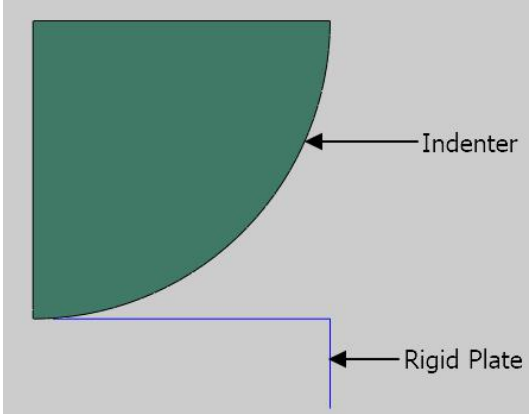
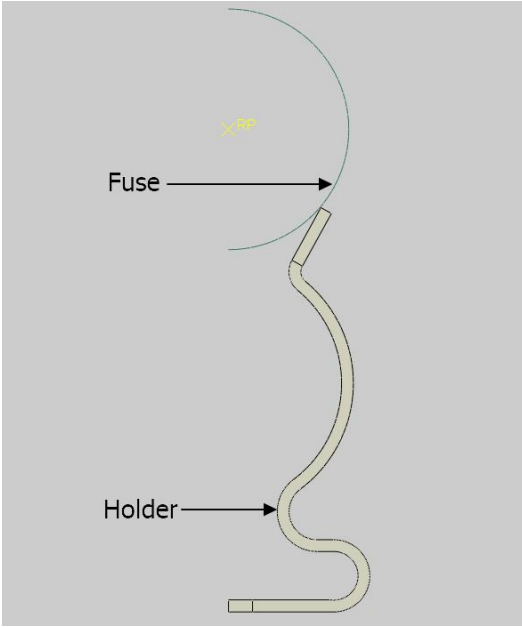
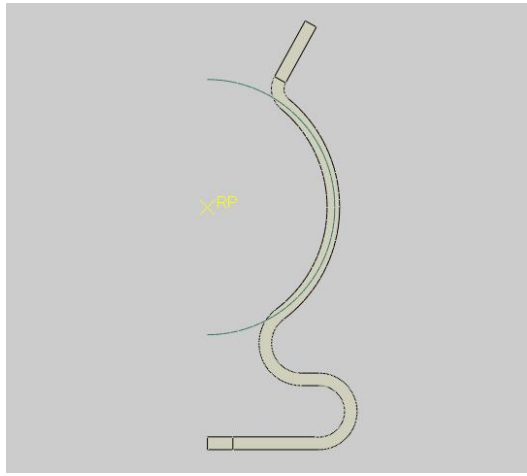
Exercises

This course aims to provide practical information to perform complex contact analysis in Abaqus. We have prepared a large number of exercises providing intensive instructions to perform analysis of contact problems. During such analysis it is very common to face convergence difficulties. Quite a few exercises are devoted to diagnose such difficulties and take the corrective action. Details of topics covered in exercises is given below.

Exercise 1 ● Defining a contact pair interaction ● Plotting contact pressure along a path	
Exercise 2 ● Using boundary conditions to establish contact ● Extruding and mirroring simulation results	

