Assignment 5

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Finite Element Analysis I

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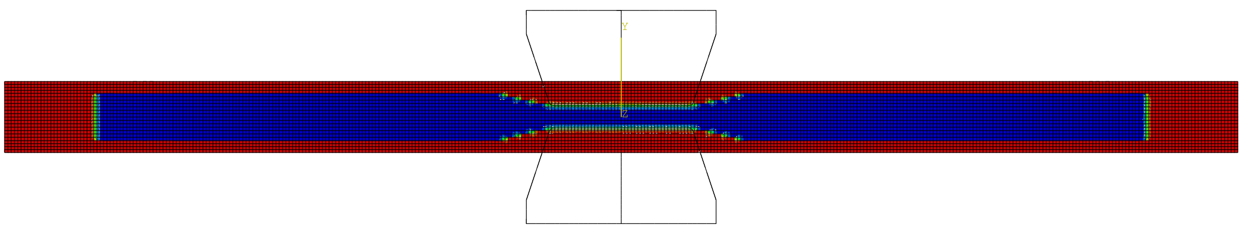

Abstract

In this assignment, we examine the behavior of a metal plate under compression. A rigid press, modeled as a 3D shell, squeezes the plate together. By retrieving the force and displacement values over time, we can determine the plastic behavior of our specimen. In this assignment, we use the findings from the previous assignment 4 and instead of using a Lagrangian formulation we are using a Eulerian.

Contents

1 Introduction

Like in the previous assignment 4, the plate is compressed from both sides. Symmetry is used to keeep computation time low. Eulerian modeling can only be done on 3D models. As the previous model was in 2D, for this assignment we remodeled the parts in 3D. We use the same material coefficients as in the previous assignment. Despite using 3D-modelling, our specimen consits of only one element in depth with encastered front and back surfaces. The behaviour is therefore 2D-alike.

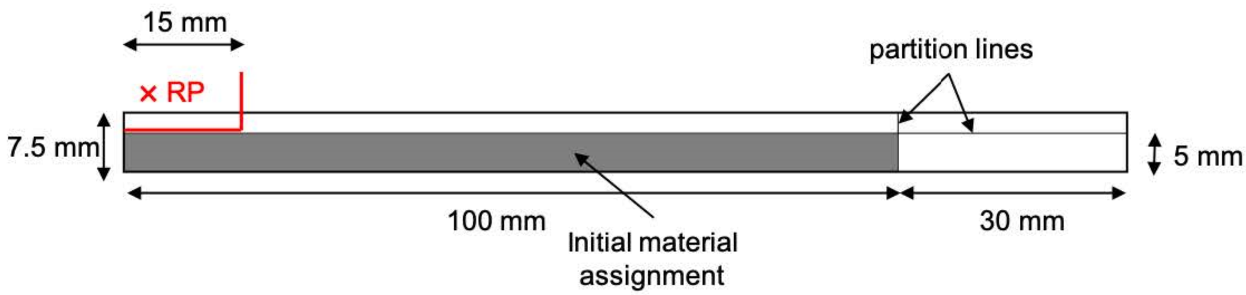

Figure 1: Model of the plate with Eulerian formulation

As shown in Figure 1, the model of the plate has to be partitioned. We have to anticipate the final distribution of the material (white ares), as Abaqus needs us to define the are/volume where the original material (shaded area) will be "flowing" during simulation. Again, only a quarter of the model has to be sketched due to symmetry.

2 Methods

2.1 Coupled Lagrangian-Eulerian Analysis in Abacus

In this assignment we used eularian parts. The most obvious difference to the previous Lagrangian simulations is the behaviour of the mesh during simulation. Whereas lagrangian meshes deform and compress with the part, eularian meshes stay intact. This, however, needs to be taken into account when meshing the part in the first place, as there has to be enough "meshed space" around the model, where the material can flow into. This material flow is then measured to draw conclusions about the material characteristics.

