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Challenges of 3d printed architectural ceramic components structures: controlling the shrinkage and preventing the cracking

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Abstract

The use of ceramic materials in the additive manufacturing (AM) of architectural components has more and more examples and undeniably shows the potential of its application. However, one of the main characteristics inherent to this material, which happens in drying and firing phases, is the shrinkage of the material, which causes deformations and cracks in the surface of the produced elements. Thus, the shrinkage of the ceramic material may constitute an obstacle to the regular use of this material in the AM of architectural components. In this sense, it is important to study and point out ways and strategies to mitigate this drawback, making possible the correspondence between the final produced models and the digital ones in which they are based. This paper presents the main challenges and outcomes of several projects that use Liquid Deposition Modelling (LDM) of clay-paste as construction methodology.

Keywords: Ceramic 3D printing, additive manufacturing, ceramic retraction, parametric design, computational models, shrinkage, ceramic paste, Liquid Deposition Modelling.

References

[1] Barbosa, I., & Figueiredo, B. (2017). Optimized Brick – Print Optimization. In Chanllenges For Technology Innovation - An Agenda for the Future: Proceedings of the International Conference on Sustainable SmartManufacturing (S2M 2016): The International Conference on SustainableSmart Manufacturing (S2M), Lisboa, Portugal, 207-210. Leiden, Portugal: CRCPress.

[1] Khalili, K. et al. (2014). Numerical simulation of drying ceramic using finite element machine vision. Procedia Technology 12. 388-393.

[2] Susanga Costa, Jayantha Kodikara. Modelling of desiccation crack development in clay soils. International Association for Computer Methods and Advanced in Geomechanices (IAMCMAG). 2008; 1099-1107

[3] Anton, A., Abdelmahgoub, A. (2018). Ceramic Components – Computational Design for Bespoke Robotic 3D Printing on Curved Support. Computing for a better tomorrow, Volume 2, eCAADe 2018 36th Annual Conference. 71-78

[4] Cruz, P. J. S., Knaack, U., Figueiredo, B., & Witte, D. De. (2017). Ceramic 3D printing – The future of brick architecture, Proceedings of the IASS Annual Symposium 2017. A. Crisfield, *Non-linear Finite Element Analysis of Solids and Structures. Volume 2: Advanced Topics*. (2nd ed.). New York: Wiley, 1997.

[5] Emerging Objects. Web page URL - http://www.emergingobjects.com/

[6] Building Bytes. Web page URL - http://www.buildingbytes.info/

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