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University of Miami's RB²C tests advanced structural materials

The University of Miami College of Engineering's Civil, Architectural, and Environmental Department Center for Repair of Buildings and Bridges with Composites (RB²C) is a National Science Foundation Industry/University Cooperative Research Center (I/UCRC). RB²C focuses on conducting high-quality and industrially relevant engineering research in the areas of sustainable construction and of structural rehabilitation of buildings and bridges using advanced composites and high-performance materials and technologies.

The RB²C uses a 200,000 lb Baldwin screw gear universal testing machine dating back to 1959 to test structural elements. In 2004 the University updated the analog machine replacing the motor, controllers and an old analog vacuum tube console that had failed, with retrofitted components and controllers from ADMET. In 2009 the machine continues to provide service and is at the center of testing for the fiber reinforced polymer (FRP) research program.

The University of Miami's NSF I/UCRC for Repair of Buildings and Bridges with Composites (RB²C), headquartered at the College of Engineering Department of Civil, Architectural, and Environmental conducts theoretical and experimental research on novel composite materials and systems for new construction and structural rehabilitation.

Explained Fabio Matta, PhD of RB²C, "These technologies have been applied extensively around the world. We're trying to push the envelope using new materials that are more sustainable, more environmentally friendly and more efficient from a structural standpoint.

"We're devising technologies that can be implemented on a large scale, ranging from studying fundamentals and providing experimental evidence, to developing design guidelines and codes of practice."

Three research programs

The first RB²C program uses externally bonded carbon fiber sheets that are impregnated with epoxy resin and bonded to the concrete surface in order to strengthen the concrete I-beams representative of full-scale bridge girders in shear.

The tests, utilizing a 200,000 lb Universal Testing Frame (UTM), seek to identify and evaluate advances in fiber reinforced polymer (FRP) wrapping technologies used to rehabilitate

SOLUTION OVERVIEW

Industry: Construction Research

ADMET Product: Retrofit of Baldwin frame with MTESTWindows® and Precise Digital Controller

Customer: University of Miami Center for Repair of Buildings and Bridges with Composites

Application: Testing FRP wrappings and components

damaged or worn concrete beams.

The fibers are oriented in the most efficient manner from a structural standpoint. In the case of shear strengthening, the fibers are placed to span the cracks that develop in the beam. Practical anchorage methods are being studied to maximize efficiency.

A second project seeks to optimize and verify the design of a technology that is still under development. A prefabricated composite laminate plate is attached using bolts to strengthen concrete beams. There is no use of adhesives or chemicals.

This approach is appropriate for quick, emergency repairs after earthquakes or for military applications when there is not time to prepare the concrete surface or apply adhesives to irregular surfaces.

The research also examines the use of polyvinyl chloride (PVC) laminates that do not pose the problem of electromagnetic fields that could result from the use of bonded carbon FRP.

A third project tests new materials to confine concrete columns in order to enhance their capacity and ability to deform. In the early stages of the research, feasibility is evaluated on concrete cylinders that are wrapped with synthetic and with natural reinforcing fibers impregnated with a cement-based matrix, and tested under compression.

ADMET provides precise control

Each of these programs requires precise displacement control in order to accurately record the load and deformation response of the specimens.

The testing is done on a 50-year-old 200,000 lb Baldwin screw gear universal test machine (UTM) that has been updated with ADMET digital controls and the MTESTWindows testing system.

The data are collected over several channels. Sensors include load cells, strain gauges, crack gauges, linear variable differential transformers (LVDTs), etc.

“The ADMET system we use provides the displacement control that we require to ensure reliable results for analysis,” concluded Matta.

For more information:

For more information about ADMET products or services, please call us at 800-667-3220 or 781-769-0850, email sales@admet.com or visit our Web site at http://www.admet.com.

For additional information on University of Miami NSF I/UCRC RB²C, visit www.rb2c.miami.edu.