AIRMESH: Inhabitable Stainless-Steel 3D Printed Space

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Abstract

This paper investigates the application of metal 3D-printing as structural element in architectural scale for complex space frame structure with the theoretical and practical implication. An on-going research, design and construction for a 30 sqm surface and 4.8-meter-tall inhabitable lightweight stainless-steel space frame pavilion by the authors support the hypothesis that AM in stainless steel has a clear application in both architectural and structural design. The integration of multiple functional building components of architectural system such as foundation, openings, floor decking, façade cladding, as well as lighting features are implemented in a tetrahedral structure. The main aim is to explore the spectrum of pliability and adaptability of nodal joint system to achieve seamless aesthetic composition alongside with optimal structural performance.

Using an entirely computational-driven design workflow, the non-standard load-bearing structure is conceived and manufactured through bespoke algorithms that combine spatial requirements, structural performance and site-specific data to inform its form. Geometric optimization processes based on force distribution are applied to attain structural efficiency and extreme material reduction in developing a fully functional space frame. This process demonstrates that metal 3D printing opens an entire new set of design opportunities, spanning from extreme levels of precision to minimal tolerances and transition between printed and non-printed standard components, that require the use of custom-built software and dynamic parametric models to conceptualize and advance a new conception of architecture.

Fig 1: Images of the AIRMESH 3D Printed 1:1 prototype using bespoke metal joints, standard stainless-steel bars.

References

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