Delft University of Technology

Linear modeling
AE4ASM004

Assignment: Homework Assignment 1

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Question 2

Assumption 1: For calculations, we have assumed the area of cross-section of each of the elements to be rectangular instead of a trapezoidal element (area varying along the length). This would lead to an approximation of stiffness values for each element and as we assemble the elements for the global stiffness matrix, the error compounds.

Assumption 2: As seen from the analytical solution, the displacement is a logarithmic function, but we have assumed a linearly varying shape function for the purpose of solving this problem. This introduces inaccuracies and we can see that to obtain the same accuracy as the exact solution we need to divide the continuum into a very high number of elements.

Question 3

Node No.	Displacement from code (mm)	Displacement from Abaqus (mm)	Element No.	Stress from code (MPa)	Stress from Abaqus (MPa)
1	0	0	1	7.31	7.31
2	0.006530	0.006530	2	8.53	8.53
3	0.014149	0.014149	3	10.24	10.24
4	0.023293	0.023292	4	12.80	12.80
5	0.034721	0.034721			

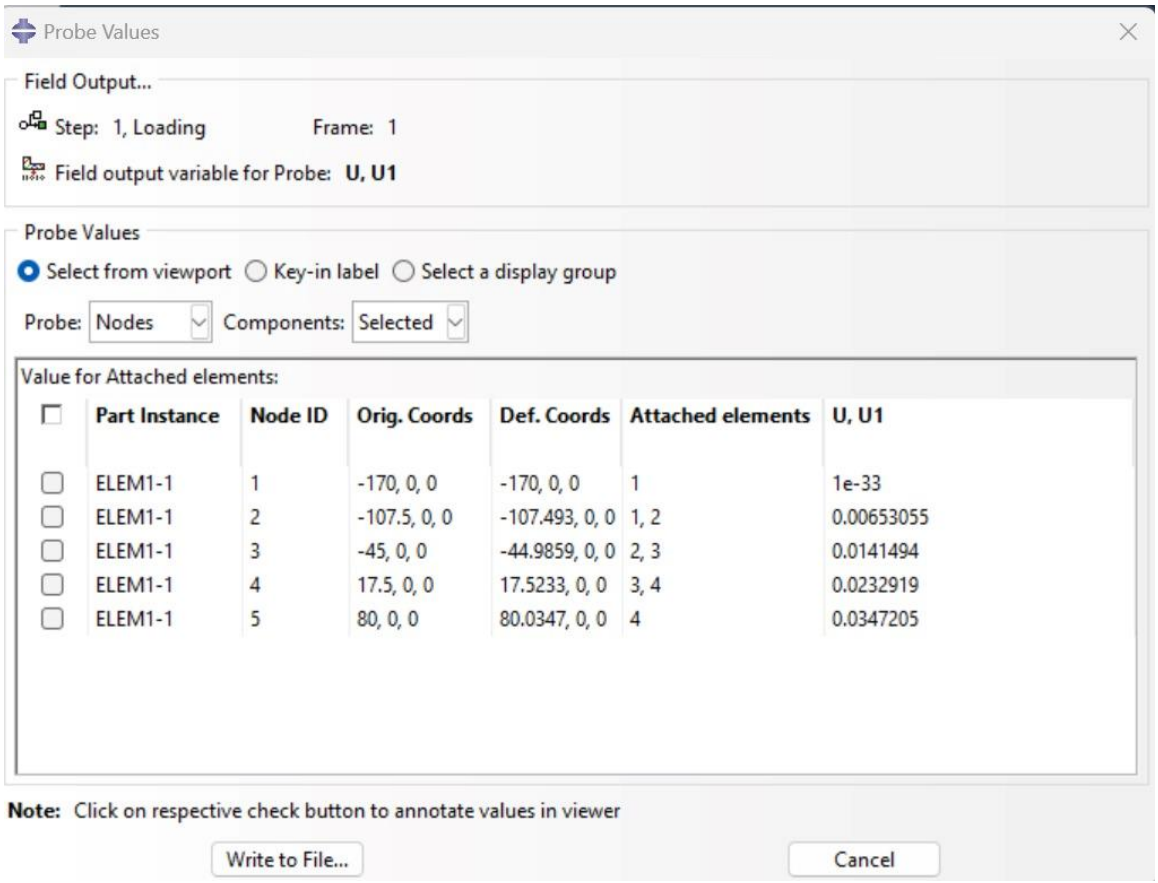

Figure 1: Results pertaining to displacement in the X-direction from ABAQUS

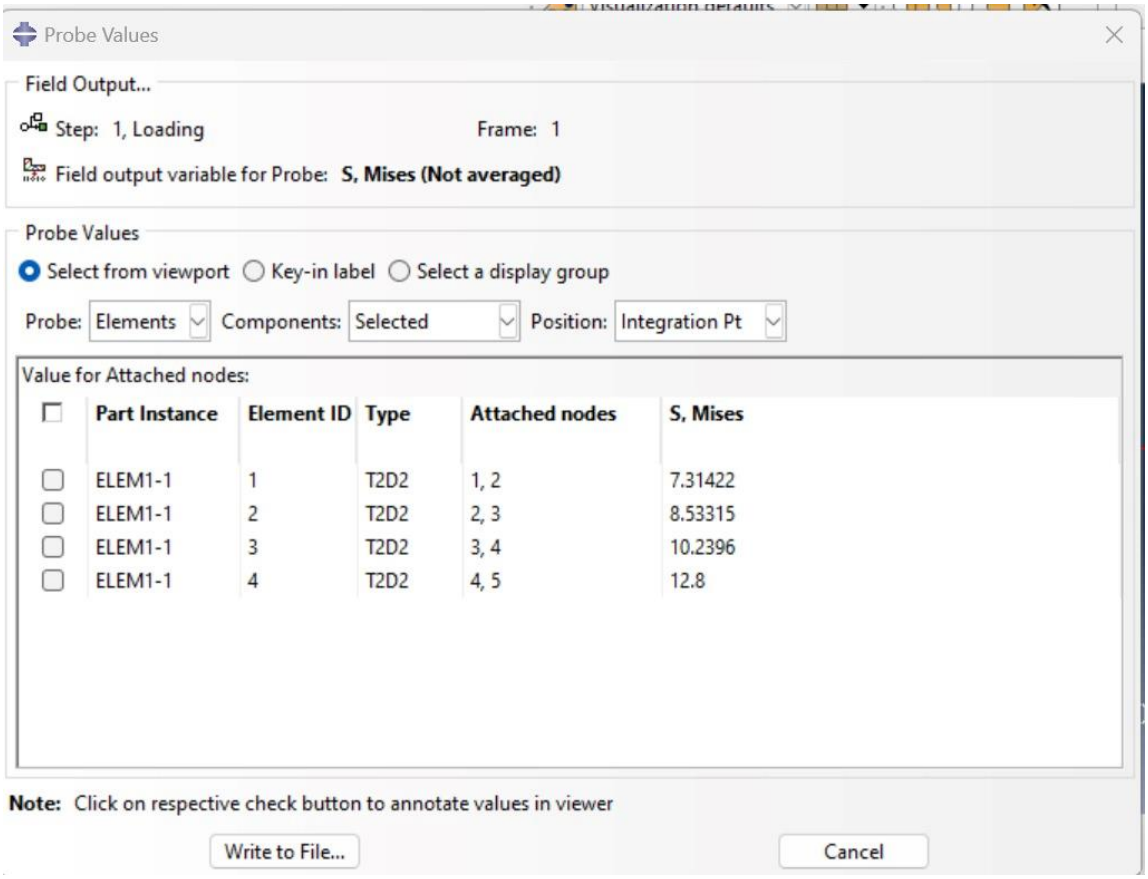

Figure 2: Results pertaining to stresses in various elements in ABAQUS

Question 4

No, if the area of the cross-section is constant throughout the length, it doesn't matter how many elements we choose to model our problem. The analytical solution becomes linear for displacement, and our assumptions would then match with the problem at hand.

The shape function assumption of linear displacement would no longer pose a problem in introducing inaccuracies into our solution.