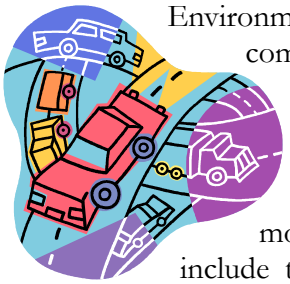
Vibro-Acoustic Consultants Series on Vibration and Noise Control Issues – June 2007

Environmental Vibrations

For many high-tech projects – including semiconductor and nanotech labs – building vibration is a key parameter to successful manufacturing and R&D. As an "invisible contaminant", facility vibration can be a major contributor to product loss, poor yield, and low throughput. In this article, Byron Davis explores the limitations imposed by environmental ground vibrations.

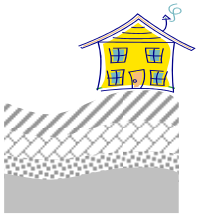


Environmental ground vibrations can come from various sources, both human-made and natural. In most settings, particularly in urban and semi-urban settings, human activities comprise the most important sources. These include transportation, such as rail and highway traffic; machinery at adjacent facilities; and construction work. In vibration-sensitive labs and manufacturing settings, these environmental ground vibrations can be a limiting factor.

The effects of these sources vary immensely. The variation is caused not only by intensity or number of sources; soil condition plays a critical role in the long-distance propagation of vibrations. The same source that is no issue in one region might be very significant in another region. The impact depends critically on the soil geology conditions in the area. This is why during site selection, site vibration test data are evaluated with respect to the temporary site soil condition. Often, the topsoil has some effect that will disappear when the topsoil is removed for construction.

In any case, environmental ground vibrations impose a limit to the final vibration performance of a facility. This is because, for traditional structures, *the background vibration environment is the quietest possible state for the final facility.* The building essentially rides on the waves in the ground, similar to a boat riding on the waves of the sea. Since the waves extend very deep into the ground, the building appears to ride on the very surface.

In many cases, even a deep foundation might not be enough to circumvent these deep waves. It is usually not possible to mitigate environmental vibrations by using conventional building techniques. In some cases (weak soil over a shallow, stiff bedrock layer) it is possible to use end-bearing piles to reach and engage the stiff soil layer. This is similar to anchoring the boat to the seabed, such as with shallow-water drill rigs.



But usually, this technique has only modest success due to skin-friction along the pile and due to the *increase* in vibration levels in the horizontal direction. Successful accommodation of environmental vibrations often is accomplished either by increasing the setback distance or by treating the source itself.

It is important to understand that traditional structures cannot change the environment. A poorly-designed structure might *amplify* the environmental ground vibrations, but it cannot *reduce* them. While alternatives exist, such as floating the entire building on spring isolators, this is uneconomical in most cases.

Vibro-Acoustic Consultants specializes in vibration and noise design in demanding settings, serving clients around the world. Contact Byron by visiting www.va-consult.com

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