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Slab Impulse Response

Introduction

Slab Impulse Response (Slab IR) investigations are performed primarily to identify sub-grade voids below slabs-on-grade. The method is excellent for evaluating the repair of slab sub-grade support conditions by comparing the support conditions before and after repairs.

The Slab IR test method can also be used on concrete structures to quickly locate areas of delamination or void in the concrete, if the damage is relatively shallow. Slab IR can be performed on reinforced and non-reinforced concrete slabs as well as asphalt or asphalt-overlay slabs. The schematic below shows the field setup used in Slab IR investigations.

The elements that can be tested include, concrete slabs, pavements, runways, spillways, pond and pool bottoms, and tunnel liners. The Slab IR method is often used in conjunction with GPR for sub-grade void detection and mapping.

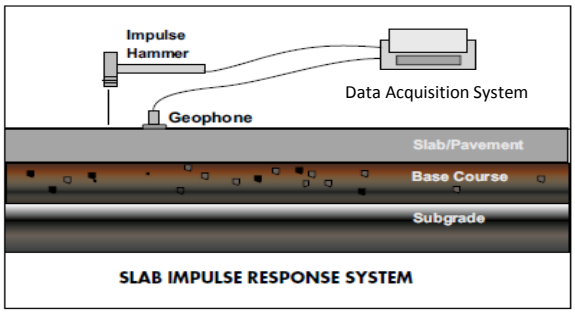
Applications

The applications for Slab IR are varied:

- Identify sub-grade voids below slabs-on-grade
- Voiding beneath concrete slabs in highways, spillways and floors
- Curling of plates
- Anchoring of panels
- Delaminations and honeycombing in bridge decks, slabs, walls and large structures such as dams, chimney stacks and silos
- Freeze-thaw damage
- Presence of ASR
- De-bonding of asphalt, concrete overlays and patches from concrete substrates

Access

The Slab IR method requires access to the top surface for receiver locations and hammer hitting. The receiver is mounted to the surface of the slab adjacent to the impact location and generally 3-4 inches away. In easy access areas, 400-600 Slab IR tests can be performed in an 8 hour work day.



How it works

In a Slab IR investigation, the slab top is impacted with an impulse hammer and the response of the slab is monitored by a geophone placed next to the impact point. The hammer input and the receiver output are recorded by a data collection system (Freedom DataPC or NDE360) equipped with the Slab Impulse Response System (SIR-1).

Freedom DataPC Slab IR System

NDE360 Slab IR System

Processing Techniques

Fast Fourier Transform (FFT) operations performed by the Slab IR software transform the impulse force and vibration velocity response time domain signals to

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produce a plot of mobility (vibration velocity/newtons force). After transformation to the frequency domain, the transfer and coherence curves are automatically generated by the Slab IR software. The coherence indicates the quality of the data. A value of close to one is ideal. Analysis of the mobility plot provides information on the subgrade support conditions within a radius of 150 to 300mm from the test point depending on slab thickness.

Interpretation of Data

Support condition evaluation includes two measurement parameters. Data is shown in Figure 1.

1. The dynamic stiffness is calculated. The initial slope of the mobility plot indicates the quasi-static flexibility of the system. The steeper the slope of the initial part of the mobility plot, the more flexible and less stiff the system is.
2. The shape and/or magnitude of the mobility plot above the initial straight line portion of the curve are an indication of support condition. The response curve is more irregular and has a greater mobility value where concrete support is voided. Good support conditions where the mobility is lower, due to the decreased damping of the slab vibration response. The presence of high amplitude, low frequency spikes in the mobility plot is an additional indication of void conditions.

Effectiveness

Slab IR cannot determine the thickness of any voids found. Collecting Slab IR data at multiple, densely-spaced locations can improve the conclusions by mapping relative areas of higher and lower mobility. However, relatively low mobility does not indicate the absence of a subgrade void, but relatively indicates that such an area appears to be more solidly supported than an area with higher mobility. For thick slabs (> 600mm), the interpretation of the Slab IR data becomes difficult, the stiffness of the system is controlled by the slab itself and not by the support conditions under the slab

Platforms Available

We offer two devices available for the SASW technique. These include the NDE360 and DataPC. These offer differing levels of mobility and on-site analsysis. Please see the individual brochures for more in depth specifications for the platforms.

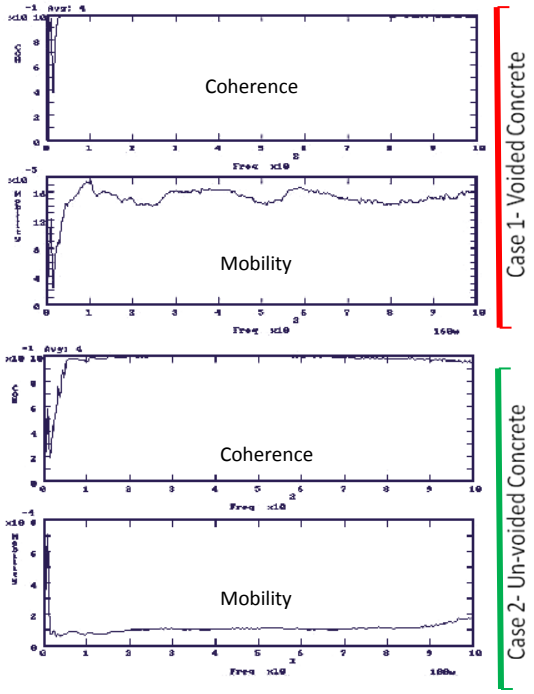

Figure 1 shows two cases- mobility for voided concrete sub-base and sound subsurface conditions, respectively. In both cases, the upper plot for coherence indicates good data quality. The difference in shape and average mobility can be noted on the

About PCTE

PCTE have over 30years experience in the measurement and testing of concrete. With experience in research, consulting and construction they are able to assist you in reviewing the issues and developing solutions. PCTE can provide more than just the equipment. They can provide leading technical support for your business.

Other Equipment

The Olson Instrument range also includes the NDE360, CTG, Freedom Data PC and DAS as well as the resonance tester. The full Proceq range of equipment is available for insitu non destructive concrete measurement, including Schmidt Hammers, Covermeters, Half Potentials, Resistivity, Ultrasonic's and Permeability.
We also supply Intelli-Rock maturity, temp and humidity logging systems, corrosion rate monitoring equipment, Ground Penetrating Radar. Our newest piece of equipment is the MIRA Ultrasonic Pulse Echo imaging system.