Abstract: Seismic-Induced Damage and Cracking of Earth Dams

by

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Earth dams, when subjected to seismic loads, may exhibit longitudinal and lateral deformations, settlement, and the formation of longitudinal and transverse cracks. Cracking poses a severe threat to these structures, as it may lead to piping failure due to increased seepage and internal erosion through the cracks. Ensuring the safety of earth dams relies on an adequate assessment of their seismically-induced deformations. Current empirical methods for estimating the size and depth of longitudinal and transverse cracking produced during an earthquake are grounded in case studies from the 1960s to the 1990s. This study expands and modernizes the existing database, with information on the performance of 385 dams during 21 different seismic events, from 2000 through 2023. Data collection involved an exhaustive search from existing databases, published reports of seismic damage on embankments and earth dams, and from publications from technical journals and conferences. The new information, together with the previous database, has been examined using statistical analysis and machine learning algorithms. Correlations have been proposed between the type of dam, its geometry, peak ground acceleration (PGA), and/or earthquake intensity, and the resulting damage to the dam in the form of settlement, longitudinal and transverse cracking. Additionally, a dynamic parametric analysis was carried out to understand the fundamental dimensions/parameters that are significant in developing seismic-induced cracks. The data gathered, together with the correlations established can be used by designers to enhance the seismic resilience of embankments and earth dams, as well as by researchers to advance our knowledge on the seismic response of dams, to develop new numerical models or calibrate or verify existing ones.