Hepburn and Sons LLC

Ingalls Shipbuilding
A Division of Huntington Ingalls Industries

MELD MANUFACTURING

Panel Project Status – Using MELD to Additively Manufacture Flight Deck Tie Downs

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Agenda

- **Project Status**
- **Project Overview (Re-scope) & Highlights**
- **Deliverable Schedule (Re-scope)**
- **Motivation for Project**
- **Examples of MELD in use**

Project Status

- Due to unresolved MELD tooling issues in processing steel for another NSRP project, a change in scope was required to produce flight deck tie downs.
- It was decided that the focus would be on eliminating the explosively bonded joint required in the standard “tri-metal” tie down used in aluminum flight decks.
- If successful in joining aluminum and steel without the use of the explosively bonded joint, many other shipbuilding applications would be possible.
- The re-scoped project plan was presented to the ECB at the June meeting
- The ECB requested that the Project Team verify there were no patent infringement issues before approval.
- The Project Team completed their review and forwarded their findings to the PTR and ATI last week.
- Awaiting formal Re-scope approval from NSRP

Using MELD to Additively Manufacture Flight Deck Tie Downs

Project Lead Organization: Hepburn and Sons LLC
Project Team Members: Ingalls Shipbuilding, MELD Manufacturing, NSWCs Carderock and Philadelphia

Concept/Idea

Issue: Current flight deck tie downs are expensive and have long lead times.

Re-scope presented to ECB at June meeting

Re-scoped Solution(s): Provide an alternative manufacturing strategy for flight deck tie downs using MELSD's additive friction stir deposition (AFSD) process, providing cost and schedule benefits to the Navy shipbuilders compared to the current supply chain. Flight deck tie downs will be produced while maintaining the same geometry and function of the current tie down. The focus will be on the aluminum tri-metal tie down, eliminating the explosively bonded interface between the steel and aluminum.

Benefits/Justification

Benefits of the project

- Eliminating the need for an explosively bonded joint between flight deck and tie down
- Maintain the geometry and function of current tie downs while reducing cost and schedule for the Navy and shipbuilders/ship repair facilities
- Provide the shipbuilders or repair yards the ability to produce tie downs on site thus reducing acquisition costs and long (6-20 week plus) lead times
- Aligns to NAVSEA mission to implement AM
- Estimated ROI of 59% ($6.89M) in savings over five years

Project Approach

High level statement of work

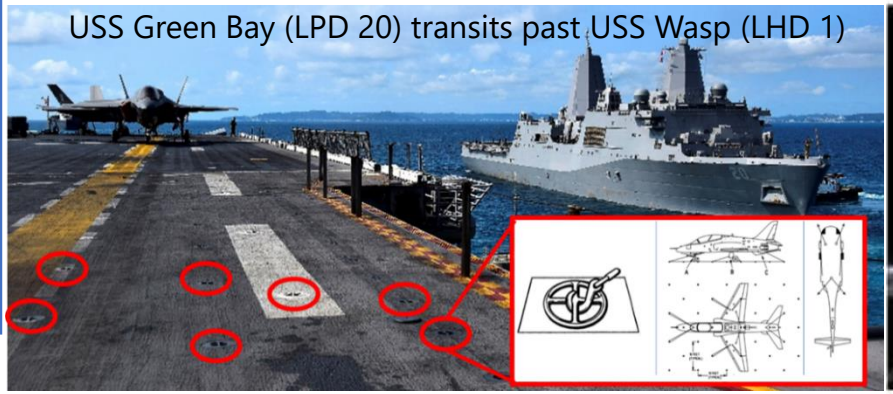
- Develop a process to join AA5083 to 1020 steel and 8620 steel
- Fabricate test samples of bi-metallic joints
- Verify properties
- Produce two steel/aluminum flight deck tie downs
- Send tie downs to NSWC-Carderock for metallurgical/mechanical examination

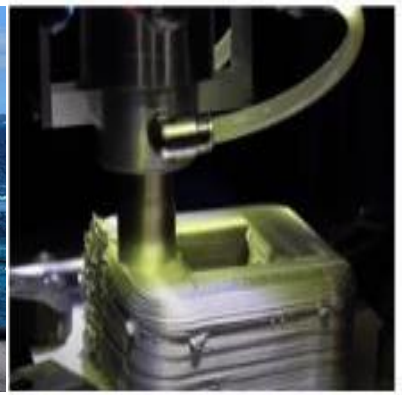
Metric(s) of Success

- Satisfactory steel/aluminum joint

Cost/Images/Relevant Information

Project Estimated Cost: $149,985 (6-month POP)


USS Green Bay (LPD 20) transits past USS Wasp (LHD 1)



Deliverable Schedule

- Kickoff Meeting Report (21 days after Contract Award) Complete
- Tie Down Test Plan (21 days after Re-scope Approval)
- Quarterly Status Report #1 (90 days after Contract Award)
- Verification of successful aluminum/steel joint properties (30 days after re-scope approval)
- Two tie-downs delivered to NSWCCD for examination (90 days after Re-scope approval)
- Quarterly Status Report #2 (180 days after Contract Award)
- Examination Report (120 days after Rescope approval)
- Final Report (150 days after Re-scope approval)

