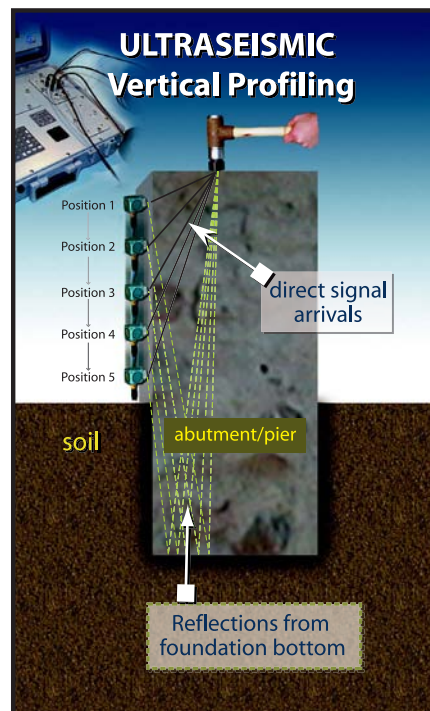
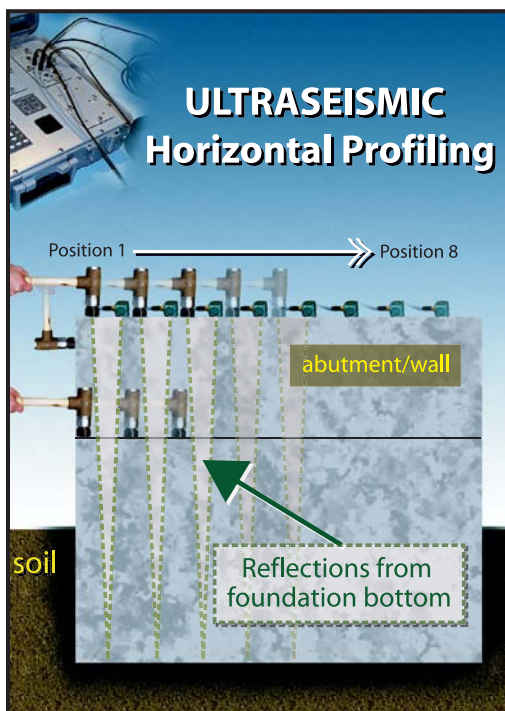


APPLICATION

Ultraseismic (US) investigations are performed to evaluate the integrity and determine the length of shallow and deep foundations. US investigations can be performed on drilled shafts and driven or auger-cast piles. The investigation can also be performed on shallow wall-shaped substructures such as an abutment or a wall pier of a bridge provided at least 5 to 6 feet of the side of the structural element are exposed for mounting instrumentation. The 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 internally developed at Olson Engineering as a response to encountered difficulties 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 is much greater than that of concrete and wood due to the large surface areas and small cross-sectional areas of steel piles.



STANDARDS

No standards for United States currently exist.

■ See end of document for full references.



