

UTC Project Information	
Project Title	MPC-516 – Innovative Strengthening for Deteriorated Concrete Bridges Using Embedded Composite Sheets Bonded with Polyester-silica
University	University of Colorado Denver
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Funding Agencies	USDOT, Research and Innovative Technology Administration
Agency ID or Contract Number	DTRT13-G-UTC38
Project Cost	\$49,507.50
Start and End Dates	September 30, 2013 to September 30, 2018
Project Duration	September 30, 2013 to September 30, 2018
Brief Description of Research Project	<p>Structural strengthening of deteriorated concrete bridges using advanced composite materials such as carbon fiber reinforced polymer (CFRP) has gained significant attention from the infrastructure engineering community. CFRP may be bonded along the tensile substrate of a concrete member with an epoxy adhesive to upgrade the load-carrying capacity of the member. Numerous advantages are expected when a structural member is retrofitted with CFRP sheets; for instance, insignificant increase in dead load, high-strength and favorable modulus, resistance to corrosion and fatigue, and reduced maintenance costs.</p> <p>Although CFRP-strengthening has been broadly used for buildings and bridges over the last decade, it is recognized that premature bond failure is a critical concern, which would substantially reduce the efficacy of structural strengthening. A number of research projects were conducted to understand the bond failure mechanism of CFRP-strengthened concrete beams and to propose enhanced implementation methods (Bank 2006). The current state-of-the-art of debonding-control includes use of anchorage that can retard the failure of CFRP-concrete interface (Kalfat et al. 2013). Various types of anchor systems were suggested previously such as mechanical anchors (Ortega 2007), non-mechanical anchors (Kim et al. 2008), and CFRP U-wraps (Pham and Al-Mahaidi 2006). These approaches,</p>

	<p>however, are not a permanent solution because i) mechanical anchors are susceptible to corrosion that can cause secondary distress to the bonded CFRP; ii) non-metallic anchors need extra endeavors and will eventually fail when excessive mechanical stresses are associated; and iii) CFRP U-wraps can also debond from the concrete. An intrinsically different approach is essential to address the critical debonding problem in externally-bonded CFRP application.</p>
<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>The proposed strengthening method will fundamentally reframe existing knowledge about externally-bonded CFRP application by alleviating the risk of premature debonding failure. The method will also address the aesthetic aspect of strengthened members because the CFRP is located inside a concrete substrate without the needs for external anchor systems. Detailed investigations into multi-material interaction will contribute to formulating a complete set of understanding of the embedded-CFRP system. The durability performance of the strengthened concrete members will be improved because of the reason stated above (CFRP sheets are located inside the concrete substrate where stress concentrations exist and hence the failure of the system induced by environmental or physical distress is precluded). The research will fulfill the need of bridge engineers who want to adopt state-of-the-art repair techniques and will be a valuable investment for our constructed infrastructure and associated sustainability.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>Educational components of this project are as important as research findings because new generation engineers are responsible for our constructed transportation infrastructure. The PI will train highly qualified personnel (two graduate students: Abdullah Alajmi and one more) and will integrate technical outcomes with structural engineering courses at the University of Colorado Denver. A number of undergraduate and graduate students will, therefore, benefit from the current MPC project. The PI will encourage his graduate students involved in infrastructure research to participate in conference activities and technical committees so that they can present their findings and can communicate with colleagues and potential employers. The PI will devote himself to maximizing the educational benefit of this MPC-sponsored project.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project Website 	<p>https://www.ugpti.org/resources/reports/details.php?id=983</p>