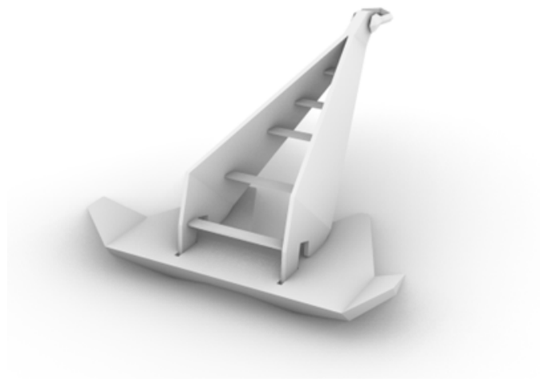
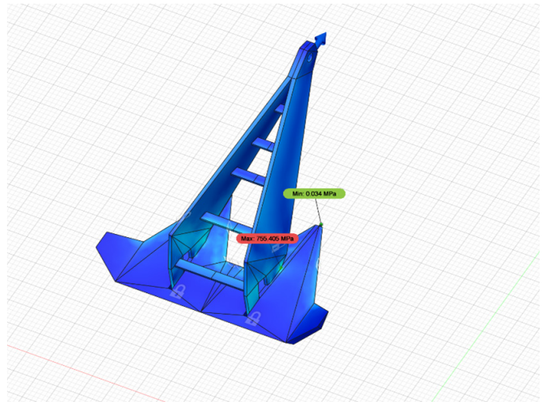
CASE STUDY MMC016

OPTIMISATION OF DRAG ANCHORS FOR ADVANCED MANUFACTURING

Malin Marine Consultants (MMC) have spent the last few years working on advancing marine applications for Large Scale Additive Manufacturing (LSAM) and, via the MariLight series of projects, concluded that there are significant savings in material, emissions, and manufacturing effort to be realised by strategic deployment of additive manufacturing technologies. MMC has proposed that drag anchors could be a good candidate for these technologies, and this project is expected to verify this proposal and give an early view on the potential savings.
Drag anchors have traditionally been designed and built using a 'welded plate' philosophy, fusing large, thick, shaped plates together to create a heavy structure with the required resistance when embedded in the seabed. The manufacture is laborious and significantly time consuming. However, the recent developments in topology optimisation and large scale additive manufacturing introduces the potential to completely redesign drag anchors to be more efficient and effective while allowing a scalable, robotic process to automatically series-produce the required numbers for offshore wind.

Having established a baseline anchor (Figure 1) which bears a close resemblance to industry standard anchors, MMC used a variety of methods to create a series of test models which were printed in polymer and tested using a small test rig designed by the engineering team.





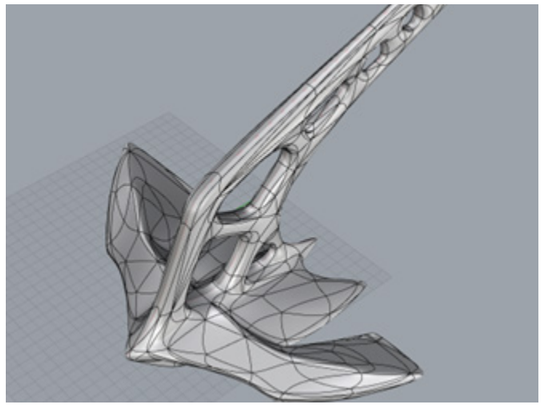


Figure 1-4 (clockwise): Standard Drag Embedment Anchor; Baseline Drag Anchor Von Mises Plot; Optimised Drag Anchor Geometry; Freeform Geometry

The results are compelling, and can be summarised as follows:

- Average anchor material savings = 11% (best anchor is 17% lighter than baseline)
- Production material savings (reduced scrap) = 20% (concluded from MariLight projects)
- Production emissions = >27% (concluded from MariLight projects)
- Best performing freeform anchor = 251% more holding capacity than baseline anchor

The project confirmed that there are significant opportunities presented by the introduction of LSAM technologies to drag anchor fabrication. These are not simply limited to improving productivity and reducing waste in the fabrication process but amplified by the freedoms unlocked with Design for Additive Manufacturing (DfAM) that can position material exactly where it needs to be for best performance of the anchor.

There is a considerable amount of de-risking work to be done before this becomes a full-scale, commercial reality, however the steps are clear and achievable, and the prize is significant. The next stage of this project should be to design and print an optimised, scale model in carbon steel and have its performance verified and validated at the Offshore Renewable Energy Catapult (OREC) Floating Wind Innovation Centre (FLOWIC) test facility in Aberdeen.

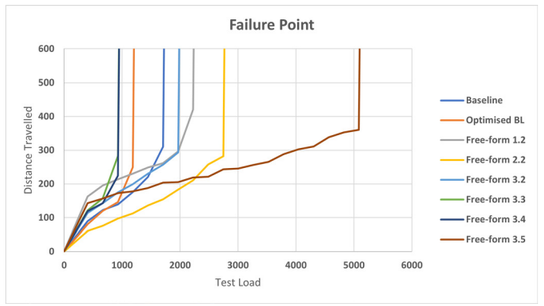


Figure 5-8 (clockwise): Printed Anchor; Test Rig Arrangement; Distance Travelled vs Test Load; Series of test drang anchors 3D printed to be tested.