Asymptotic and experimental modelling of three-point bending of sheet metal

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Abstract

The three-point bending test evaluates a metal sheet's response to bending. The ability to accurately predict the behaviour of material in this experiment is sought-after by mechanical engineers, as it would provide a link between experimental results and the material's properties. We endeavour to gain a comprehensive understanding of the underlying principles governing the deformation and failure of materials during this test by constructing a mathematical model of three-point bending.

We will discuss the experimental setup, the challenges encountered in obtaining consistent results and the analysis of the data collected. The key factors that were identified as influencing the outcomes at various length-scales include the direction of the grains in the material, the hardening of the material and the friction between the sheet and the punch of the testing equipment. We therefore explore hardening and friction laws to formulate an accurate mathematical description of the experiment. Additionally, we would like to address some of the challenges posed by non-linearities in the underlaying governing equations, using asymptotic analysis and numerical simulations to provide insights into the influence of these factors. In the long term, this model would be validated against further experimental data and could be adapted to other experimental scenarios.

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