STIC Note

Additive Manufacturing Materials Testing

BACKGROUND/PROBLEM

Additive Manufacturing (AM), or 3D Printing, is a method of manufacturing that makes objects by sequentially layering materials by a computer controlled device. AM could be used by the Coast Guard to improve mission effectiveness and reduce operating cost by allowing unique parts to be developed and printed on demand. However, there are some unique challenges inherent in the AM process that need to be accounted for in the design and development of AM parts. Quality Assurance (QA) in AM parts can also be a challenge since each part is a discrete manufacturing process.

Surface Forces Logistics Center (SFLC) is developing guidelines for part validation and certification. RDC's STIC Branch, supported the Industrial Production Facility (IPF) New Orleans' effort to evaluate various materials and methods to help inform personnel and to ensure the policy they were developing was adequate for AM.

METHODS

STIC met with IPF New Orleans to discuss their current AM capabilities. It was determined that a new 3D printer would be needed that was capable of printing a large number of materials with a large build volume to support the testing.

Based on the requirements determined by IPF, a Fusion3 Edge printer was selected. The Fusion Edge3 is made in the United States and has been verified by the manufacturer to print using a variety of materials. Using the new printer, IPF New Orleans personnel would print test parts out of different materials and at different orientations. Additionally, some parts were then subjected to a maritime environment. Finally, a simple strength test was conducted to verify the guidelines being recommended for AM part development were sufficient.

Figure 1. Fusion3 edge printer at IPF NOLA. (Source: U.S. Coast Guard)

EVALUATION

IPF New Orleans identified some example parts that could be used as test cases. The group identified several parameters that could influence the test parts and optimized the parts for the AM process. The test parts were printed from various thermoplastic materials, print orientations, and part densities. The parts were tested for ultimate strength so the developers could see direct correlation between design decisions and part strength.

CONCLUSIONS

The effort was successful in allowing policy and guideline developers at SFLC and IPF New Orleans to better understand the implications of AM process parameters on the ultimate success of the part. The testing results and AM part development workflow of the testing efforts are being included as recommendations in the policy being developed for AM part design and verification. The working title for the guideline under development is "SFLC AM Part Triage, Development and Deployment."

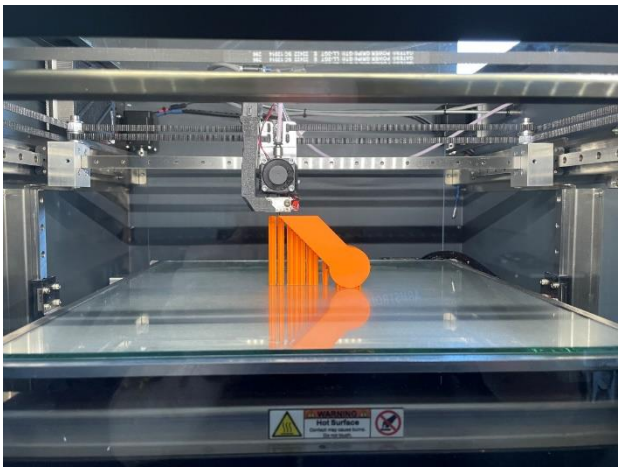

Figure 2. Printing test parts at a 45-degree orientation. (Source: U.S. Coast Guard)

Figure 3. IPF member testing the ultimate strength of a part. (Source: U.S. Coast Guard)

FUTURE WORK

SFLC, IPF New Orleans, and the STIC continue to collaborate on AM efforts with the ultimate goal of wider application of AM technology throughout the USCG. While this effort helped informed policy and guideline development, specific QA procedures still need to be identified.

The Science and Technology Innovation Center (STIC) is a DHS S&T and USCG collaboration.