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Shenyang Aircraft cuts aircraft structure parts' weight using PAM-STAMP

中航工业沈阳飞机工业（集团）有限公司
AVIC SHENYANG AIRCRAFT CORPORATION

THE CHALLENGE

The mass of a aircraft directly impacts its performance. Mass reduction can only be addressed by a combination of lighter materials and adapted design, using state-of-the-art technology such as Super-Plastic Forming and Diffusion Bonding to eliminate the need for fasteners. But using such technologies on high-performance materials such as a titanium alloy requires careful design and advanced simulation capabilities, which Shenyang Aircraft Corporation (SAC) found in ESI's PAM-STAMP.

THE BENEFITS

- The structure parts' weight of the new Naval Aircraft was reduced,
- The average cost of the total structure parts was cut,
- SAC Design Engineers acquired valuable know-how,
- The new Naval Aircraft was delivered on time.

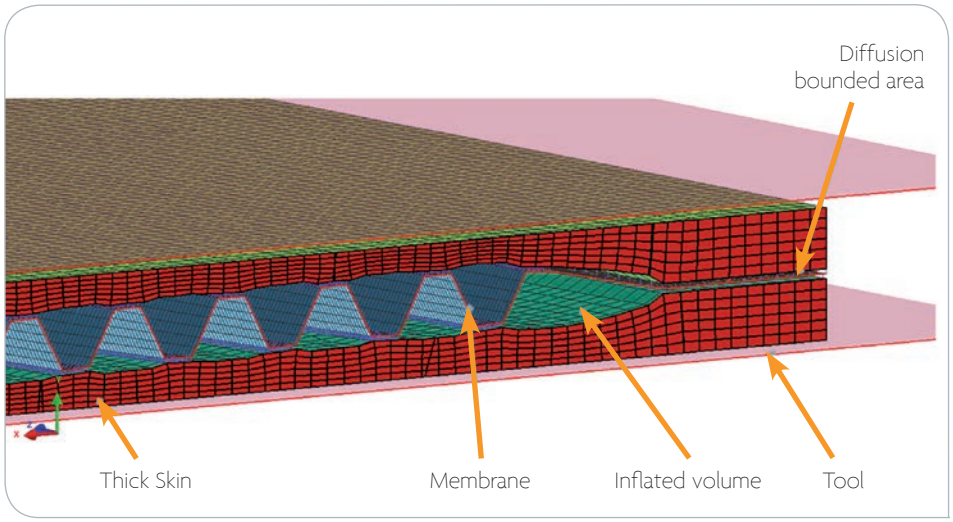
With both superplastic forming and diffusion bonding simulation using PAM-STAMP, SAC cut by half its average tooling development time of the complicated structure parts and made the fighter lighter."

Yuan Li,
General Manager,
Shenyang Aircraft Corporation.

Naval Aircraft - PLA NAVY.

Shenyang Aircraft Corporation (SAC) is China's largest fighter aircraft manufacturing enterprise. When they developed the Naval Aircraft PLA NAVY, mass reduction was critical in order to provide maximum speed, range and maneuverability.

SAC utilized new high performance materials, such as the TA15 titanium alloy, to help reduce weight. While such materials can be used readily to manufacture components, the real benefit comes from manufacturing the many intricate shapes the design required, without the need for assembly using traditional fastening techniques such as riveting, screwing and adhesive joints, all of which would add weight and increase the number of parts on the aircraft and the complexity of manufacture.

