The Sixth International Stress Wave conference on the application of stress wave theory to piles is being held in São Paulo, Brazil from 11-13 September. The event, hosted by the Brazilian Society for Soil Mechanics and Geotechnical Engineering, aims to provide a forum for discussion of the important challenges and developments in dynamic testing for geotechnical and foundation engineering. This year, the emphasis is on quality assurance of land and offshore piling. As part of *Ground Engineering's* focus on dynamic testing, over the next few pages, we present summaries of the keynote lecturers from a selection of the ten conference sessions and two workshops to give a flavour of the main issues and developments in the sector.

Session 2
Driving equipment and recent developments New technologies for quality assurance of piles

Frank Rausche, keynote lecturer session 2

Deep foundations are expensive: they are labour and equipment intensive and pile material is costly. If they are necessary, they become a significant part of the total cost of a project. For this reason, new installation methods and associated machinery are continuously being developed.

For prefabricated piles, impact driving is still the preferred method of installation. New or improved types of hammers and driving systems appear on the market almost daily with the promise of better productivity, reduced environmental problems or lower cost.

Vibratory hammer installation is another development that promises great improvements in productivity.

These developments must be understood by those dealing with quality assurance of the installed deep foundation element. Computer programs are now available for both a rational selection of equipment for a particular piling job and for the assessment of pile driveability.

Analysts have to understand the effect of the pile driving proces on soil properties.

However, these analytical tools can only be properly used by engineers who are familiar with the physical design principles of the pile installation equipment. At the same time, the analysts have to understand the geotechnical properties of the soil and the effect of the pile-driving process on soil properties. Such pile-driving installation simulations consider hammer, driving system (packing, helmets), pile and soil whose dynamic model parameters should be determined by dynamic testing.

No matter how sophisticated our analytical and electronic capabilities, hammers are still the most widely used quality assurance tool for piling. Test hammers range in mass from less than 100g to almost 200t. These test devices may be the actual pile driving hammer, a big ram specifically built for drilled shaft testing or a little hand-held hammer for integrity testing of any type of pile made of concrete or timber.

Hammers may be uncushioned to create a sharp, well defined stress wave in the pile, or cushioned to protect the pile top while still transferring enough energy for a complete activation of the pile bearing capacity.

Another approach generates a slower dynamic load, either by means of a very soft cushion or by lifting the mass with a combustion from the pile top rather than dropping it onto the pile top. In any event, hammers can only be effective test tools when they are used with electronic measurements.

Other quality assurance tools computerise what has been done manually in the past; they record a variety of observations such as energy and set per blow as a function of pile penetration. In this way, for each pile, an objective electronic or printed record can be supplied.

Another stress wave-based method uses an ultrasonic transducer rather than a hammer to generate a test signal. Non stress wave-based methods now include video equipment, fibre optics etc. All the quality assurance tools have limitations but the great variety of methods available is of particular benefit to the construction control professional.

In this session, the keynote lecture will summarise the present state of equipment technology for pile installation, analytical simulation and electronic testing will provide a framework against which new technologies can be evaluated regarding their usefulness and the future trends of technical developments.

This should give a thorough understanding of the technical principles of equipment, analyses and test methods.

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