Thermal Analysis Tutorial

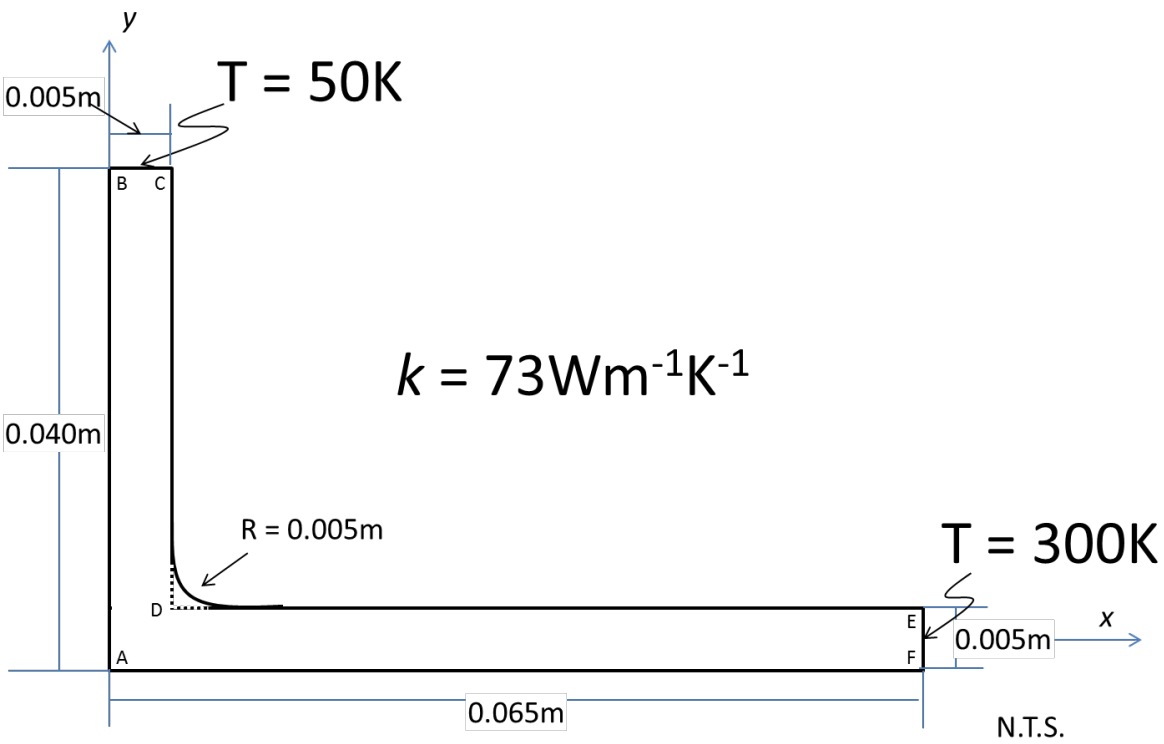


Figure 1. Geometry of Example Problem

Point	X (m)	Y (m)
A	0.0000	-0.0025
B	0.0000	0.0375
C	0.0050	0.0375
D	0.0050	0.0025
E	0.0650	0.0025
F	0.0650	-0.0025

Table 1. Points in Figure 1

Geometry

Part

- Double click on Parts the menu in Figure 2 will appear
- Choose 2D, Deformable, shell, and an approximate size of 0.13 (2 x max dimension)

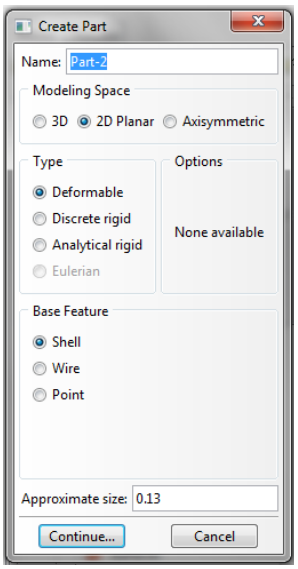
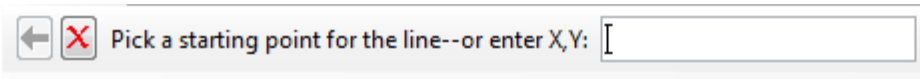


Figure 2

- A sketch will come up, use the “create lines connected” button  and type in the starting and ending point (in table 1) for each line in the prompt at the bottom of the window



- When complete add the fillet using the “create Fillet Between 2 curves “ button  . Frist type the fillet radius in the prompt then select the two line which are part of the fillet. The end sketch is shown in figure 3. Click the middle mouse button to finish the sketch.