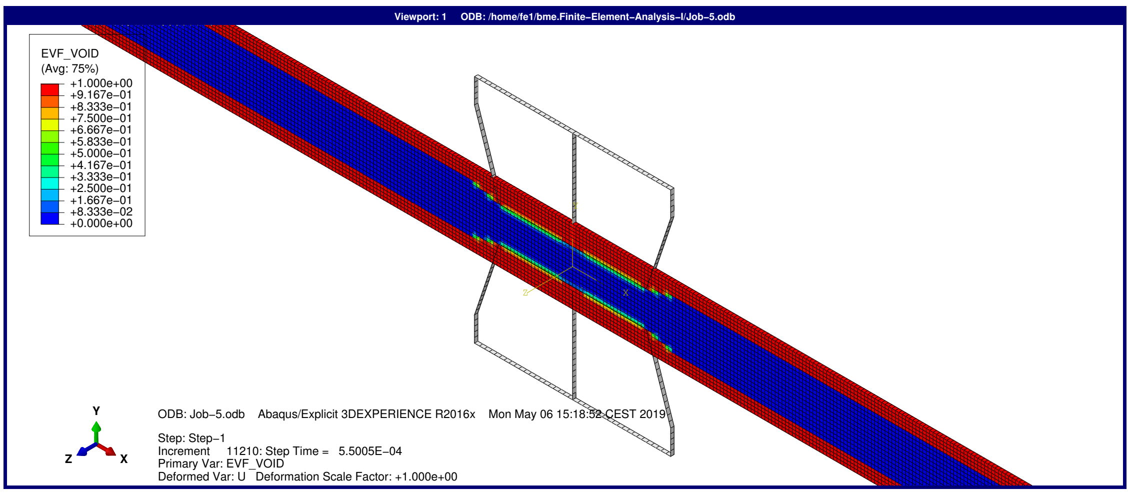

Figure 2: Node to node with no sliding

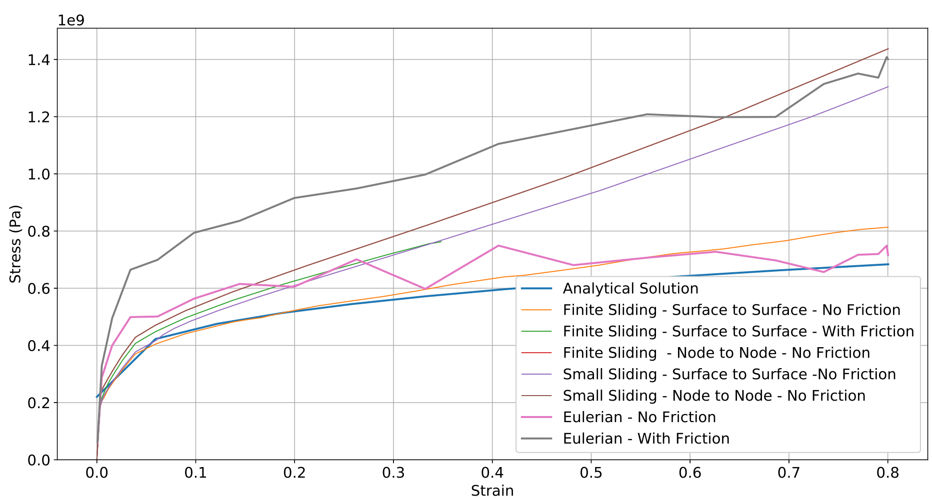

Figure 3: Result of the previous assignment with eulerian result

3 Results and Discussion

The gained results from the eularian simulation are similar to the lagrangian results from the prvious assignment. Both simulations, with or without friction, lie in the region of stress/strain ratio as in the previous assignment. We assume the lagrangian approach to be better or equal to eularian for small deformations. As soon as the deformations get larger, the lagrangian elements will be deformed significantly, which may impact the accuracy. As the eularian mesh is independent of the part, it stays in in its original shape.

References

[1] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[2] Nalet Meinen, Pascal Wyss. *FEM Assignment 4/2019*.