NDT of Concrete Plates

A Spotlight on the Impact - Echo Method

Concrete slabs and wall elements are critical elements in many constructed facilities. The form bridge decks, parking garage decks, shear walls, and abutment walls. Different Nondestructive Testing (NDT) methods have been developed for the inspection, scanning and testing of these structural elements.

Impact-Echo is widely used method to evaluate the structural integrity of concrete and masonry structures.

What is Impact-Echo Test ?

Impact-echo test works based on the generation of stress waves through a short-duration mechanical impact on the surface of concrete element. Followed by the mechanical impact, reflection and refraction of stress waves from internal interfaces (concrete-crack, concrete-air, concrete-rebar) or external boundaries (echo) is recorded through a proper transducer (e.g. piezoelectric accelerometer or geophone). The reflectogram is analyzed in either time-domain or frequency-domain.

The test method was first adapted in 1998 as a standard test procedure by the American Society of Testing Materials (ASTM C 1383) "Standard Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method."

Applications of Impact-Echo

The impact-echo method can be used to:

- Evaluate Thickness of Plate Concrete Elements,
- Evaluation, and Localization of Subsurface Defects,
- Estimate crack depth in concrete and masonry.

Use Cases

- Material characterization
- Delamination in Bridge Decks
- Estimating thickness of Tunnel Linings
- Estimating thickness of Walls in Concrete Tanks

FPrimeC SOLUTIONS

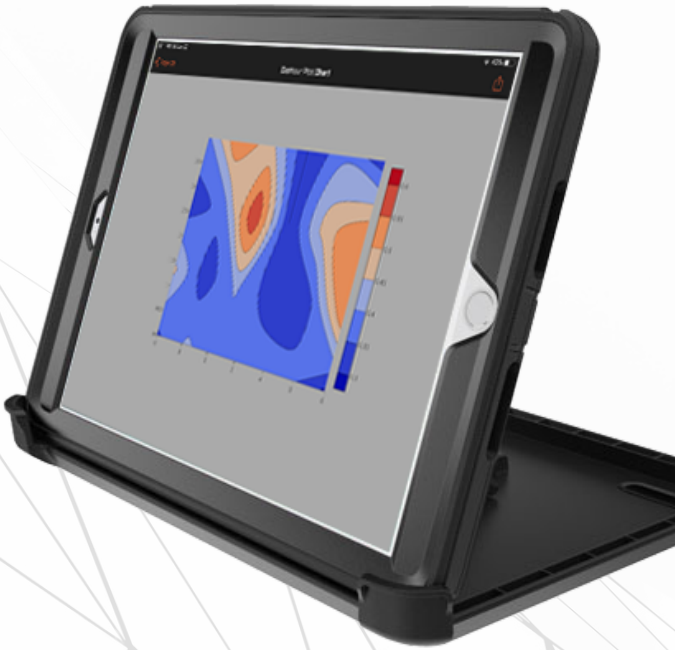
How Impact-Echo Works?

FPrimeC Impact-Echo has three main components:

- Advanced Integrated Wireless Sensor
- Steel Ball Impactors
- Mobile App for iPad for Data Collection, Visualization, Analysis, Plotting and Reporting.

The Steel ball impactor is used to strike the plate element. Impact-Echo sensor should be placed close to the source of impact. Followed by the mechanical impact, reflections are recorded using Impact-Echo sensor. Data are digitized and transmitted to the tablet for post processing, thickness measurement and generating contour plots of thickness variation. Test results are often presented and analyzed in Frequency Domain.

Practical Tips



Impactor Size (Contact Time): The steel ball's diameter is related to the contract time and the frequency range. Smaller diameter creates shorter contract times and creates a higher frequency range suitable for testing concrete elements at a shallower depth.

Transducer-Impact Point Distance: The distance of the impact point to the transducer should be 20% to 50% of the shallowest interface depth.

Boundary Effects: It is important to avoid testing close to boundaries and edges, especially for smaller structural elements such as beams and columns.

Useful References

- FPrimeC Solutions Inc. (2020, August 5). How to Test Concrete Using Impact Echo (IE) Method? https://www.fprimec.com/how-to-test-concrete-using-impact-echo-ie-method/
- Lacroix, Francis 2020. “Non-destructive condition assessment of concrete slabs with artificial defects using wireless Impact Echo" University of Ottawa, Ottawa, Canada
- Transportation Research Board Washington (2012). Nondestructive Testing to Identify Concrete Bridge Deck Deterioration. Strategic Highway Research Program 2