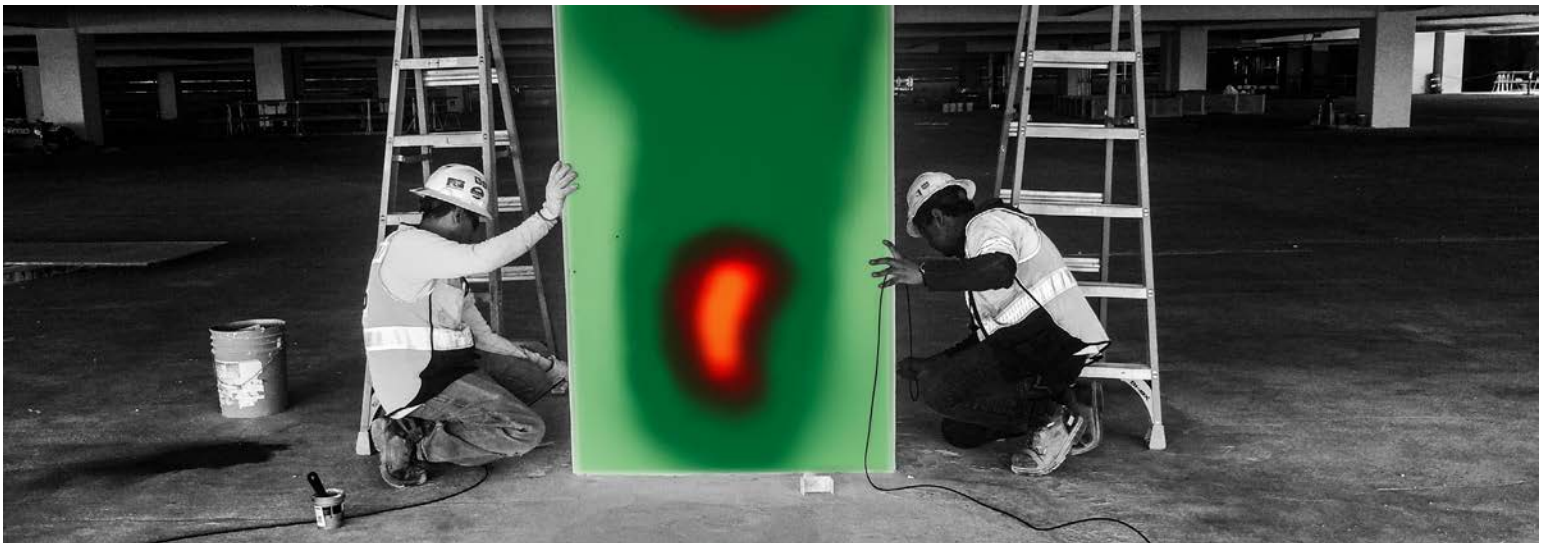
Olson ENGINEERING

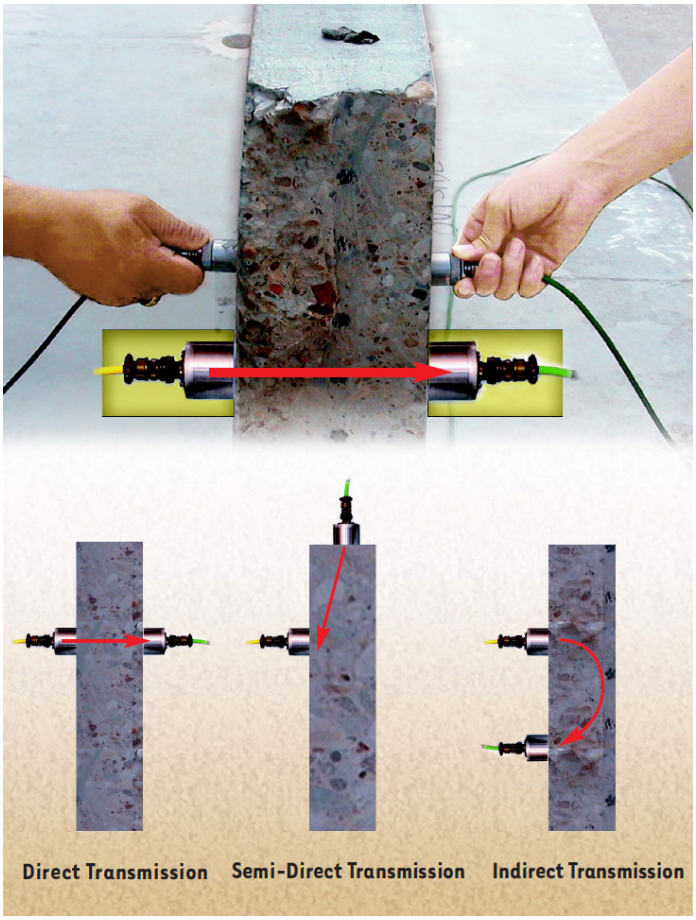
ULTRASONIC PULSE VELOCITY (UPV)