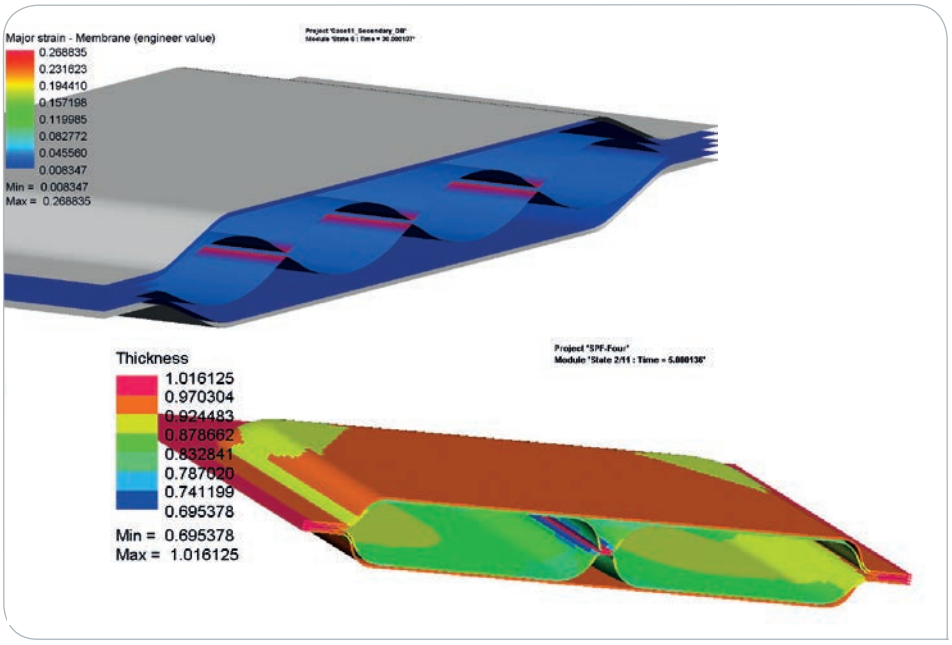


Simulation model in PAM-STAMP.

The only solution was to increase the complexity of the formed parts and to assemble them without additional fasteners, through the use of diffusion bonding (DB), a technology using the mingling the atoms of two adjacent parts to achieve permanent bonding.

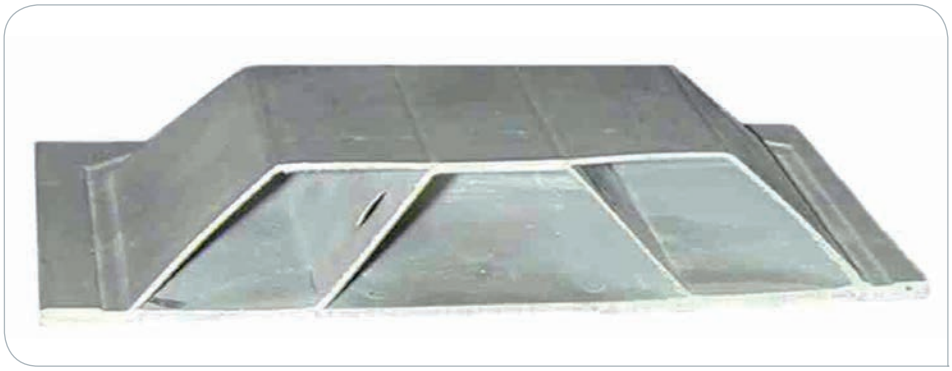
Shenyang Aircraft Corporation experimented with Superplastic Forming (SPF) as one option to meet challenging geometrical requirements, but with material thickness reaching 50mm, SPF invariably resulted in local striction or thinning. Having read about SPF simulation carried out successfully with PAM-STAMP by other leading aircraft manufacturers, SAC then turned to simulation. They chose to rely on the only solution which has demonstrated its capacity to predict, and thereafter avoid, the thinning of the titanium alloy parts: PAM-STAMP. SAC trained no less than 150 engineers on the usage of PAM-STAMP, not only for SPF and DB, but also for other more conventional aero-stamping processes.

One of the many processes simulated to achieve expected results was the double-blanks' SPF and DB forming process under air pressure. Simulation allowed them to predict and control the thinning of the SPF and DB. In this example, several complex components were replaced by a single part, saving up in weight and avoiding cost- and time-consuming welding operations.



After superplastic forming process simulation

With the help of such innovative manufacturing processes, and assisted by PAM-STAMP, SAC managed to achieve an overall mass reduction on the Naval Aircraft, giving this aircraft an agility which would have remained out of reach if conventional manufacturing and assembly techniques had been employed. Incidentally the use of simulation, significantly reduced development costs as large numbers of costly trials were avoided.



Superplastic Forming / Diffusion Bonding parts.

ABOUT SHENYANG AIRCRAFT CORPORATION

Shenyang Aircraft Corporation (SAC) has emerged as China's largest fighter aircraft enterprise since its establishment in 1953. SAC has over 15 000 workers and operating personnel, with 2 872 high level and middle level engineers.
In addition to jet fighters, SAC's other two primary products are commercial aero-structures and non-aeronautical products like buses and factory storage systems. SAC in the past has done work for British Aerospace, Airbus and Lockheed, and currently has a manufacturing sub-assembly venture with Canadian firm Bombardier Aerospace. China's J-15 carrier-based fighter is the most widely known product made by SAC.

ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact on product use under normal or accidental conditions. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is a French company listed in compartment C of NYSE Euronext Paris.

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