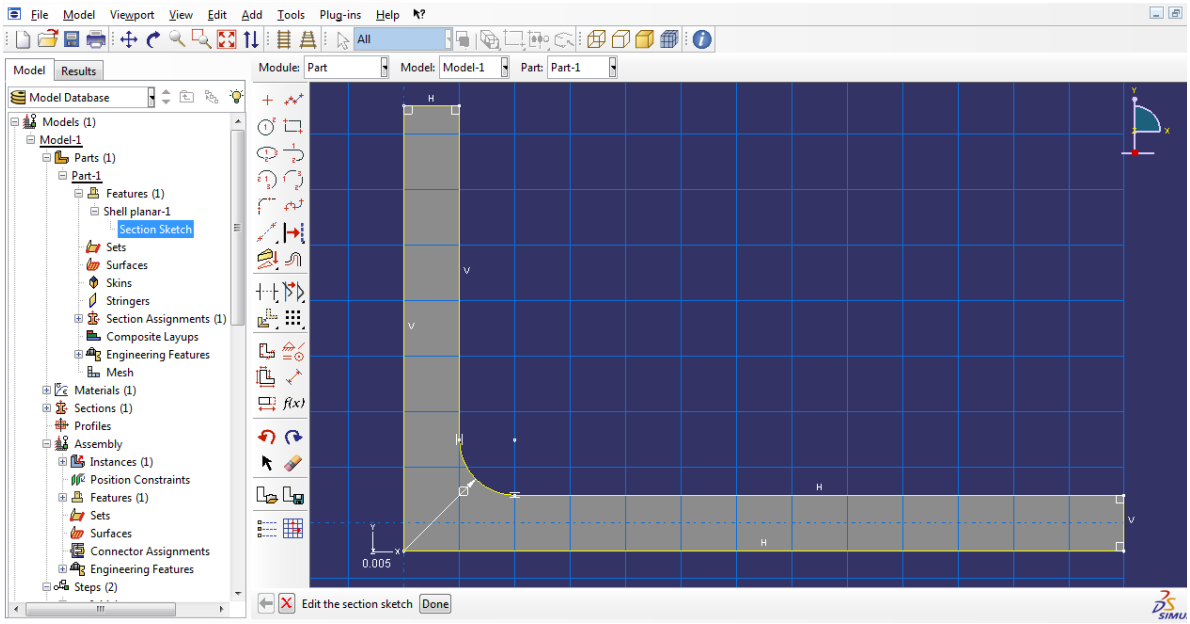


Figure 3

Material

- Double click on Material and input 73 as the conductivity as shown in figure 4. Call the Material, Material-1

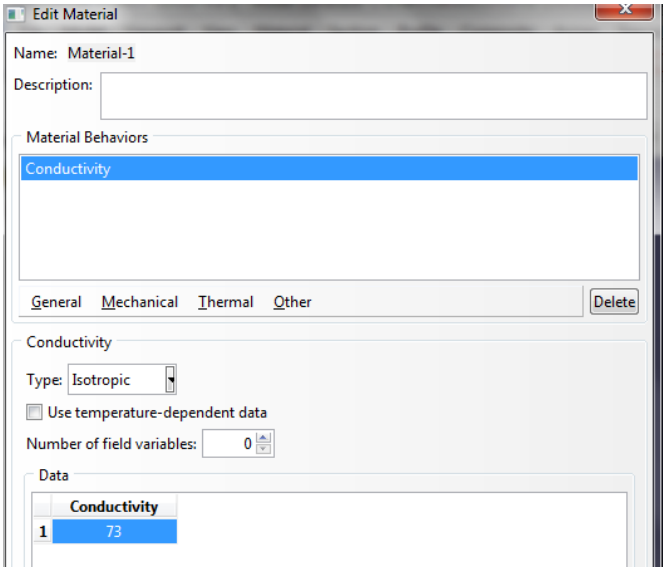
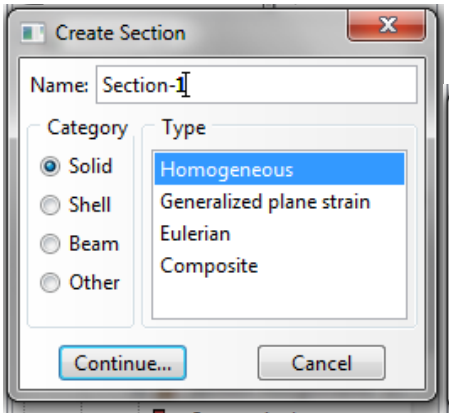


Figure 4

Section

- Double click on Section and select homogeneous as shown in figure 5.
- Create the section using Material-1 as in Figure 6



