

# IMPULSE-RESPONSE

## Purpose

The Impulse-Response test system is a rapid, easy to use method for screening of the integrity of structures. The idea is to quickly screen a structure for flaws and identify suspect areas for subsequent detailed analysis, e.g. by the impact-echo test, pulse-echo testing, or by invasive inspection with drilled cores.



## Principle

The Impulse-Response system uses a low-strain impact, produced by an instrumented rubber tipped hammer, to send stress waves through the tested element. The impact causes the element to vibrate in a bending mode and a velocity transducer, placed adjacent to the impact point, measures the amplitude of the response. The hammer load cell and the velocity transducer are linked to a portable field computer with software for data acquisition, signal processing and storage. The time histories of the hammer force and the measured response velocity are transformed into the frequency domain using the fast Fourier transform (FFT) algorithm. The resultant velocity spectrum is divided by the force spectrum, to obtain the mobility as a function of frequency. An example of such a mobility plot is shown in Figure 1 for a solid concrete member. Mobility is expressed in units of velocity per unit force, such as (m/s)/N.

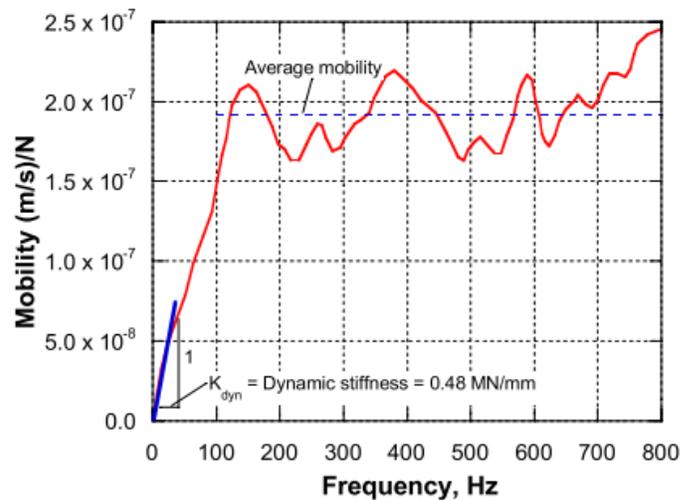


Figure 1: Mobility vs. Frequency

The parameters from the mobility plot that are used for integrity evaluation are:

- The dynamic stiffness (the inverse of initial the slope of the mobility plot, the blue line in Figure 1);
- The average mobility (dotted blue line in previous figure);
- The mobility slope between 100 to 800 Hz; and
- The voids ratio (the ratio of the amplitude of the initial mobility peak to the average mobility)

Testing is performed on a grid marked on the surface of the structure. The software constructs color contour plots of the various parameters, from which it is easy to identify anomalous regions of the structure that merit detailed investigation (Figure 2). This is done on-site after the testing has been completed, producing immediate information of the presence of anomalies.

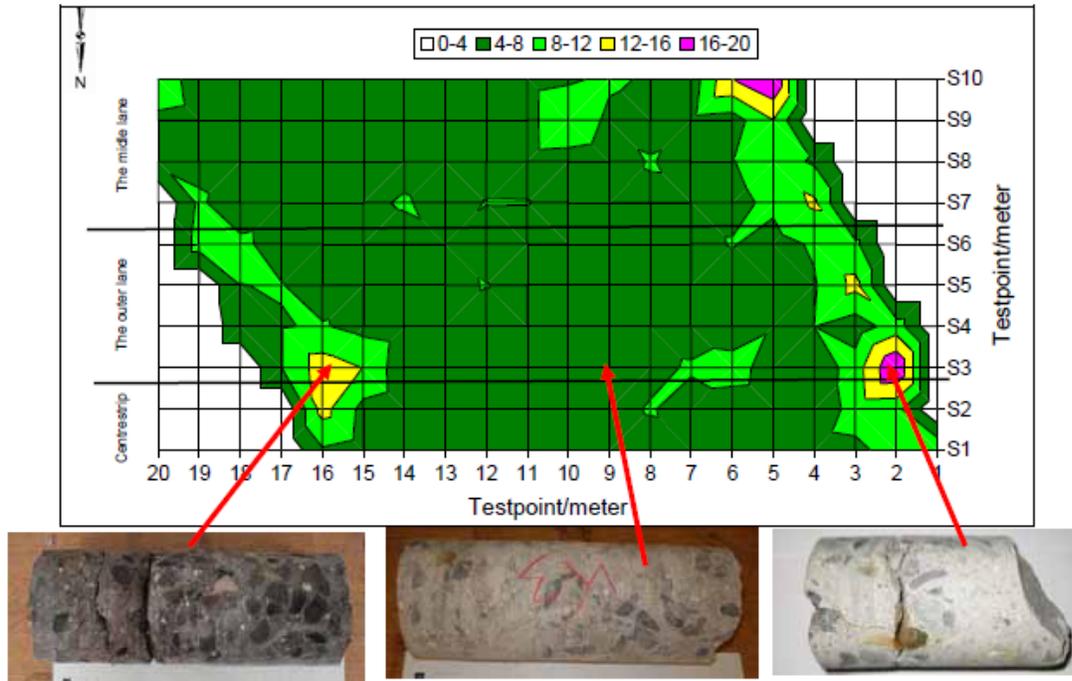


Figure 2: Mobility Color Contour Plot

### Applications

- Detecting voids beneath concrete slabs in highways, spillways and floors
- Detecting the curling of slabs
- Evaluating anchoring systems of wall panels
- Locating delaminations and honeycombing in bridge decks, slabs, walls and large structures such as dams, chimney stacks and silos
- Detecting the presence of damage due to freezing and thawing
- Detecting the presence of alkali-silica reaction (ASR)
- Detecting debonding of asphalt and concrete overlays and repair patches from concrete substrates
- Evaluating the effectiveness of load transfer system in transmitting stresses across joints in concrete Structures

### Vendor Information:

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