Summer 2007

Consultants Corner

Engineering for the future

New Geophysical Capabilities at Earth Systems

Earth Systems has added new capabilities to our Geophysical Division through our Southwest office in Bermuda Dunes. We are now offering refraction microtremor, or ReMi, surveys, in addition to seismic refraction.

ReMi is a seismic method developed by Optim Software™ of Reno, Nevada, for estimating shear-wave (S-wave) velocities down to depths of 300 feet or more. Testing is performed at the surface using the same seismograph and geophones used to acquire traditional refraction data. Instead of explosives or the dreaded sledgehammer, the seismic source consists of ambient seismic "noise," which is constantly being generated by urban traffic, airports, construction, mining, waves and wind. It takes only two to three hours for data acquisition and analysis. Figure 1 shows a ReMi setup for a recent survey at a high-rise hotel site.

ReMi can save money on a project because of the rapid data acquisition and analysis. Moreover, data can be acquired along roads, in buildings and at active construction sites—areas often inaccessible to a drill rig. It can also decrease the number of borings needed to classify a site, and is non-invasive.

With ReMi "Vs" profiles, you can estimate subsurface properties and derive parameters useful for geotechnical engineering, such as earthquake site response.

Site Classification

Shear-wave data recorded with ReMi can be used to classify the soil profile type for the top 100 feet of a site. According to the California Building Code, there are only three approved methods for determining the soil profile type, and ReMi is the least expensive. At one site consisting of deep alluvium, ReMi data established the soil profile type as C, rather than D, resulting in a 10% reduction in engineering costs to the client.

Figure 1

Compaction of Artificial Fill at a Proposed Hotel Site

ReMi data was used on a recent project to help evaluate the quality of undocumented fill. A hotel with villas and a spa wing is proposed for the site. There were large areas of artificial fill with unknown compaction. The client did not want to remove and replace the entire fill. We wanted to evaluate the quality of the fill without drilling a huge number of borings.

In another area of the project site, we had removed some undocumented fill and replaced and recompacted it to 95% relative compaction. Since the composi-

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tion of this fill was about the same as in our area of interest, we decided to use ReMi. We acquired data over the well-compacted area in order to obtain a "thumbprint" of good fill (*Figure 2*). We next acquired data over the fill of unknown compaction (*Figure 3*). It's clear when comparing the upper portions of the data plots that something's "not right" with the undocumented fill area. This is exactly what the client said when they saw the plots; not much explanation was necessary. Further excavation supported the observed data—the lower shear-wave velocities at depth were zones of lower compaction.

This was a new and innovative use of the ReMi method. While absolute, hard conclusions should not be made based entirely on a geophysical method, it can be a valuable and cost-saving tool when used with drilling and other investigative techniques to help decide where to drill or in which direction to head

—Joseph McKinney

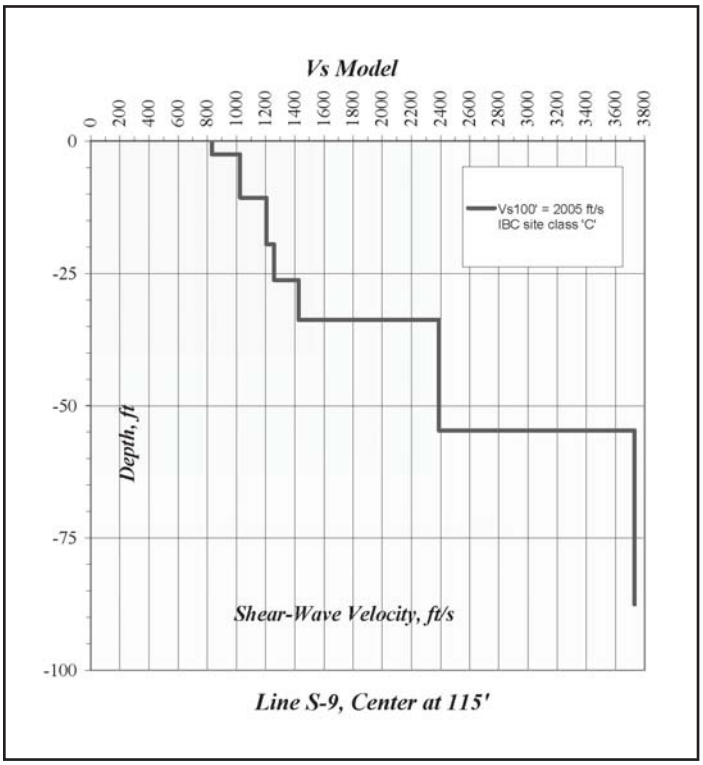

Figure 2

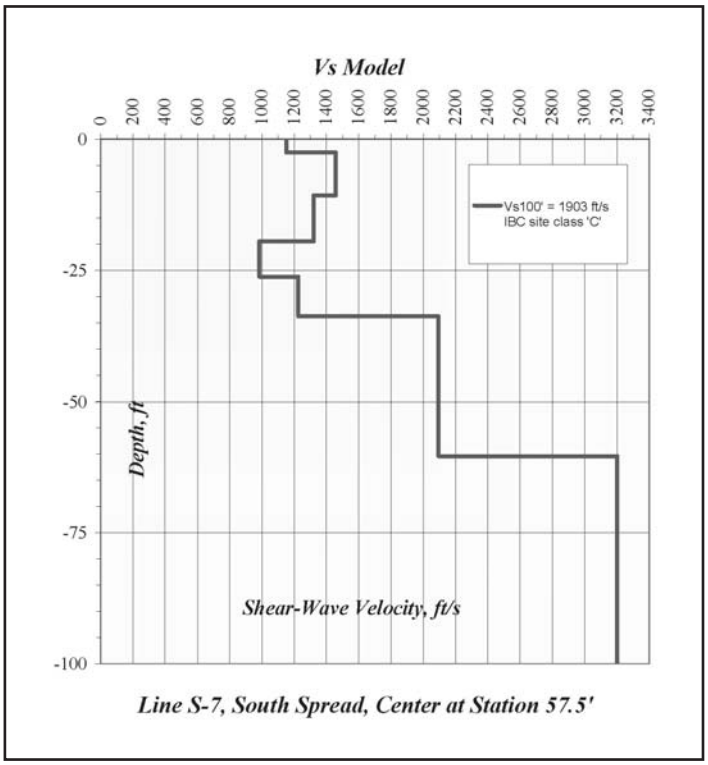

Figure 3