Zerstörungsfreie Prüfung im Bauwesen

ZfPBau

Automated Impact-Echo: 2- and 3-D Imaging of Concrete Elements

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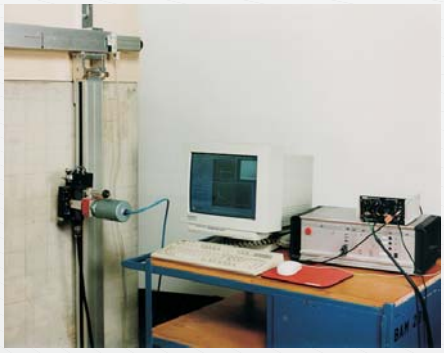
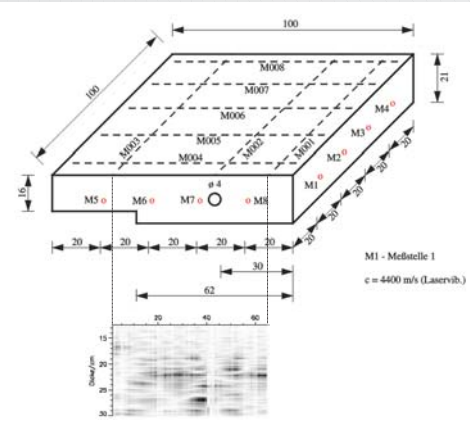
Zusammenfassung
Das Impact-Echo (IE) wird häufig und mit gutem Erfolg zur Untersuchung von Betonbauteilen eingesetzt. Trotzdem können IE Daten zu Fehlinterpretationen führen, ausgebildetes Personal ist daher eine Voraussetzung für einen breiteren Einsatz der Methode in der Praxis. In diesem Beitrag werden automatisierte IE Messungen beschrieben, die deutlich zeigen, daß lokale Punktmessungen mit dieser Methode zu falschen Ergebnissen führen können. Notwendig sind Rastermessungen zur Identifikation von wahren Meßergebnissen und Geometrieeffekten.



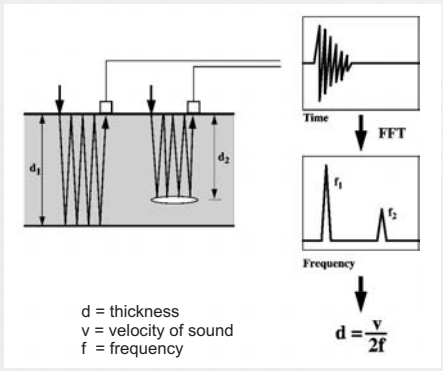
A frame system permitted automation of measurement collection. The two axis of the frame can move the IE unit in an area of 1.5 m x 2 m with high precision. Surveyed lines can have any orientation. Reading stations are freely spaced. The IE unit is pressed with constant force against the surface.

Objectives
The aims were:

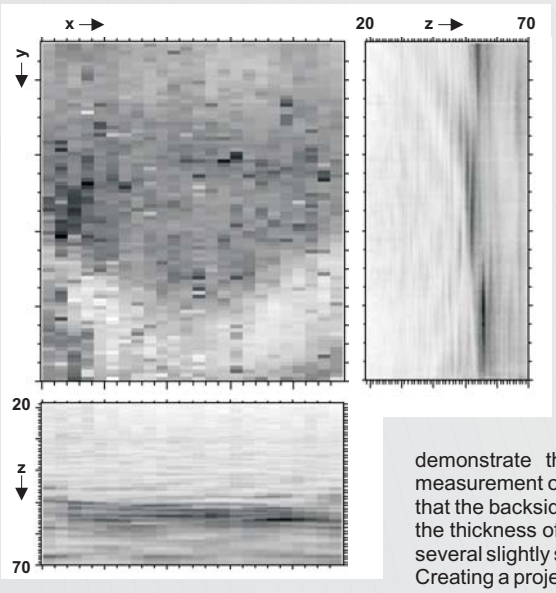
- to get reliable data independently from the operator by automising the collection procedure
- attentions to reproducibility of experiments, structure surface characteristics, position of the reading stations, transducers coupling pressure.
- ease data interpretation



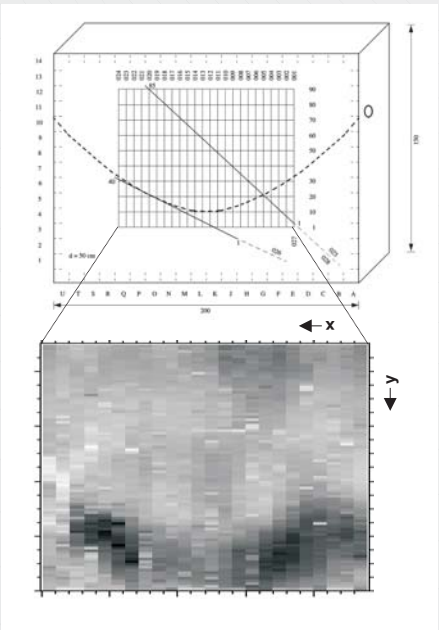
The left figure shows a plate with a step and a steel tube (diameter 4 cm) parallel to the step. Below the figure, a scan is visualised across the specimen (M004). The back face signal of the plate is clearly identified at 22 cm, the thinner part of the plate at 17 cm. At the position of the pipe, which screens the direct measurement of the backside, a much increased intensity is measured at a much greater apparent thickness. It is almost as if the sound waves are focused by the pipe. The position of the pipe can not be read directly but as increased thickness.



IE uses multiple propagation of low frequency waves between the external surface and any internal reflectors to measure transient resonance frequencies and so to calculate depths and evaluate integrity of the structure.



The right figure displays a concrete specimen with reinforcement in one half side (along x axis) and a duct built in which has a concrete cover of 15 cm from one side. Previous IE tests did not locate the duct . A large set of data was collected on this specimen: 27 parallel lines with 90 points each separated 1 cm. At each point, the average of three single measurements was collected. This 3D-array was used to create images of projection slices through the specimen.
The figures on the left show the XZ projection, the YZ projection and the projection in the XY plane. The XZ and YZ projections clearly demonstrate that there is no sign of a direct measurement of the duct. These figures also reveal that the backside echo is not a single straight line at the thickness of the specimen, but is a collection of several slightly shifted reflection horizons.
Creating a projection through the data set using only data beyond the element thickness results in figure on the right which shows clearly the position of the duct in the XY-plane. What happens is that the back side signal is screened by the presence of the duct, the path for the waves is longer around the duct and the backside signals appear "behind" the specimen.



Conclusion
The results clearly show the advantages of scanning over point measurements. They unambiguously prove that IE can lead to wrong results when point measurements are used for interpretation. Geometrical effects seem to play a very important role in data interpretation and it is intended to study them further.
Simulation of IE experiments would be a very helpful tool for fully understanding the experimental results.

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