

Measuring the integrity of piles

Measuring the integrity of piles is performed in the framework of quantity surveying, during the construction of pile foundations, lamella of underground walls or monocoque concrete constructions built from foundation or construction elements.

Measurements are made using either pile integrity testing (PIT) or CHA ultrasound measurements, or a combination of the two.

Pile integrity testing

Pile integrity testing is based on the analysis of measured signals propagated in a longitudinal direction from the pile or the tested concrete element.

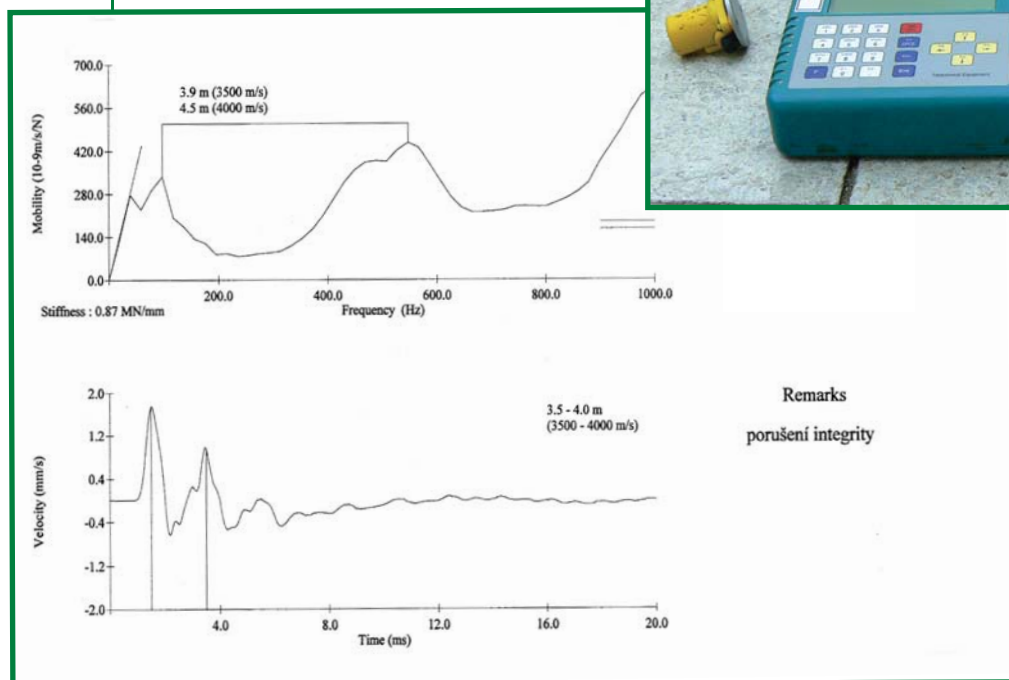


The signal is excited in the area of the head pile or the surface of the tested element with a strength impulse made using a percussion hammer with a strength sensor.

The apparatus measures the time the signal propagates through the concrete. The signal response in the concrete is registered by a sensor of the velocity of oscillations in the area of the head pile.

The time of the onset of signals reflected off the distinct non-homogeneity inside the piles can be distinguished from the time of the onset of the signal from the pile by using the recording of the time slope of the velocity of oscillations.

PIT measurement apparatus



disturbance in the integrity of the piles to a depth of 4 m registered in frequency and time zones

Important information is provided by the frequency range of the monitored recording of the velocity of oscillations of the head pile – the so-called mobility.

From this is determined the length of the piles and the depth of the possible inhomogeneous material is localized.

It is a quick non-destructive test which allows the quality of the constructed concrete element to be determined. It is best to perform these tests on all pile foundations.

CHA ultrasound measurement method

The CHA ultrasound measurement method is based on the analysis of responses of the concrete column of the pile shaft to an ultrasound signal. The quality of the concrete is measured by the propagation rate of the signal between the probes led through preinstalled measurement pipes. The propagation rate is derived from the time measurement of the passage of the acoustic signal between the probes under the assumption that we know their position.

A spatial image of the distribution of the velocity of propagation in the body of the pile is obtained by monitoring the wave image of a combination of vapors in the measurement pipe.

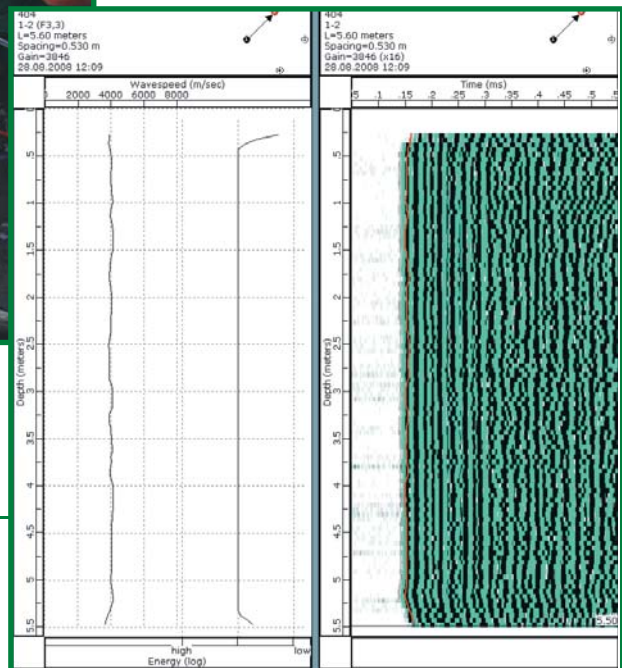
The measurement involves the processing and evaluation of ultrasound wave signals from the penetration of measured elements between the transmitter and the receiver.



