Ensuring Additive Manufacturing Success

As designers embrace the exciting new world of additive manufacturing (AM) they must not only conquer new challenges for innovative design, but also ensure that the part will print accurately during the manufacturing process. The only way to do this reliably is to leverage specialized tools for AM.

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ANSYS Workbench Additive — Seamless Workflow for Additive Manufacturing
ansys.com/am-workflow

Poor execution can kill even the greatest ideas.

As additive manufacturing matures to a commercial-scale manufacturing process, we are watching the stuff of science fiction become reality. Bringing to life organic shapes that were previously impossible to manufacture, employing radically new materials with never-before-seen properties, and transporting a machine and some metal powder to remote corners of the world (or even the universe) to manufacture all kinds of complex components on demand are some of the promises of AM.

CHALLENGES TO AM SUCCESS

But there are challenges. Before we send an AM machine into space to help build an infrastructure to colonize Mars, a large problem must be addressed. Parts deform as they print. Specifically, during the powder-bed metal AM process temperatures oscillate as relatively cool metal is suddenly zapped by a laser followed by a relatively rapid cooldown, before being zapped again through a fresh layer of powder. This causes thermal stresses to build, which can cause the parts to deform, pull off the build plate or even explode inside the expensive metal AM machine.

> **"How do designers avoid the fate of having their great designs destroyed during the AM manufacturing process?"**

Design for additive manufacturing, DfAM, is a hot new field for designers. Through topology optimization and design exploration tools, the engineering design process is becoming decoupled from the spheres and blocks of traditional CAD. With the promise of AM, designers' creativity is being unleashed to leverage shapes that previously could only be found, for example, in the bending of tree branches or the veins of a butterfly wing. These shapes now appear in aerospace heat exchangers, automotive brackets and custom knee replacements.

Yet, this rapid growth provides more questions than answers. As eager designers, lured by the AM promise, are inspired to create wonderful new designs with organic channels and intricate manifolds, many do not realize that their great ideas might, through the complexity of the AM process itself, force them to redesign parts repeatedly in order to print parts that conform to spec.

So how do designers avoid the fate of having their great designs destroyed during the AM manufacturing process? The answer is simulation.

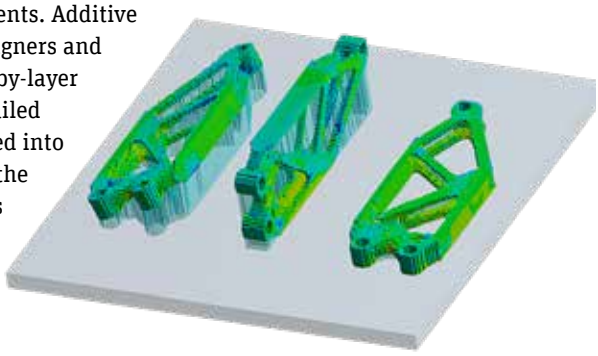
If a designer who is creating a product for additive manufacturing has access to simulation tools that allow him/her to visualize whether the part will actually print accurately, before it is sent for manufacturing, the designer stays in control of his or her design and makes sure the design stays true to its form even through the printing process.

ANSYS Additive Print predicts displacement for a heat exchanger. Courtesy Additive Industries.

SIMULATION FOR ADDITIVE MANUFACTURING

Because every engineer works differently and wants tools that fit seamlessly into their workflow, ANSYS provides a number of solutions for additive

manufacturing that take into account different requirements. Additive Print, a stand-alone solution, was created with DfAM designers and AM machine operators in mind. The Additive Print layer-by-layer metal powder bed simulation tool is key to eliminating failed builds and physical trial and error, and is easily integrated into designers' and AM machine operators' workflows. While the underlying solvers are sophisticated, the user interface is uncomplicated. Designers can import their CAD or STL files into Additive Print, run a simulation faster than printing a physical part, visualize what would happen to their design during the print process, and adjust their supports or designs accordingly.



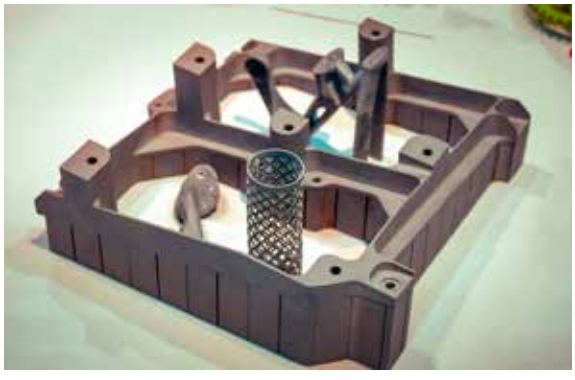
ANSYS Workbench Additive

> **"Additive manufacturing is opening the doors of imagination for both designers and analysts."**

Just like Additive Print, ANSYS Workbench Additive also simulates the metal powder bed printing process but within the familiar Workbench environment. It helps users to eliminate failed builds and to visualize deformation and thermal stresses during the print process. But unlike Additive Print, Workbench Additive was created for engineering analysts so they can remain within the ANSYS Workbench environment throughout the entire simulation process.

HOW IT WORKS

For example, an aerospace engineer might import a complex CAD geometry, consisting of thousands of parts, into Workbench, then clean the geometry by applying ANSYS SpaceClaim and set up a full analysis file, for either just one part or the entire assembly. The engineer can then run full transient heat-transfer simulation, full structural and/or thermal analysis to determine what kind of geometry changes are needed, all inside Workbench. He or she can also run a CFD analysis to see how geometry variations can affect pressure drop, for example. The engineer can also run topology or lattice optimization analysis, and then re-run any of the structural, CFD or modal analyses — all without leaving ANSYS Workbench.



Once the engineer determines that the part will perform as needed, he or she can run Workbench Additive to determine how the part will print. Is there thermal stress buildup? Is there deformation? Should the supports be adjusted or must the part be redesigned and reanalyzed? After the print simulation, post treatments like removal from the base plate and heat treatment can also be simulated — all inside ANSYS Mechanical. ANSYS Workbench allows engineers to perform fatigue analysis to see if the part or assembly (whether printed or manufactured traditionally) will hold up through wear and tear, and to perform a variety of optimization processes.

Additive manufacturing is opening the doors of imagination for both designers and analysts. Many thrilling design ideas will come to life in the upcoming years. Simulation will ensure that those ideas can survive the challenges of the additive manufacturing process so they can come to life.