get it right®

LETOV composite forming tools produce two components in a single high quality part with PAM-FORM

THE CHALLENGE

- Reduce production costs with the forming of an integrated shape in one shot without impairing its mechanical characteristics.
- Accurately design parts made of high performance reinforced thermoplastics.
- Use a dedicated software tool to evaluate the composite materials and the effect of their application.

THE STORY

"PAM-FORM helped us achieve our project goals: ***lower weight and cost of production while preserving the mechanical properties of the part.*** *Additionally, it provided us with more information on optimizing our production process which can be reapplied to similar projects."*

Josef Křena, Development Manager
LETOV LETECKA VYROBA, Ltd.,
GROUPE LATECOERE.

THE BENEFITS

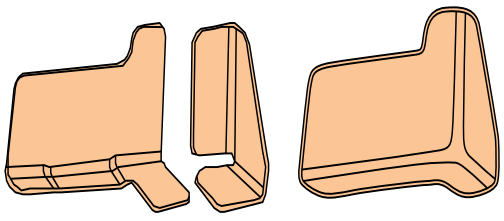
- Reduce weight of the part while maintaining the part's mechanical properties.
- Lower production costs.
- Leverage engineering expertise to address the challenges of high performance composites.
- Increase process and material understanding for future applications.

LETOV LETECKA VYROBA Ltd. is the oldest aircraft manufacturer in the Czech Republic. Established in 1918 as the first facility for aircraft manufacturing, they mostly develop and manufacture parts and subassemblies for civil and military aircraft. In 2000, LETOV joined the French company GROUPE LATECOERE. LETOV has a dedicated center for composites parts: the Composite Production Center, which was created for development and manufacturing of composite parts for civil aircraft.

In one of their recent projects, LETOV produced clips for a major aircraft constructor. Clips are small joining parts in the fuselage structure of an airplane. A standard clip consists of two components. In order to lower production costs and weight, LETOV engineers sought to develop an integrated part in a single shot, without impacting the mechanical properties of the clip. To do so, LETOV engineers used ESI composites forming simulation software PAM-FORM to analyze and optimize the forming process of the integrated composites clip that is quite complex by its shape. PAM-FORM was also used for tool design optimization.

STANDARD SHAPE VERSUS INTEGRATED SHAPE

Generally to produce such components, engineers use flat composite plates which are, after preheating, formed into the corresponding shape by press. Carbon fibers fabric is used for reinforcement in a very different process mechanism compared to sheet metal forming, the methodology usually applied for a developable shape.



Standard shape | Integrated shape

Even if the shape corresponded to the usual sheet metal design method, the use of composite materials gave LETOV engineers the chance to use new shapes. "*Only a new design philosophy with high integration of structural requirements can make the best of composite potential*", said Josef Křena, Development Manager at LETOV LETECKA VYROBA, Ltd., GROUPE LATECOERE. ***"We wanted to develop a forming tool shape that would enable us to produce a clip in one shot"***, he continued.

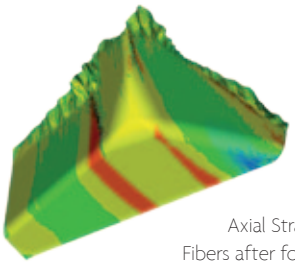
LETOV engineers were dealing with three levels of complexity: the geometry of the integrated clip itself, the composite material it is made of, and the part's rigorous mechanical requirements. In addition, the risk of folding and other defects appearing during the forming process were very high. To reach their target, many trials and considerable development time would be required for the elaboration of the optimal tooling and process parameters.

In order to decrease development time, LETOV used PAM-FORM to evaluate multiple strategies and determine the right tooling and process parameters.

DIE OPTIMIZATION

Determining the right tools and process, LETOV engineers measured the high temperature material property values which characterize the forming behavior of the composites part. These tests were simulated and thus the right modeling conception verified.