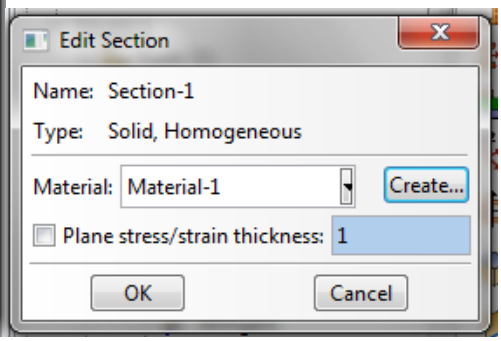


Figure 5 **Figure 6**

- Under the Part menu select Section Assignment as in figure 7

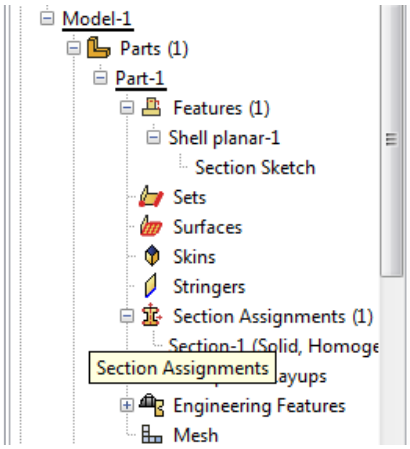
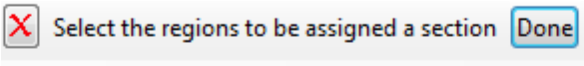


Figure 7

- Select the part in the window and then hit done as below



Assembly

- Under the assembly window select Instance and create an instance for Part-1 (Choose dependent)

Boundary Conditions and Loads Steps

Load Step

- Double click on load steps and create Step-1 and select Heat Transfer as in figure 8

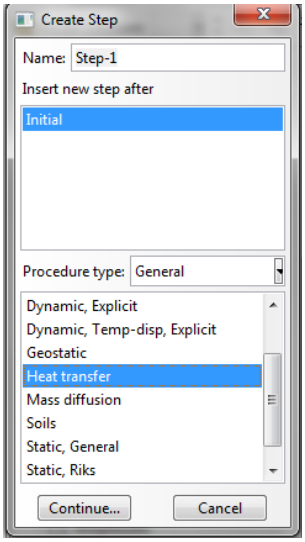


Figure 8

- Double click on step one bringing up the edit step menu in Figure 8A. Select Stead-State Analysis

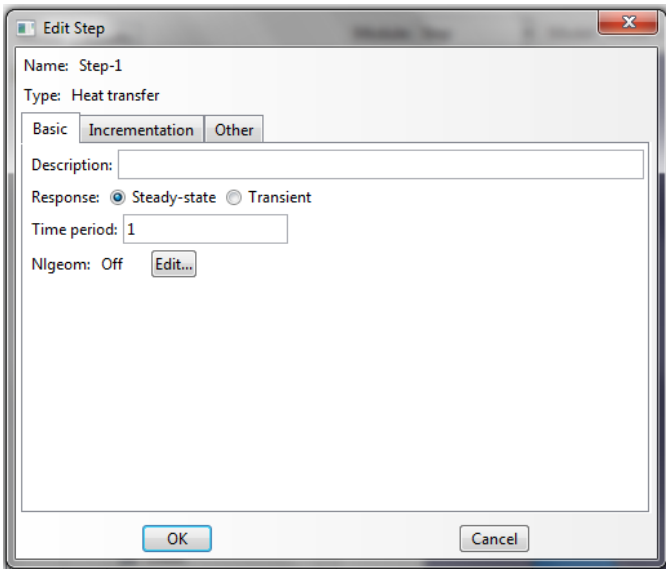


Figure 8A

- Double click on BC's and create a Temperature boundary condition as in Figure 9

