Custom Tooling for Aircraft Sheet Metal Repair Using Consumer Grade 3D-Printer and PLA

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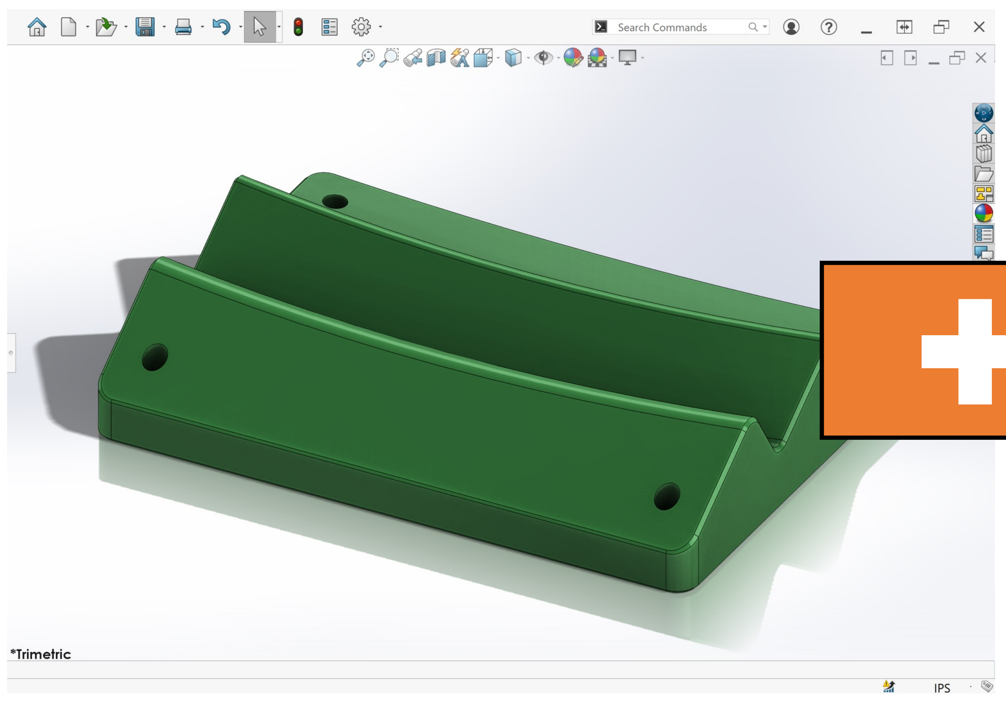
IDEA

Sheet metal repair parts for aircraft are sometimes difficult to fabricate.

Can 3D-printed tooling make this job easier?



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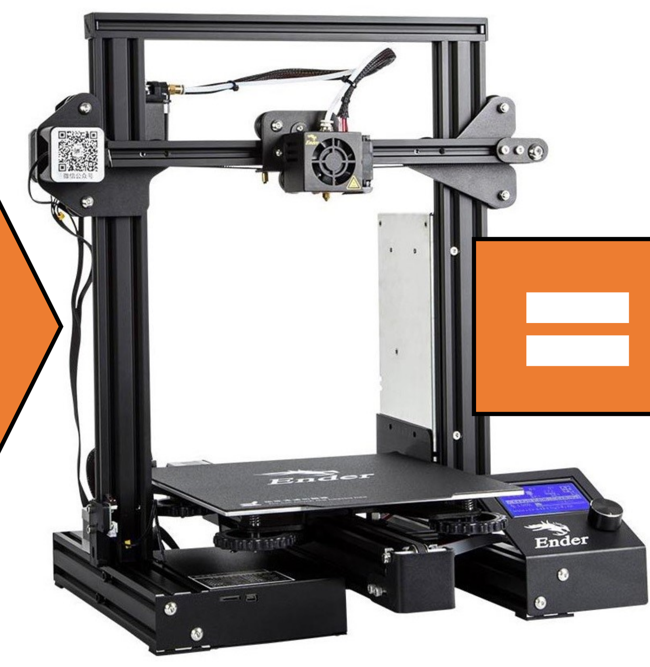

