Material Model Evaluation of a Processed Steel by Direct Energy Deposition Using Miniaturized Specimens

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ABSTRACT

This work addresses the evaluation of properties of a steel obtained by an additive manufacturing technology, with the goal of establishing a reliable material model that includes features as plasticity, anisotropy and fracture toughness.

The material used is a 316L stainless steel obtained by direct energy deposition with a "zig-zag" strategy, using a InssTek MX600 3D Printer for metallic materials. The material is examined as built, i.e., without any type of treatments or post processing. Samples, consisting in miniaturized specimens, are extracted in three directions from 3D printed blocks, both from the sides and from inside the blocks, and are tested in order to investigate possible anisotropy and location effects. Testing is performed under quasi-static loading conditions at room temperature. During the additive process, temperature is measured by thermocouples and residual stresses are evaluated by a contour cut method. Comparisons are performed with a FEM thermomechanical model.

Porosity of the processed material is also evaluated aiming to incorporate its effect into the material model.

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