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Influence of Internal Topologies on Components Produced by Selective Laser Melting: Numerical Analysis

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Abstract : Regardless of the manufacturing process used, subtractive or additive, material, purpose and application, produced components are conventionally solid mass with more or less complex shape depending on the production technology selected. Aspects such as reducing the weight of components, associated with the low volume of material required and the almost non-existent material waste, speed and flexibility of production and, primarily, a high mechanical strength combined with high structural performance, are competitive advantages in any industrial sector, from automotive, molds, aviation, aerospace, construction, pharmaceuticals, medicine and more recently in human tissue engineering. Such features, properties and functionalities are attained in metal components produced using the additive technique of Rapid Prototyping from metal powders commonly known as Selective Laser Melting (SLM), with optimized internal topologies and varying densities. In order to produce components with high strength and high structural and functional performance, regardless of the type of application, three different internal topologies were developed and analyzed using numerical computational tools. The developed topologies were numerically submitted to mechanical compression and four point bending testing. Finite Element Analysis results demonstrate how different internal topologies can contribute to improve mechanical properties, even with a high degree of porosity relatively to fully dense components. Results are very promising not only from the point of view of mechanical resistance, but especially through the achievement of considerable variation in density without loss of structural and functional high performance.

Keywords : additive manufacturing, internal topologies, porosity, rapid prototyping, selective laser melting
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