Topology Optimization of 3d Printed Prototypes

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ABSTRACT

A new design starts from an idea and become a final product, during this process the evaluation stage it's a nessecity, the most useful evaluation tool is prototyping. Conceptual models are very important in product design. Improving product quality is always an important issue of manufacturing, even if a design study is well organized it is possible some errors may still escape from the review of engineers and designers. The touch of the physical objects can reveal unanticipated problems and sometimes spark a better design. With the traditional method, developing of prototypes to validate or optimize a design is often time consuming and costly. Inject Binder is one of the most well-developed rapid prototyping or additive manufacturing technology, actually is a Powder-based inkjet 3D printing method. It is a powder-based RP system in which a binder solution is jetted onto pre-deposited powder layers. One of the main advantage of this method is the production of fullcolor models suitable for Architecture maquets, prototypes of new products like furnitures and other objects. In prototyping process a restriction is production cost which basicly depends from the amount of printed material. In current study furniture prototypes are printed in a inject binder printer, the printed models have common design like a chair and a table. The raw materials used in this study were a plaster-based powder (zp151) and an appropriate water based solution with 2-Pyrrolidone as a binder (zb63). Three different model of each model (trhee chairs and three tables) are printed, the main difference between them is wall thickeness, the first model thickness was 5mm, the second 10mm and third is 20mm. The printed parts are tested in a compresion tester device to check models elasticity and compressive resistance. Then the lab results are used to create a FEA (Finite Element Analysis) study in a popular CAE program. In the final stage an optimization study was performed to determine an optimized shell geometry and wall thickness. The results are a useful tool for designers and engineers in order to decide the appropriate wall thickness and shell geometry (pattern) so to void model over dimension.

Keywords: powder printer, furniture prototype, CAE, topology optimization, compression test