A Finite Element Model of steel slitting

UPPSALA UNIVERSITET

IMPETUS

SSAB

Project in Scientific Computing

Authors
Alvin Ljung
Alvin.Ljung.2844@student.uu.se
Adam Ahlgren Peters
Adam.Ahlgrenpeters.4216@student.uu.se

Supervisor
Lars Olovsson
Lars@impetus.se
IMPETUS Afea

Course Coordinator
Maya Neytcheva
Maya.Neytcheva@it.uu.se
Uppsala Universitet

Conclusions: Element bias in the model was effectively reduced by altering the mesh structure. The model seems to be very accurate, although more real-life testing is needed to verify this.

Introduction: In the last two decades, the yield strength of produced steel has seen significant improvements. The increased hardness and durability puts high demands on the equipment used to cut (slit) the steel.

For future improvements in production, a demand for accurate simulations of the process is rising.

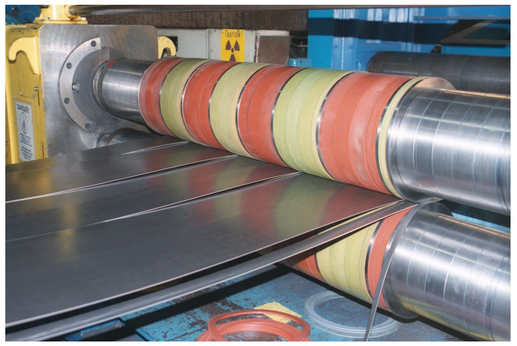

Figure 1: Example of industrial steel slitting, closely mimicking the setup at SSAB.

Purpose: Investigate the feasibility of modelling steel slitting with high accuracy using a Finite Element model. The setup to be emulated is located in SSAB's steel factory in Borlänge.

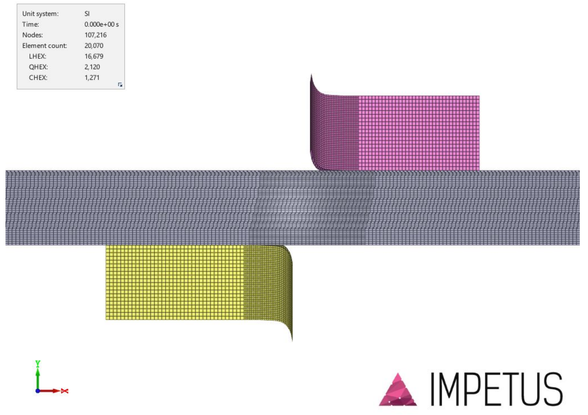

Figure 2: The final model with mesh alteration. The pink component is the cutter.

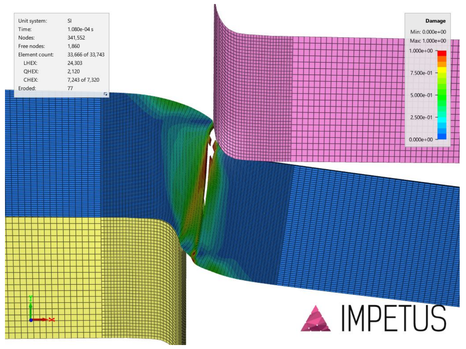

Figure 3: The fracture line is biased towards the mesh grid.

Method: The model was constructed with the Impetus Afea Solver. It is a non-linear finite element solver, specialised in modelling material deformations under load.

We considered a 2-dimensional model of a steel sheet (Figure 2). To reduce the mesh bias, the mesh was altered according to simulated damage property of the material to anticipate the most appropriate fracture propagation.

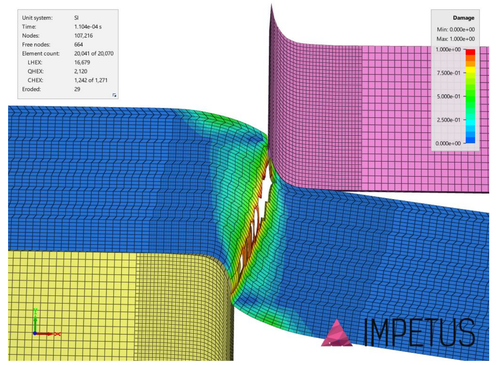

Figure 4: The fracture line now follows the path of most damaged elements.

Results: The resulting fracture line of the model mimics what is to be expected from this type of steel slitting (compare Figure 3 with Figure 4). However, this model does not take into account microcracks which propagate horizontally in the material.

To verify if the model is valid, microscopic images of slitted steel from the production plant would need to be compared to the fracture lines and damage zone of the model.

The yield and tensile strength of the alloy would need to be more accurately measured for a more precise damage function.