METHOD BRIEF



APPLICATION

Ultrasonic Pulse Velocity (UPV) tests are performed to assess the condition of structural members with two-sided access such as elevated slabs, beams, and columns. Voids, honeycomb, cracks, delaminations, and other damage in concrete, wood, masonry, stone, ceramics, and metal materials can be identified and mapped with the method. UPV tests are also performed to predict strength of early age concrete. The UPV test relies on direct arrival of compressional waves. Sources and receivers used in the tests have resonant frequencies ranging from 50 to 150 kHz. The higher resonant frequency receivers are typically used with thinner structural members for higher resolution and smaller anomaly identification. In the basic UPV test, Olson Engineering records the full waveform with a data acquisition system for troubleshooting of material condition and velocity measurement.



STANDARDS

Standards for the UPV method include ASTM C597 Standard Test Method for Pulse Velocity through concrete, ASTM E494 for measuring ultrasonic velocity in materials, BSI 98/105795 DC for determining the ultrasonic velocity of concrete, and ACI 228.2R for NDE applications.

** See end of document for full references.*

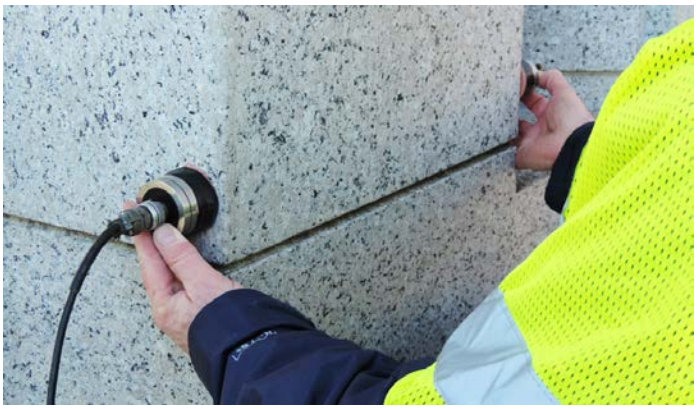
FIELD INVESTIGATION

ACCESS

Two surfaces are generally required to perform the test, but single-surface tests are possible. Depending on the orientation of the two surfaces, the test is referred to as a direct transmission test, a semi-direct transmission test, or an indirect transmission test (see figure on previous page).

COLLECTION OF DATA

In a standard UPV test, a piezoceramic source is electrically pulsed to generate ultrasonic waves which travel in the structural element, which are then sensed by the receiver on the opposite side of the test member. The source and receiver signals are recorded by an Olson Instruments Data Collection Platform equipped with an UPV System. Knowing the travel distance and travel time, the ultrasonic compressional wave velocity is calculated.



DATA REDUCTION

PROCESSING TECHNIQUES

The receiver output is recorded by a digital oscilloscope card in a Freedom Data PC or an NDE 360. Three parameters are used in the interpretation of data: 1) arrival time of compressional waves, 2) signal strength and 3) distortion of the transmitted signal. These parameters are available in the Olson Instruments WinUPV system software.

INTERPRETATION OF DATA

In defect areas, the compressional wave velocity is slower than in sound areas and signal amplitude is usually lower. For structural members containing large, severe voids, signal transmission may be completely lost. In some defect areas, such as honeycombs, the compressional wave velocity may be almost the same as in sound areas, but distortion of the signal (filtering of high frequencies) may be used as an indication of a honeycomb defect.

