

## Nondestructive Evaluation of Bridges

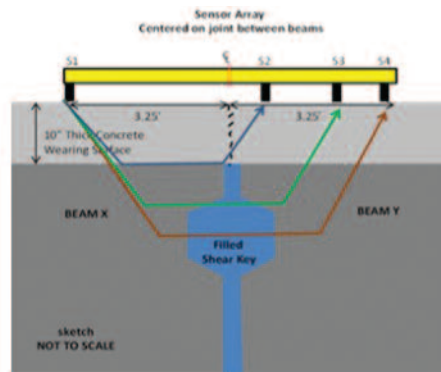
*Paul S. Fisk, President NDT Corporation*

### Nondestructive Evaluation of Box Beam Shear Keys

NDT Corporation conducted sonic/ultrasonic pulse velocity measurements on box beam bridges at Houston International Airport to determine if visible cracking coincident with the spacing and location of the joints between box beams extended to and possibly through the concrete filled shear keys. Depending on the depth of a crack, wave velocity will be lower for measurement across a crack. A full depth crack through the shear key would inhibit the propagation of the waves, resulting in no discernible signal arriving at the sensor.

### As Built Details

Bridge ratings of culverts and small bridges require knowledge of the spacing, cover and size of the reinforcing bars in the abutments and deck, thickness of the dead load materials, as well as concrete thicknesses and strength. NDT Corporation primarily uses two testing methods to inspect as-built details: ground penetrating radar to determine the reinforcing characteristics and thickness of the dead load materials, and sonic/ultrasonic pulse velocity measurements to determine average dynamic concrete strengths. Rebar sizes are usually determined by exposing a bar and measuring with a caliper.



Sonic/ultrasonic array and testing configuration for crack depth assessment.



Sonic/ultrasonic pulse velocity measurements being taken on a bridge in the field.

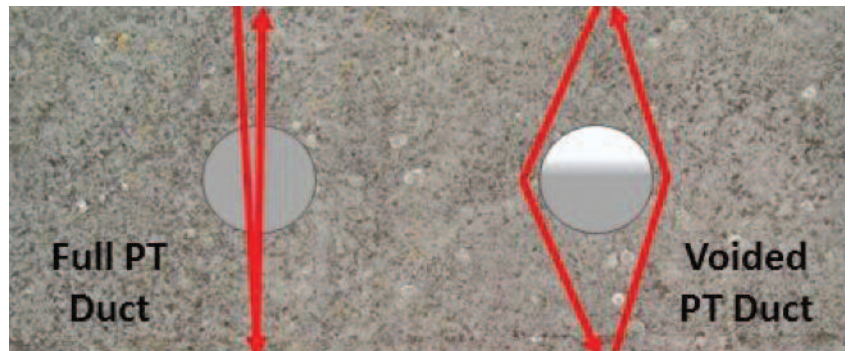
- ▶ BRIDGE TESTING
- ▶ PIPE TESTING
- ▶ TUNNEL TESTING
- ▶ SOIL & BEDROCK TESTING
- ▶ BUILDING TESTING
- ▶ PILES & DRILL SHAFT TESTING
- ▶ WALL TESTING
- ▶ DAM TESTING
- ▶ TOWER TESTING
- ▶ RAILROAD CROSS TIE TESTING
- ▶ TANK TESTING

## Detection of Voids, Soft Grout & Tendon Corrosion in Internal Bridge Post Tensioning Ducts

Post-tensioning makes possible the cost-effective construction of high-quality bridges. In recent years, a number of instances of problems with voids and soft grout in the post tensioning (PT) ducts have occurred. Open voids and soft grout create a favorable environment for strand corrosion, and if not detected and remediated, corroding strands can fail, potentially causing a bridge to fail. Correct allocation of funds for monitoring post-tensioning duct condition, maintenance and repair is critical. Cost-effectively locating and quantifying voided and soft grout conditions in PT ducts are important for planning and budgeting remedial actions.

NDT Corporation has successfully used nondestructive impact echo testing to identify specific locations within internal post tensioning ducts where grout voids and soft grout exist. Nondestructive testing results are verified by drilling a small hole to the duct, opening the duct with tools designed for this task, and verifying grout condition with probing and documenting tendon corrosion with video borescope imaging. The results of these investigations are used to determine appropriate repair methods and prepare repair bid documents. In the last 15 years, NDT Corporation has successfully completed investigations of PT ducts on bridges including:

- Bayonne Bridge, Bayonne, NJ
- Robert E. Lee Bridge, VA
- Wonderwood Bridge, FL
- Kellogg Bridges, KS  
(ACEC National Award Winner)
- Moakley Bridge, MA
- Jamestown-Verrazzano, RI



Sound waves pass through full PT ducts, but deflect and slow as they pass around voided PT ducts.



Documentation of a PT duct void via a borescope inspection.

## Inspection of Recently Poured Concrete

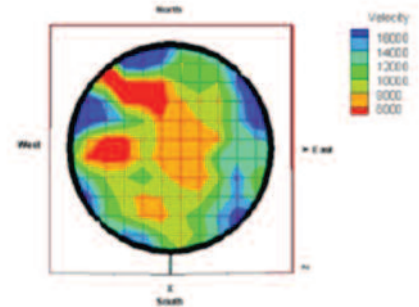
Occasionally problems arise during construction of a new structure that affect the structural integrity or appearance of the structure. These problems can be due to late deliveries of concrete; improper vibration; rebar spaced too closely for aggregate to pass between during pouring of the concrete; thermal affects as a result of pouring concrete in cold or hot weather; or too much air entrainment or entrapment.

The questions that arise are: Where, how extensive and how severe is the problem? NDT Corporation has successfully used direct through velocity measurements with tomographic imaging to identify the locations of low velocity concrete associated with weak, voided, fractured or honey combed concrete. These measurements can be repeated after repairs have been made to determine how effective the repairs have been.



Pulse velocity measurements determined the extent of the weak areas in the recently poured concrete.

Tomographic image of a support column cross-section show weak concrete as red areas.



## NDT Corporation

We are nondestructive and geophysical testing experts with more than 700 projects across the US to our credit. Our geophysical tests assess soil and bedrock conditions to identify sinkholes, subsidence, shear zones and voiding. Our non-destructive concrete tests provide documented, cost-effective assessments of the integrity, as-built details and weakness or deterioration of concrete structures.



- ▶ BRIDGE TESTING
- ▶ PIPE TESTING
- ▶ TUNNEL TESTING
- ▶ SOIL & BEDROCK TESTING
- ▶ BUILDING TESTING
- ▶ PILES & DRILL SHAFT TESTING
- ▶ WALL TESTING
- ▶ DAM TESTING
- ▶ TOWER TESTING
- ▶ RAILROAD CROSS TIE TESTING
- ▶ TANK TESTING