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Mechanical engineering

**Design, manufacture and performance evaluation of a machine tool ram based on a steel/foam sandwich structure**Goletti M.<sup>1</sup>, Mussi V.<sup>1</sup>, Albertelli P.<sup>2</sup>, Rossi A.<sup>1</sup>, Monno M.<sup>2</sup>, Schiavi B.<sup>3</sup><sup>1</sup>Laboratorio MUSP, Piacenza<sup>2</sup>Politecnico di Milano, Dipartimento di Meccanica, Milano<sup>3</sup>Jobs S.p.A., Piacenza

The aim of this work was to increase the material removal capability of a machining center with gantry structure in heavy milling operations. A foam filled sandwich structure was applied in the design of a new machine tool ram. The redesign was intended to be a replacement of an existing ram made of welded steel panels of a 5-axis milling machine. Sandwich structures replaced steel plates and stiffening components in order to increase specific stiffness. The shape and dimensions of the newly designed ram were obtained by applying an optimal design procedure.

Two different types of foam fillings were considered: aluminum foam obtained by the powder compact melting technique [1] and Hybrid Advanced Pore Morphology (Hybrid APM) based on aluminum foam spheres in a polymeric matrix [2][3]. The latter solution was chosen due to the technological considerations emerged during the manufacture of preliminary specimens. The manufacture of the foamed component is here discussed in detail.

Performance evaluation of the realized component have been carried out with experimental modal analysis, trajectories tracking and face milling tests. The axial depth of cut limit (Stability Lobe Limit) have been experimentally measured for the proposed redesigned ram against the traditional ram solution. An important increase in performance has been observed.

[1] J. Banhart. Manufacture, characterisation and application of cellular metals and metal foams. Progress in Materials Science, 2001, vol. 46, p. 559–632.

[2] J. Baumeister. Methods for Filling Hollow Structures with Aluminium Foam Materials Science Forum Vols. 638-642 (2010) p. 61, doi:10.4028/www.scientific.net/MSF.638-642.61

[3] M. Monno, J. Baumeister, M. Goletti, V. Mussi, J. Weise. Dynamic behavior of hybrid APM and aluminum foam filled structures. Proceedings of the Conf. MetFoam 2011, Busan, (In Press)