IMPLEMENTATION OF 3D ADDITIVE PRINTING TECHNOLOGIES FOR PROMOTING AND RESTORING THE VALENCIAN HERITAGE

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ABSTRACT

The Valencia Region enjoys a great variety of architectural as well sculptural historical and artistic elements. Recent years have witnessed great efforts to valorise, register, and preserve Valencian architectural heritage, though the costs associated with materials and skilled labour have largely restricted the number of actions.

The new additive manufacturing technologies, commonly known as 3D printing, provide great flexibility in fabricating unique pieces, which makes them particularly attractive for application to this sector, in which pieces or scale models are unique items, with resultant high cost. However, current 3D printing techniques only partially address the detected needs, when it is sought to make items of a ceramic nature or high mechanical strength, as well as of great size.

The **3DRestaurAM** emerged in this frame, the project's main aim being adaptation of the new 3D printing technologies to the field of restoration and promotion of the Valencian heritage by additive manufacturing of ceramic pieces or composites.

The results of this project seek to respond to the aim of developing ceramic materials for 3D printing techniques to enable heritage promotion and restoration. The developed materials and prototypes will be validated by experts in architectural graphic expression.

As large pieces, sometimes with quite complex geometries, need to be printed, the additive manufacturing techniques selected to carry out the project were those that allowed freedom of design and could be scaled up to large sizes, such as binder jetting or laser sintering, which work with powders. To obtain these prototypes, the following series of tasks were performed:

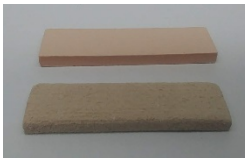
- Scanning and 3D modelling of items from the Valencian heritage.
- Formulation of clay-based materials for each selected printing technique.
- Optimisation of printing parameters.
- Aesthetic and technical validation of the prototypes made.

The first printing trials, using binder jetting technology, were performed using a Zcorp model 310 additive manufacturing printer.

In the frame of this project, compositions of a clayey nature with different organic agents are being formulated, using an aqueous medium as binder for printing.

Binder viscosity	1.1–1.3 Pa·s

Layer thickness (mm)	Saturation level (%)		Bleed compensation (mm)			Max top thickness (mm)	Min top thickness (mm)
	Shell	Core	X	Y	Z		
0.125	160	160	0.3556	0.3556	0.3048	8	4



Ceramic pieces were successfully printed with this technology. However, work is ongoing to improve the printing composition in order to optimise different parameters such as green and fired mechanical strength.

The main characterisation parameters of the final pieces were porosity and bending strength. The directionality of the pieces during printing was observed to affect test piece mechanical strength.

Quartz (%)	Kaolinite (%)	Mica (%)	Sodium feldspar (%)	Organic additives (%)
25–30	20–25	5–10	25–30	10–5

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