DEFORM™ Application #401

Hydroforming Simulation

The Process:

Hydroforming is one of the fastest growing processes in the automotive industry today. The primary applications are structural components. Process benefits include weight, stiffness, durability and cost. Hydroforming involves the process complexities of stamping and forging, but without the decades of experience in the nuances of process development enjoyed by those manufacturers.

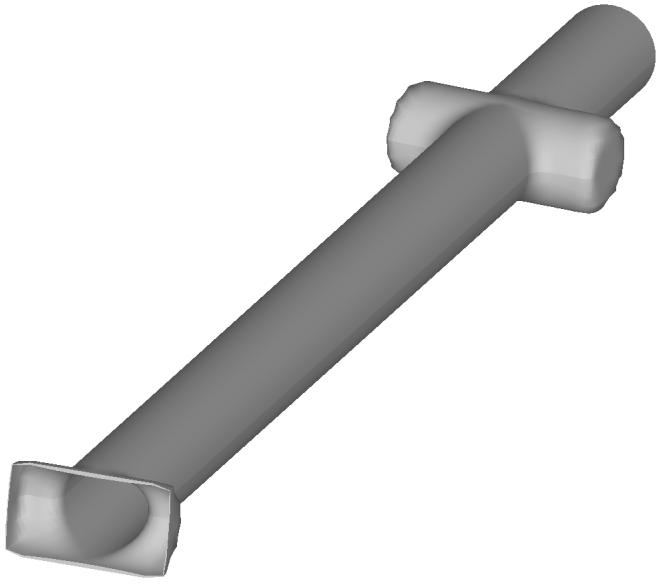
With aggressive product requirements and short lead-times, fast development is mandatory. Using the 'trial and error' method, it's not possible to achieve competitive results in a rapidly changing and growing market. Development trials using a 'state of the art' process simulation system are faster and lower cost than shop trials using hard tools. Development costs are far lower and more information is available about the process.

Process Simulation:

Since hydroforming achieves final part shape with large plastic deformation, material behavior is non-linear and material flow is not always intuitive. Wall thinning during bending or preforming will influence wall thickness in the final part. Process development involves initial material geometry, preform and/or bending design, plunger movement, clamping, die movement and internal pressure.

The Analysis:

DEFORM™-3D was used in these process simulations to analyze and understand the process. The results correlated well with actual production experience. Process simulation can be used to understand the influence of preform, plunger displacement and pressure profile on the finished product.



The simulation result of this light-weight automotive component was presented at FABTECH 2000.

DEFORM™

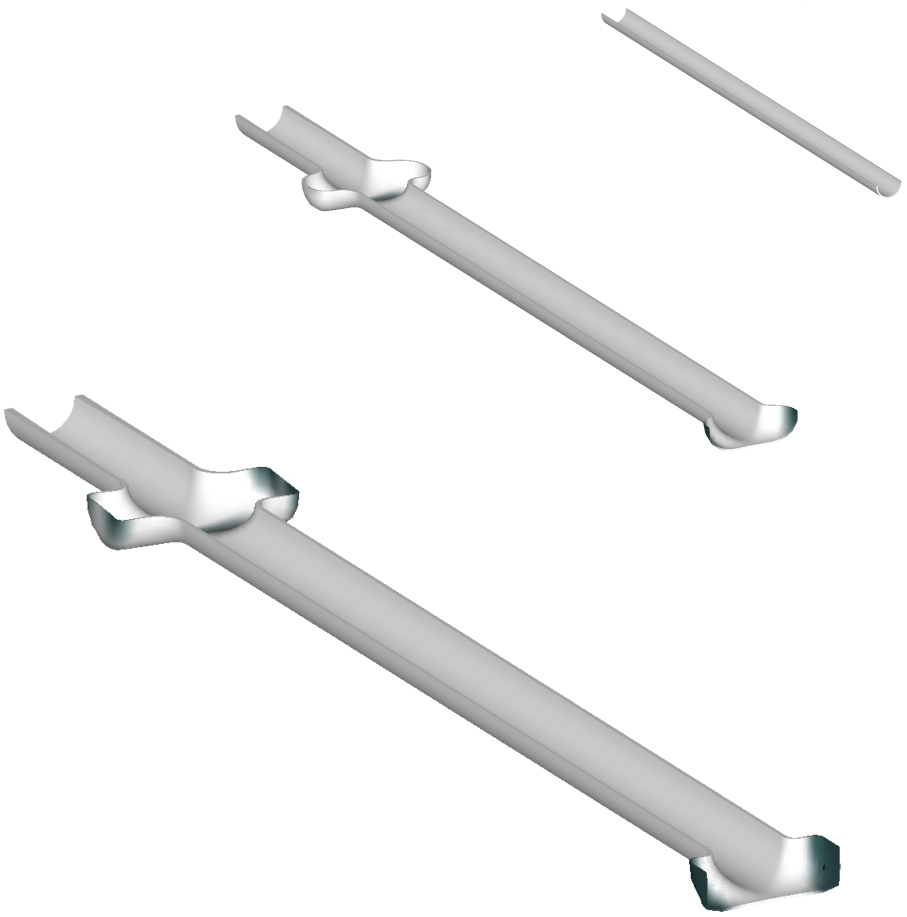
Design Environment for FORMing

Solid Element Formulations:

In the world of process simulation, bulk parts are typically analyzed using models with solid elements in either two-dimensional or three-dimensional models. Analysis of very thin sections such as auto body panels are analyzed using models with 'shell' elements that neglect shear stresses through the thickness. Hydroforming is a process that produces structural components where local bending and shear effects are required to accurately understand material flow and final part geometry. DEFORM™ uses solid elements to more accurately represent local effects that could be easily missed with the use of shell elements.

The Opportunity:

Process simulation is routinely used to optimize the volume distribution, resulting in a high quality, low cost process without defects. The cost of traditional process development is high. Developing a process might take days or weeks of engineering time. Building a full-scale die set and preparing for a trial run costs thousands of dollars. Running the trial can take hours or even days of production time. Trial run cost can be staggering when all components are considered. Even worse, the lead-time for shop trials rarely meets the customer requirements and expectations. DEFORM™ is a 'state of the art' process simulation tool that is faster, less costly and provides far more information about a proposed process than shop trials.



The above figures represent a half (sliced) section of a hydroforming analysis performed using DEFORM™-3D at various stages of the process. Contours of DAMAGE (Cockroft-Latham) are shown. Darker regions represent higher values of DAMAGE, thus a higher risk of fracture.

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