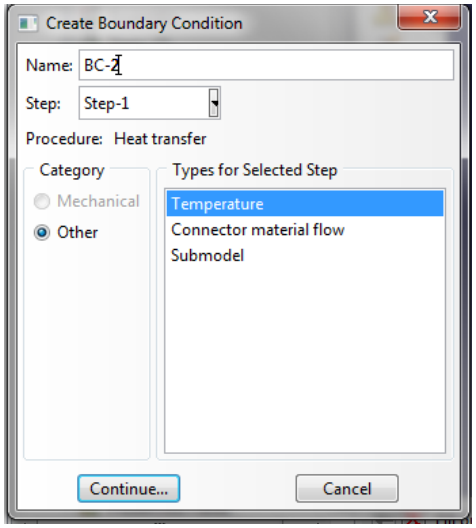


Figure 9

- Select the upper edge and apply 50K temperature as shown in Figure 10

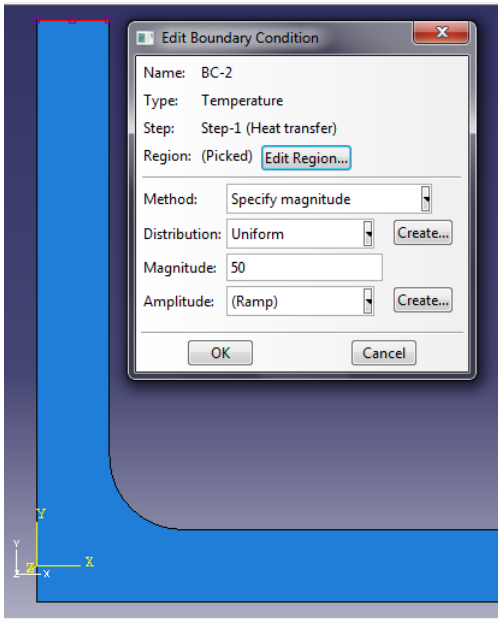


Figure 10

- Select the right edge and apply 300K temperature

Mesh

- Under the Part menu select Mesh as shown in figure 11

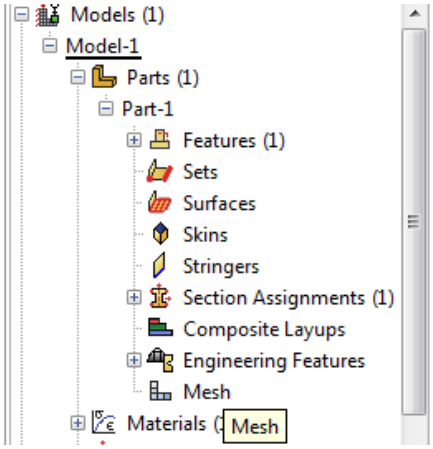


Figure 11

- Under the Mesh menu (top of screen) select Mesh Controls. Select Tri elements and a Free Mesh Technique as in figure 12

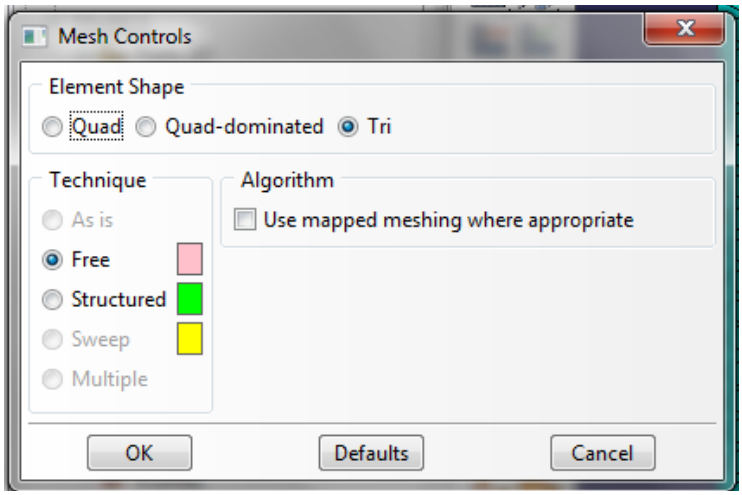


Figure 12

- Under the Mesh menu (top of screen) select Element Type. Select Standard Linear Heat Transfer Elements as in figure 13

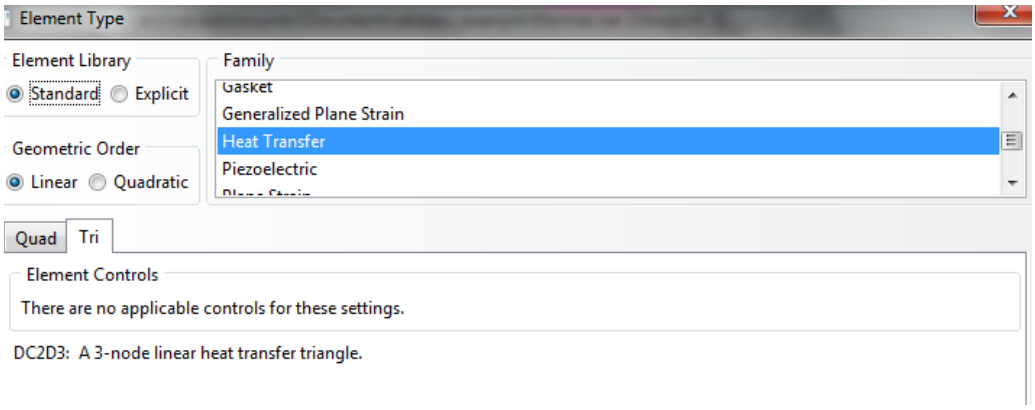


Figure 13

- Under the Seed menu (top of screen) select Part and enter an Approximate Global Size of 0.0015 as in Figure 14

