



ACSW PAVEMENT INVESTIGATIONS

Guidance Note SSGN027

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Background

Advanced Continuous Surface Wave (ACSW) testing in an engineering testing system developed by SoilSafe Limited to provide rapid and accurate ground stiffness profiles non-intrusively. ACSW uses a short 3m long array of geophones to measure the speed of surface waves (Rayleigh waves) generated by a portable vibrating source - see SSGN010 for a full description of ACSW theory. ACSW testing is controlled, analysed and reported using SoilSafe's advanced C-DAS software – see SSGN022 SoilSafe's ACSW system. The system is transported by a standard 4WD vehicle but, if necessary, can be fully demounted for operating anywhere where there is person access, including within buildings. ACSW design to operate in all weathers and on active construction sites or busy infrastructure. The system can test directly on hardstanding such as solid floors, runways, concrete slabs or highways without damage or impact on services.



ACSW data provides a stiffness profile (values of G and E) down to depths of typically 10 to 15m, as well as providing shear wave velocity (V_s) values and Rayleigh wave velocity (V_r) values (for example for high-speed rail design). Data provided gives the in-situ bulk properties of the ground, without the effects of disturbance, and does not rely on site specific empirical relationships.

The non-intrusive nature means ACSW is ideal for investigating beneath pavements to identify areas of poor ground beneath or for determination of stiffness properties for design. As for all test data, appropriate professional engineering judgement in the context of a suitable range of ground investigation information must be applied in using ACSW data.

Testing on Pavements

Each test requires area about 1m x 6m to set up the 3m long geophone array and shaker source, with the test vehicle normally located within about 10m of the test position. On pavements the shaker is seated on a sandbag and the geophones on metal bases, and hence there is no risk of damage, and the area can be released for normal use immediately following testing. Levels of noise and vibration are low (see SSGN025 Noise & vibration levels associated with ACSW testing), so potential disturbance from night-time working (for example) is very low. Each test takes only around 20 minutes to complete by a single operator, with on-site outputs provided by the SoilSafe C- DAS software which



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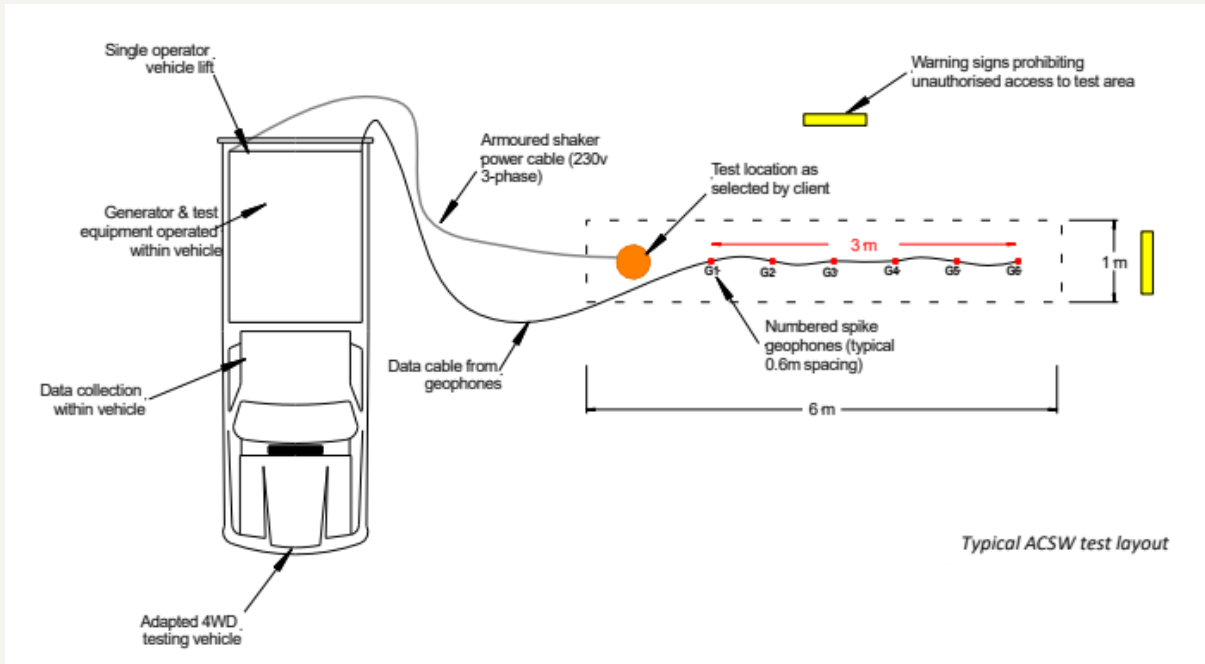


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controls and reports the test. Between 12 and 20 tests are normally achieved in a standard shift.



