



STRETCH FORMING SIMULATION

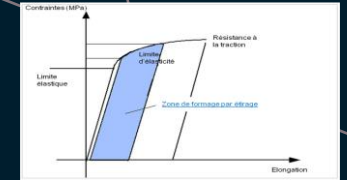
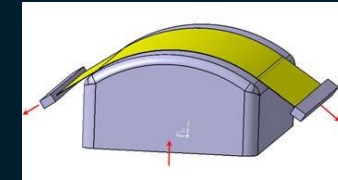
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SHEET-METAL STRETCH FORMING

Process definition?

The basic principle of this technology is to stretch materials beyond their elastic limit in order to reach the plastic zone and obtain permanent deformation with very little elastic return and residual stresses.



Target parts

It allows the production of large double-contour parts, most often made of aluminum. this process enables the manufacture of the exterior cockpit panels, the rear fuselage, and the wing leading edges.



Machine

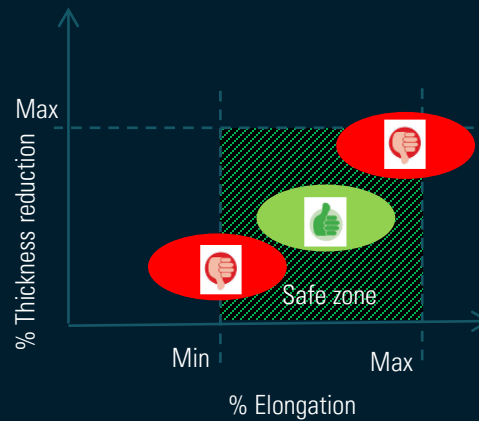
Stretcher is a machine with 2 articulated jaws capable of stretching material with a force of 500 tons and a central table with a force of 1000 tons.

PROBLEM DEFINITION

Stretch forming simulation is a relatively undeveloped field in the industry, and there are relatively few companies specializing in it compared to other forming fields. Furthermore, few simulators are specifically designed for stretch forming and effective in a production environment. The formability of parts is difficult to predict, and all forming parameters for double-curvature panels are established through trial and error directly on the production line, based on the knowledge and expertise of the operators and specialists. There are several anomalies in stretch-formed parts that we must avoid, and these are not predictable during the panel or block design phase. This is where simulation comes into play, with the aim of developing the best possible forming process to prevent defects and production problems.

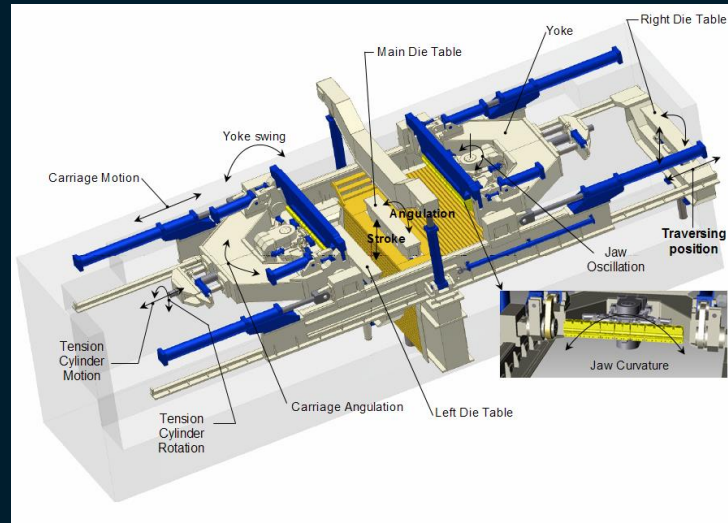
PROCESS REQUIREMENT

Several defects, such as material breakage, spring back, thickness variation, insufficient minimum elongation, creases, waviness, and Luder lines, cause defects in stretched skins and lead to their rejection. The factors influencing forming conditions are numerous and often difficult to predict before the first production trial. One of the most important is the material's elongation and thinning. If these requirements are not met, the panel will be rejected.



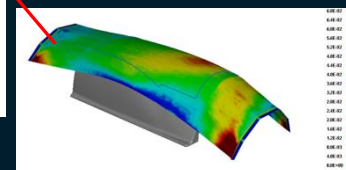
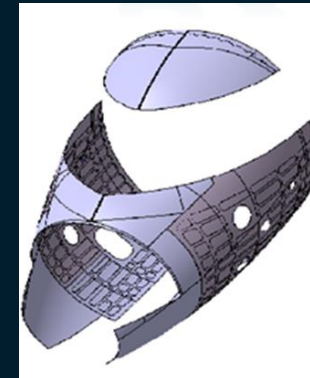
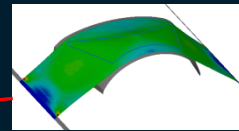
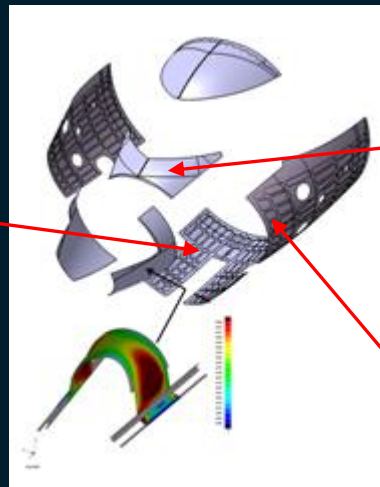
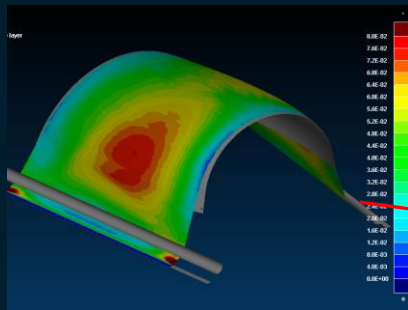
MACHINE MODELING IN SIMULATION

