

ANNOUNCING ICRI'S NEW NDE GUIDELINE

ICRI Committee 210, Evaluation, announces the publishing of ICRI Technical Guideline 210.4-2009, "Guide for Nondestructive Evaluation Methods for Condition Assessment, Repair, and Performance Monitoring of Concrete Structures."

From the guideline:

"The purpose of this guideline is to assist contractors, owners, engineers, architects, and material suppliers involved in concrete repair projects in the selection of the most suitable nondestructive evaluation (NDE) methods for evaluating specific conditions relating to the condition assessment, repair program quality control, and/or performance monitoring of a structure. This guideline also provides assistance in understanding which specific conditions related to the condition assessment, repair quality control, or performance monitoring of a structure can be suitably evaluated using various NDE methods. An essential component to proper maintenance and repair of a concrete structure is a thorough understanding of the structure in terms of the cause, extent, and rate of progression of distress or deterioration. Arriving at such an understanding requires experience and a set of tools that are in some ways quite distinct from those applicable to new construction. Critical aspects of distress or deterioration may be hidden from view. The simplest repair approach is to address symptoms rather than causes that may result in ineffective repairs. NDE methods offer the advantage of being able to diagnose internal concrete conditions, thereby enhancing repair design, quality assurance of concrete repairs, and performance monitoring of concrete repairs over the long-term."

The guideline offers assistance in selecting appropriate NDE methods for all phases of concrete repair projects:

"NDE offers tools through which valuable information can be gained regarding the condition of a structure and the nature, extent, and severity of hidden, internal distress or deterioration. In some applications, NDE offers essential tools without which there would remain significant uncertainties that have the potential of compromising the feasibility of repair. Searching through the many NDE techniques, while recognizing the strengths and limitations of each method to arrive at the proper NDE program for a specific structure, can be a daunting task. This guideline offers assistance in selecting appropriate NDE methods to determine



the properties and/or conditions of concrete prior to repairs (diagnosis), for quality assurance (QA) and quality control (QC) during repairs, and for long-term performance monitoring of repaired structures."

Recognizing that not all NDE tools will work for all issues, this guideline reviews the appropriate uses for the tools and techniques that are available. Some common uses of NDE for the condition assessment of structural concrete prior to repair design and execution include:

- Prediction of in-place concrete strength (relative strength comparison, unless correlated with laboratory strength tests, for example, core compressive strength tests);
- Location and extent of delaminations due to reinforcement corrosion;
- Location, size, and distribution of reinforcement bars;
- Location and extent of concrete cracking;
- Severity, location, and extent of fire and frost damage;
- Location and extent of void honeycombing;
- Determination of concrete thicknesses; and
- Evaluation of reinforcement corrosion activity and rate.

Guideline tables for the selection of NDE methods are presented, including those for concrete strength prediction; structural and general concrete condition assessment; foundation condition, integrity, and length; and reinforcement location, cover depth, sizing, and corrosion condition assessment. An example of one of the tables contained in the guideline follows.

Each of the NDE methods discussed in the guideline tables such as that shown previously are briefly described and illustrated in the Appendix. For example, the Ultrasonic Pulse Velocity test is shown in the guideline as follows:

Table 7.1: NDE Methods for Concrete Strength Prediction

NDE methods	Cast-in-place cylinders	Maturity	Rebound hammer	Pin/probe penetration resistance	Pullout (fresh and hardened concrete)	Pulse velocity	Tensile pull-off
References Standards/guidelines	ASTM C873	ASTM C1074	ASTM C805	ASTM C803	ASTM C900	ASTM C597	ASTM C1583 ICRI 210.3-2004
Appendix section	A.1.2	A.1.3	A.1.5	A.1.4	A.1.7	A.1.8	A.1.6
Property/condition							
Compressive strength	X	X	X	X	X	X	—
Tensile strength	X	X	—	—	X	X	X
Bond strength/quality	—	—	—	—	—	—	X

Note: ACI 228.1R requires that nondestructive strength predictions be based on appropriate NDE-to-destructive-strength correlation tests for the NDE methods discussed therein. Also note that the Break-off Number Test is discussed in Section A.1.1 but this test was withdrawn by ASTM in 2002 so is not included in Table I.

“A.1.8 Ultrasonic Pulse Velocity Test (ASTM C597)

The ultrasonic pulse velocity method involves transmitting and receiving ultrasonic sound wave energy at a frequency of typically 54 kiloHertz (kHz) and calculating the pulse velocity as the travel path distance divided by the travel time in microseconds, as shown in Fig. 7. As discussed in ACI 228.1R, velocity raised to the fourth power is proportional to Young’s Modulus to the second power, which is proportional to concrete compressive strength. Correlations between velocity and strength of cylinders and cores may also be best developed using multiple regression correlation techniques. Ultrasonic pulse velocity measurements are highly repeatable. Any stress wave measurement of velocity using lower frequency sonic pulse velocity and/or spectral analysis of surface waves methods in the field can also be correlated with pulse velocity results on cylinders/cores in the laboratory to predict concrete strength.”

The overall guideline compliments reports from American Concrete Institute’s (ACI) Committee 228, Nondestructive Testing of Concrete—ACI 228.1R and ACI 228.2R—that provide more in-depth information on most of the NDE methods discussed in this guideline.

ACI has given permission to reproduce a number of the NDE method schematics from ACI 228.1R and ACI 228.2R committee reports that were drawn

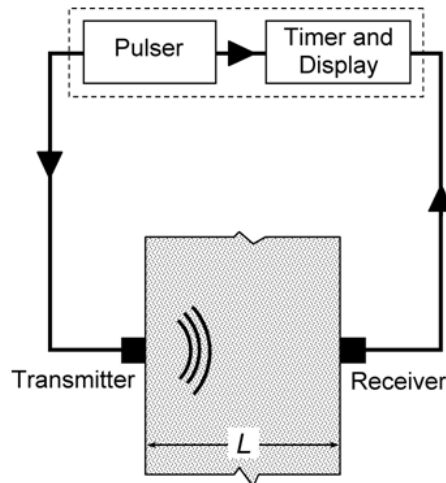


Fig. 7: Ultrasonic pulse velocity method

by Dr. Nicholas J. Carino, former Chair of ACI 228. Accordingly, the ICRI Evaluation Committee gratefully acknowledges the contribution by ACI and Dr. Carino to this ICRI Technical Guideline.

The roster of **ICRI Committee 210, Evaluation**, for ICRI Technical Guideline 210.4-2009, “Guide for Nondestructive Evaluation Methods for Condition Assessment, Repair, and Performance Monitoring of Concrete Structures,” was as follows:

Larry D. Olson, Chair; Dennis Wipf, Vice Chair; David Rodler, Secretary; Jesse Binford; Boris Dragunsky; Eric L. Edelson; Tim Gumina; Peter Kolf; Kenneth Lozen; Kevin Michols; Larry G. Mrazek; Dennis A. Sack; Matthew Sherman; Jeffrey A. Travis; Stéphan Trépanier; Hamid Vossoughi; and Tanya Wattenburg Komars.