GBG Australia

Some of our recent work undertaken using Impact Echo technique

Concrete Quality testing of a Car Park Ramp, Blacktown, NSW
Mahaffey Associates (2004)

Determining the depth of stanchion footings at Merrylands Station, NSW
RailCorp (2007)

Assessing concrete strength of Northbound bridge number 3 over Mulwaree flood plain, Goulburn, NSW
RTA (2007)

Assessing bond quality of infill Slabs At Chatswood railway station, NSW
ARUP (2007)

Determining the wall thickness in a Tunnel in Melbourne, VIC
CityLink Melbourne Ltd (2007)

Determining the depth of Over-Head Wiring System (OHWS) footings from Beverly Hills station to Narwee station, NSW
K2RQ ALLIANCE (2008)

Locating the extent of delamination in a Tunnel in Melbourne, VIC
Maunsell AECOM (2008)

Determining the thickness of a ground and abutment slab in a four cell box culvert, Camden, NSW
Hyder Consulting (2009)

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Non-destructive technique

IMPACT ECHO

Typical Applications

Estimating Concrete strength based on measured acoustic velocity.

Measuring Slab Thickness.

Locating position, extent and depth of cracks and voids. Note that this method can not determine the volume of a void only its projected area.

Locating area of shallow delamination. Note cannot detect the depth of shallow delamination.

Locate areas of unconsolidated (honeycombed concrete) and approximate depth.

Determine the depth and direction of inclination of surface cracks. Note that this method cannot be used if the crack has been grouted at the surface.

Locating voids under slabs.

Determining the layer thickness of two different materials bonded together.

Determination of the bond quality between two layers of material.

In special cases can detect corrosion of reinforcement bars.

Locate un-grouted tendon ducts. Tendon ducts must be metal.

Determine the wall thickness and internal defects in large diameter concrete pipes.

Determine the wall thickness, internal defects and voiding behind concrete tunnel shaft liners.

Find internal defects in circular and rectangular concrete members.

Finding unfilled block in reinforced masonry block walls.

Finding voids between brick widths

Finding tie blocks in masonry retaining walls or brick facades.

IMPACT ECHO INSTRUMENT USED IN GBG AUSTRALIA

GBG Australia

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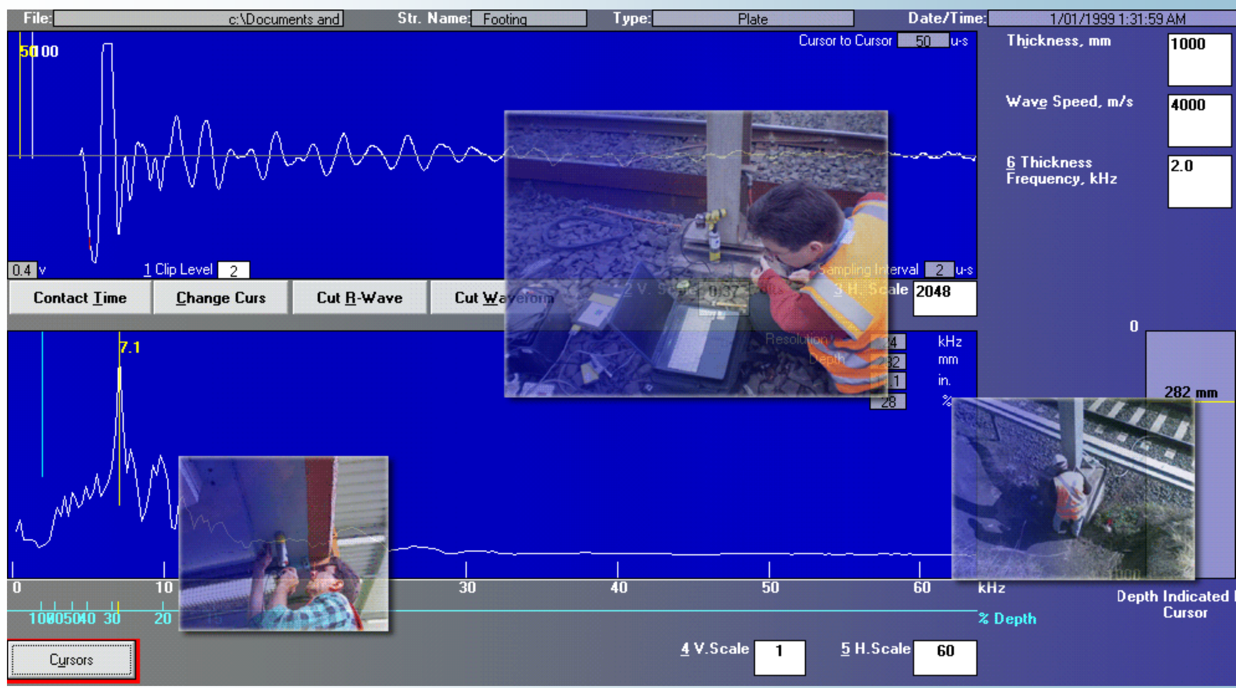
Non Destructive Techniques
Impact Echo Testing



GBG Australia

GBG Australia is a specialist in applying non-destructive investigative techniques for a wide range of environmental and engineering applications. Employing engineers and geophysicists of considerable experience, GBG provides advanced subsurface solutions using a variety of non-destructive and geophysical techniques. **Impact Echo** (or dynamic impedance) is an acoustic non destructive test method used to assess the dimensions and integrity of concrete and masonry. This technique has been successfully undertaken by GBG for over five years.