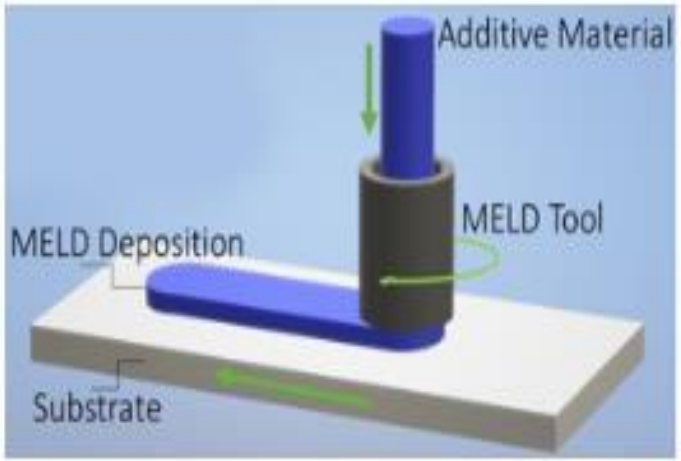
Motivation to MELD Print Tie Down – Low-Cost High Volume

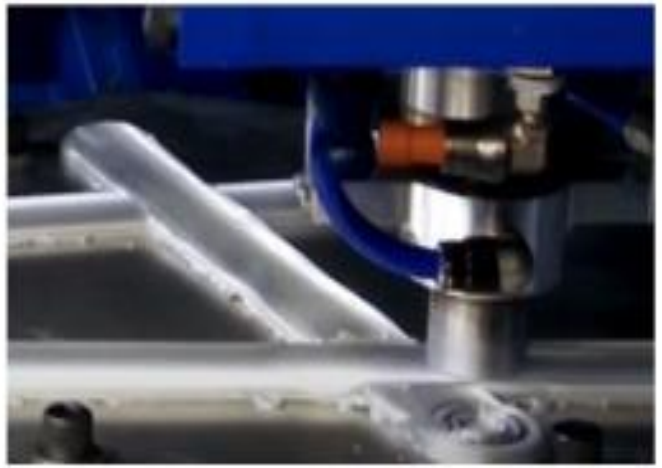
Using MELD to Additively Manufacture Flight Deck Tie Downs

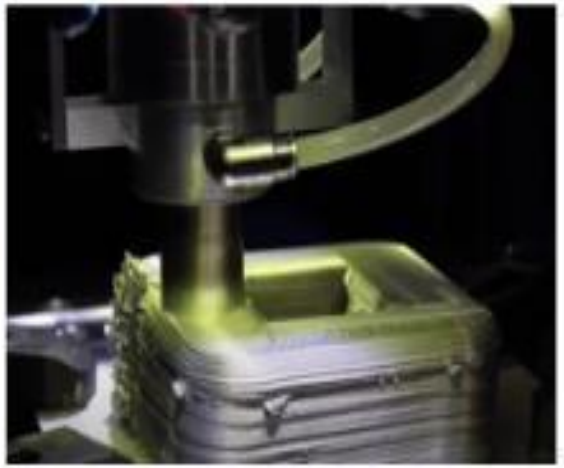
Type 14 - Type XIV US Navy Aircraft Tie Down - Flush
For Welding Into Steel Deck
Type 14 (Replaces Type 1)
Type XIV (Replaces Type I)
Per NAVSEA Drawing 803-1916300

Type 18 - Type XVIII US Navy Aircraft Tie Down - Flush
For Welding Into Aluminum Deck
Type 18 (Replaces Type 17)
Type XVIII (Replaces Type XVII)
Per NAVSEA Drawing 803-1916300

ALCOA Flight Deck Tie Down Assembly 05003554 Substitute
For PK-T50 USN Decking
LCS Type Ships with Aluminum Deck







How MELD Works…

Step 1: Perform a cost-benefit analysis for part orientation during MELD printing. Considerations include print time, feedstock cost, subtractive manufacturing capability, etc.

Step 2: Use CAD software to design the near-net part the MELD process will be used to print.

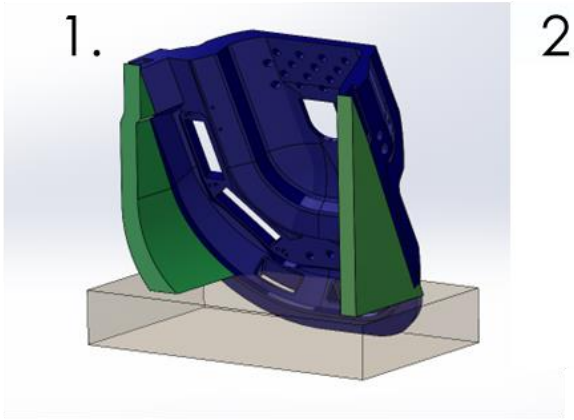
Step 3: Use software and create toolpath model creation; slicing model for using MELD to print; tool path programmed for part

Step 4: Load solid bar feedstock into MELD machine. Using MELD additive friction stir deposition technology, apply layers of material to build up part with layering

Hatch Model Orientation & Toolpath Model Creation

Hatch Slicing and Printing

1.



