



**Melbourne Office**  
 Niddrie  
 (03) 9938 3830  
[r.barnes@pcte.com.au](mailto:r.barnes@pcte.com.au)

**Perth Office**  
 Nowergup  
 (08) 9407 5363

**Website**  
[www.pcte.com.au](http://www.pcte.com.au)

**Sydney Office**  
 Brookvale  
 (02) 9939 7177

# SPECTRAL ANALYSIS OF SURFACE WAVES (SASW)



### How it works

The SASW method uses the dispersive characteristics of surface waves to determine the variation of the shear wave velocity (stiffness) of layered systems with depth. The SASW testing is applied from the surface which makes the method non-destructive and nonintrusive. In SASW tests, two receivers are placed on the surface, and a hammer is used to generate the wave energy. An Olson Instruments FreedomData PC or NDE360 records the hammer input and the receiver output.

### Access

The SASW method requires an accessible surface for receiver attachments. The extent of the accessible surface limits the investigation depth. As a rule of thumb, if one is interested in material properties to a depth  $D$ , then the accessible surface should extend in the line of receivers direction to a distance equal to  $1.5D$ , preferably  $2D$ .

### Setup Arrangement

Figure 1 shows the general field arrangement used in SASW testing. Receiver spacings ranging from 15cm to +90m have been used in the field to investigate depths from 5cm up to +90m.

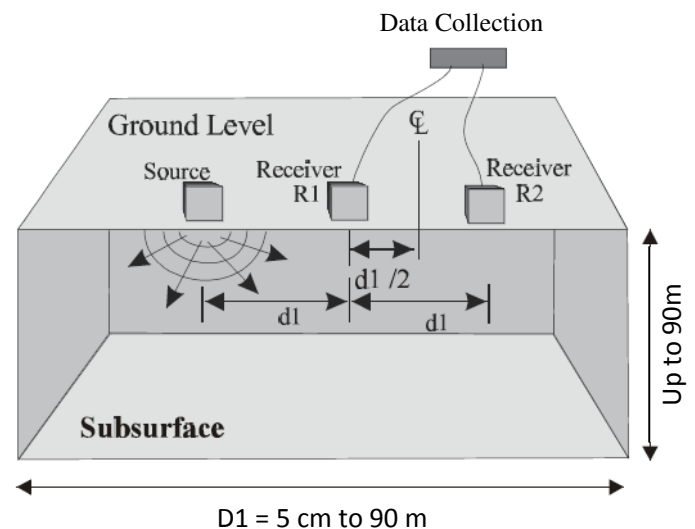
### Introduction

SASW tests allow the user to determine; the different profiles in a pavement system, including their depth, and also the condition of each of these layers. It is all done non-destructively from the top surface of the pavement. The test can be performed on concrete, asphalt, masonry, soil and wood and can be used to investigate profiles up to 90 meters deep.

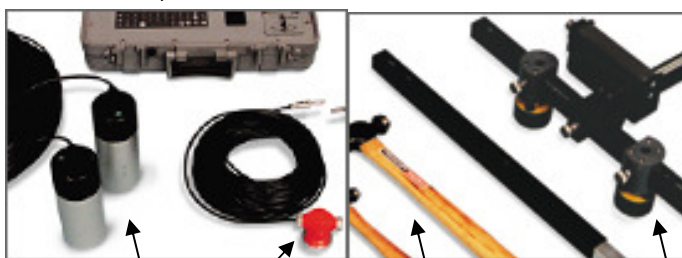
### Applications

SASW investigations can determine:

1. Pavement system profiles including the surface layer, base and sub grade materials.
2. Determination of soil velocity profiles needed for earthquake and dynamic loading analysis
3. Determination of abutment depths of bridges
4. The condition assessments of concrete liners in tunnels, and other structural concrete conditions



**Figure 1 Field Setup for SASW Tests**



Accelerometer    Geophone    Hammer    Fixed Receivers

**Papworths Construction Testing Equipment- Australia's leading Concrete NDT Equipment Supplier**



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### Collection of Data

In SASW tests, two receivers are placed on the surface, and a hammer is used to generate the wave energy. Short receiver (typically accelerometers) spacings are used to sample the shallow layers while long receiver (typically velocity transducers) spacings are used in sampling the deep materials. Two profiles, a forward profile and a reverse profile, are typically obtained in SASW measurements where the accessible surface is struck by a hammer on two opposite sides of the receivers. A signal analyzer is used to collect and transform the receiver outputs to the frequency domain. Two functions in the frequency domain are of great importance in SASW tests:

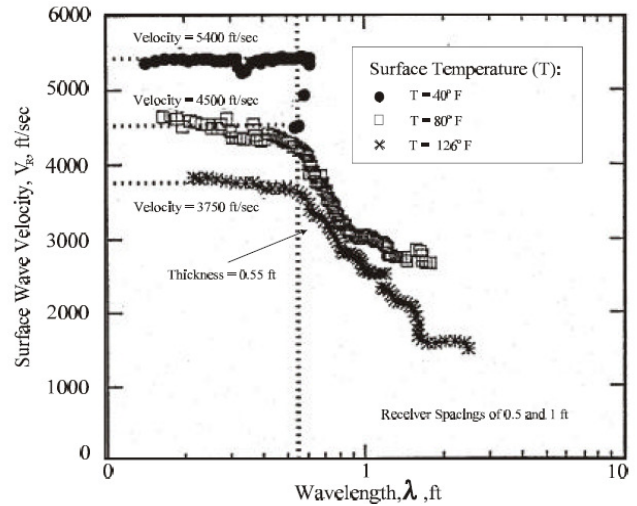
- the cross power spectrum between the two receivers (used in the preparation of the experimental dispersion curve)
- the coherence function (used to ensure that high signal-to-noise ratio data is being collected).

### Accuracy

SASW measurements are accurate to within 5% for the determination of the thickness and stiffness of the top layer in a pavement system or of the concrete liner of a tunnel. Correlation between SASW and Crosshole Seismic tests on soil sites showed that the values from both tests typically compare within a 10% difference.

### Case Study

Figure 2 shows dispersion curves determined from SASW measurements on asphalt pavement. Shown in this figure is the variation of the surface wave velocity (modulus) as the asphalt layer warms up. The SASW measurements were also effective in determining the thickness of the surface layer.



**Figure 2 Determination of thickness and stiffness of an asphalt concrete pavement layer under different climatic conditions**

### Platforms Available

We offer two devices available for the SASW 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.

### 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

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

The full Proceq range of equipment is available for insitu 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.



**NDE360**



**Freedom Data PC**