



ACCELERATED BRIDGE CONSTRUCTION  
UNIVERSITY TRANSPORTATION CENTER

<b>UTC Project Information</b>	
Project Title	Rapid Retrofitting Techniques for Induced Earthquakes – Phase I
University	Oklahoma University
Principal Investigator	Dr. Phillip Harvey
PI Contact Information	harvey@ou.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	ABC-UTC funds: \$58,000 Match fund from OU: \$29,000
Total Project Cost	\$87,000
Agency ID or Contract Number	Accelerated Bridge Construction University Transportation Center (ABC-UTC) 69A3551747121
Start and End Dates	01/01/2018- 07/01/2019
Brief Description of Research Project	<p>Since 2009, there has been a dramatic increase in the number of earthquakes in the central United States. States such as Oklahoma, Kansas, Arkansas, and Texas have not historically experienced earthquakes at the rate currently observed, nor of this magnitude. Studies have linked the increased rate of seismic activity since 2009 to wastewater injection in disposal wells.</p> <p>These induced earthquakes are not limited to the U.S., but are also experienced in other countries including Canada, China, and the United Kingdom. The seismicity of places such as California and the New Madrid seismic zone is well documented and generally thought of when discussing seismic hazards in the contiguous U.S., yet the cumulative moment in Oklahoma over the last two years (1 January 2015 to 31 December 2016) exceeds that of southern California and the New Madrid seismic zones. While collapse is unlikely for the induced earthquakes currently observed, the cumulative effects of a large number of small earthquakes on bridges are not fully understood. These cumulative effects compounded with the occasional moderate earthquake (M5.0 and larger) may lead to damage requiring rapid repairs to avoid acute traffic control issues at the affected bridge sites. To reduce impacts to the driving public, accelerated bridge construction (ABC) techniques have been developed over recent years, but have primarily focused on rapidly constructing new or replacement structures. Another benefit derived from these ABC methods is rapid post-earthquake repair of damaged structures. Post-earthquake accelerated column repair/replacements has focused solely on moderate-to-high</p>

	<p>seismic zones. The need for additional analysis, new techniques, and associated specifications is also critical for low-to-moderate seismic zones affected by induced earthquakes. This project addresses the current knowledge gap on the effects of low-level frequent seismic events on bridges, as well as ABC methods to repair/retrofit damaged bridges. The recent surge in seismic activity in the central U.S. has motivated the need for rapid repair techniques that leverage ABC methods. The overarching objective of this project is to develop analysis techniques to study the effect of large number of small earthquakes on bridges and identify appropriate ABC methods for repair of bridges damaged by induced earthquakes. The project will use Oklahoma as a case study and develop techniques and tools that can be applied to other regions experiencing low-level frequent seismic events.</p>
<p>Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here</p>	<p>The outcomes will be tracked and reported once they are identified.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>Texas DOT, with similar issue, approached research team for advice, May 2020 (see also C2-OU02)</p>
<p>Web Links</p> <ul style="list-style-type: none"> <li>• Reports</li> <li>• Project website</li> </ul>	<p><a href="https://abc-utc.fiu.edu/research-projects/ou-research-projects/rapid-retrofitting-techniques-for-induced-earthquakes/">https://abc-utc.fiu.edu/research-projects/ou-research-projects/rapid-retrofitting-techniques-for-induced-earthquakes/</a></p>