UNIVERSITY TRANSPORTATION CENTER FOR RAILWAY SAFETY

Exhibit F - UTCRS

UTC Project Information	
Project Title	Structural Integrity of Railroad Bearing Adapters with Modifications for Onboard Monitoring Applications
University	The University of Texas Rio Grande Valley (UTRGV)
Principal Investigator	Arturo A. Fuentes, Ph.D., Mechanical Engineering (PI) Constantine Tarawneh, Ph.D., Mechanical Engineering (Co-PI)
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Funding Source(s) and Amounts Provided (by each agency or organization)	Federal Funds (USDOT UTC Program): $24,741 Cost Share Funds (UTPA): $12,668
Total Project Cost	$37,409
Agency ID or Contract Number	DTRT13-G-UTC59
Start and End Dates	November2013 – December 2014
Brief Description of Research Project	The primary purpose of this project is to study the structural integrity of railroad bearing adapters modified for onboard monitoring applications. The UTPA Railroad Research Group funded by a private railroad industry (Amsted Rail) is attempting to provide one of the first economical, reliable sensors for keeping track of both dynamic and static loads on a railcar. The sensor is embedded in a bearing adapter under a thermoplastic elastomer suspension element patented as the AdapterPlus™ Pad. Bearing adapter modifications (e.g. cut-outs) were necessary to house the sensor and, thus, it is imperative to determine the structural integrity of the modified railroad bearing adapter to ensure the safe operation of the modified adapter in field service operating conditions. To that end, work performed under the University Transportation Center for Railway Safety aimed at developing CAD models of the railroad bearing adapters with the suggested modifications, and constructing finite

	element (FE) models using the ALGOR commercial software. The devised finite element models were used to conduct finite element analyses using some of the expected operational boundary conditions and loads. The FE models were validated with some physical experiments that were carried out in a laboratory setting.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	One of the major goals of the University Transportation Center for Railway Safety (UTCRS) is to increase the railway reliability by, among other things, developing advanced technology for infrastructure monitoring and developing innovative safety assessments and decision-making tools. Along these lines, the Railroad Research Group at the University of Texas-Pan American has been working on onboard monitoring systems for the railroad industry. Future technologies are focusing on continuous temperature tracking of railroad bearings (e.g. IONX motes). Since placing sensors directly on the bearing cup is not feasible due to cup indexing during field service, the next logical location for such sensors is the bearing adapters. The railroad bearing adapters act as a medium between the axle assembly (bearings and wheels) and the side frames. Modifications (e.g. cut-outs) to the bearing adapters were necessary in order to house the sensors. Therefore, it is necessary to determine the structural integrity and reliability of the modified railroad bearing adapter. The performed research produced experimentally validated Finite Element Analysis (FEA) stress results, and explored the fatigue life of conventional and modified adapters under different extreme case loading scenarios for the bearing adapters, which included the effect of a railroad flat wheel. In this worst case scenario, the flat wheel translated into a periodic impact load on the bearing adapter. The Stress-Life approach was used to calculate the life of the railroad bearing adapters made out of cast iron and subjected to cyclic loading. From the known material properties of the adapter (cast iron), the operational life was estimated with a mathematical relationship. The finite element analysis and experimental results (samples shown in Figure 1 and 2, respectively) revealed that conventional and modified adapters would have an infinite life at all studied loading conditions. The worst case scenario studied for the adapters was the case when it is subjected to periodic dynamic loading such as a wheel impact load which translates into an equivalent static load of 90,000 lb on the bearing adapter.