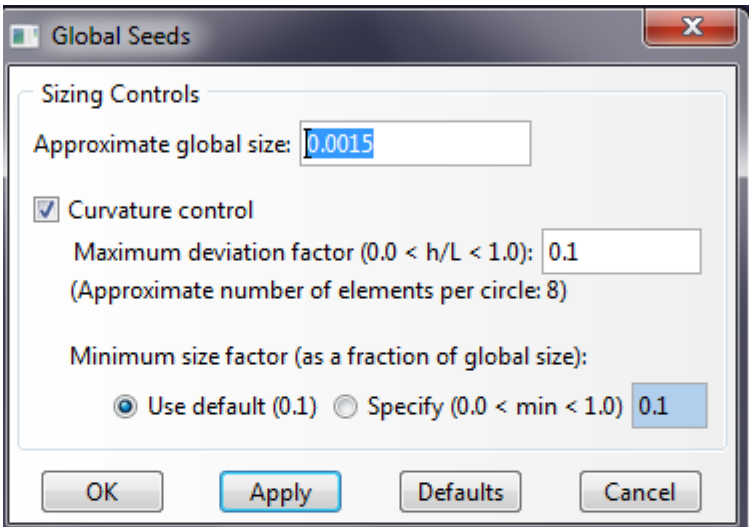


Figure 14

- Under Mesh select part and configure that it is ok to mesh the part. The mesh is shown in Figure 15.
- To check the number of nodes and elements go to the Tools menu and select Query. Select Mesh and then select the Done button by “display detailed report” This mesh has the following attributes
  Total number of nodes: 304
  Total number of elements: 468
  468 linear triangular elements of type DC2D3

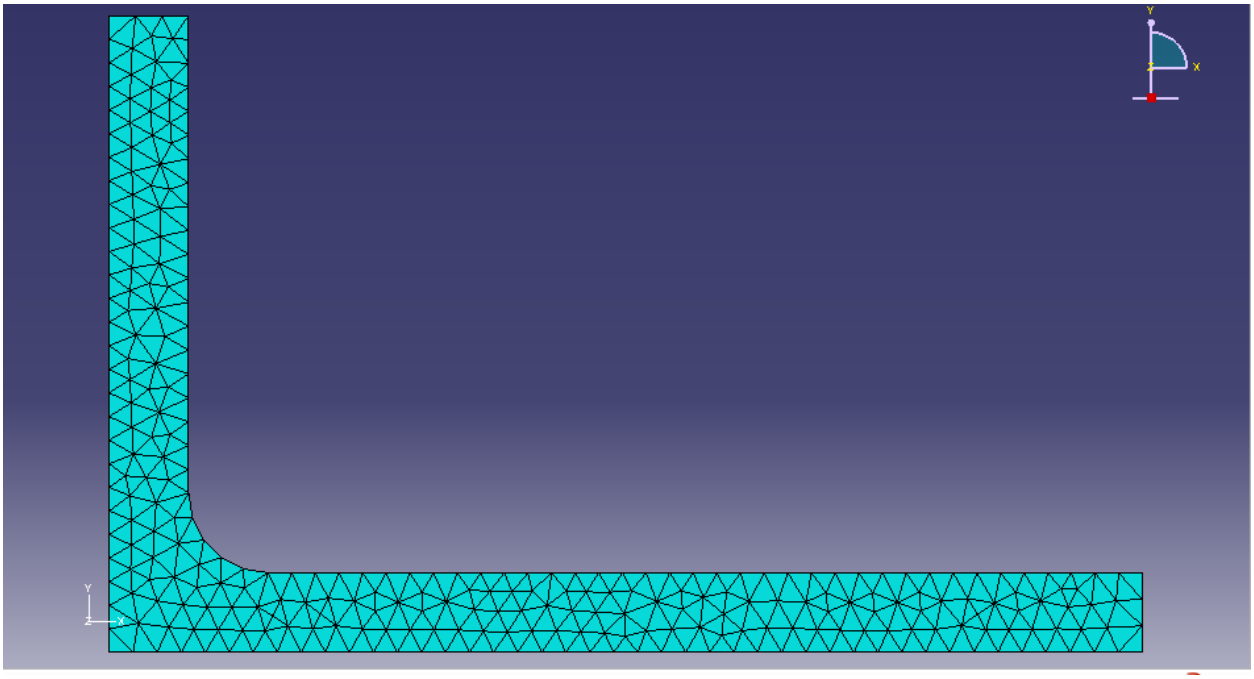


Figure 15

Solution

- Under the analysis menu double click on jobs to bring up the menu in Figure 16

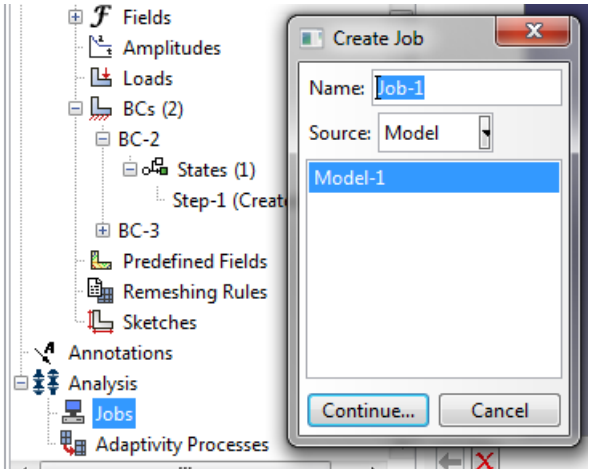


Figure 16

- Select continue and then select ok in the Edit job menu
- Select the Job Manager button  bring up the menu in Figure 17