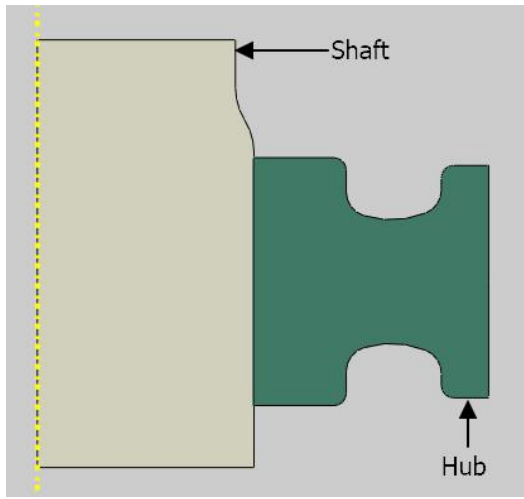
Exercise 3

- Resolving interference to establish contact



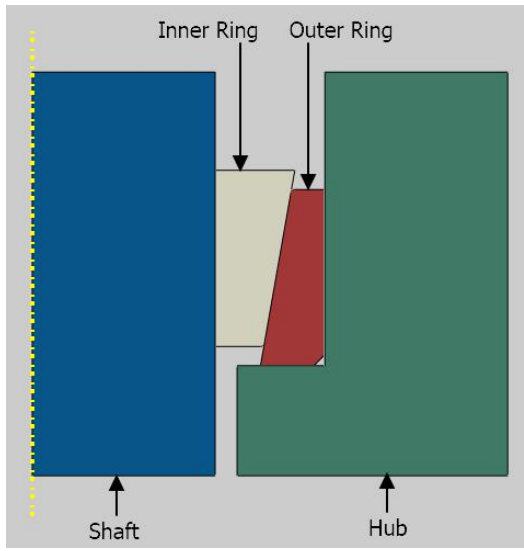
Exercise 4

- Obtaining a solution by interference resolution
- Obtaining a solution by thermal expansion and later contraction of hub
- Comparing solution by interference resolution vs. solution by thermal expansion
- Maximum torque that surfaces in contact can transmit



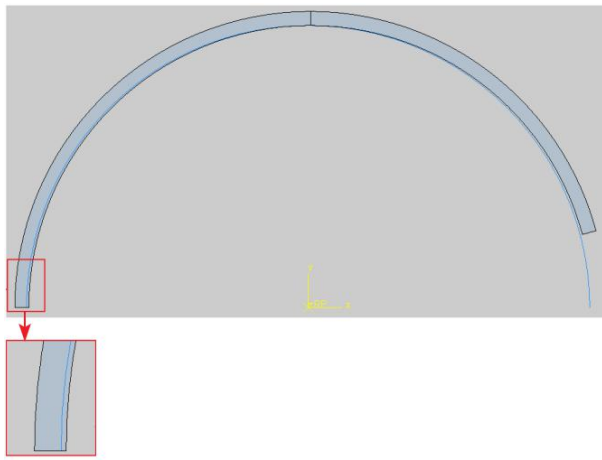
Exercise 5

- Choosing a master surface among two deformable surfaces.
- Diagnosing the error messages with Job Diagnostics dialog box
- Invoking unsymmetric solver



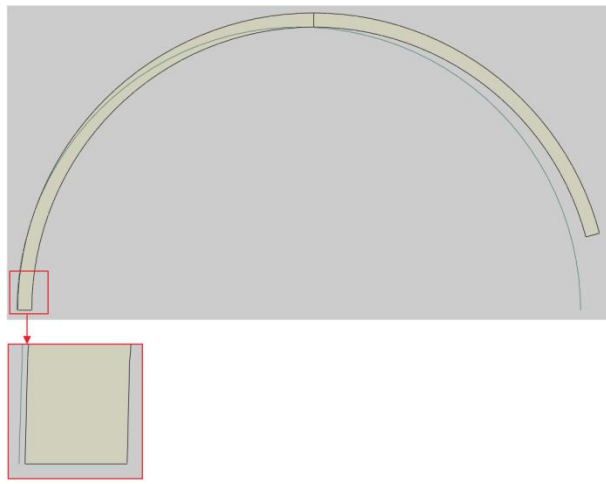
Exercise 6

- Using interference resolution capability to resolve initial overclosure
- Comparing the results obtained with small sliding vs. finite sliding
- Introducing the contact stabilization to alleviate the convergence difficulties
- Improving refinement level of displayed results
- CSTATUS output variable



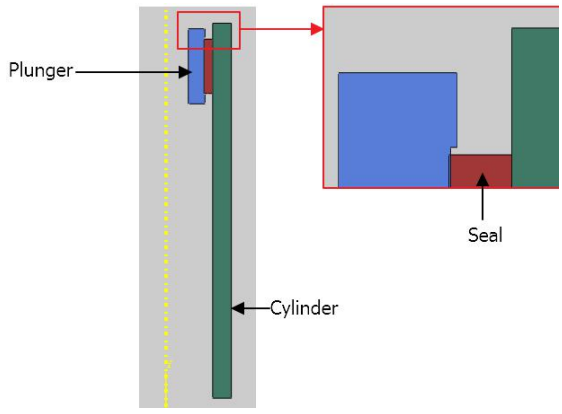
Exercise 7

- Using multi-step approach instead of interference resolution to solve the contact problem



