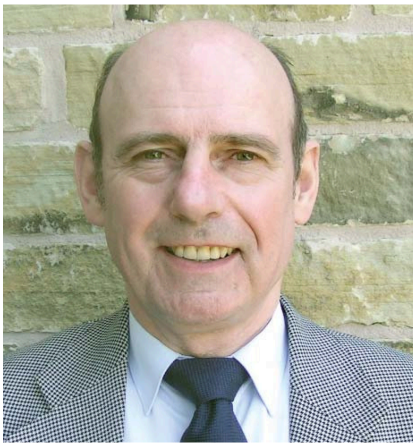
Firm foundations for sure

Are you sure that your machine tool's foundations are equal to the task? A conventional structural engineering approach might compromise your investment, says Huddersfield University's Alan Myers



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The vast majority of medium to large machine tools rely on their foundation to provide adequately stiff support, and fall into one of two groups: those machines that have a cutting force loop between tool and workpiece and which lies entirely within the machine structure; and those machine configurations where the workpiece and the machine are structurally connected by the foundation and where the force loop passes through the foundation.

In both cases, the foundation provides the static and dynamic stiffness required to maintain geometrical alignments under changing loads.

The traditional method when specifying foundations is to stipulate a minimum depth, based upon the nature of the sub-soil. The burden is left with the civil engineer to assess the required depth based only on *loads* but without knowledge of the required *stiffness*.

Since machine tool structures are designed on stiffness-based criteria, the load-based approach is often inadequate.

However, today's technology allows an accurate assessment of foundation depth to be made with the help of Finite Element Analysis (FEA) and adoption of the appropriate procedures.

The required stiffness and loading at the surface of the foundation should be specified based upon required stiffness between machine spindle and work-piece and geometrical alignment accuracy determined by the appropriate ISO standards etc.

Sub-soil conditions should be evaluated by test bore drillings, and by undertaking a load/deflection plate test on the sub-soil after excavation, the 'Modulus of Uniform Elastic Compression' for the sub-soil can then be determined.

With properties known, you can then design the foundation using FEA and determine whether piling is required, and generate and analyse a FEA model of the foundation, including the sub-soil, and optimise the depth of the base to give the required surface stiffness.

Having been careful with your initial design, you should test the foundation to confirm the design criteria have been met prior to installation. This is done by reviewing the machine configuration and determining the moving elements, their traverses and weights.

With these known, place the necessary instrumentation equipment, such as water pots, electronic levels, measuring reference frame with transducers, on the foundation upper surface as required.

With that done, systematically load the foundation in a manner that simulates the machine movements as it is cycled through its working range and, using modern techniques, measure the surface deflections to an accuracy better than 10 microns.

Using the readings obtained, plot the results to show the 3D topography of the foundation when loaded and assess its rigid body movement relative to gravity as well as the distortion of the base.

Following the above procedure enables an accurate, quantifiable assessment to be made of the correct design for the foundation so as to produce a support surface for your machine tool that will ensure its correct overall structural integrity. M