A second step was the elaboration in the simulation software of the real tool shapes that would be used to form

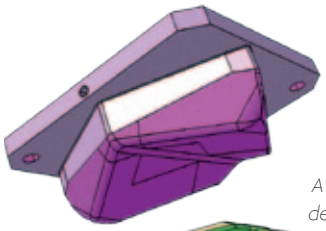


Axial Strain on Fibers after forming

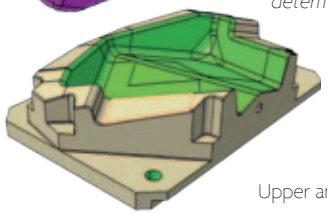
the integrated clip. PAM-FORM includes many parameters that LETOV engineers used for die optimization. It allowed them to evaluate and compare the folding, wrinkles and inner tensile stress of the part in order to find an optimal configuration.

The simulation also displayed the fiber orientation changes resulting from the shaping, especially in the corners. The fiber orientation induced by the forming process is critical for the mechanical behavior of the final part.

Simulation with PAM-FORM allowed LETOV engineers to design a theoretical virtual model with the forming tool and blank shape they determined to be best. Once the model was validated with simulation, they produced physical prototypes which verified the virtual prototype.



Numerous variants for the tool shape were evaluated. A double part die design was determined with PAM-FORM.

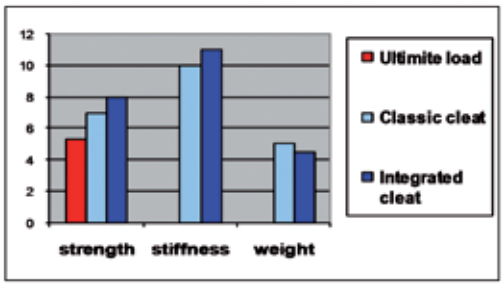


Upper and lower forming tools

ASSESSMENT OF PHYSICAL PROTOTYPES

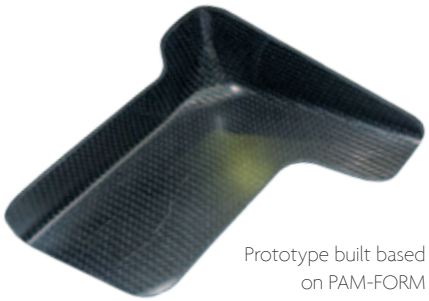
All physical prototypes of the clip were submitted to mechanical testing including impact, fatigue and heat exposure.

The production of one piece instead of two, and in one shot, allowed a significant decrease of production costs in line with mechanical requirements (even slightly improved).



Comparisons of strength, stiffness and weight of the clips

The successful use of PAM-FORM for the virtual prototyping of clips confirmed that the combination of experienced engineers and PAM-FORM simulation tool can be very effective for problem solving in high performance composite applications.



Prototype built based on PAM-FORM computations

To find out more about ESI's Composites Simulation Suite, including PAM-FORM, visit: www.esi-group.com/composites

ABOUT LETOV LETECKA VYROBA LTD

The company was established in 1918 as the first facility for aircraft manufacturing in the Czech Republic, developing and manufacturing parts and subassemblies for civil and military aircraft. Since 2000, LETOV LETECKA VYROBA Ltd. is a subsidiary of the French company, GROUPE LATECOERE. The Composite Production Center was created for development and manufacturing of composite parts for civil aircrafts.

ABOUT ESI GROUP

ESI is a world-leading supplier and pioneer of digital simulation software for prototyping and manufacturing processes that take into account the physics of materials. ESI has developed an extensive suite of coherent, industry-oriented applications to realistically simulate a product's behavior during testing, to fine-tune manufacturing processes in accordance with desired product performance, and to evaluate the environment's impact on product performance. ESI's products represent a unique collaborative and open environment for Simulation-Based Design, enabling virtual prototypes to be improved in a continuous and collaborative manner while eliminating the need for physical prototypes during product development. The company employs over 750 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in compartment C of NYSE Euronext Paris. For further information, visit www.esi-group.com.

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