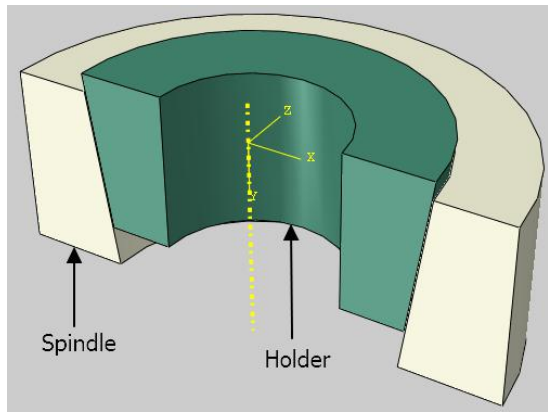
Exercise 8

- Slip-rate dependent friction model
- Exponential decay friction model
- Rough friction
- Stick-slip behavior



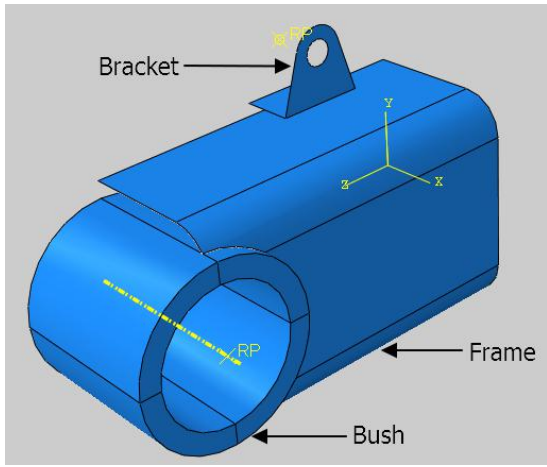
Exercise 9

- Smoothing contact surfaces to overcome the contact stress inaccuracy arising due to faceted surface geometry.



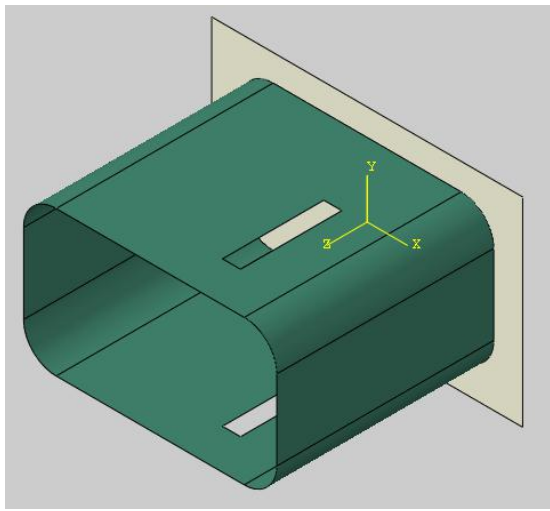
Exercise 10

- Welding a shell part to a solid part using
  i. Tied contact
  ii. Tie constraint
- Slave node adjustment to establish contact
- STRAINFREE output variable
- Diagnosing the error messages with Job Monitor dialog box



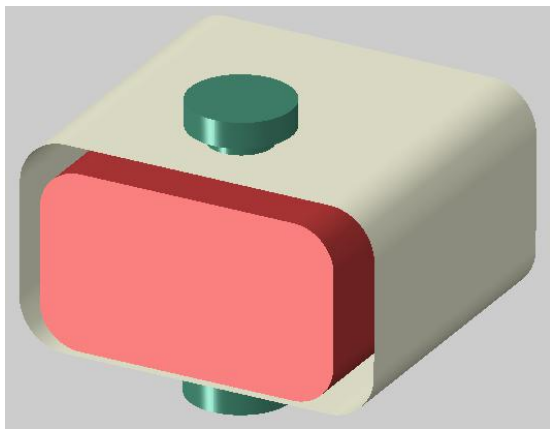
Exercise 11

- Using tied contact to "weld" two shell parts together
- Using shell offset to avoid overlapping
- Using query tool to determine SPOS/SNEG faces of shell



