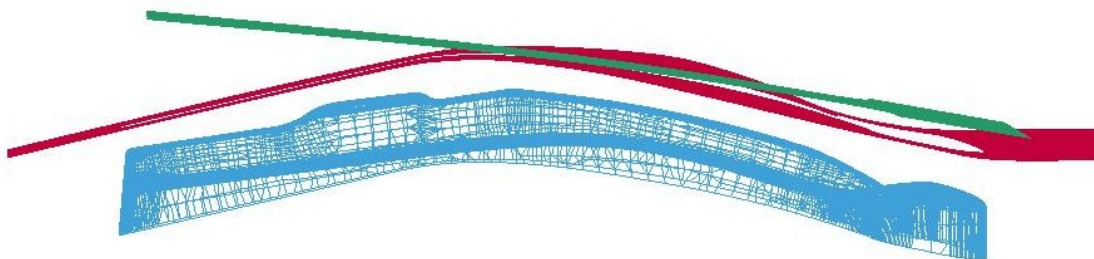


Figure 14 Final blank position and deformed shape

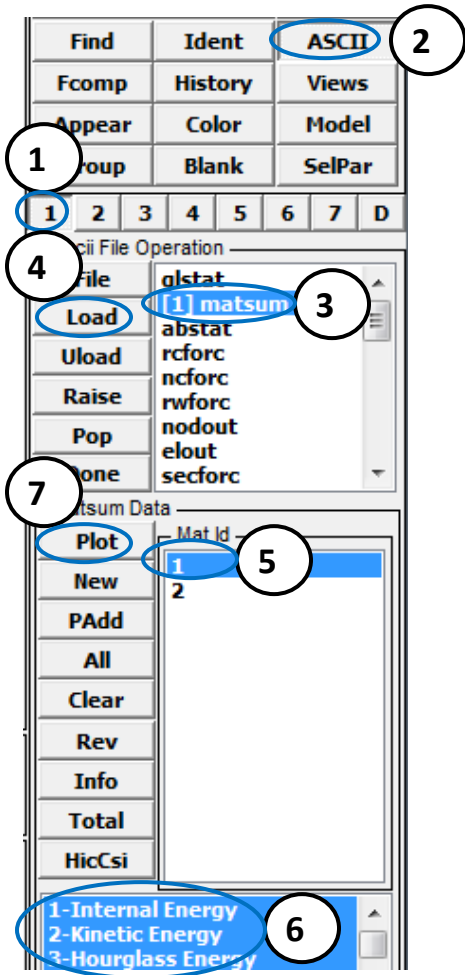


Figure 15

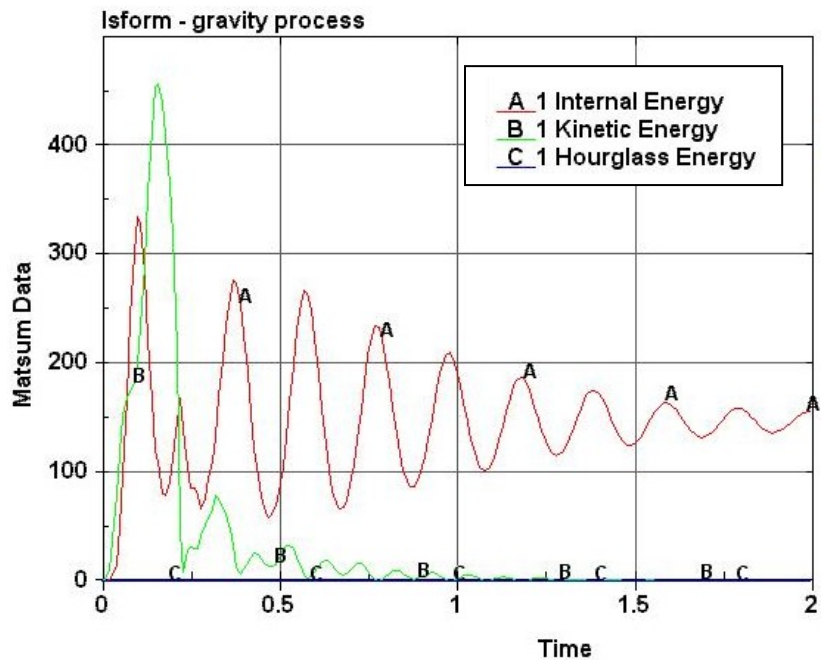


Figure 16