Case Study

Case Study: Continuous Surface Wave System (CSWS)

User: Alan Moxhay, Ground Improvement Consultant, Surface Wave Surveys Limited, UK.

Surface Wave Surveys Limited is a UK – based site investigation company, the owners of which have pioneered the use of surface wave surveying to provide soil shear wave velocity and stiffness information on construction sites since 1997.

Alan Moxhay is a Ground Improvement Consultant who has spent his working life in the industry.

Useful Links:

www.surfacewavesurveys.co.uk

The Problem

Since the early days of surface wave surveying it has been apparent that ground stiffness increases naturally as a function of time after treatment has taken place. If a series of measurements could be taken over a long enough period of time on sites with different soil types, it should be possible to develop a formulation to predict the long-term element of the ground settlement. The trouble is that sites are rarely accessible for such a time as construction generally commences immediately on completion of ground preparation.

The Solution

A rare opportunity recently presented itself, with an industrial development at Quedgeley near Gloucester. The project was divided into two construction phases, the second not commencing until over a year after ground improvement had taken place. This provided an ideal situation to obtain the different series of stiffness measurements required.

Continuous Surface Wave surveys of the site were carried out using GDS Instruments Continuous Surface Wave Systems (CSWS). The CSWS enables a stiffness profile to be determined to depths of around 10m in granular soils and weak rocks and up to 30m in bedrock (without the need to provide a borehole).

It provides on-line data processing such that the stiffness-depth profile may be viewed as the test is in progress. This allows the operator to assess the quality of the data before moving to another location. The data was recorded before and after treatment at the Quedgeley site and again ten months later.

Fig 1, shows construction of phase 2, with the completed phase 1 in the background.

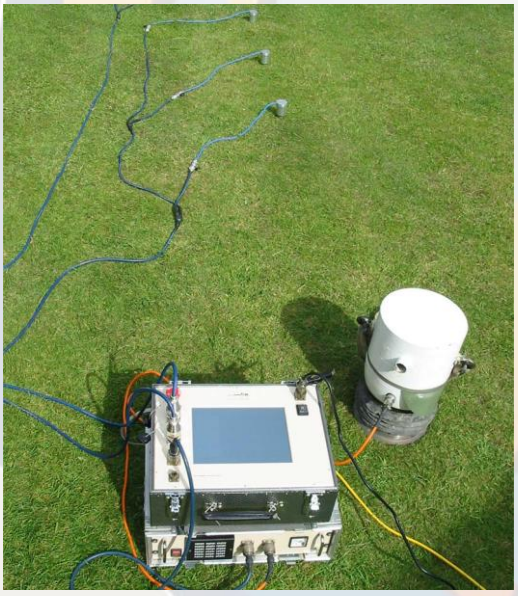

Fig 2, shows the CSWS set-up during a test.

GDS Instruments
Unit 32 Murrell Green
Business Park
London Road
Hook
Hampshire
RG27 9GR
UK

☏: +44 (0)1256 382450
🖷: +44 (0)1256 382451

info@gdsinstruments.com
www.gdsinstruments.com

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Results

The measurement of ground stiffness and prediction of foundation settlement on construction sites where some means of mechanical ground improvement has been carried out has traditionally been based on probing techniques and load tests. These have major limitations in that only very small areas of the site can be tested and destructuring of the soil during the probing process can lead to unreliable results. Surface wave surveying overcomes these problems as it is non-intrusive and the measurements are made by averaging over a distance rather than at point locations. The technique has been successfully used for a number of years and a settlement prediction method based on the results has been established.

However, the nature of the propagation of seismic waves dictates that it is the minimum-strain dynamic stiffness that is measured and the instantaneous elastic settlement that is calculated.

Whilst this information is extremely useful to design engineers, it does not extend the technique to include long-term settlement. However, with the results obtained from the three surveys at a particular location on the Quedgeley site (See Fig 3) we can see that the stiffness increases both as a result of the treatment process and also leaving for a period of time afterwards are evident.

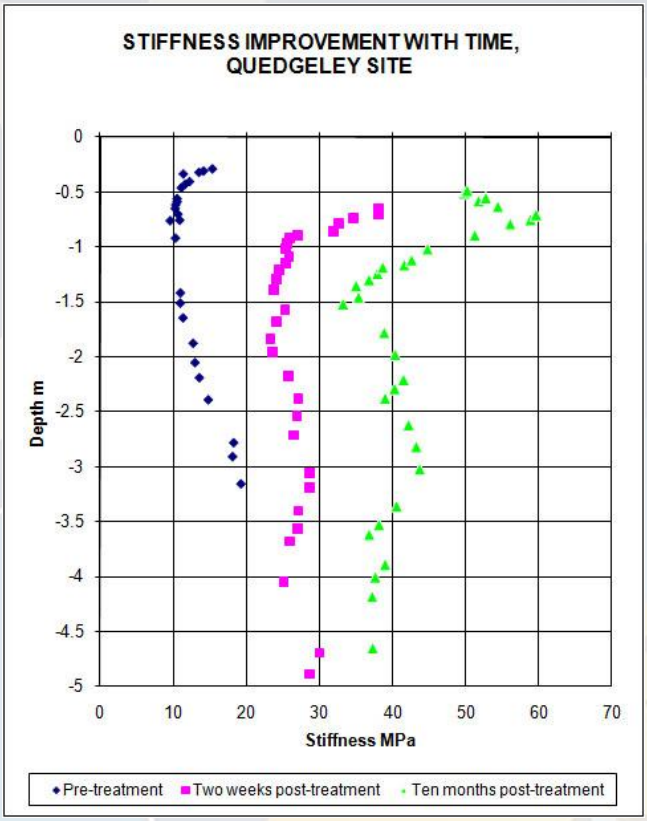

Fig 3, shows the results before, two months after and 10 months after treatment.

Testing Equipment Purchased

GDS Continuous Surface Wave System, comprising…

- Controller,
- Amplifier,
- Inertial Vibrator,
- Geophones
- Cables and
- GDS PostPro Software.

Conclusion / Testimonial

Alan Moxhay says… “The GDS Continuous Surface Wave System has proven a very useful tool for measuring ground stiffness over the years and there are some soil types which cannot be monitored effectively by any other means. What has been missing is the ability to quantify the long-term stiffness increase which we know always takes place. The measurements taken at the Quedgeley site will prove invaluable in helping me to resolve this issue and develop a formulation which will enable the advance prediction of long-term settlement on other sites, with obvious benefits for all involved.”