

Request for Research Funding for FY 2020-2021

Requesting Office	CO Structures Office	Priority	1 of 6
Proposed Title	Detailing of Externally Bonded FRP for Shear Strengthening		
Justification	<p>Carbon fiber reinforced polymer (CFRP) strengthening has been used throughout the state for bridges that have been damaged by over-height vehicles, corrosion damage, and for load strengthening. Increased use for shear strengthening has occurred over the past several years. Currently, Volume 4 of the FDOT Structures Design Manual (SDM) allows for complete wrapping or 3-sided wrapping only. The 3-sided method requires anchorage details to prevent debonding. Complete wrapping is typically impractical, therefore making the 3-sided with anchorage the most utilized method. The current issue is the methodology of properly anchoring the CFRP wrap. The primary method that has been utilized to anchor the CFRP wrap has been evaluated with past research work at TxDOT. This research evaluated the use of spike anchors. The spike anchors are invasive to the concrete section as it requires drilling holes, however it has shown to be effective. Due to the invasive nature, however, it extends the working time and could possibly create further issues if an excessive number of holes is required. Other anchorage methods have been proposed but they have not been properly evaluated to allow their use.</p> <p>This research is to perform a synthesis of existing research on the topic, along with some basic analytical effort and provide modifications to the current design and detailing guidance within Volume 4 of the SDM. It is anticipated that this would be a 2-phase research project. This initial phase would propose the anticipated research and testing plan for the 2nd phase, if determined necessary.</p>		
Impact	The results of this research will investigate improving the process and efficiency of repairing bridge girders which have insufficient shear capacity with FRPs. This could result in fewer bridges needing replacement due to insufficient capacity and allowing a more optimized design and reduce the construction time of the repair.		
Affected Offices	Structures Design, Structures Maintenance		
Existing Work	<p>Use of CFRP with Anchors for Shear-Strengthening and Design Recommendations/Quality Control Procedures (TxDOT 0-9783-1)</p> <p>Shear Strengthening of Reinforced and Prestressed Concrete Beams Using CFRP Sheets and Anchors (TxDOT 0-6306 and 5-6306)</p> <p>Anchorage Devices Used to Improve the Performance of RC Beams Retrofitted with FRP Composites: State-of-the-Art Review, R. Kalfat, R. Al-Mahaidi, and S. Smith, Journal of Composites for Construction, ASCE January/February 2013.</p> <p>Use of Anchors in Shear Strengthening of RC T-beams with FRP, L. Koutas and T. Triantafillou, Journal of Composites for Construction, ASCE January/February 2013.</p> <p>Development of Anchorage System for FRP Strengthening Applications Using Integrated FRP Composite Anchors, G. McGuirk and S. Brena, CRC ACI Foundation, October 2012.</p> <p>Effect of FRP Anchors on the FRP Rehabilitation of Shear Critical RC Beams and Flexure Critical RC Slabs, D. Baggio, Thesis for University of Waterloo, 2013</p>		
Keywords Used In Existing Work Search (Cannot leave blank)	FRP shear strengthening		
Related Contracts (Give contract numbers)	BDV31 977-01, BDK82 977-03, BC354-55, BC190		
Funding Request	\$125,000	Anticipated Duration	1.5 years
Project Manager	Will Potter	Contracting Method	RFP

Urgency	1	This project scored highest in a rating of research ideas by FDOT's Central and District Structures Design Offices.
Implementability	1	FRP repairs have already been extensively researched and can currently be used on bridges in service. FRP is commonly used to strengthen for moment due to insufficient capacity or an over-height hit. FRP shear strengthening can be done but is currently invasive. This project will evaluate and determine less invasive anchoring methods for shear strengthening so that the technology can be expanded for shear strengthening bridge girders in service.
Project Benefits (Succinct, complete explanation)		
This research will make it more feasible to repair in-service bridge girders which have insufficient shear capacity. By expanding the number of bridges which can be repaired, fewer bridges will need to be replaced due to insufficient shear capacity. Non-invasive methods will allow for repair with less traffic closure. In addition, current anchoring methods will not work for Florida-I Beams, so research is needed to determine how those new beams should be repaired.		
Project Benefits (Select all that apply and explain)	Quantifiable Benefits (units, dollars, etc...if applicable)	Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits
<input type="radio"/> Materials Enhancement		This research could enhance the current methods and materials by proposing new anchorage methods.
<input type="radio"/> Materials Savings		Fewer bridge replacements means less material used.
<input type="radio"/> Time Savings		Less invasive methods would complement the already advantages of using CFRP which minimizes repair time and has minimal impact to traffic.
<input type="radio"/> Lives Saved/Injuries Prevented		Less invasive methods may require less MOT, which will increase driver safety.
<input type="radio"/> Other (Explain)		

*Comments should explain and support urgency, financial benefit, and implementability scores