



# Transportation Consortium of South Central States

## Key Points

**Project Number:**

18GTASU04

**Start Date:**

07/01/2018

**End Date:**

06/30/2020

**Principal Investigator(s):**

*Ashraf Elsayed*

Arkansas State University

[aelsayed@astate.edu](mailto:aelsayed@astate.edu)

*Zahid Hossain*

Arkansas State University

[mhossain@astate.edu](mailto:mhossain@astate.edu)

**Lead Institution:**

Arkansas State University

**Funds Requested to UTC:**

\$0

**Funding Source(s):**

Arkansas Department of  
Transportation

**Total Project Cost:**

\$184,995

## Spatial Analysis of Benefits of Site Specific Ground Motion Response Analysis

### Brief Project Description

The purpose of this study is to develop a decision tree or a GIS map that can be used by the Arkansas Department of Transportation (ArDOT) to determine when site-specific ground motion response analysis (SSGMRA) should be conducted and its possible cost savings. A cost-benefit analysis will be performed to determine the cost savings based on the type, size, and location of the constructed bridge. To achieve this goal, the research team will build upon the existing work and obtain shear-wave velocity ( $V_s$ ) profiles for 20 sites, in addition to 15 previously sites surveyed through earlier ArDOT projects.

### Problem Statement

Results from previous research projects sponsored by ArDOT indicate that seismic demands can be reduced in portions of Arkansas by conducting a SSGMRA, which is expected to have economic benefits regarding the construction of bridges and embankments. However, the single SSGMRA and bridge redesign from previous research only provides a discrete estimation of the potential cost savings of conducting a SSGMRA for bridge projects.

Variables such as distance from the fault, which influences seismic design category, soil conditions, liquefaction potential, initial bridge specifications, and embankment requirements vary across the state. The geographic locations and conditions where potential cost savings from SSGMRA can be realized are unknown and needs to be determined to provide the most economic benefit for bridge and embankment design and prevent conducting SSGMRA when economic benefits would not be likely. To better predict when conducting a SSGMRA would be economically beneficial and where it would be cost prohibitive, a spatial sensitivity analysis needs to be performed to better determine where and under what site specific conditions a SSGMRA would be economically beneficial for bridge and embankment design.



# Transportation Consortium of South Central States

## **Objectives**

The objective of this study is to conduct a spatial sensitivity analysis in order to better predict when conducting an SSGMRA would be economically beneficial. This spatial analysis will include a minimum of 25 sites, selected in consultation with ArDOT, and the analysis will incorporate the 15 sites analyzed under a current research project.

## **Intended Implementation of Research**

Site-specific seismic studies can lead to reduction in the design of seismic acceleration if results are favorable, which in turn will result in a reduction in seismic design and construction cost. At the end of this study, the PI will supply ArDOT with a detailed report documenting appropriate recommendations on how to implement findings and at what circumstances a site-specific seismic study may be beneficial. It is foreseen that ArDOT engineers will use the data and the site-specific hazard contour maps (provided as a study deliverable) to determine whether a site-specific study is warranted. If there is a decision to perform a site-specific study, then ArDOT engineers can use the developed specifications (provided as a study deliverable) to select appropriate and qualified consultants. Furthermore, detailed information will be provided to ensure that site-specific studies are performed in accordance with ArDOT requirements.

## **Anticipated Impacts/Benefits of Implementation**

ArDOT will be provided with detailed shear-wave velocity profiles at 20 sites, distributed geographically within the state of Arkansas. Site-specific hazard maps will be developed at the ground surface. These maps will provide ArDOT engineers with an important tool in determining when and where to perform SSGMRAs to reduce seismic demands. At the conclusion of the study, a contour map of PGA will be developed. Using GIS, bridges to be built each year will be overlaid on the PGA. Then, using the PGA contour map and location of each bridge, the cost savings (of performing or foregoing a SSMGRA) will be estimated. Finally, a set of specifications will be provided to ArDOT used to assess the qualification of hazard analysts as well as requirements needed for an analyst to perform a successful SSGMRA.

## **Weblinks:**

<http://transet.lsu.edu/research/research-in-progress/>

<https://rip.trb.org/View/1549885>