Company Profile

GBG Australia is a subsidiary of the GBG Group, a multi-national company specialising in the application of geophysical and advanced applied physics for precision investigations of geotechnical, environmental sites and engineered structures in UK and Europe since 1982. GBG has had a presence in Australia since 1993 originally through a joint venture with CMPS&F and GHD before becoming a stand alone company in 2003, operating in three main areas of business: geotechnical and environmental investigations; non destructive investigation of structures and contracting of equipment and staff for data collection, processing and interpretation of data.

GBG Australia is an independent provider of non destructive and shallow geophysical investigation services with applications ranging from the location of a single pre-stressing strand in a concrete slab to mine scale exploration geophysics. With clients ranging from Local to Federal Government, and from developers and engineering companies to private individuals, we can provide tailored solutions to your particular subsurface investigation requirements.

Technique for

Non-destructive testing

Impact Echo

Impact Echo (or dynamic impedance) is an acoustic non destructive test method used to assess the dimensions and integrity of concrete and masonry. In this method the surface of a structural element is struck with a tuned hammer (a steel ball of specific size) to produce a pressure wave (P-wave) pulse in the material of up to 90 kHz that propagate into the structure and is reflected by internal discontinuities or external surfaces. The wavelengths of these stress waves are typically greater than 50mm, longer than the scale of natural inhomogeneous regions in concrete such as aggregate, air bubbles and micro-cracks. As a result they are only weakly attenuated and multiple reflections of these waves within the structure excite local modes of vibration. The resulting surface displacements are detected by a sensitive acoustic transducer, placed on the surface near the impact point and the resulting signal waveform is digitizes & recorded. This wave form is later analysed in both the frequency and time domain to provide information on the element thickness and internal defects such as voids, honeycombing and discontinuities (cracks/delaminations).

The velocity of an acoustic wave within the material is proportional to its density and elastic modulus, thus accurate assessments of depth can be made even where the steel is dense. This fact also means that the calculated velocity can be used to estimate the concrete compressive strength.

Data is collected at point samples so a large number of points are required to cover large areas in detail. Used in conjunction with the radar, this technique can verify the continuity, integrity and mechanical properties of the structure at critical points - once the generalities of a structure has been found by radar. Cross correlation provides greater confidence in any conclusion resulting from the investigation.

APPLICATION EXAMPLE 1 : IMPACT ECHO TESTING FOR DETERMINATION OF FOOTING DEPTHS

Background

Excavation of a trench for drainage pipes was planned to cut in front of a number of OHWS stanchions. It was required to determine if the footings are sufficiently deep to withstand overturning during excavation. To avoid the difficulty of coring the piles it has been decided to attempt to determine the footing depth by non-destructive test methods. GBG Australia proposed to use Impact Echo as a NDT system to carry out this investigation.

FIGURE 1: IMPACT ECHO EQUIPMENT BEING USED TO MEASURE FOOTING DEPTH.

Method

In the case of pile testing the top of the pile is struck with a hammer to induce a pressure wave. This wave travels down the pile, the sides of the pile acting as a wave guide and is reflected from the base of the pile. The reflected wave is detected back at the top of the pile with a sensitive displacement transducer. The length of the pile is then determined from the time taken for the pressure pulse to return based on an assumed velocity.

Result

The signal waveform received by transducer is digitized and recorded for later processing and analyzing. An example of a filtered record in time domain and in frequency domain taken on a short footing is shown in Figure 2.