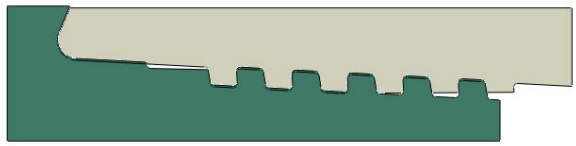
Exercise 12

- Accounting for shell thickness
- Using unsymmetric solver for better convergence
- Plotting surface normal to determine SPOS/SNEG faces of shell
- Choosing a master surface among two deformable surfaces.



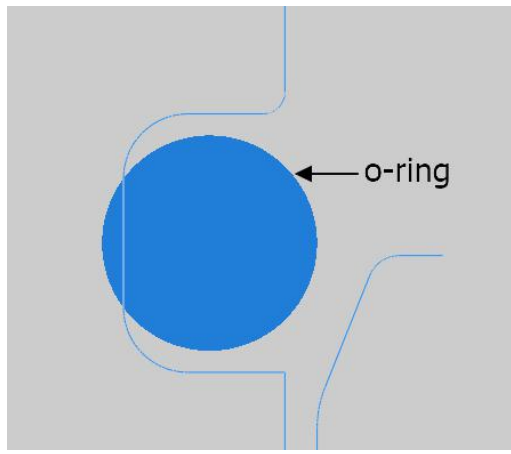
Exercise 13

- Analyzing stresses in a VAM TOP connector due to internal fluid pressure
- Pressure penetration loading
- PPRESS output variable



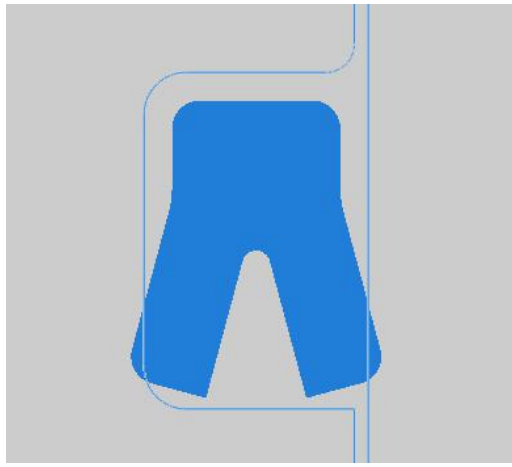
Exercise 14

- Analysis of an o-ring under the pressure of a fluid
- Pressure penetration interaction
- Diagnosing the convergence problems



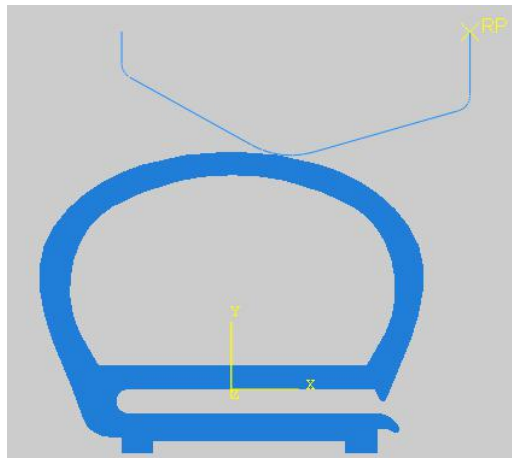
Exercise 15

- Analysis of an u-cup under the pressure of a fluid
- Node-to-surface discretization for interference resolution
- Diagnosing the cause of error message using Job Diagnostics dialog box
- Introducing the contact stabilization to alleviate the convergence difficulties



