Reducing the Strain of Additive Manufacturing

Ansys

Courtesy Rosswag Engineering

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Sector: metalworking
Reto: Rosswag Engineering innovates optimized metallic parts with incredibly intricate internal structures and complex shapes.

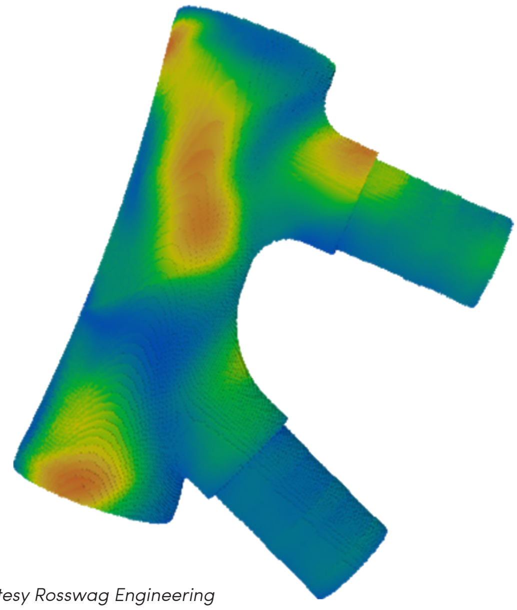
Solución: leveraging ANSYS ADDITIVE PRINT, Rosswag engineers determine strain prior to printing to eliminate distortion, stress and blade crashes, and reduce the number of builds.

CHALLENGE

When Rosswag Engineering launched metal AM production, a highly complex project may have required up to 10 printing iterations to produce a desired geometry.

Material behavior during the printing process remained unpredictable, which necessitated this trial-and-error approach. A single build (print) failure due to internal stresses and thermal distortion could cost the company thousands of dollars in development time, delay part delivery to the customer and destroy parts of the expensive AM machine.

To optimize customer part geometries, reduce print failures and shorten development time, the Rosswag team adopted ANSYS ADDITIVE PRINT. Integral to the company's design process, ANSYS ADDITIVE PRINT simulates how materials will behave during the printing process. It predicts part shape distortion and stress, and designs optimal support structures for distortion compensation. The design of jobs can be finished in 50%–60% less time.



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The hybrid part ForgeBrid® was produced by a combination of open die forging and additive manufacturing at Rosswag.

SOLUTION

By simulating thermal stresses to perform thermal-mechanical analysis, designers can calculate heating and cooling at virtually any point on the part's scan vector. With high-fidelity simulation (up to 15 µm resolution), this capability detects very fine features and differences in the strain, revealing part deformations with accuracy.

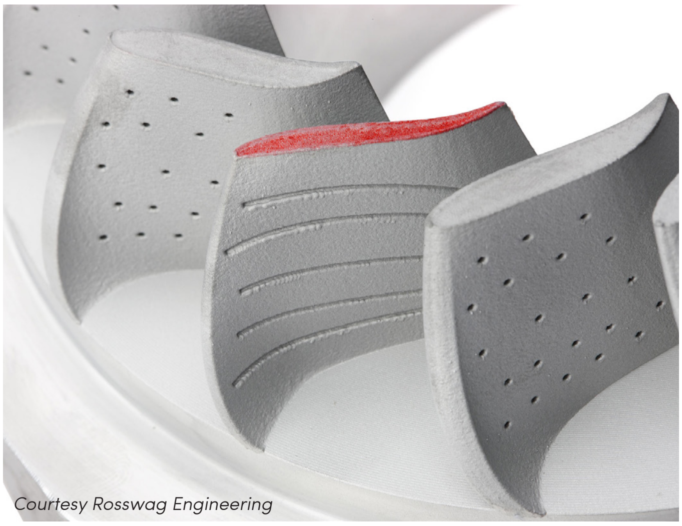
Simulation also helps to predict and identify areas on the part that have the highets potential for causing printing accidents. This problem occurs when a part being build lacks sufficient support structures, and tilts up to collide with the recoater blade, damaging the part and potentially the machine. Adding support structures offsets thermal strain challenges to estibilize the part.

Based on the predictions of these three modes, engineers determine the part's optimal geometry compensation.

Should distortion be detected, the team employs the software's automatic distortion compensation tool, which takes the desired geometry and reverse distorts it so that it reverts to the correct shape during the pinting process.

In the next round of simulation, the software reveals the sopport structures' effectiveness and determines whether more stability may be required to confirm that the part will be built without unexpected distortions.

Depending on the part's geometry, if there are critical or overhanging edges, the support structure will be used for heat transfer and to reinforce the layer that needs it. Following the print, designers verify the geometry of the part by scanning and measuring it using a 3D laser scanner, to certify that the part exactly matches the geometry the customer approved.



The patented production process for adding highly complex blade structures with internal channel structures on conventional manufactured parts could be the next game changer for the aerospace and energy machinery industry.

BENEFITS

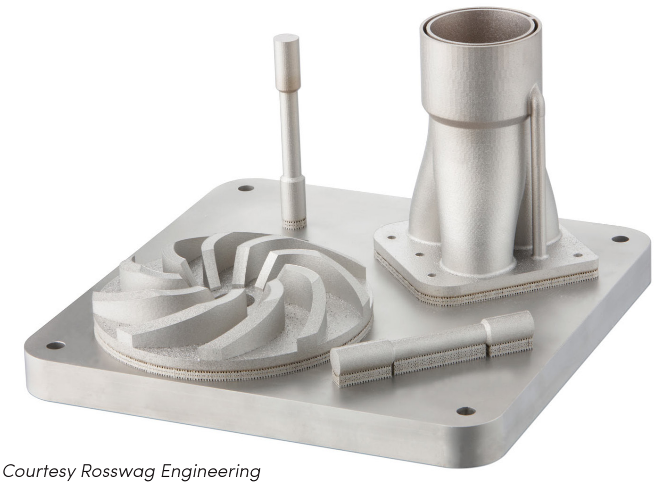
Thanks to the early detection of problems through simulation, Rosswag engineers were able to determine the required modifications, redesigning the part, and thereby significantly reducing the number of pritings needed. Featuring three stress detection modes, with increasing levels of fidelity, the simulations are produced within a reasonable time frame.

The team uses assumed uniform strain capabilities to analyze parts, layer by layer, similar to how the printer builds layers of material. This simulation provides fast turnaround and a good understanding of the pattern of the displacement that the part will experience.

ANSYS ADDITIVE PRINT allows them to increase the reliability of their results and reduce the number of printings required to optimize each part. For example, if the team completes the job in two printings rather tan four or five, the reliability of the production process is higher.

Using ANSYS ADDITIVE PRINT to manufacture parts, the company now saves about four manufacturing tasks each month. All this significantly streamlined Rosswag's operation, saving him 100,000 euros per year.

In the case of complex parts, the simulation software saves the company 30,000 euros per project, equivalent to ten printing jobs. Finally, since each task takes two to three days to complete, this saves between 20 and 30 days in printing time.



Examples of parts manufactured by additive manufacturing with samples for mechanical tests on a plate.