

## 3D Printing with Drones - The Sky is the Limit?

Paul SHEPHERD\*, Chris WILLIAMS<sup>a,b</sup> and Robert STUART-SMITH<sup>c,d</sup>

\*Department of Architecture & Civil Engineering, University of Bath, Bath BA2 7AY, UK  
[p.shepherd@nbath.ac.uk](mailto:p.shepherd@nbath.ac.uk)

<sup>a</sup> Department of Architecture & Civil Engineering, University of Bath, UK

<sup>b</sup> Department of Architecture & Civil Engineering, Chalmers University of Technology, Sweden

<sup>c</sup> School of Design, University of Pennsylvania, USA

<sup>d</sup> Department of Computer Science, University College London, UK

### Abstract

Many researchers have reported on the potential innovations available when additive manufacturing (3D printing) is applied to the building construction process, be it at the scale of an individual building component (Galiaard et. al. [1]) or the building itself (Baarsen et. al. [2]). However, by the very fact that the printing takes place inside the volume of the 3D printer, the finished product must be of a similar scale to the machine used to create it.

To overcome this limitation, the authors are involved in a project to develop autonomous flying drones, capable of 3D printing in the classic sense, by extruding liquid through a nozzle which then sets solid ([www.aerial-abm.com](http://www.aerial-abm.com)). The authors presented their early work to the IASS community in 2017 [3], discussing the complex material requirements and benefits of integrated structural analysis during printing.

This paper provides an update on the progress of the authors' research on this project over the past two years. It demonstrates that the concept of 3D printing buildings with drones is indeed feasible from a technological point of view. And from this premise, the implications are discussed in terms of the maximum practical height of building that could be printed. This involves an understanding of material properties, local and global geometry, structural stability as well as architectural considerations.

### References

- [1] S. Galiaard, S. Hofman, N. Perry and S. Ren, "Optimizing Structural Building Elements in Metal by using Additive Manufacturing", in *IASS Symposium 2015: Future Visions*, Amsterdam, 2015.
- [2] S. B. Baarsen, J. Schönwälder, R. Houtman, A. C. Veen, H. Vermeulen and S. Haan, "The 3D Printed Canal House", in *IASS Symposium 2015: Future Visions*, Amsterdam, 2015.
- [3] P. Shepherd and C. Williams, "Shell Design Considerations for 3D Printing with Drones", in *IASS Symposium 2017: Interfaces*, Hamburg, 2017.