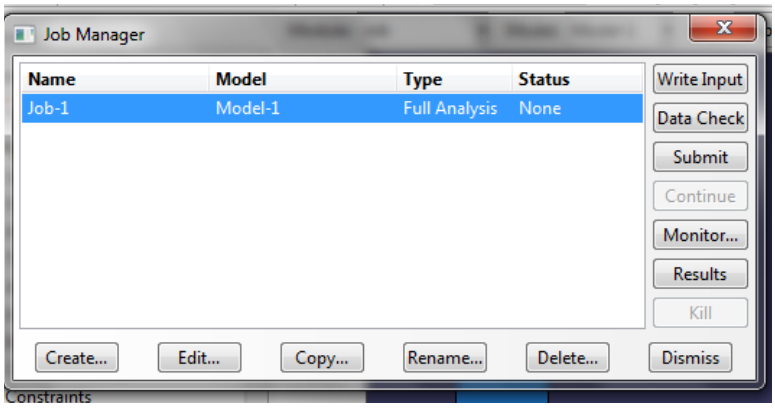


Figure 17

- Select Data Check to check in the input deck is correct
- If Data Check complets successfully select Submit
- Ignore any warning about History Variables (results as a function of time) this is a steady state analysis (results are after a long time)
- The output window should read
- The job "Job-1" has been created.
  The job input file "Job-1.inp" has been submitted for analysis.
  Job Job-1: Analysis Input File Processor completed successfully.

Job Job-1: Abaqus/Standard completed successfully.
Job Job-1 completed successfully.

- Select results which will take you to Abaqus viewer.

Post Processing

- Select the contour plot button 
- Under the Results menu (top of Screen) select field output and Nodal Temperature NT11 as in Figure 18

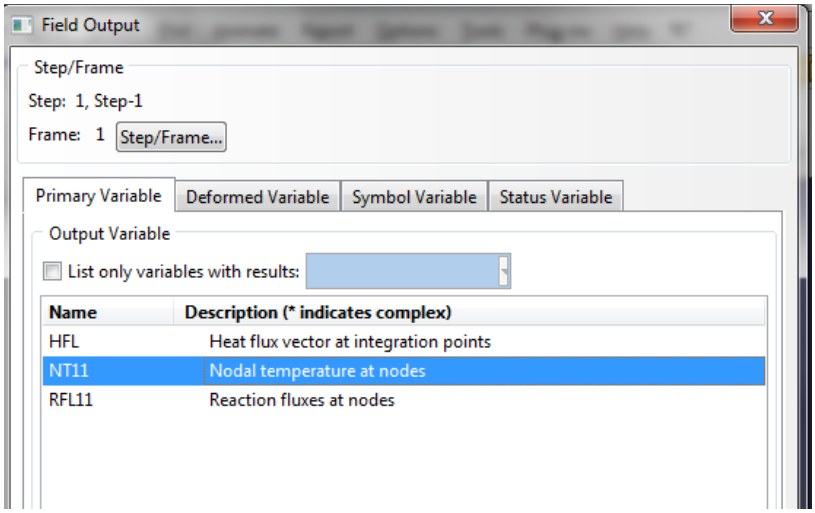


Figure 18

- Select the contour plot button again if needed to give temperature results as shown in Figure 19

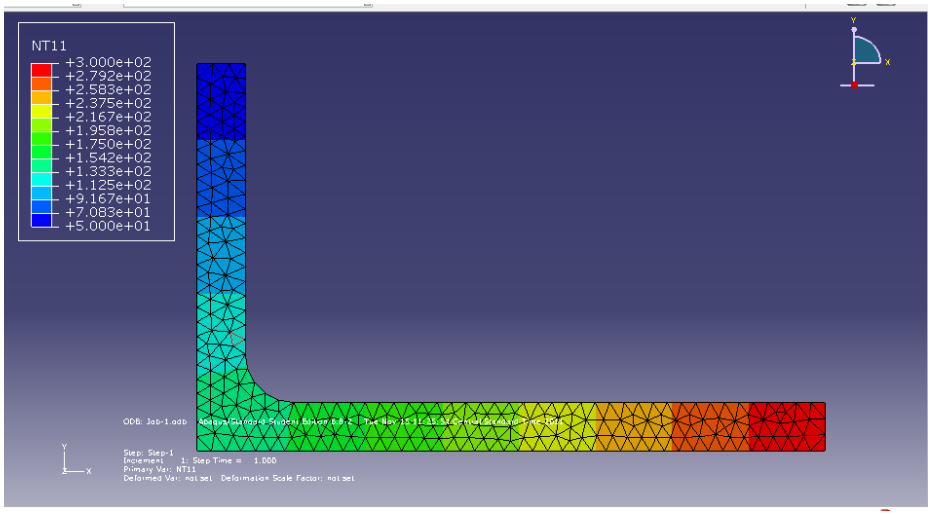


Figure 19 Temperature K

- To plot the temperature distribution at y = 0 (through the middle of the bottom leg) as shown in Figure 20