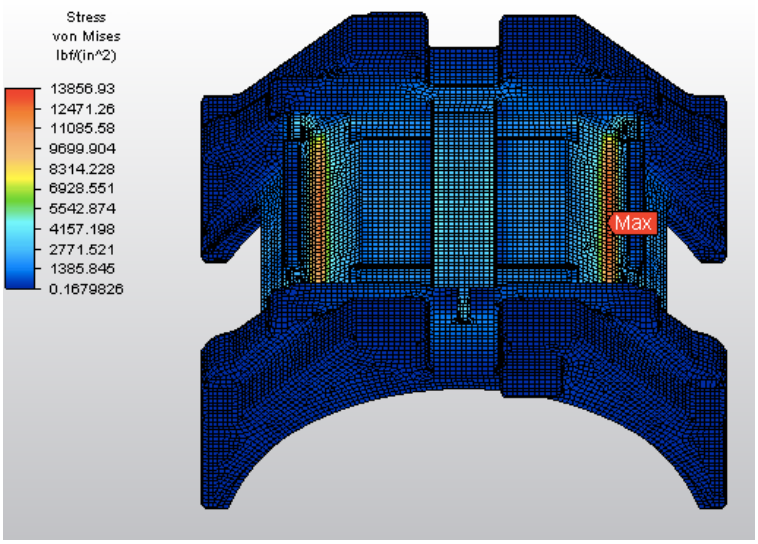
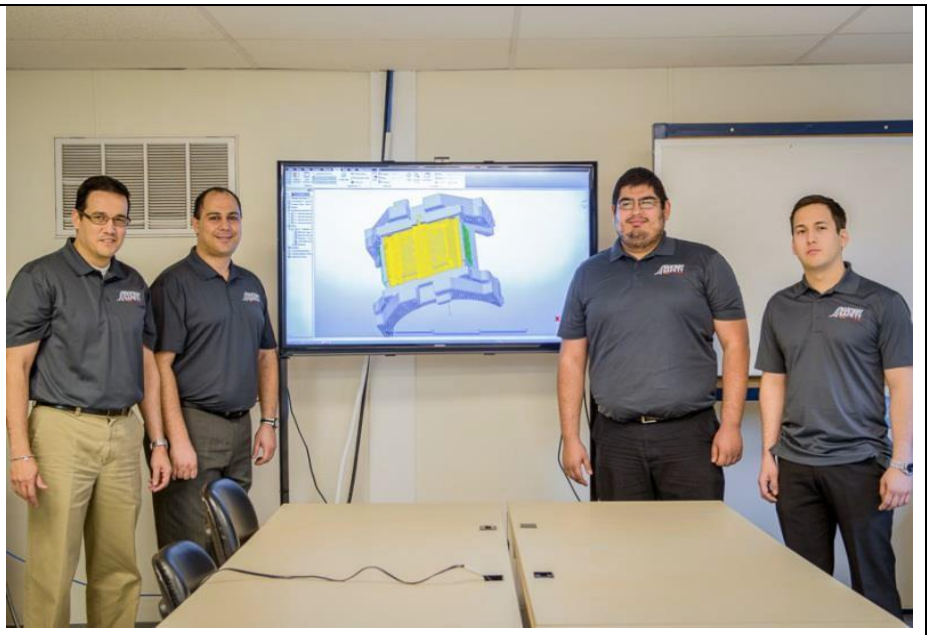


Figure 1: Sample FEA Result for Class K Modified Adapter

Figure 2: Sample Experiment for Class K Bearing Adapter

Additional work is recommended to look at other worst case scenarios with loading conditions that may develop in the field through the operating life of the railroad track, the railcar truck assembly, and the railroad bearing.

Figure 3 is a picture of the research team composed of UTPA Mechanical Engineering Faculty and undergraduate students.

	 **Figure 3: Research Team**
Impacts/Benefits of Implementation (actual, not anticipated)	The researchers at the University of Texas-Pan American have established an important track record in the area of experimentally validated finite element analysis related to railroad components including railway safety. The research results from this UTC project have been presented at different local, national, and international conferences with different audiences that include science and engineering students and faculty, railroad industry representatives, and researchers in the private and public sectors. The list of publications and/or presentations for this UTC project include the following: 1. Trevino, A., Fuentes, A. A., Tarawneh, C., and Montalvo, J., " FEA Fatigue Life Estimation of Modified Railroad Bearing Adapters for Onboard Monitoring Applications," *Proceedings of the 2015 ASME Joint Rail Conference*, San Jose, California, USA, March 23-26, 2015. 2. Montalvo, J., Trevino, A., Fuentes, A. A., and Tarawneh, C., "Structural Integrity of Conventional and Modified Railroad Bearing Adapters for Onboard Monitoring Applications," *Proceedings of the ASME International Mechanical Engineering Congress and Exposition*, Montreal, Canada, November 14-20, 2014.

	3. Montalvo, J., Trevino, A., Fuentes, A. A., and Tarawneh, C., "Structural Integrity of Conventional and Modified Railroad Bearing Adapters for Onboard Monitoring Applications," poster presented at *HESTEC Science Symposium*, Edinburg, TX, September, 2014. 4. Montalvo, J., Trevino, A., Fuentes, A. A., and Tarawneh, C., "Structural Integrity of Conventional and Modified Railroad Bearing Adapters for Onboard Monitoring Applications," poster presented at *University Transportation Center for Railway Safety Inauguration*, Edinburg, TX, February, 2014. An important benefit of this project is the training of a critical mass of students in Finite Element Analyses pertaining to the field of transportation, with emphasis on railway safety.
Web Links • Report • Project Website	http://www.utrgv.edu/railwaysafety/research/mechanical/2014/modified-railroad-bearing-adapter-for-onboard-monitoring/index.htm