Summer, 2012

Volume 10, No. 3

DEFORM™ News

Training:

- December 4-7, 2012: DEFORM training will be conducted at the SFTC office in Columbus, OH.
- February 5-8, 2013 DEFORM training will be conducted at the SFTC office in Columbus, OH.

Events:

- November 7 & 8, 2012: DEFORM User Group Meeting will be held at the Bridgewater Banquet & Conference Center in Columbus, OH.

DEFORM has its origins in the simulation of bulk metal forming. Simulation of sheet metal forming, while very similar to bulk forming, has its own set of unique requirements, both in terms of input data requirements and post-processing.

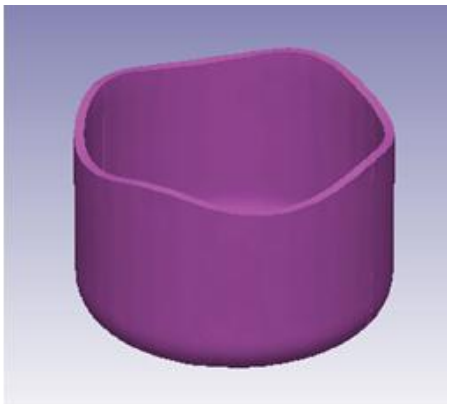
Over time, DEFORM has evolved to include a wide range of features which are useful for sheet metal simulation. Anisotropy models can capture directional effects from sheet metal rolling which can cause effects like earing. Damage models based on forming limit diagrams can highlight potential areas of tearing.

Brick meshing offers significant advantages in performance and resolution over a tetrahedral mesh for very thin parts. Since DEFORM always uses solid formulation elements, it provides a more accurate solution than software using shell elements in processes where the sheet thickness influences the result.

In post-processing, thickness plots are available to easily evaluate thinning due to stretching.

Anisotropy

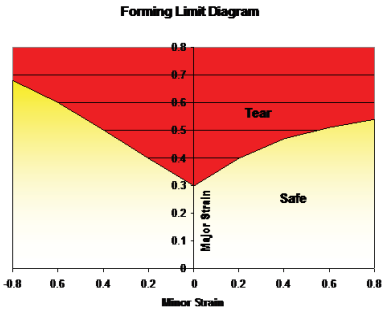
When metals are rolled into sheet, they develop a directional crystal structure which leads to variations in strength in different directions. This anisotropy can lead to defects such as “earing” where an axisymmetric forming process does not produce an axisymmetric part.

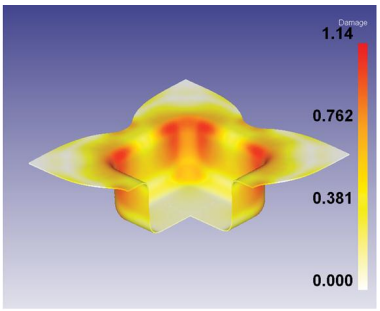


Hill’s anisotropy model captures these directional effects. In addition to the normal flow stress curve, it requires only the data from three tension test samples cut at specific directions relative to the rolled sheet.

Tearing

DEFORM uses damage models as indicators of the likelihood of fracture during hot and cold bulk forming.





In sheet metal, the generally accepted predictor of fracture or tearing is known as a Forming Limit Diagram. A forming limit diagram plots major and minor strain directions on an X-Y graph. A curve represents the forming limit. Combinations of major and minor strain which lie above the curve represent likely tearing. Those below the curve represent a safe region.

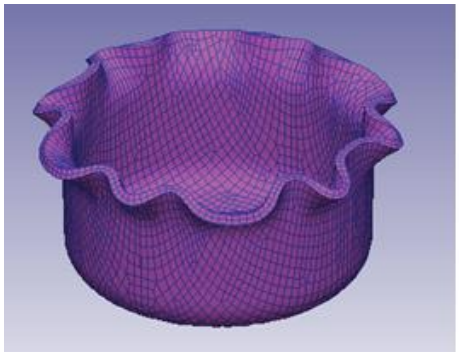
The forming limit diagram is one of several damage models available in DEFORM. The damage value represents the fraction of allowable minor strain for a calculated major strain in a given element. If the damage value is less than one, the strain components are in a safe region. If it is greater than one, the likelihood of tearing is greater.