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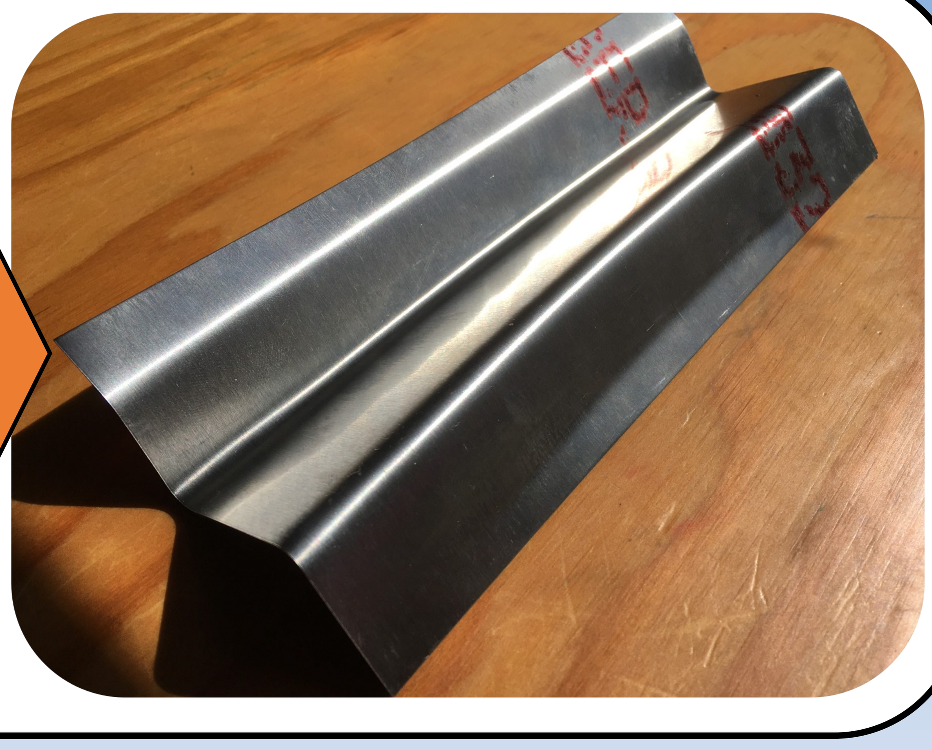
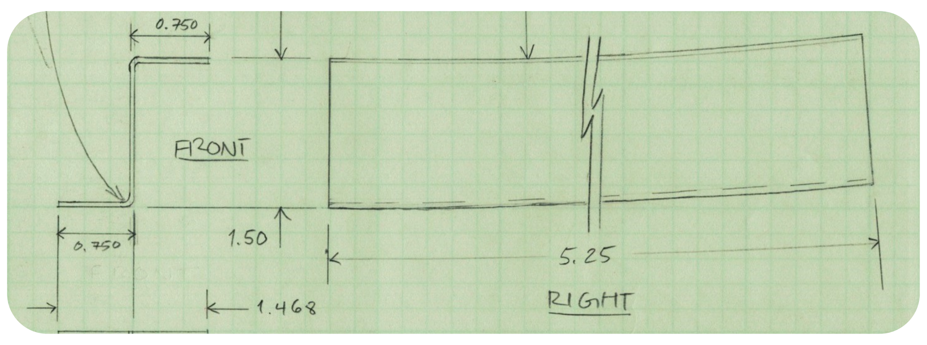
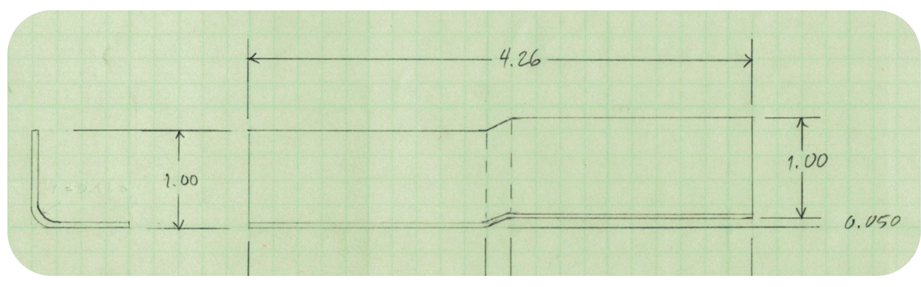


