

Thermal and Mechanical Finite Element Analysis of a Mineral Casting Machine Frame

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Abstract : Thermal distortion of the machine tool plays a critical role in its machining accuracy. This study investigates the thermal performance of a high-precision machine frame with future-oriented mineral casting components. A thermo-mechanical finite element model (FEM) was established to evaluate the thermal behavior of the frame under environmental thermal fluctuations. The validity of the presented FEM model was confirmed experimentally by a series of laser interferometer tests. Good agreement between numerical and experimental results demonstrates that the proposed model can accurately predict the thermal deformation of the frame with thermo-mechanical coupling effect. The results also show that keeping the workshop in thermally stable conditions is crucial for improving the machine accuracy of the system with large scale components. The goal of this paper is to investigate the feasibility of innovative mineral casting material applied in high-precision drilling machine and to provide a strategy for machine tool industry seeking a perfect substitute for classic frame materials such as cast iron and granite.

Keywords : thermo-mechanical model, finite element method, laser interferometer, mineral casting frame

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