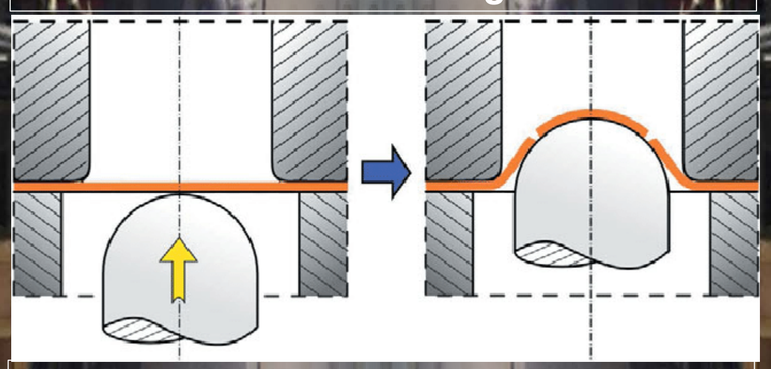
Formability Characteristics Of Perforated Steel For Die Forming Processes

Rationale

ADM Pressings Ltd is an automotive pressings company based in Newcastle Upon Tyne. As an Engineer I have been asked to investigate reliability issues regarding die forming of perforated steel sheet. Currently die forming processes with perforated sheet steels produce large amounts of scrap, making the process uneconomical. Study of the subject appears to be relatively un-common in industry. Producing a reliable method of simulating die forming processes using this material will provide valuable insight to the business and myself.

Erichsen Test Diagram



An Erichsen Test consists of spherical punch being forced into a die holding the test material. The material is marked with wih circles of known dimensions. The punch stretches the material until near failure. The material is removed and the deformations of the circles are measured. From this the major strain e_{ma} and minor e_{mi} are tabulated to produce a FLD (forming limit diagram) and using this a FLC (forming limit curve) can be used to plot the formability of the material being tested.

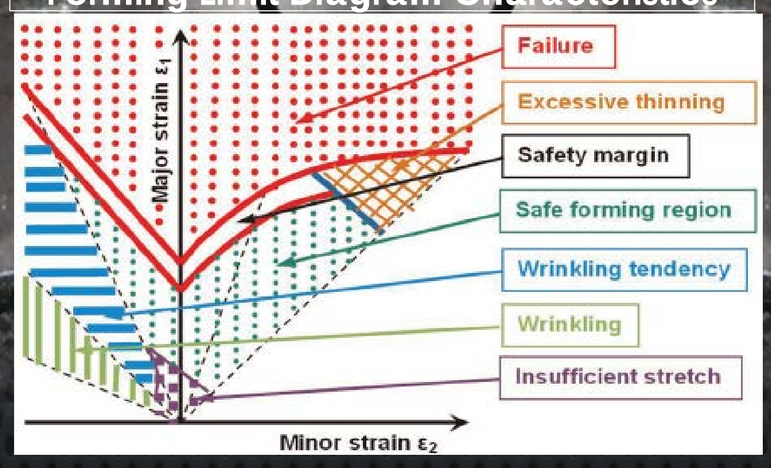
Further Experiments

Confirmation of tensile results will require repeated testing to establish validity of mechanical properties. Calculation of Youngs modulus from these results will then take place. Design and manufacture of an Erichsen cup testing jig to perform formability testing. Computer simulation of final part using mechanical properties recorded from experiments.

Key Learning

Secondary research has been carried out using peer reviewed journals on the testing methods used to quantify formability characteristics of sheet metals. Primary research such as Tensile testing has been used to calculate some of the mechanical properties of the material in question. Forming tests such as an Erichsen test are required to asses the material so process predictions can be made using a forming limit diagram. Basic forming characteristics can be obtained from mechanical testing such as tensile, bulge and hardness (*Bayraktar, Isac and Arnold, 2005*). Computer models are being developed using Ansys® to generate results for material properties and Autoform to create and validate formability values.

Forming Limit Diagram Characteristics



Further Study

Further study of the contributing attributes of the of the material in question will need to be investigated as (*Marciniak and Kuczyński, 1967; Kim et al., 2011*) have shown the anisotropy of the material can effect the formability, further experiments recording grain direction of the non-perforated and perforated sheet will need to be carried out to investigate this point. It is also relevant to generate and examine comparisons for use during computer modelling as a custom material card will need to be created.

References

Bayraktar, E., Isac, N. and Arnold, G. (2005) 'An experimental study on the forming parameters of deep-drawable steel sheets in automotive industry', *Journal of Materials Processing Technology*, 162–163(SPEC. ISS.), pp. 471–476. doi: 10.1016/j.jmatprotec.2005.02.059.

Kim, S. B. *et al.* (2011) 'Forming limit diagram of auto-body steel sheets for high-speed sheet metal forming', *Journal of Materials Processing Technology*. Elsevier B.V., 211(5), pp. 851–862. doi: 10.1016/j.jmatprotec.2010.01.006.

Marciniak, Z. and Kuczyński, K. (1967) 'Limit strains in the processes of stretch-forming sheet metal', *International Journal of Mechanical Sciences*, 9(9), pp. 609–620. doi: 10.1016/0020-7403(67)90066-5.

AUTOFORM Forming Reality

Newcastle College

ANSYS®

BEng Mechanical Manufacturing Engineering - Adam Harper