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American Concrete Pipe Association, Irving, Texas 75063-2595, USA

Post-installation inspection training required for acknowledging the production quality of reinforced concrete pipe

Automated and fully robotic concrete pipe plants, the Quality Cast certification program, a culture of plant safety, and continuous technical training combine to assure owners, contractors, specifiers and designers that they are working with a modern material and a variety of pipe and precast box products that will perform for the design life of projects. To strengthen the performance expectations of pipelines and culverts, the concrete pipe industry has extended its education about plants and products to the people who inspect the structures assembled by contractors. The American Concrete Pipe Association (ACPA) has post installation inspection (PII) courses that address common characteristics of a high performance pipe that might be mistaken as a deficiency by an inspector unfamiliar with pipe design, production and in-plant testing.

Matt Childs, P.E.,
American Concrete Pipe Association, USA

Many municipalities in America require Pipeline Assessment and Certification Program (PACP)-certified inspectors and condition assessment codes to be used for pipeline condition assessments. Since more post installation inspection data are generated and presented to owners, engineers, and inspection professionals, the need to properly and quickly evaluate a red flag in an inspection document becomes critical. Video inspections are often used to determine the acceptance of installations. During these video inspections, cracks may be evident. All too often, an untrained inspector views a small crack in a post installation video inspection to be a failure. This occurs most often because many of the cameras produce some distortion and magnify hairline cracks. This causes the cracks to appear as though they are much larger, resulting in unnecessary repairs or replacements, and unfair questioning of the quality of pipe production and in-plant testing.

Three-edge Bearing Test. Photo: Courtesy American Concrete Pipe Association

Reinforced concrete pipe design accommodates the high compressive strength of concrete and the high tensile strength of steel. As load on the pipe increases, and the tensile strength of the concrete is exceeded, cracks will form as the tensile load is transferred to the steel. The presence of a 0.01-inch crack does not represent failure, but rather an indication that the concrete and reinforcement are working together, as intended. The 0.01-inch crack was never intended to determine the failure. It was established by Professor W.J. Schlick of Iowa State University to establish the comparative strength of RCP in a three-edge-bearing test by using a simple 0.01-inch thick leaf gauge to determine a measurable and definitive size crack. The three-edge-bearing test is a plant test. Specifications for RCP require an ultimate load resistance that exceeds the required 0.01-inch crack strength, giving the designed pipe a significant factor of safety above the required service load. ASTM C76-06 states, "As used in this specification, the 0.01-inch crack is a test criterion for pipe tested in the three-edge-bearing test and is not intended as an indication of overstressed or failed pipe under installed conditions." The AASHTO LRFD Bridge Construction Specification Section 27 allows acceptance of cracks up to and beyond 0.10 inch (the thickness of two dimes) in reinforced concrete pipe.

ACPA's PII demonstration Tool Kit includes sample PowerPoint decks, "How To" notes for key demonstration components, and plant tour suggestions. Member companies may approach ACPA staff for a copy of the kit, and assistance in planning a PII demonstration. Since the launch of the PII program in 2012, dozens of post installation inspection demonstrations have taken place, combined with concrete pipe plant tours. PII demonstrations highlight robotic inspection equipment and specific issues that the evaluation team must understand about the accuracy of the data that are collected. Discussions include the proper technique for crack measurement accuracy, joint gap measurement accuracy, and deformation measurements and inclinometer measurements for thermoplastic conduits. Demonstrations generally take place in states that have added PII in specifications for newly installed pipe, or in states that are considering revisions to their pipe inspection requirements.

