SounDAR

BDI'S DECK ACOUSTIC RESPONSE (DAR) SYSTEM PROVIDES AN AUTOMATED & INNOVATIVE METHOD OF PERFORMING SOUNDING OF BRIDGE DECKS

Similar to the methods of Impact Echo or Chain Drag (ASTM C1383 and ASTM D4580), the Deck Acoustic Response (DAR) method is used to identify and quantify areas of subsurface degradation including delamination, debonding, and spalling. Typical acoustic methods use a low strain, stress wave and are used to interrogate the integrity of concrete structures. This includes a variety of methods including traditional methods such as hammer sounding and chain drag as well as nondestructive techniques such as impulse response and impact echo. The DAR method utilizes a combination of these techniques along with a novel analysis technique to accurately identify the location and size of flaws in concrete bridge decks and other structural concrete structures.

THE AUTOMATED SYSTEM ALLOWS FOR BRIDGE DECK TESTING IN A FRACTION OF THE TIME TYPICALLY REQUIRED BY CHAIN DRAG

RESULTS PRODUCED REFLECT THOSE TYPICALLY ACHIEVED BY CHAIN DRAG AND THE HUMAN EAR

1 Using small steel spheres or chains, the concrete surface is struck, and the mechanical wave response is recorded by a microphone into a high-speed data acquisition unit.

2 For concrete bridge decks, the induced elastic wave travels from the point of impact to the bottom of the deck or a location of a flaw, reflects back to the surface, and continues this reverberation pattern.

3 Time domain data is transferred into the frequency domain using a Fast Fourier Transform (FFT), and the frequency domain is analyzed to determine the velocity of the concrete, depth of the slab, location of delaminations, or all three.

4 Data is input into a novel algorithm which analyzes multiple waveform types to determine the location of delaminated areas. Similarly, the human ear detects similar changes in frequency during investigation using hammer sounding and chain drag techniques.

5 The method has been validated with cores and chain drag in multiple states as part of the SHRP2 R06A Implementation Program.

BDI — RAW DATA. REFINED RESULTS.

SOUNDAR UTILIZES A NOVEL ANALYSIS METHOD THAT REPLICATES THE FUNCTION OF THE HUMAN EAR BY DETECTING CHANGES IN FREQUENCY, AMPLITUDE, AND RELATIVE ENERGY DISTRIBUTION. IN THIS WAY, IT PROVIDES AN AUTOMATED NDE METHOD SIMILAR TO MANUAL SOUNDING AT A FRACTION OF THE COST.

SounDAR is modular, to allow sounding via individual impacts similar to IE or by dragging chains across the bridge deck in a more traditional chain drag approach. Additionally, SounDAR can be mounted to any vehicle with a tow hitch and is operated in a continuous motion that allows for bridge deck inspection with a rolling closure.

SounDAR is equipped with a high-precision electronic distance measurement encoder attached to the vehicle wheel and an integrated GPS unit to allow for a sophisticated geospatial data analysis. The system is computer controlled and autonomous (except for the driver of the vehicle) and is capable of producing a map of delaminations immediately after data acquisition.

SounDAR is an industrial grade data collection system designed and manufactured by BDI. BDI has 30 years of experience developing specialized hardware for making precise measurements on civil infrastructure.

HIGH RESOLUTION VIDEO (HRV)

BDI pairs this service with other NDE techniques such as GPR and IR, but most importantly with HRV. HRV data results in a visual map of the bridge deck collected utilizing a 4k high-resolution video camera operated from an elevated platform attached to the survey vehicle. The HRV camera is capable of capturing a full lane width of data per driving pass. To facilitate accurate location of defects, data from a high precision electronic distance measurement encoder (+/- 3″ accuracy) attached to the vehicle wheel is collected synchronously with SounDAR. The HRV data is analyzed to quantify and identify spalling, hot mix asphalt patches, concrete patches, bridge deck expansion joints, and reference lines. The plan-view HRV images are provided as a value-added deliverable to provide a record of existing cracking and other bridge deck surface features.

DATA PRESENTATION

These results of HRV are provided in 4K resolution with overlaid SounDAR data identifying other physical features of the bridge deck such as debonding, patching, and delaminations.
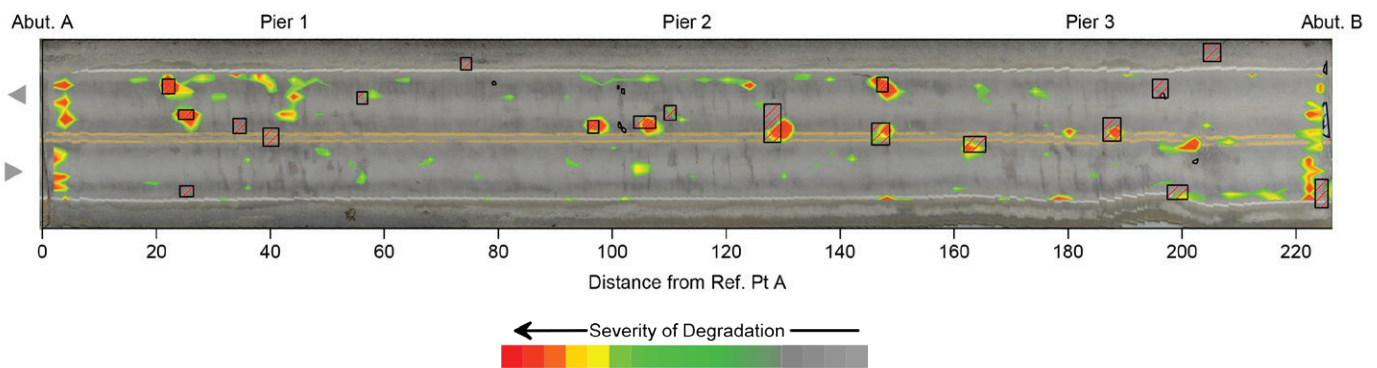
Sample SounDAR Compared to Manual Chain Drag (Chain Drag in Black Boxes)