EFFECTIVENESS

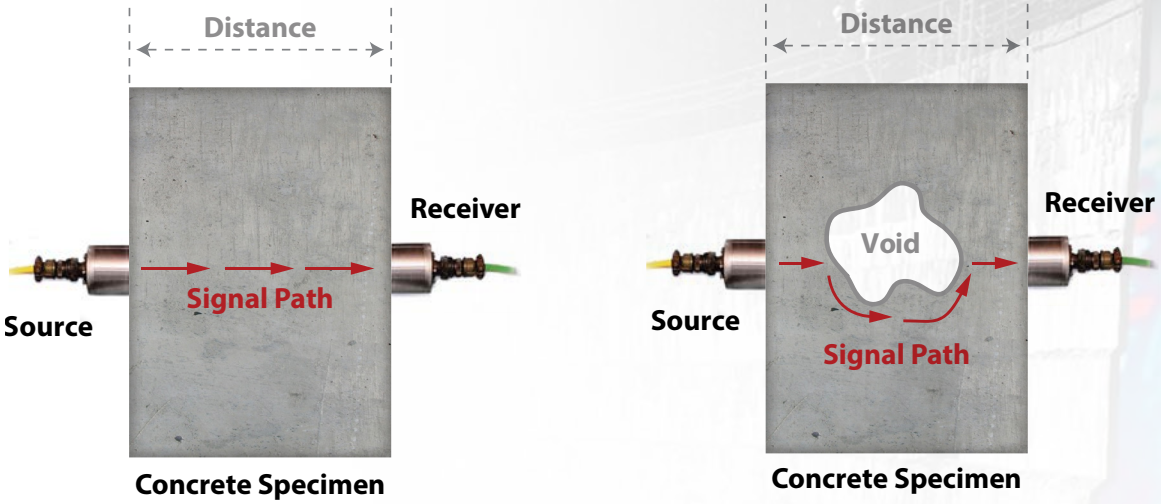
The method requires access to two surfaces on the same test member, preferably two parallel surfaces such as the top and bottom surfaces of a slab or the inside and outside surfaces of a wall.

NDE 360 Data Platform

UPV System

FDPC Data Platform

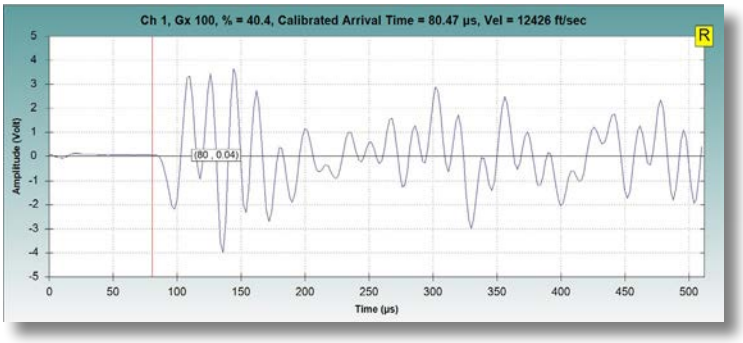
TEST METHODS

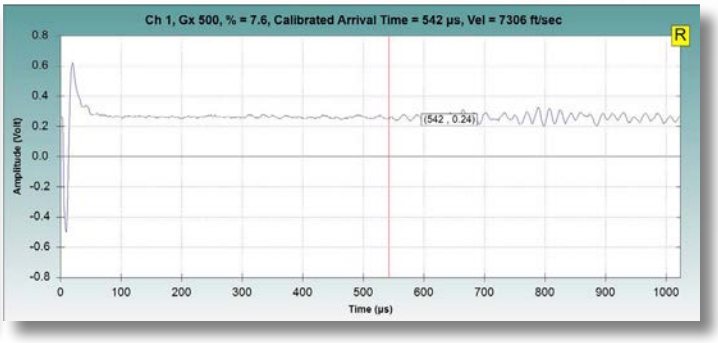


EXAMPLE RESULTS

STRUCTURAL – CONCRETE COLUMN

To illustrate the concepts of UPV tests, example results from tests on concrete are presented below. The first figure presented shows a strong signal where testing was performed through sound concrete. The second figure presented shows a very weak signal indicative of poorly consolidated concrete or wave travel representing void conditions.





REFERENCES

STANDARDS AND GOVERNMENTAL REPORTS

- ACI 228.2R, "Nondestructive Test Methods for Evaluation of Concrete in Structures", *ACI Manual of Concrete Practice, Part 2*, Construction Practices and Inspection, Pavements, ACI International.

- ASTM C597, "Standard Test Method for Pulse Velocity Through Concrete", Book of Standards Volume 04.02, ASTM International.

- ASTM E494, "Standard Practice for Measuring Ultrasonic Velocity in Materials", Book of Standards Volume 03.03, ASTM International.

- BSI 98/105795 DC, "prEN 13296. Testing Concrete. Determination of ultrasonic pulse velocity", British Standards.

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