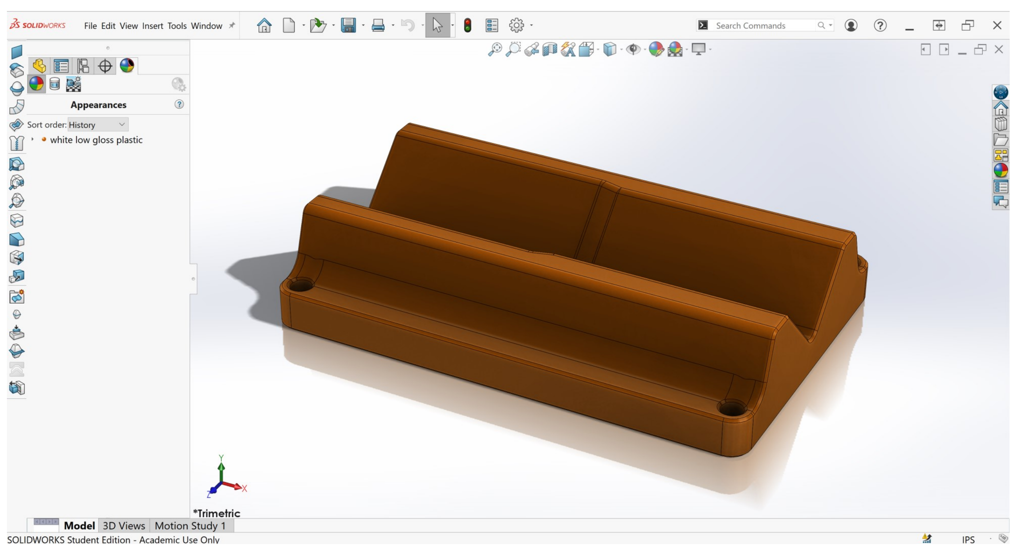
PLAN

An investigation into the production of 3D-printed tooling would help answer this question.

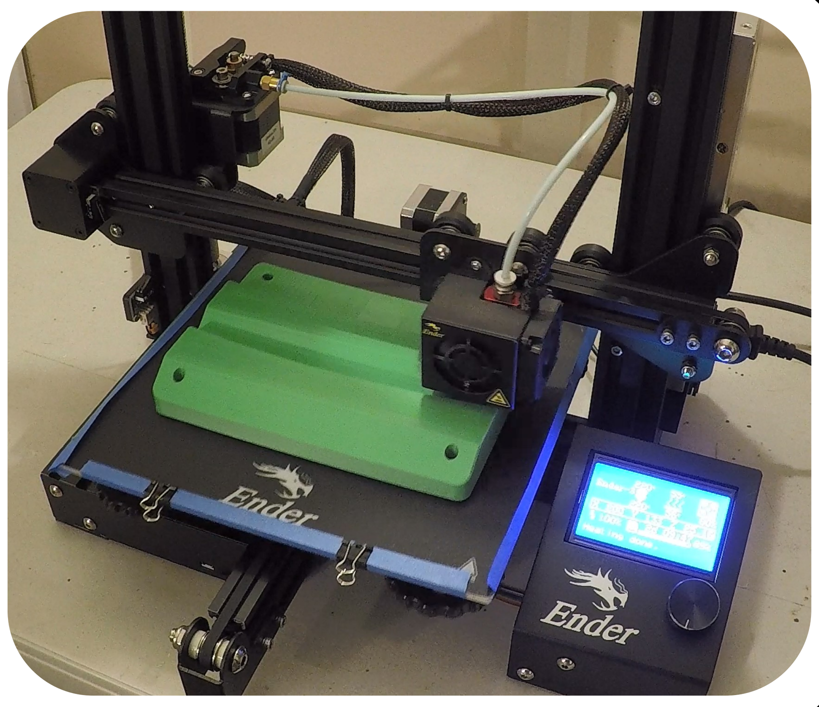


Two example repair parts were chosen.



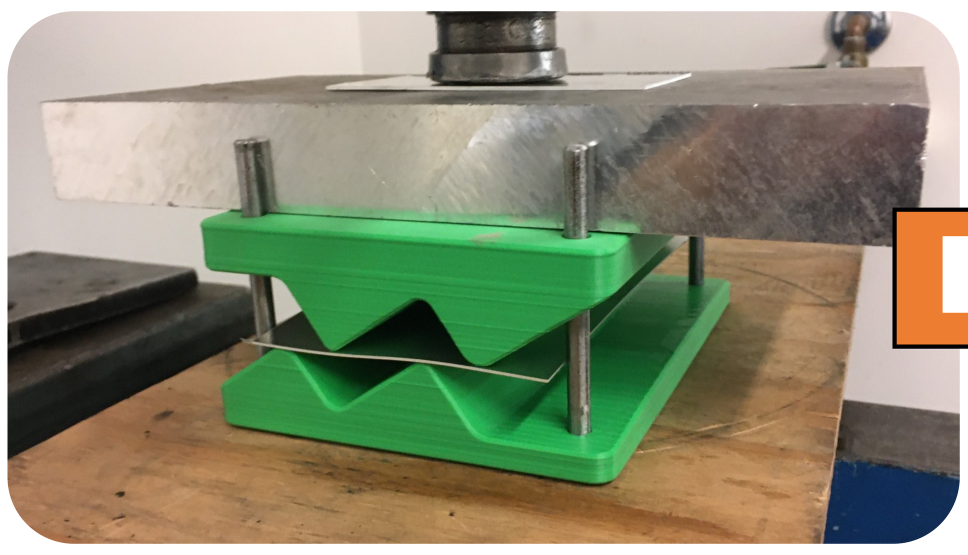


Tooling was designed, modeled in CAD software, then printed on a consumer-grade 3D-printer.