Exercise 16

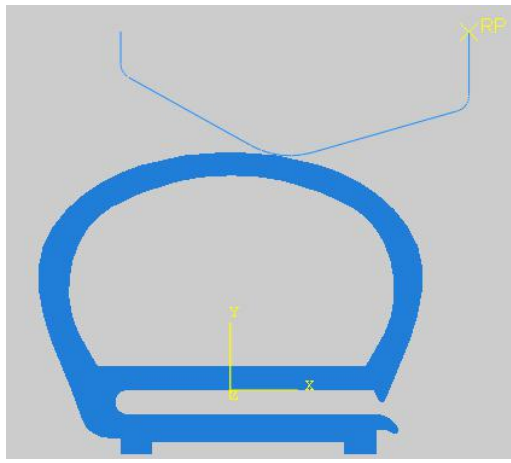
- Defining self contact
- Detecting chattering in the contact using Job Diagnostics dialog box
- Understanding “Negative eigenvalues” error message
- Introducing the contact stabilization
- Fraction of damping at end of step



Exercise 17

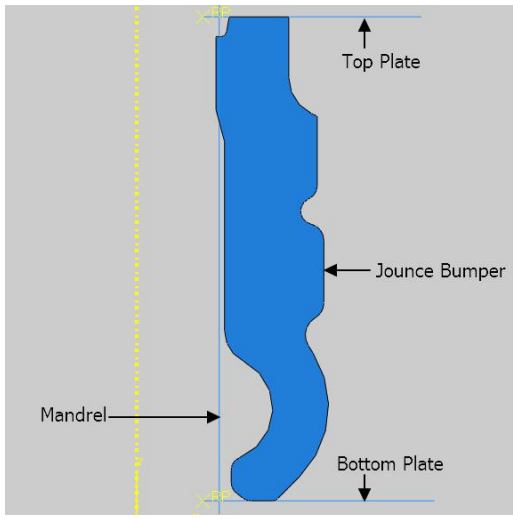
Contact analysis using following softened contact approaches.

i. Exponential
ii. Linear
iii. Tabular



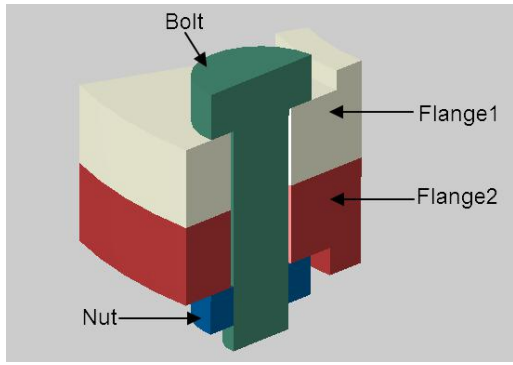
Exercise 18

- Defining self contact
- Using Line Search algorithm to prevent divergence



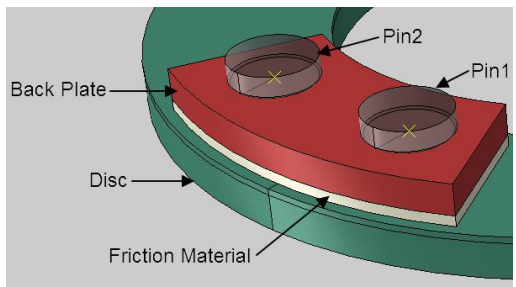
Exercise 19

- Defining thermal contact conductance as a function of contact pressure
- Finding contact pairs using contact detection tool



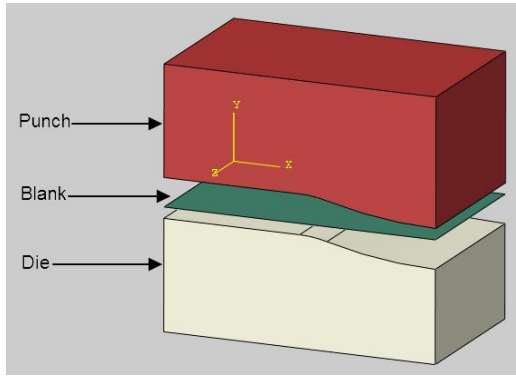
Exercise 20

- Defining temperature dependent coefficient of friction
- Defining thermal contact conductance is a function of gap clearance
- Defining an interaction to model heat transfer due to convection
- Specifying heat generation and its distribution
- Modifying solution controls to reduce computational cost



