Project Title: **Nonlinear Dynamic Response of Reinforced Concrete Buildings and the Effect of the Directionality of Seismic Accelerations: An Innovative Structural Analysis Program**

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Abstract:

More than half of Puerto Rico's population is in coastal municipalities, where the vast majority of the country's infrastructure is also located, a short distance from critical geological faults that practically surround the island. The seismicity of Puerto Rico is classified by the Federal Emergency Management Agency between a high-risk and moderately high-risk zone. Recent technical investigations identify faults on the island that could reveal that the real risk has been underestimated. Numerous population centers are located on soils with characteristics that would increase seismic loads and amplify earthquake damages. This work presents an innovative program for the three-dimensional nonlinear analysis for reinforced concrete structures. Incremental methods are used to apply loads, displacements, and seismic accelerations in the base, considering horizontal orthogonal directions and the vertical component. The analysis model includes elements with rigid section, elastic section, and rotational spring in both directions to model the inelastic behavior in bending. Internal forces are compared with the element's capabilities to adjust the structure's stiffness to consider element failures during the earthquake. The program has a graphical interface for Windows, coding in Visual Basic 2017, and a computational executor coding in Fortran 2008. The work's objectives include using the program developed for the modeling of various buildings designed according to current building codes. To contrast the seismic response before different incidence scenarios of seismic accelerations in terms of the directions (making those orthogonal directions of the applied acceleration records do not match the elements' orthogonal axes and the frame arrangement, which are typically defined during design). It is expected that this work will provide an analysis tool for future studies of seismicity in structures and provide better knowledge about the inelastic dynamic performance of buildings that, in turn, will serve for the design of more safe structures for earthquakes.