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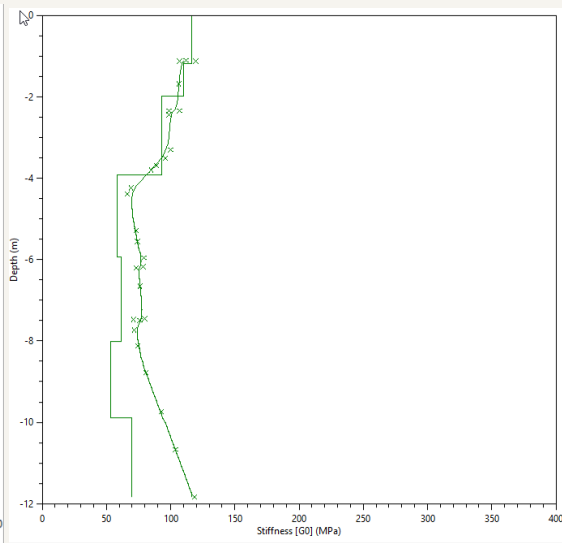
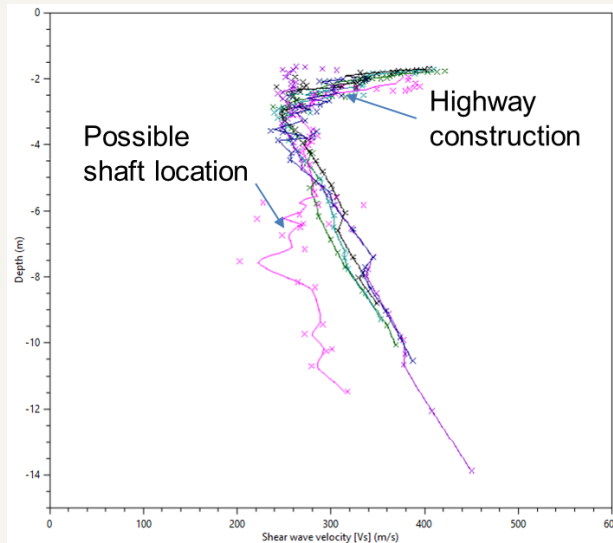
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ACSW Outputs

Key ACSW outputs are:

- Dispersion curve – Rayleigh wave velocity against frequency
- Simple inversion average stiffness with depth profile (generate on site)
- Advanced inversion layered stiffness with depth profile (generated following completion of testing)



Project: _____ **Report:** P-1224-CSW-001

Shift: 1 **Client:** _____

Test: CSW01 **Date:** _____

Test notes: Test undertaken on ploughed field.
Shaker directly on ground surface with spiked geophones.
Model Fit = 3.566m/s: Excellent model fit, indicates very high level of model confidence.

Default values of density and Poisson's Ratio in the highlighted columns may be adjusted to known values
Strain level of softened value of Young's Modulus using the Rollins equation can be adjusted in the cell below.
See the SoilSafe report ref P-1224-CSW-001 for conditions of use of data

Strain level to softened to:

Vs (m/s)	Thickness (m)	Depth (m)	Density (kg/m ³)	Go (MPa)	v	Eo (MPa)	E at x% strain (MPa)
117	1.0	0.0	1800	25	0.26	62.4	21.3
123	1.0	1.0	1800	27	0.26	68.9	23.5
133	1.0	2.0	1800	32	0.26	79.8	27.2
132	1.0	3.0	1800	31	0.26	78.6	26.8
132	1.0	4.0	1800	31	0.26	78.8	26.8
126	1.0	5.0	1800	29	0.26	72.1	24.5

Notes:

- Vs values have been determined from advanced inversion of field dispersion data.
Vs values derived by inversion rely on assumptions of soil density and Poisson's Ratio. Where no project specific data is provided then default values of $\gamma=1800\text{kg/m}^3$ and $\nu=0.26$ are assumed. Refer to above SoilSafe report conditions for further information.
- $G = \rho \cdot v^2$
- $E = G \cdot (2 \cdot (1 + \nu))$
- Softened values of stiffness are calculated using Rollins equation:

$$\frac{G}{G_o} = \frac{1}{[1 + 16\gamma(1.2 + 10^{-20\gamma})]}$$

Rollins et al. (1998)

where γ is shear strain.

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