

## Sonic Echo / Impulse Response (SE/IR) – Analysis of Buried Structures



### Introduction

Sonic Echo / Impulse Response (SE/IR) investigations are performed to evaluate the integrity and determine the length of deep foundations. The test can also be performed on shallow wall structures. The SE/IR test can be performed on concrete, wooden and steel piles. It can be used to determine the depth of a foundation, find breaks, cracks, defects, intrusions and bulbs in the foundation. The beauty of these two methods is that they use the same raw data but treat it differently.

### Applications

The applications for SE/IR are varied:

- Structural investigations of structures where foundation depth is unknown
- Assessing the condition of foundations
- Investigation of damage to foundations
- Investigation of bulbs in foundations

### Platforms Available

We offer two devices available for the SE/IR technique. These include the NDE360 and DataPC. These offer



differing levels of mobility and on-site analysis. Please see the individual brochures for more in depth specifications for the platforms.

### How it works

In an SE/IR test, the foundation top is struck by a hammer and the response of the foundation is monitored by a receiver. An Olson Instruments Freedom Data PC Sonic Echo/Impulse Response (SE/IR-1) system (shown below) records the hammer input and the receiver output.

### Sonic Echo

The Sonic Echo data is used to determine the depth of the foundation based on the time separation between the first arrival and the first reflection events or between any two consecutive reflection events.

A reflector can be the bottom of the foundation or any discontinuity along the embedded part of the foundation. Also, the Sonic Echo data can be used to determine the existence of a bulb or a neck in a shaft or the end conditions of the shaft based on the polarity of the reflection events. This is shown in the SE data overleaf where the troughs (reflections) in the data are used to calculate the depth of the pile.

### Impulse Response

The Impulse Response data is also used to determine the depth of reflectors. In addition, the IR data provides information about the dynamic stiffness of the foundation. This value can be used to predict foundation behavior under working loads or correlated with the results of load tests to more accurately predict foundation settlement.





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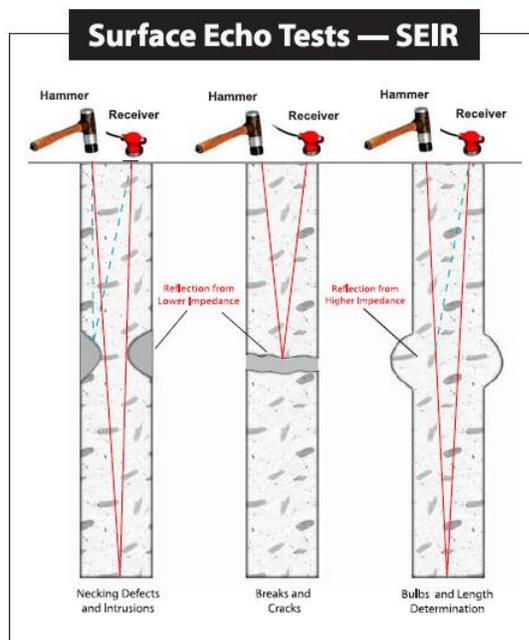
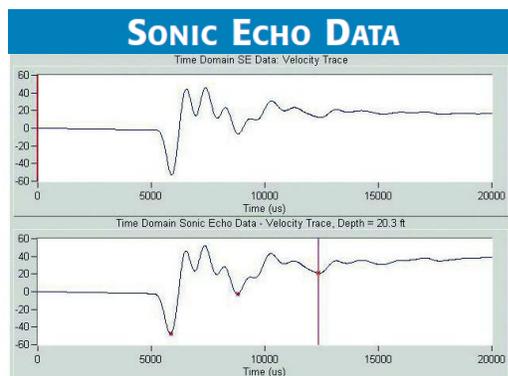
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## Effectiveness

The SE/IR method works best for columnar type foundations such as piles and drilled shafts. Reflection events are clearest if there is nothing on top of the foundations (such as a column). In cases where the superstructure is in place, the SE/IR data becomes more difficult to interpret because of the many reflecting boundaries and 2 or more receivers should be used to track reflections. Typically, SE/IR tests are performed on shafts or piles of length to diameter ratios of up to 20:1. Higher ratios (30:1 or greater) are possible in softer soils. Where a simple element such as a slab or footing rests on the pile, the thickness of the element must not exceed 1.7 times the diameter of the pile for the SE/IR analysis to be interpretable.

## Accuracy

SE/IR tests are accurate to within 5% in the determination of the depth of the foundation provided an independent measurement of the wave velocity used in the depth calculation is made. In case the wave velocity is assumed based on the material type, SE/IR tests are normally accurate to within about 10%.

## NDE360 and Freedom Data PC Configurations

The SE and IR configurations are available separately or combined and are compatible with both the Freedom DataPC and NDE360.

### SE-1

The SE-1 module includes the calibrated hammer, accelerometer and firmware

### IR-1

The IR-1 Module includes the calibrated hammer, accelerometer, geophone and firmware

### SE/IR-1

A combined SE and IR system is also available.

## About PCTE

PCTE have over 30 years experience in the measurement and testing of concrete. With experience in research, consulting and construction they are able to assist you in reviewing the issues and developing solutions. PCTE can provide more than just the equipment. They can provide leading technical support for your business.

## Other Equipment

The Olson Instrument range includes the CTG, NDE360 Freedom Data PC and DAS as well as the resonance tester.

The full Proceq range of equipment is available for in situ non destructive concrete measurement, including Schmidt Hammers, Covermeters, Half Potentials, Resistivity, Ultrasonic's and Permeability. We also supply Intelli-Rock maturity, temp and humidity logging systems, corrosion rate monitoring equipment, Ground Penetrating Radar.

Our newest piece of equipment is the MIRA Ultrasonic Pulse Echo imaging system.