Florida Department of Transportation Research

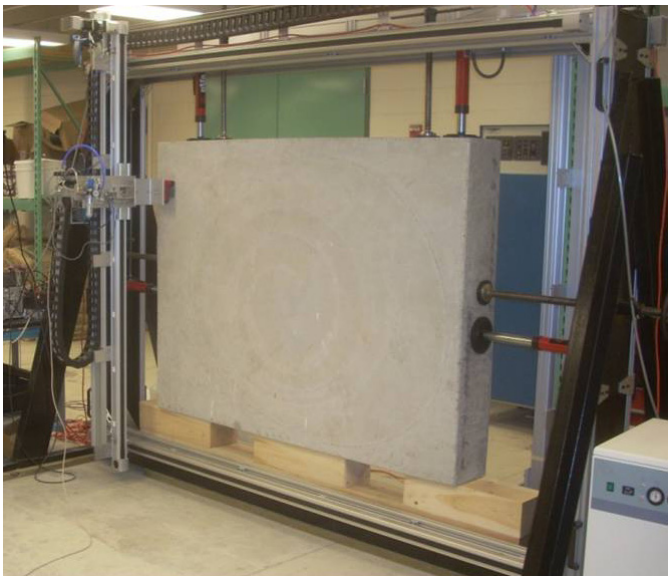
Validation of Nondestructive Testing Equipment for Concrete
BD545-80

A problelm affecting durability of concrete structures in coastal areas is corrosion of reinforcing steel caused by saltwater. Saltwater infiltrates concrete through construction flaws caused by improper placement of steel reinforcements, inconsistent consolidation that results in de-bonding and air pockets, and surface cracks due to improper finishing and curing. Currently, certification of concrete structures is based on visual inspections and results from traditional tests such as slump and cylinder breaks.

Researchers at the University of Florida (UF), Department of Civil and Coastal Engineering, recently studied methods to conduct nondestructive tests and evaluation (NDT/NDE) of concrete structures in the field. Researchers sought to determine whether applying NDT/NDE methods can improve the quality of concrete construction, improve durability, and save construction costs.

Researchers designed and constructed a testing facility to implement first-stage certification capabilities for calibrating and validating methodologies for NDT/NDE of structural concrete materials. They built four concrete specimens with known material properties and flaws, and conducted experiments using NDT/NDE technologies. They implemented an automated scanning system, currently used by the Federal Institute for Materials Research and Testing in Berlin, Germany, to collect measurements, and developed a software program that controls the scanner and synchronizes, saves, and visualizes data.

Testing focused on four problems: (1) locating and measuring the concrete cover of steel reinforcement; (2) measuring the thickness of concrete components and locating irregularities; (3) inspecting tendon ducts; and (4) applying NDT/NDE to determine elastic parameters. Automated measurements were taken in the scanning mode with impact-echo, ultrasonic echo, and covermeter techniques on the concrete specimens.



The automated testing frame holds block specimens in place while a scanner takes automated measurements.

Researchers determined that the covermeter method demonstrated potential to measure the amount of concrete covering the steel reinforcements. Likewise, the complementary ultrasonic-echo method, coupled with the synthetic aperture focusing technique (SAFT) analysis, showed potential to measure steel reinforcement. Measurements taken on the specimen with varying thicknesses demonstrated the capabilities of the ultrasonic-echo technique. The impact-echo 2-D, 3-D ultrasonic echo, and covermeter all located tendon ducts in the tendon duct specimen.

Researchers concluded that the NDT/NDE validation system works precisely and reliably. They determined that the system implements automated scanning measurements and data analysis techniques with NDT/NDE hardware to produce an advanced sensing system for assessing the integrity of concrete structures. Researchers recommend further research to establish detailed capabilities of the techniques and to establish a statistical database from which appropriate acceptance criteria can be developed.

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