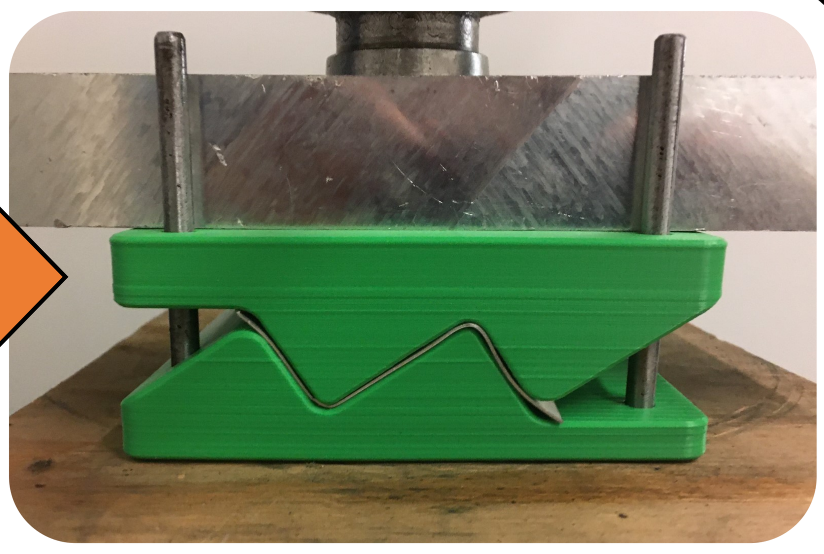


TRIAL

Printed from biodegradable PLA thermoplastic, toolsets were used with a hydraulic press to form repair parts of sheet aluminum.



PRESS

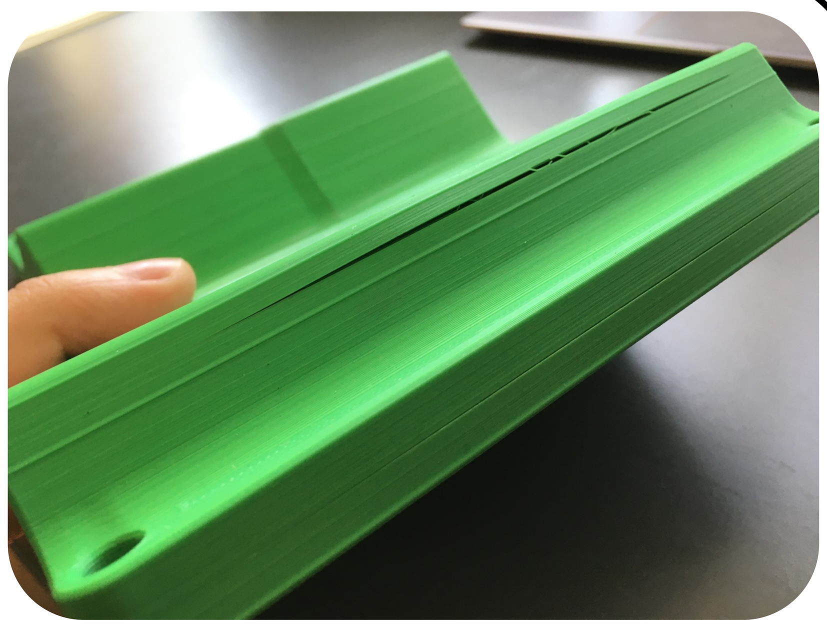


Left: The industrial hydraulic press used with the toolsets to form parts.

Above: A piece of sheet aluminum is sandwiched between the two halves of a tool set, then forced together by the ram of the press. The four steel pins align the tool halves during operation.

RESULTS

- Parts were well formed without defects, such as cracks or kinks.
- The tooling was reusable with little wear noted.
- Pushed to failure, one tool set was tested at a force of nearly nine tons—far more than necessary for part formation.



Right: Failure mode of the tool set that was destructively tested. Splitting occurred between print layers.

Left: The ten example repair parts produced by the 3D-printed tool sets.

CONCLUSIONS

Unexpected Success: It was not expected that the 3D-printed tooling would withstand the forces required to press-form the sheet metal parts or do so well.

Drawbacks: With a considerable tool design process and print times lasting several days, this method offers little advantage over that of conventional fabrication.

The Future: The success of this research warrants further investigation. However, the development of 3D-printing technology will likely outpace such research, reaching the same ends by faster means.

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