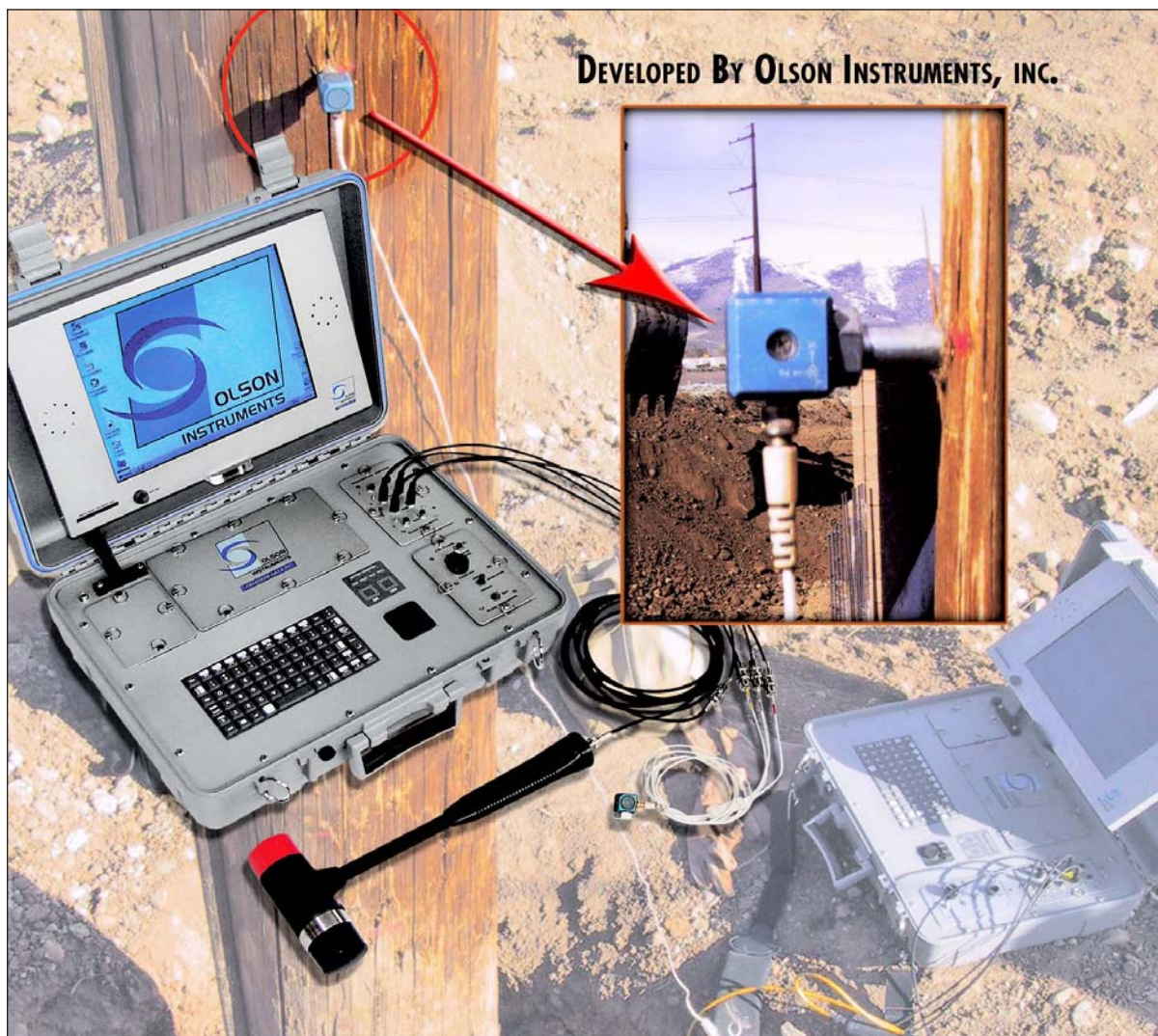
FIELD INVESTIGATION

ACCESS

The US method requires at least 5 to 6 feet of the foundation be exposed for 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 Freedom Data PC equipped with the Ultraseismic System (US-1). 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 with 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. Applications of digital filters and auto gain controlled techniques to the data enhance weak echoes. Separation of negative polarized events and positive polarized events enhances the weak echoes coming from the bottom of the foundation or 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.

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

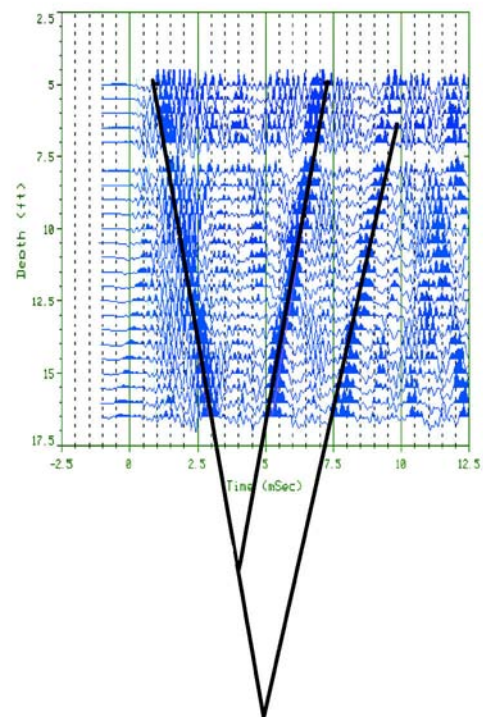
EFFECTIVENESS

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

The US method requires at least 5 to 6 feet of the structural member to 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.

EXAMPLE RESULTS**CONCRETE PIER FOUNDATION**

To illustrate the concepts of the Ultraseismic investigation, an example from a Ultraseismic investigation on a concrete pier foundation is shown at right. Using IX Foundation®, all 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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