

COMPRESSION BEHAVIOUR OF CELLULAR STRUCTURES PRODUCED BY
SELECTIVE LASER BEAM ADDITIVE MANUFACTURING :
X-RAY TOMOGRAPHY BASED FINITE ELEMENT AND EXPERIMENTAL
APPROACHES

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Selective laser melting is a novel additive manufacturing technique to produce cellular structures with desired shape and pattern provided by a computer-aided design software. During the process, series of layers consisting of metal powders are molten and solidified on top of each other using a laser beam. Two face-centred cubic structures with the same shape and repetitive pattern but different beam and node thicknesses were produced for this work using this technique. Deformation of the structures under compression is imaged by in situ and ex-situ X-ray tomography scanning. The initial state of the structures is scanned using the stitching tomography method to capture high-resolution 3D images illustrating micro and macro porosities. A 3D image-based conformal finite element model is then built for the simulation of the compression test using porous plasticity. The local porosity of each element is directly informed from high resolution tomography. Simulations considering a homogeneous matrix with an average initial porosity everywhere are compared to the new inhomogeneous model. A fairly good agreement is found between the inhomogeneous model and experiments.