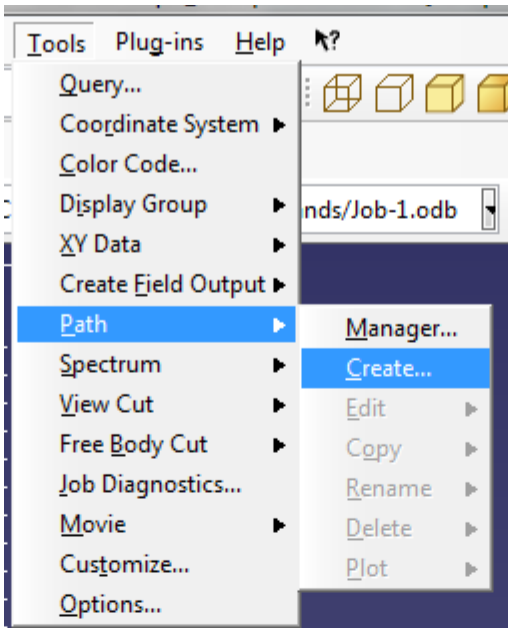


Figure 20

- Select Point List then Continue
- The plot will only show output at points in the list so add a point every 0.005m along x as in Figure 21

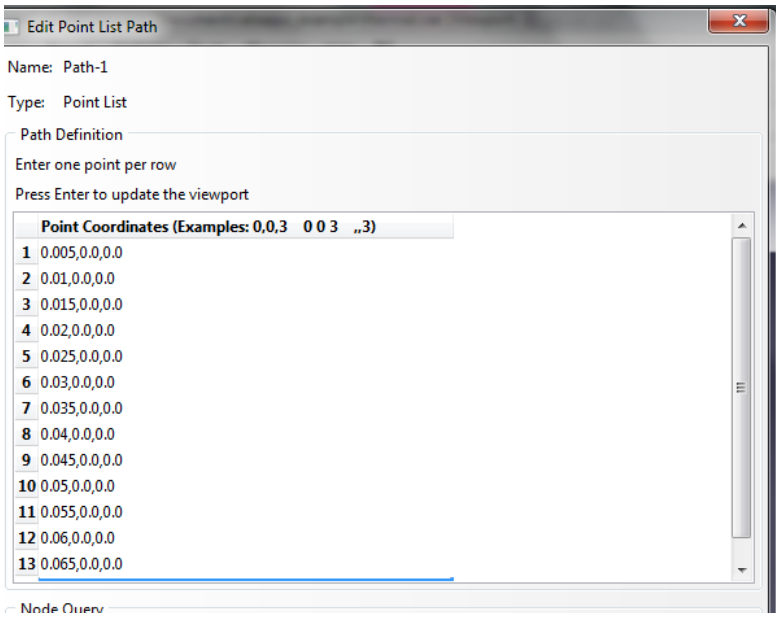


Figure 21

- Select ok
- Under Tools select XY Data then Create as in Figure 22

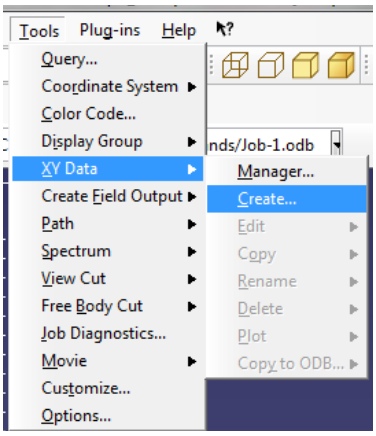


Figure 22

- In the Create XY Data menu select Path as in Figure 23

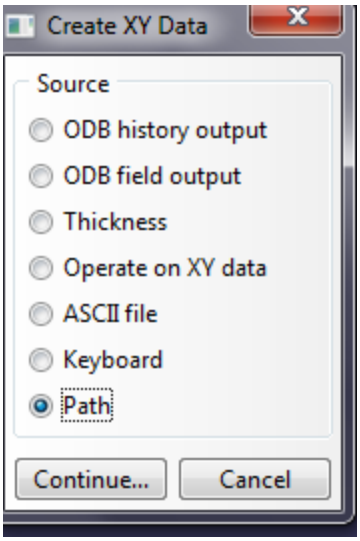


Figure 23

- In the XY Data from Path menu select undeformed and true distance. Also check that Field Output variable is NT11 if you intend to plot temperature. If not select the Field Output button and the field output of interest as in Figure 24.

