

## White Paper

### EPIC HYPER OPTICS PAVEMENT VOIDS ANALYSIS (PVA) VERIFICATION TESTING

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Electronic Pavement Infrastructure Charting, Inc. (EPIC) is marketing services to non-invasively quantify support conditions of pavement systems, specifically the areal extent, depth, and location of voids. The EPIC system, known as Hyper Optics Pavement Voids Analysis (PVA), consists of multiple state-of-the-art air-launched ground penetrating radar (GPR) systems and advanced proprietary analysis software.

EPIC retained the professional services of Dr. Michael I. Hammons, PE, of the Transportation Sector of Applied Research Associates, Inc. to be an impartial observer at validation tests of the PVA technology. The validation tests consisted of experiments to measure the areal extent, location, and thickness of voids beneath portland cement concrete (PCC) pavement slabs.

The PVA vehicle is capable of collecting data at highway speeds with little or no interruption to traffic flow. It features an array of four air-launched horn antennas integrated into a weatherproof housing within a scan vehicle allowing full-coverage of a 12-foot-wide lane in a single pass. The vehicle is equipped with differential GPS receivers and a distance measuring instrument (DMI) to track its position on the roadway.

The PVA software automates processing and calculations on the radar signals and provides a three-dimensional color plot of calculated void location, areal coverage, and void thickness. PVA results can be reviewed in the field on a personal computer as soon as the data are collected. No analyst post-processing interpretation is required by the system.

Validation tests were conducted in December 2004 on an abandoned roadway in Fort Bend County, Texas. Two test sections were prepared with pre-determined support conditions ranging from intimate contact between the slab and base to a void of approximately 3 inches thick. One section was covered with precast 8-inch-thick PCC slabs, while the other was covered with precast 12-inch-thick slabs. The Hyper Optics PVA unit collected data on the test sections at vehicle speeds ranging from crawl speed (approximately 3 mph) to 50 mph.

Table 1 summarizes the results of the validation testing. PVA calculated values for the first 12 feet (where the slabs rested directly on the soil) were highly accurate in verifying that no voids existed within these sections. PVA values for the relatively flat sections (28 to 34 feet) closely matched the pre-test measured values. While Table 1 compares the PVA calculated values within  $\pm 1/2$  inch of the pre-test measurements, many PVA-calculated values fell within 1/8 inch to 1/4 inch of the pre-test measurements.

**TABLE 1. Summary of Test Results:  
Percent of PVA calculated values falling within  $\pm 1/2$  inch of measured voids**

12-INCH-THICK SLAB	VEHICLE SPEED, MPH				
	3	10	20	30	40
0 to 12 feet (Slab on Soil)	100	100	100	92	100
28 to 34 feet (Flat Void)	100	100	71	100	86

8-INCH-THICK SLAB	VEHICLE SPEED, MPH					
	3	10	20	30	40	50
0 to 12 feet (Slab on Soil)	100	83	100	100	83	92
28 to 34 feet (Flat Void)	100	100	71	57	71	57

The PVA system is a significant advancement in GPR technology for automated void detection beneath pavements both in equipment and data processing. The ability of the system to pinpoint the location and areal coverage of voids underneath PCC slabs up to 12 inches in thickness was demonstrated satisfactorily.