By using Dynaform we are capable of predicting the reaction of the metal sheet to drawing. However, one of the major challenges is the machine's kinematics; with 12 drawing axes, this simulation is complex. One of the most important requirements for accurate simulations is the ability to reproduce the machine's dynamics. Furthermore, for the tool to be usable in a constantly changing and fast-moving production environment, it must be simple and quick to use (user-friendly).



SIMULATION RESULTS

Dynaform is extremely useful to us for the Global 7000/8000 program. We used it to design and simulate the cockpit panels, and the tooling team is now using the data to manufacture the mold. We were able to perform additional tests on certain critical panels and modify the molds for these more complex panels. As a result, the part is of higher quality from the outset."

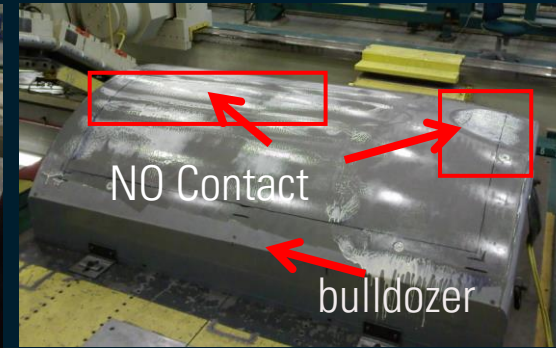
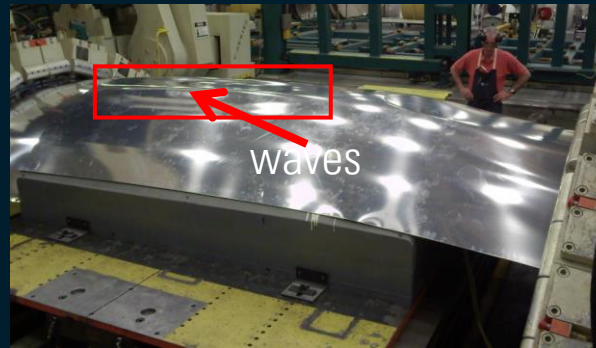
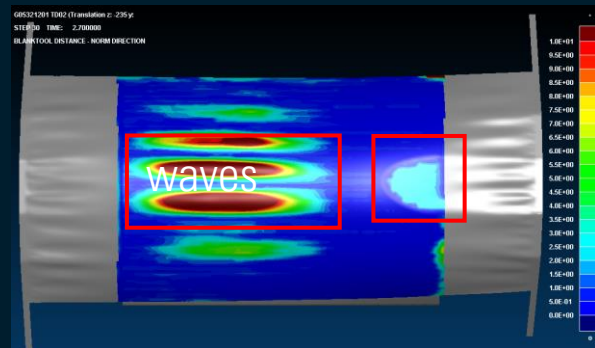


CASE STUDIES:

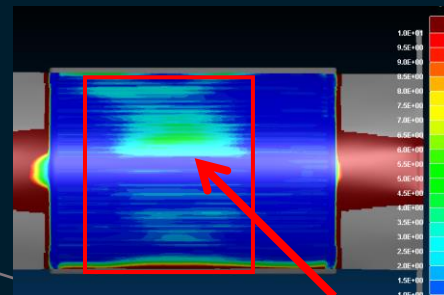
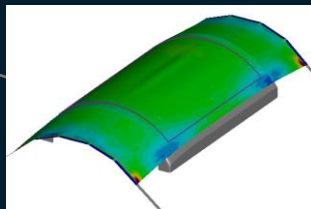
Here are some cases where Dynaform has helped us predicting and preventing issues and defining right stretch forming strategy:

- Waves and non-contact zones within the EOP

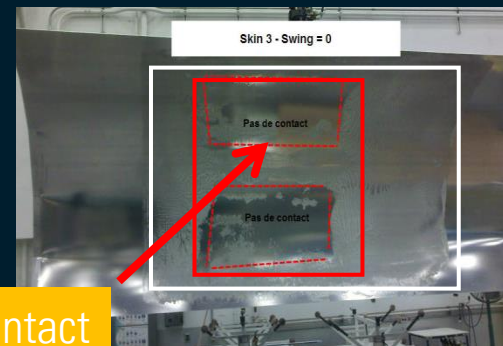
It was possible to detect waves in the simple contour section of the part. This type of part needs to be stretched using a bulldozer-type forming die. (The bulldozer die sandwiches the material between male and female parts during stretching.)



The non-contact zone in the simulation below was observed and represents an out-of-tolerance zone according to the surface profile of the part.



NO Contact



CASE STUDIES:

- Critical elongation zone:

The simulation allowed us to identify the critical elongation zones in the extra material. These zones pose a high risk of material failure during forming.