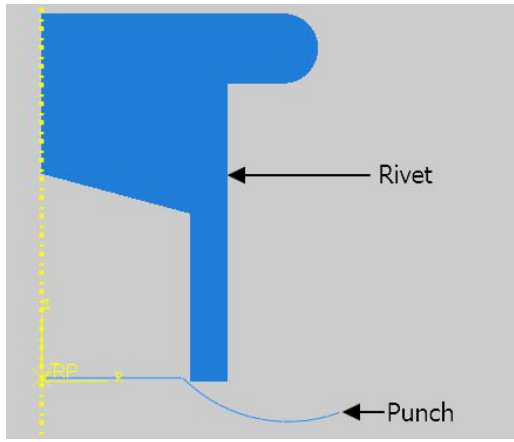
Exercise 21

- Using general contact approach to define interaction
- Comparing contact pressure plots for general contact and contact pairs approach



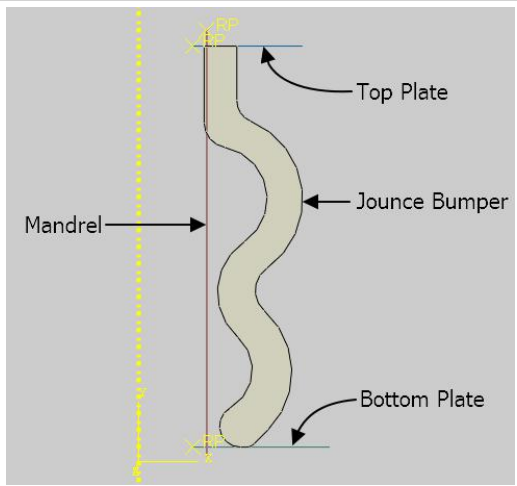
Exercise 22

- Visualizing default master-slave assignment in general contact
- Overriding the default master-slave assignment in general contact
- Automatic surface smoothing in general contact
- Comparing contact normal force for the general contact approach with contact pairs approach



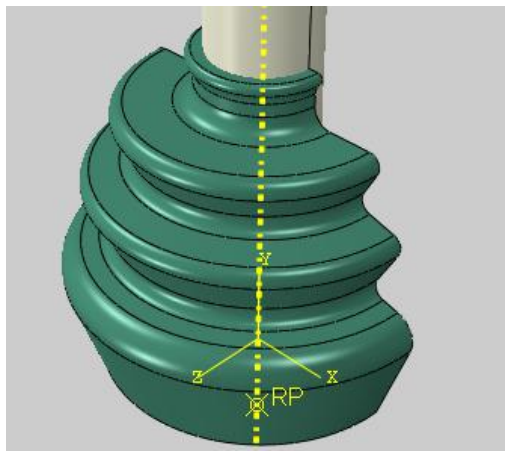
Exercise 23

- Defining a contact initialization to resolve initial overclosures in a general contact interaction



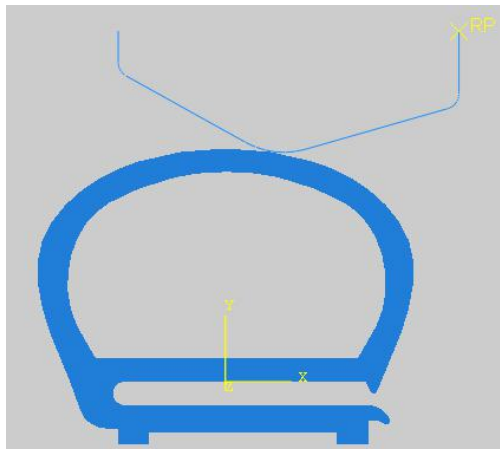
Exercise 24

- Defining a contact pairs and a general contact interaction together in a model



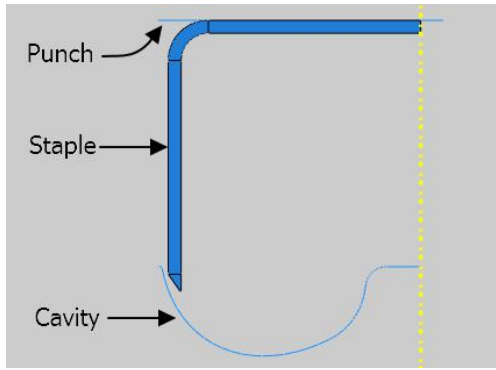
Exercise 25

- Introducing contact stabilization in a general contact interaction
- Applying stabilization in tangential direction.
- Reversing the orientation of individual faces during the surface definition



