A Framework for Post-Earthquake Response Planning in Emerging Seismic Regions: An Oklahoma Case Study

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This paper presents a framework for establishing post-earthquake response protocols in regions facing emerging seismic hazards through a case study of Oklahoma bridges. First, it establishes the need for new attenuation models for the Oklahoma area because of the poor fit of current attenuation models. Then, two methods are established to inspect bridges after an earthquake: smart inspection radii and ShakeCast. The smart radii use a modified version of the Campbell (2003) attenuation model to determine seismic demand and a trigger S_1 value to represent bridge capacity. This trigger S_1 value is validated by calculating slight HAZUS fragility curves for past earthquakes. ShakeCast is an online resource from USGS that uses real-time ground motion data (i.e., a ShakeMap) as seismic demand and modified HAZUS fragility curves to represent bridge capacity. Because of better-informed data on the ground shaking levels, ShakeCast recommends significantly fewer inspections than inspection radii, translating to cost savings for the Oklahoma Department of Transportation. [DOI: 10.1193/053117EQS100M]

INTRODUCTION

The seismicity of places such as California and the New Madrid seismic zone is well established. However, new areas are emerging, such as Oklahoma, Kansas, and Texas, that are experiencing induced seismicity (Petersen et al. 2017). Induced seismicity effects are not only limited to the United States, but also other countries, including Canada, China, and the United Kingdom (McGarr et al. 2015). The induced seismicity is not as well documented as naturally occurring seismicity. This study focuses on Oklahoma, but the framework proposed here is applicable to other emerging seismic regions.

SEISMICITY IN OKLAHOMA

Since 2009, there has been a dramatic increase in the number of earthquakes in Oklahoma. Oklahoma and the surrounding region have not historically experienced earthquakes at the rate currently observed (McGarr et al. 2015; Figure 1). Studies, such as that by

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