RELIABILITY ANALYSIS OF DAMAGE ACCUMULATION IN BRIDGE STRUCTURES SUBJECTED TO MULTIPLE EARTHQUAKES IN AUSTRALIA

Nilupa Herath¹, Lihai Zhang¹, Priyan Mendis¹, Tuan Ngo¹
¹Department of Infrastructure Engineering, University of Melbourne, VIC 3010, Australia

Although Australia is not located in a high seismic region, the damage accumulation caused by multiple earthquake impacts could still have a significant impact on the service life of bridges. In this study, a reliability-based assessment framework is presented to quantify the damage accumulation of the bridges caused by multiple earthquakes and progressive deterioration throughout their service life.

Earthquake is one of the major natural disasters which causes damage to infrastructure even loss of human lives. Although Australia is not located in a high seismic region, the impact of multiple earthquakes over time can cause severe damages to the bridges as a result of damage accumulation exceeding the threshold limit of the structural capacity of the bridges. Damage can be due to
• Multiple earthquake impacts and
• Progressive deterioration

In this study, we proposed a reliability based analysis framework to predict the damage accumulation of bridges due to multiple earthquakes in combination with progressive deterioration. The framework takes into account the probabilistic nature of the earthquakes in Australia (e.g. occurrence interval and magnitude) through statistically analysing the earthquake data occurred in Australia from 1900 to 2016 (Geoscience Australia, 2016).

STATISTICAL ANALYSIS OF GEOSCIENCE AUSTRALIA DATA

A total of 24,747 earthquakes occurred in Australia during the period from 1900 to 2016 (Geoscience Australia, 2016) were statistically analysed with the aim of understanding the distribution of earthquake occurrence interval.

RESULTS

A MATLAB program was developed based on the methodology. The results show that damage is accumulated with time and multiple earthquake impacts lead to a significant increase of failure probabilities over time. Further it shows that, under seismic conditions in Australia, the service life of bridges could reduce from 100 years (design life) to 72 years only due to the impact of multiple earthquakes, and the life span could significantly reduce to 36 years in the worst case scenario.

The comparison of probability of failure of multiple earthquake impact and the combined effect of earthquake impact and the progressive deterioration shows that in the worst case scenario, the service life of a bridge could reduce to 20 years.

REFERENCES