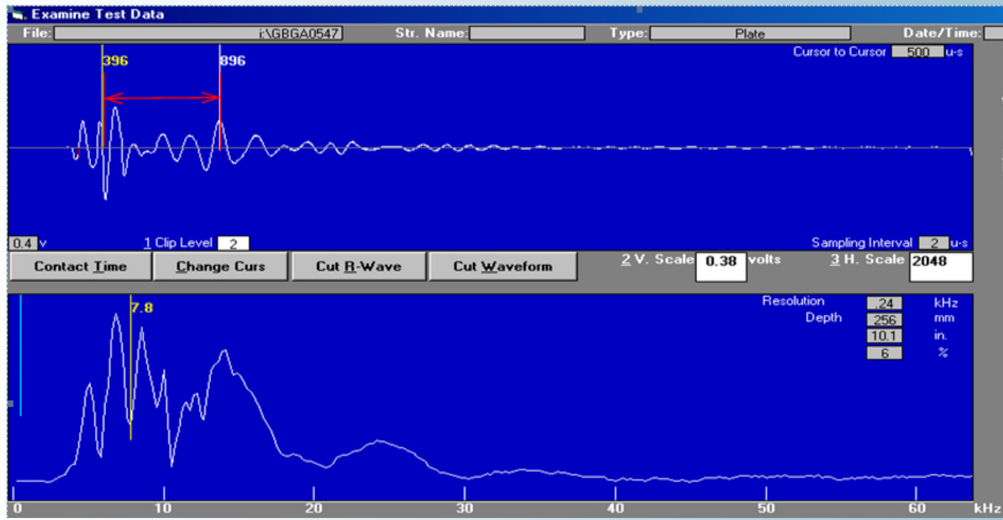


FIGURE 2: FILTERED SIGNAL IN TIME DOMAIN (TOP) AND IN FREQUENCY DOMAIN (BOTTOM).

APPLICATION EXAMPLE 2 : IMPACT ECHO TESTING FOR LOCATING AREA OF SHALLOW DELAMINATION

Background

An area of delamination was identified in the concrete lining of a tunnel. In order to get a better understanding of the extent of the delamination, GBG Australia carried out NDT investigation using Impact Echo method.

Method

Impact Echo test points were taken over a grid at 100 mm by 100 mm intervals on the area of concern. Multiple readings were taken at each test point using a variety of hammer sizes allowing for both shallow and deep defects to be detected. The data quality was assessed after each reading was taken, with good readings displaying a regular wave pattern.

Result

The optimum readings from all records were classified by the frequency response pattern. Three categories of readings were identified and have been classified as relating to probable or well developed delamination, possible or minor delamination, and no evidence of delamination (Figure 3). Thus, the existence of the delamination were resolved and then interpolated as the Figure 4.

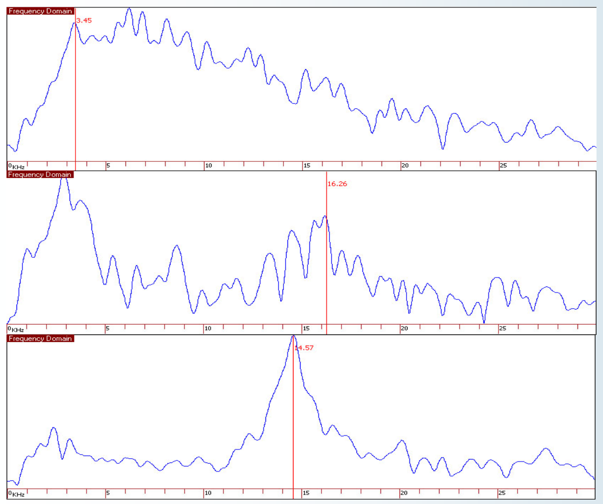


FIGURE 3: THREE CATEGORIES OF READINGS WERE IDENTIFIED IN THE FREQUENCY DOMAIN.
***TOP**: NO SECONDARY PEAK FREQUENCY VISIBLE INDICATING CONCRETE IN SOUND CONDITION.*
***MIDDLE**: INDEFINITE SECONDARY PEAK FREQUENCY, TYPICAL OF POSSIBLE OR MINOR DELAMINATION.*
***BOTTOM**: DEFINITE SECONDARY PEAK FREQUENCY, TYPICAL OF PROBABLE OR WELL DEVELOPED DELAMINATION.*

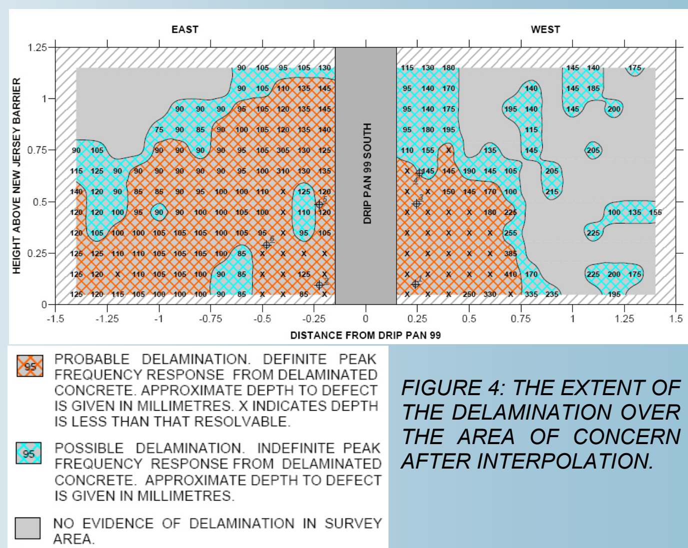


FIGURE 4: THE EXTENT OF THE DELAMINATION OVER THE AREA OF CONCERN AFTER INTERPOLATION.