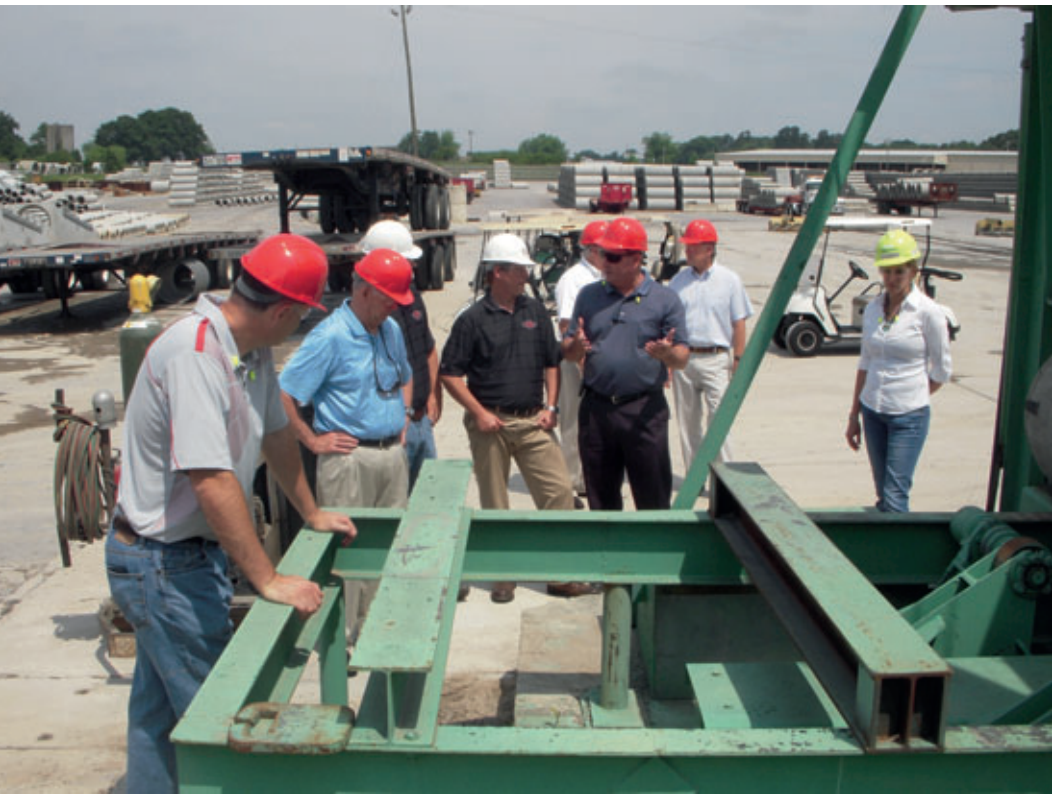
Matt Childs, P.E. is President of the American Concrete Pipe Association. He has been with ACPA since summer, 2000. Matt holds a Bachelor's Degree in Business Administration from Baylor University, a Bachelor's Degree in Civil Engineering, and a Master's Degree in Civil & Environmental Engineering from the University of Texas at Arlington. He is a registered professional engineer in the state of Texas. Matt is the fourth generation of his family to have worked in the concrete pipe industry, and worked as a laborer in a concrete pipe plant in Texas during his college years. Matt@concrete-pipe.org

The in-plant three-edge-bearing test determines D-load of a run of concrete pipe that may be included in a purchase order, or as inventory of standard product stored at the plant for immediate shipment. ASTM C-497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile includes test methods used for the production and quality control of RCP. These tests are completed to properly evaluate all the various properties required for the completion of a quality finished product. C-497 includes and discusses the following critical test procedures: Three-Edge Bearing Test Method, Core Strength Test Method, Absorption Test, Hydrostatic Test Method, Cylinder Strength Test, and Joint Shear Test. There are test methods covered in ASTM for almost all of the components of RCP, as well as test methods to confirm conformance of the installed product including joint materials and joint tightness. These tests are carried out within the laboratories or on the floor of production facilities.

The strength of RCP is stated as D-load, which is the load in pounds per lineal foot per foot of internal diameter that the pipe can support in a three-edge bearing test. Most typically, the 0.01-inch D-load is specified, which is the service load allowable that produces a 0.01-inch (0.25 mm) crack. The Ultimate D-load is when the D-load is taken to the point where the pipe cannot support any further loading. The load per linear foot which a pipe will support under this condition (0.01-inch or Ultimate) is termed the three-edge bearing strength. The three-edge bearing test is the most severe loading to which any pipe will be subjected. There is no lateral support for the pipe, as provided under actual buried conditions, and the applied forces in the test are virtually point loads.

The PII courses are best provided during a scheduled plant tour. Following presentation of the courses, a "self-guided" 30-minute plant tour is often arranged. Attendees are guided along a route through a plant by ropes and signage to stations where they could observe the various stages of concrete pipe production. Viewing stations are situated to observe reinforcement cage production, cage delivery, pipe removal from the pre-kiln floor, rounding ring removal, the pipe production machine, pipe production cycle, removal of the pipe to kiln cars, tip out, deburring, stenciling, quality control procedures, yarding, a three-edge bearing (3EB) test, and autogenous healing.

Strengths of the concrete pipe industry include its product and material Standards, supported by Standards and specifications for in-plant testing, installation and post installation inspection. ACPA's PII courses combined with plant tours are industry-education resources that help inspectors file accurate reports that in turn acknowledge the production quality of concrete pipe.



Todd Long, Deputy Commissioner (1st from left - grey shirt) Frank Ginn, State Senator, (3rd from right - dark blue shirt) Photo: Courtesy of American Concrete Pipe Association

FURTHER INFORMATION

American Concrete Pipe Association

American Concrete Pipe Association
8445 Freeport Parkway, Suite 350
Irving, Texas 75063-2595, USA
T +1.972 5067216
F +1.972 5067682
info@concrete-pipe.org
www.concrete-pipe.org