CHA measurement apparatus



measurement of the integrity of piles using CHA apparatus

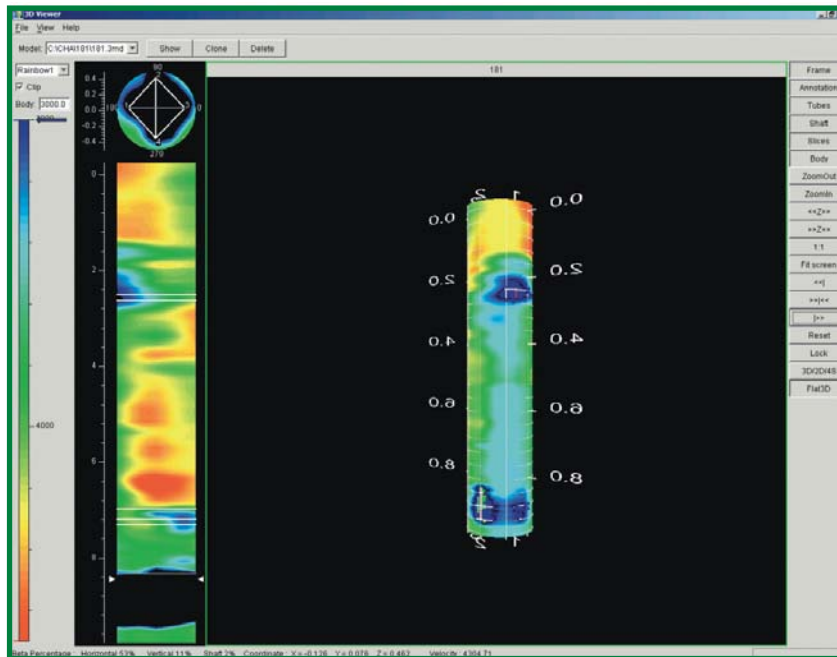


basic output from the measurement – without anomalies

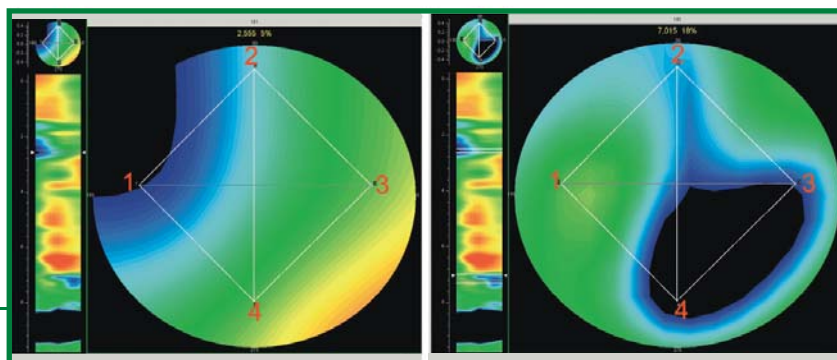
Anomalies can be accurately located in depth to determine their scale and also establish the shape of the determined anomaly by using software for tomographic 3D processing and evaluation of measured data.

Indication of defects

Defects in the concrete column of a pile are indicated by increases in the transit time or reduction in the velocity of propagation and at the same time increases in the decay of the registered signal. Defects are indicated by an increase in the transit time by about 20 % or an increase in decay by 6 dB. An increase in transit time of between 10 and 20 % is regarded as an anomaly.



top left: cross section at a depth of 8.2m, left: cross section between pipes 1 – 3, center: view of the piles from the direction of pipes 1 and 2 (blue corresponds to the velocity of propagation of mechanical waves through the pile 3 500 m/s, black is in areas with the velocity of propagation lower than 3 000 m/s – Ref. scale on the left hand side of the picture)



cross section at a depth of 2.5 m

cross section at a depth of 7.0 m

Measurement results are presented in the form of the depth dependence of the velocity of propagation of the acoustic signal in the pile, the depth dependence of the decay of the signal and a complete wave image of the individually used cross sections. The defect is interpreted directly in the curves of the above-mentioned parameters and also in measurement protocols. This measurement is also taken in the technical test room of INSET CZ, accredited pursuant to ČSN EN ISO/IEC 17025. In this case, the output is a test protocol with international validity.