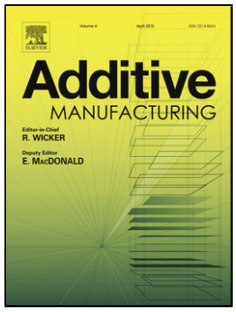

Title: Mechanical equivalent diameter of single struts for the stiffness prediction of lattice structures produced by Electron Beam Melting

Author: M. Suard G. Martin P. Lhuissier R. Dendievel F. Vignat J.-J. Blandin F. Villeneuve

PII: S2214-8604(15)00052-4
DOI: http://dx.doi.org/doi:10.1016/j.addma.2015.10.002
Reference: ADDMA 55

To appear in:

Received date: 11-7-2015
Revised date: 6-10-2015
Accepted date: 8-10-2015

Please cite this article as: <doi>http://dx.doi.org/10.1016/j.addma.2015.10.002</doi>

Mechanical equivalent diameter of single struts for the stiffness prediction of lattice structures produced by Electron Beam Melting

M. Suard[a,b*], G. Martin[a], P. Lhuissier[a], R. Dendievel[a], F. Vignat[b], J.-J. Blandin[a], F. Villeneuve[b]

[a] *Univ. Grenoble Alpes, SIMaP, F-38000 Grenoble, France*
CNRS, SIMaP, F-38000 Grenoble, France

[b] *Univ. Grenoble Alpes, G-SCOP, F-38000 Grenoble, France*
CNRS, G-SCOP, F-38000 Grenoble, France

E-mail: mathieu.suard@simap.grenoble-inp.fr

Keywords: Lattice structures; Electron Beam Melting; X-ray tomography; Image Analysis

The Electron Beam Melting (EBM) technology enables the manufacturing of new designs and sophisticated geometries. The process is particularly well suited for the fabrication of lattice structures. A standard methodology is presented in order to predict the mechanical response of lattice structures fabricated by EBM. The inner and outer structure of single struts produced by EBM was characterized using X-ray tomography. Struts with a 1mm diameter and different orientations respect to the build direction were analyzed. The geometry discrepancies between the designed and the fabricated strut were highlighted. Two effects were identified. (i): The produced struts are generally thinner than the designed ones. (ii): Within the produced struts, loads are not transmitted by the entire geometry. It was therefore suggested to separate the strut between the mechanically "efficient and inefficient" matter. The elastic response of the strut was assumed to be represented by a circular cylinder with an equivalent diameter. Two equivalent diameters were defined. The first one is the diameter of an inscribed cylinder whereas the second one is the result of a numerical simulation based on the 3D image of the strut characterized by X-ray tomography. The methodology was then applied to an octet-truss lattice structure. The difference in terms of Young's modulus between both approaches and experimental values were discussed. The mechanical