DEFORM™

Design Environment for FORMing

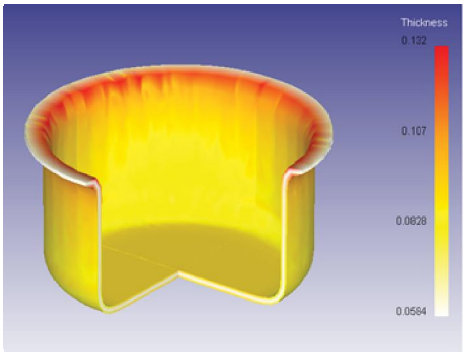
Wrinkling

A spring loaded blank holder is normally used to control the edge of a sheet. If blank holder pressure is too high, tearing may result. If blank holder pressure is too low, the result may be wrinkling of the sheet. A range of spring and force movement controls enable accurate blank holder simulation.



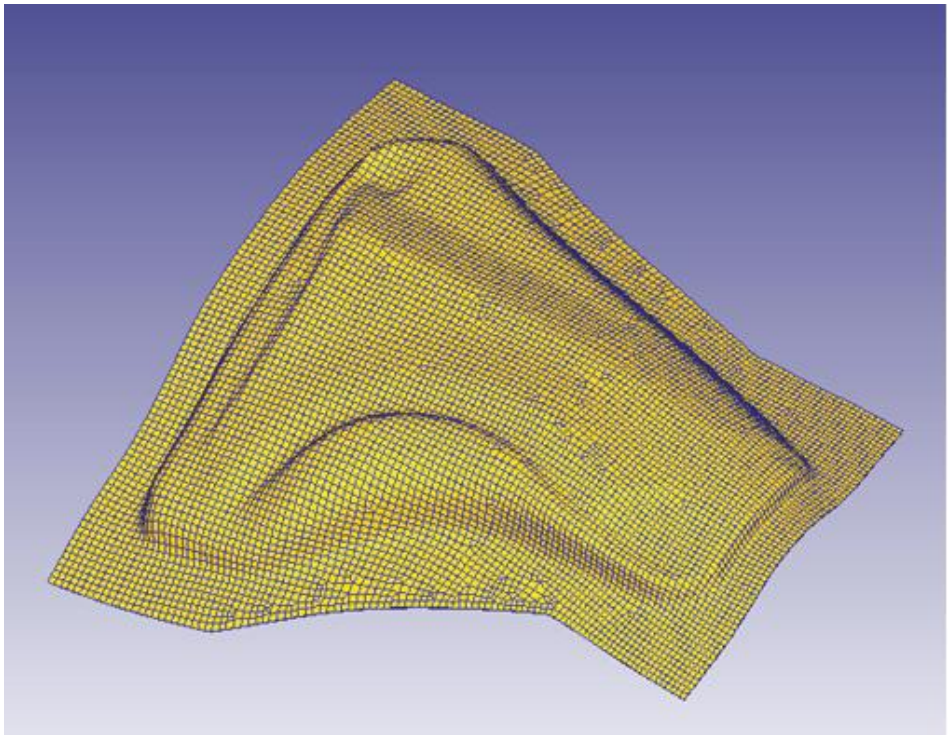
Thinning

A thickness plot is available in the post-processor to plot sheet thickness at each point in the workpiece. This allows an engineer to evaluate thinning resulting from stretching or from ironing between tools.



Meshing

For bulk metal forming, tetrahedral mesh elements are common because of their ability to adapt to complex, irregular shapes. However, tetrahedral elements give the best numerical performance when they are nearly uniform in length, width, and thickness. For a thin sheet, this requires a huge number of elements to properly mesh the thickness of the sheet. Brick (hexahedral) elements perform well when one dimension is much larger or smaller than the others. Therefore, they can be used in large, thin parts such as a fender where the number of tet elements would be computationally prohibitive.



Releases:

DEFORM V10.2.1 was released in May, 2012. It includes:

- Smoother handling of 64 bit simulations
- Improved handling of 3D hydraulic press modeling
- Improved handling of models involving multiple sliding dies

SFTC is currently working on DEFORM V11.0, which will feature many major new features:

- A completely redesigned multiple operations pre-processor
- A batch post-processor for automating many post-processing functions
- Multiple operations pre-processor for F2 and F3
- Design of experiments capability to study the effect of varying parameters on a simulation result
- Optimization of geometry and other parameters
- Dramatically enhanced material modeling capabilities, including crystal plasticity and mesoscale microstructure models
- Explicit solver
- 64 bit mesh generation for handling simulations exceeding one million elements
- Improved elastic-plastic convergence with a displacement-based formulation
- Improved ring rolling speed and stability
- Better solver performance on large models

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