Comparative Seismic Fragility Analysis of Standard Reinforced Concrete Highway Bridges in Morocco

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Abstract

Maintaining the post-earthquake functionality of highway networks requires a rigorous assessment of bridge vulnerability. This study evaluates the seismic performance and fragility of two predominant structural configurations in Morocco: The Reinforced Concrete Girder Bridge (RCGB) and the Reinforced Concrete Slab Bridge (RCSB). Nonlinear static pushover analyses were conducted to determine the lateral load-deformation capacity of both typologies along their longitudinal and transverse axes. Structural performance points were subsequently identified by intersecting capacity curves with inelastic demand spectra via the Capacity Spectrum Method (CSM). Lognormal fragility curves were then derived following the HAZUS methodology across four damage states: slight, moderate, extensive, and complete. The analytical results reveal high seismic robustness for both bridge classes. Under the considered seismic demand, the probability of experiencing extensive or complete damage is nil, while moderate damage probabilities remain statistically negligible. Although the RCGB exhibits a marginally higher susceptibility to slight damage than the RCSB, both configurations demonstrate sufficient structural capacity to ensure uninterrupted post-earthquake traffic flow. These findings provide essential quantitative metrics for regional seismic risk mitigation in Morocco.

Keywords

Seismic fragility, Fragility curves, Nonlinear static analysis, Capacity Spectrum Method, HAZUS methodology, Reinforced Concrete bridges.