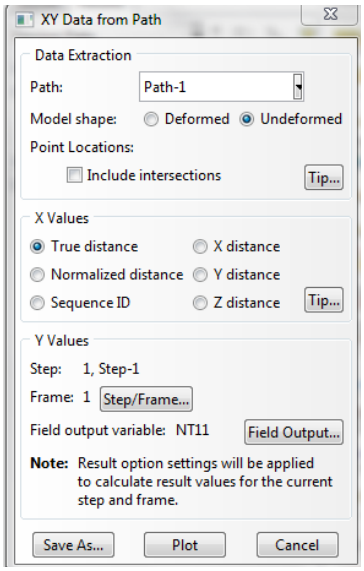


Figure 24

- Select Plot to create a plot of the temperature over the x distance as in Figure 25.

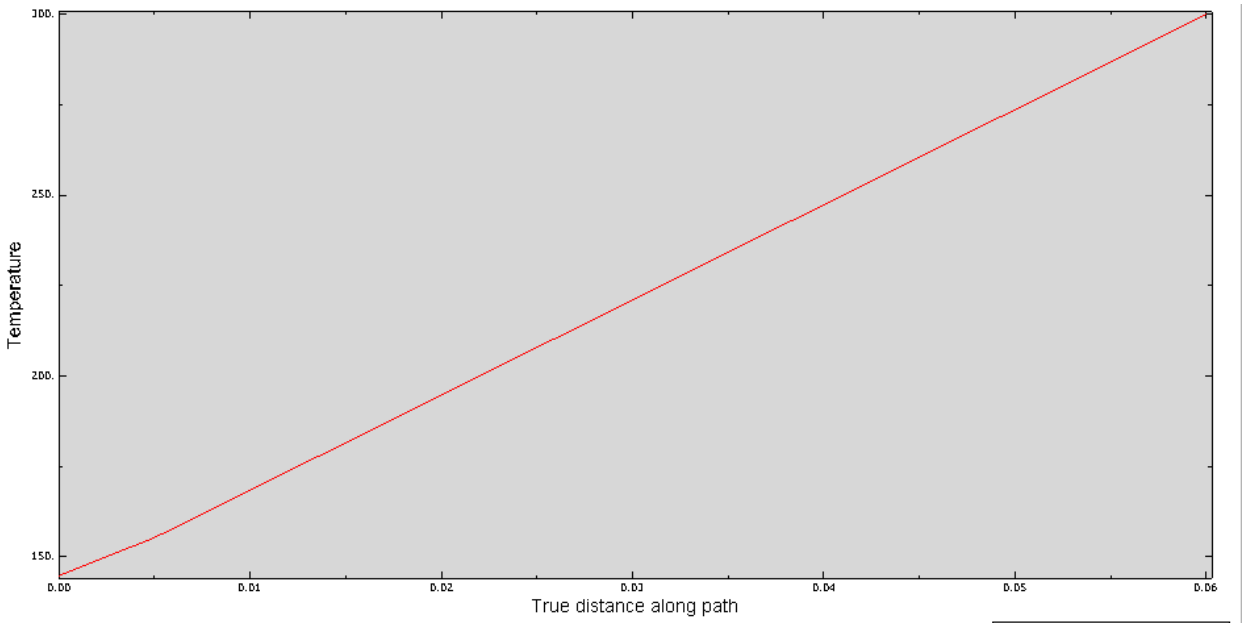


Figure 25

- Select Save As and Save the data as XYData-1
- Under the tools menu and XY Data Select Edit then XYData-1
- Since the plot in Figure 25 is difficult to format and compare with other results, it can be useful to copy the data selected in the previous step into a better plotting program (excel, matlab, etc) as in Figure 26

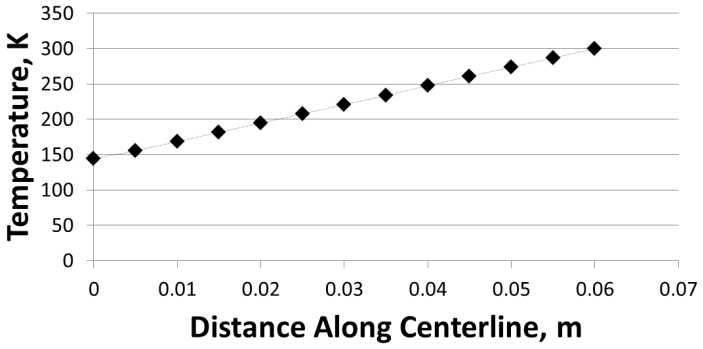

Temperature, K
350
300
250
200
150
100
50
0
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
Distance Along Centerline, m

Figure 26