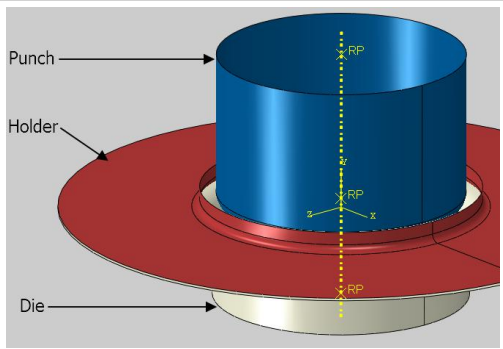
Exercise 26

- Simulating the quasi-static problem using both Abaqus/Standard and Abaqus/Explicit
- Using the "softened" contact to overcome the convergence problems



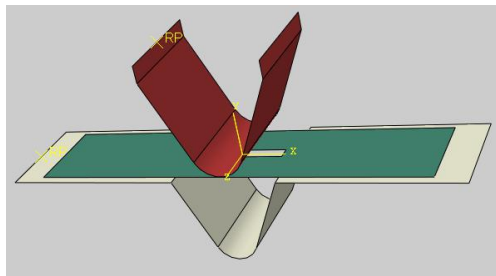
Exercise 27

- Simulating the deep drawing of a cup using both Abaqus/Standard and Abaqus/Explicit.
- Monitoring the thickness of shell elements
- Considering thickness changes in a general contact interaction



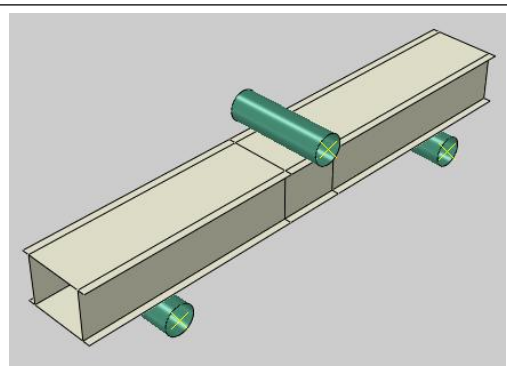
Exercise 28

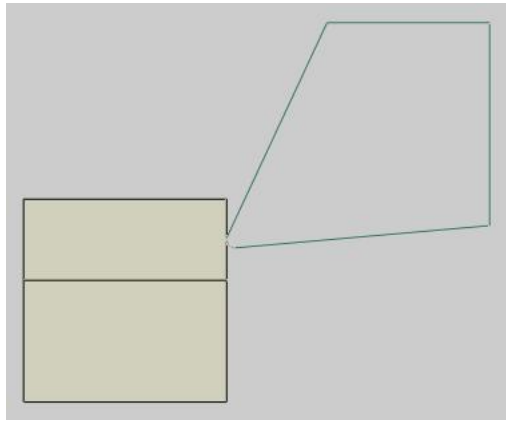
- Compare the results obtained with contact pair approach and general contact approach
- Rendering thickness of shell elements
- CTHICK output variable
- Contact controls to eliminate thickness reductions



Exercise 29

- Bending of an extrusion under quasi-static loading conditions
- Handling of T-intersections in shells in contact pair interactions
- Penalty vs Kinematic contact enforcement method



Exercise 30 ● Simulating the metal cutting using the contact pair approach ● Element deletion functionality to model erosion due to material failure ● Using a node-based surface as slave to model surface erosion ● STATUS output variable to exclude failed elements ● ALE adaptive meshing	
Exercise 31 ● Simulating the erosion of a plate due to impacting projectile ● Creating a surface containing interior faces of an element set ● Surface erosion using element-based surface ● Editing the input file