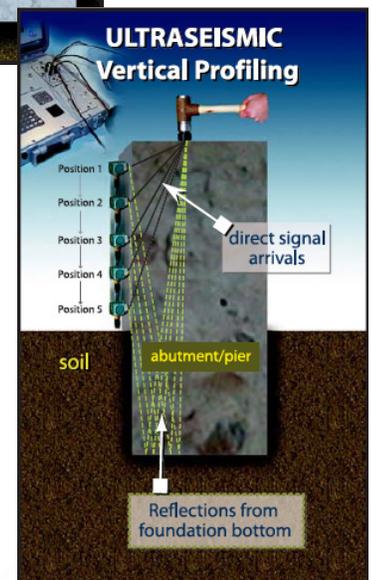
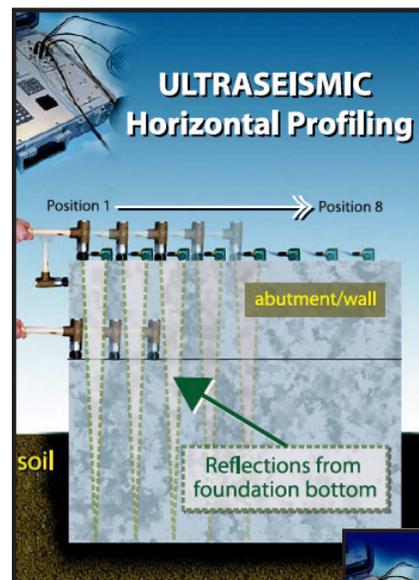




APPLICATION

Ultraseismic (US) investigations are performed to evaluate the integrity and determine the length of shallow and deep foundations. The US method can be performed on drilled shafts and on driven or auger-cast piles. The method can also be performed on shallow wall-shaped substructures such as an abutment or a wall pier of a bridge (provided that the side of the structural element is exposed by at least five to six feet for mounting instrumentation). This method is particularly useful in testing abutments and wall piers of bridges because of the relatively large exposed areas available for mounting instrumentation.

The US method represents a more sophisticated approach to the Sonic Echo/Impulse Response (SE/IR) method (for compressional waves) and the Short Kernel method (for flexural waves). The method was developed by Olson Engineering in response to difficulties encountered with the SE/IR and SKM methods when many reflecting boundaries are present. The US investigation method can be performed on concrete, masonry, stone, and wood foundations. Steel pile foundations can also be investigated, however, acoustic energy damping in steel pipes is much greater than in concrete and wood due to the large surface areas and small cross sectional areas of steel piles.



STANDARDS

No standards for the United States currently exist.

** See end of document for full references.*

FIELD INVESTIGATION

ACCESS

The US method requires at least five to six feet of the foundation be exposed for the receiver attachments. The schematic on the previous page illustrates an example investigation setup. The larger the exposed area, the better the definition of the reflected events.

COLLECTION OF DATA

In US investigations, the foundation top is struck by a hammer (both vertically and horizontally) and the response of the foundation is monitored by a three component receiver. The hammer input and the receiver outputs are recorded using an Olson Instruments Data Collection Platform equipped with an US System. The vertical hits are used to measure compressional waves while the horizontal hits are used to measure flexural waves. The receivers are moved along the exposed surface in intervals of 0.5 to 1 ft (typically vertical), depending on the extent of the exposed surfaces.

DATA REDUCTION

PROCESSING TECHNIQUES

Olson Engineering uses seismic analysis software, such as IX Foundation, to process and analyze a complete data set (instead of individual records). In addition to stacking the data from a US investigation, other geophysical data processing techniques can be used. Applying digital filters and auto gain controlled techniques to the data can enhance weak echoes. The separation of negative polarized events and positive polarized events can enhance weak echoes from the bottom of the foundation or from any discontinuity along the buried length of the foundation.

INTERPRETATION OF DATA

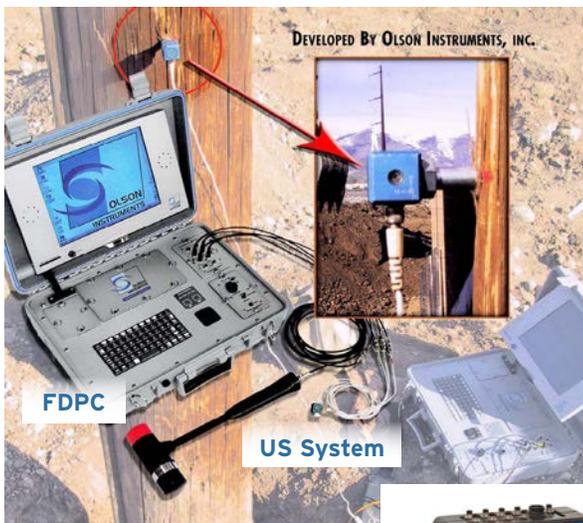
The recorded receiver outputs from the many receiver locations are stacked together - much like stacking of geophysical data. The stacking of many traces allows for better tracking of the reflected waves. In addition, the slope of coherent events in the stacked records determines the velocity of the direct and reflected waves to be used in the depth calculation.

Confidence in interpretation of US data is higher than that of SE/IR and SKM data because of the use of many receiver locations.

EFFECTIVENESS

Ultraseismic investigations can determine the depth of the foundation within 5% accuracy. However, the US method is not capable of determining depths of buried piles underneath a buried pile cap.

The US method requires at least five to six feet of the structural member be exposed, which is not always possible. For very deep foundations, echoes from the bottom may not be obtained because of the attenuation of energy in the surrounding soil.



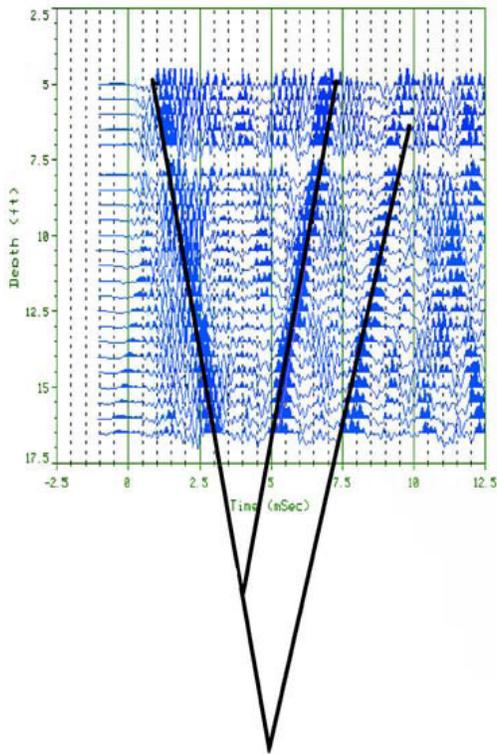
NDE 360



EXAMPLE RESULTS

CONCRETE PIER FOUNDATION

To illustrate the concepts of the US method, a test example on a concrete pier foundation is shown below. Using IX Foundation, all of the data from the multiple receivers can be presented in one plot. This allows for trends in the data to be identified, such as those highlighted in the figure shown.



REFERENCES

OLSON ENGINEERING PUBLICATIONS

- "Unknown Subsurface Bridge Foundation Testing", Olson, L. D. and Aouad, M. F., National Cooperative Highway Research Program Transportation Research Board National Research Council, 2001.



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