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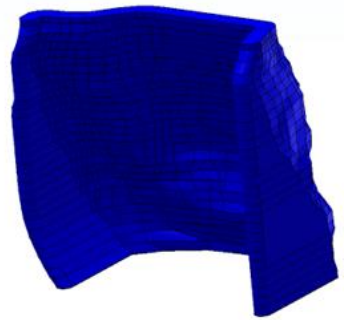

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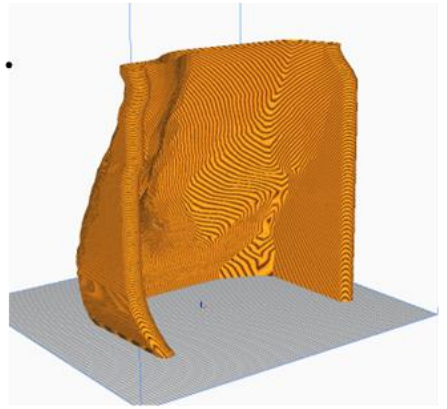


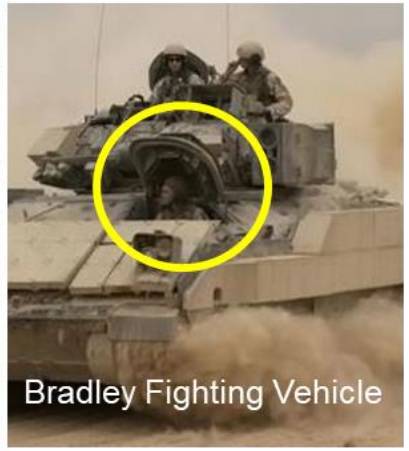
4.

Machining to Final Form – Integrate part into Vehicle

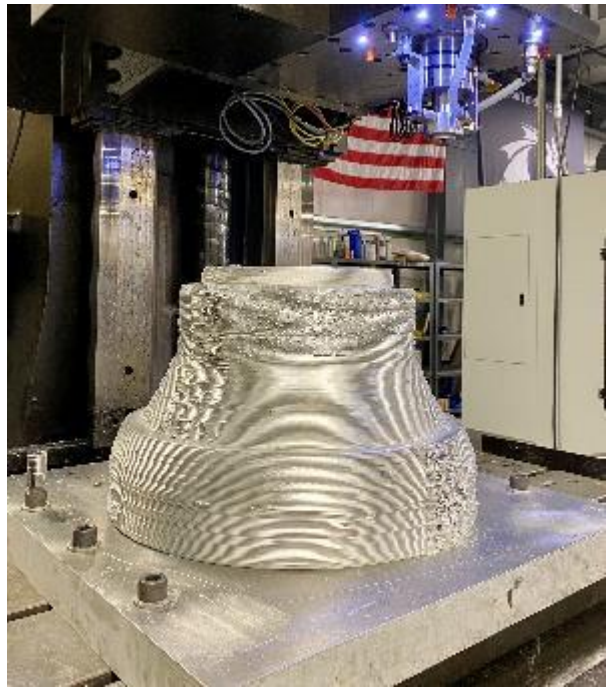
Step 5: Machine MELD part to final form by removing material

(This is where most monolithic parts suffer in production due to the immense amount of subtractive machining required from a large solid form, MELD typically saves 80%+ of subtractive work)

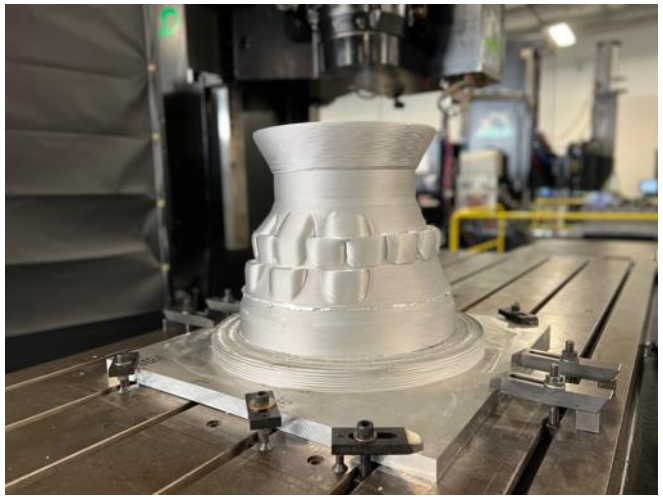
5.



Large Scale Aluminum part printing



MELD Al7050 Printed Part



MELD Al6061 Nozzle

MELD Forged Aluminum Ring Replacements

MELD Al7075 Cone

Thank You

Questions?

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