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Editorial

Seismic Impact on Building Structures: Assessment, Design, and Strengthening

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1. Genesis and Motivation

The changing landscape of building technology, seismic engineering understanding, data, innovative rehabilitation strategies, and computing efficiency have morphed the field of structural earthquake engineering and closely allied fields into one of the most dynamic and vibrant fields of civil engineering, both in research and practice. From seismic code compliance in design to high-fidelity predictions through human–artificial intelligence hybrid applications, rapid changes have occurred over the past decade. Recent earthquakes, on the other hand, have provided a momentous understanding of the seismic behavior of various structural forms, which should serve as the basis for understanding and innovation. This Special Issue aims at gather cutting edge innovations and state-of-the-art knowledge to encourage a more robust understanding for beaconing the future on the topic of seismic impact on building structures. The scope of the Special Issue is seismic vulnerability to loss assessment, damage quantification to rehabilitation, and forensics to intelligent predictions and designs. This gives rise to a one-stop solution for researchers, practitioners, and general practitioners in terms of understanding and advancements.

2. Seismic Impact on Buildings: A Bird's Eye View

This Special Issue encompasses 14 cutting-edge research papers from different parts of the world. Xu et al. [1] propose an ontology-based seismic risk assessment approach for building structures. Through the hybridization of ontology and semantic web rule language, the proposed method is justified to be capable of predicting consequences. The implications are generalized for decision making and risk assessment applications. Bessason et al. [2] create vulnerability models using loss data recorded after the notable earthquakes of 2000 and 2008 in Iceland. They conclude that the near-field mean loss will be constrained to 5% of the replacement value for timber and reinforced concrete buildings. Considering notable earthquake scenarios, Ademovic et al. [3] shed light on historical constructions during the Zagreb earthquake. Using visual inspection, in situ testing, and numerical modeling, they report grave improvements in the ultimate load capacity after FRCM interventions as opposed to non-strengthened structures. Biglari et al. [4] adopt two common index-based formulations to assess the damage index spectra of a case study school building. Their findings highlight the importance and acceptance of damage index spectra in swift vulnerability assessment campaigns of masonry buildings in active seismic regions. Papazafeiropoulos and Plevris [5] used strong motion and structural damage paradigms to underline the devastating impact of the 2023 M_w 7.8 Kahramanmaraş—Gaziantep earthquake in Turkiye. They infer that the affected structures had inferior capacity compared to the seismic excitation they observed during the earthquake. They highlight the occurrence of strong vertical shaking in damage aggravation. Based on the observations, construction improvements and seismic code updating are recommended as the way forward.

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Biglari et al. [6] assemble empirical and numerical modeling outcomes to compare fragility functions for reinforced concrete (RC) and steel buildings. Based on the hybrid approach, they conclude that the Iranian RC and steel building stocks are seismically more vulnerable than the prevalent code assumes. On the other hand, Isik et al. [7] address a very pertinent issue of the short column effect in RC buildings through numerical modeling. Using both force- and deformation-based approaches, they conclude that the short column formation notably enhances plastic rotation demand and shear force in the columns. In the meantime, the first story drift was found to be decreased because of the band type window and slope effect. Tresnjo et al. [8] conducted an experimental dynamic campaign and integrated that with a seismic assessment for a historical minaret. The comparison between experimental and eigen analyses shows a good agreement in terms of dynamic characteristics. Beside this, the applied element method was deployed in nonlinear time history analysis (NLTHA) for seismic assessment. Their results note that the transition regions observed stress concentration. Beam–column joints were noted as one of the most critical components of RC buildings. Owing to the severity and widespread concern, Ahmad et al. [9] proposed a computationally efficient approach to model the nonlinear behavior of beam–column joints in a substandard RC construction. They further reinforce the numerical modeling proposal with a full-scale quasistatic cyclic test. Congregating numerical and experimental results, they concluded that the collapse likelihood of a substandard RC under design earthquake increases from 4.20% to 29.20%. Phan et al. [10] integrated regression and classification schemes to predict shear strength and failure modes in rectangular RC columns. Using 541 experimental datasets, they concluded that the K-nearest neighbor (KNN) outperformed any other classifier or regressor. They highlighted the importance of machine learning applicability in addressing structural engineering, and also developed a graphical user interface (GUI) for shear strength prediction and failure characterization.

Despite addressing damage, vulnerability, and risk, strengthening and seismic improvements are also incorporated into the themes of this Special Issue. Shreekeshava et al. [11] used half-scaled samples to assess the efficacy of strengthened and non-strengthened masonry infilled RC frames under cyclic lateral in-plane loading. They concluded that the maximum drift can be lowered by 24% under in-plane actions if geo-fabric is used to strengthen the infill–frame interfaces. Sharifi Ghalehnoei et al. [12] reported the outcomes of numerical modeling for RC beams strengthened by carbon-fiber-reinforced polymer grid-strengthened engineering cementitious composites. They compared analytical and numerical results and concluded that the difference between these approaches is not significant. Moreover, their findings highlight that the shear capacity of strengthened beams is around 35–50% more than that of common RC beams. Wu et al. [13] assessed the performance of active and passive control techniques and concluded that the multiple active tuned mass damper with an inerter system surpasses its peers in controlling structural response and stroke of devices. They also highlighted the capacity of the multiple active tuned mass damper system with an inerter system in checking structural and environmental fluctuations, which leads to superior robustness and stability. Finally, Avinash et al. [14] provide a comprehensive review of sliding isolation systems considering several dimensions of base isolation systems. They incorporated hybrid and active isolation systems, shedding light on passive sliding isolation systems.

3. Précis and a Way Forward

Recalling the famous quote by Prof. Nick Ambraseys, "earthquakes do not kill people-building do", the evolution of structural earthquake engineering focusing on the seismic impact on buildings has remained spurious throughout, particularly due to the contributions and lessons from a vast swath of resources pivoted to damage, loss, fatalities, innovations, etc. The progress made to achieve a particular milestone is usually stirred by occasional devastating earthquakes, so the field has remained greatly dynamic. The congregation of empirical, numerical, experimental, analytical, heuristic, and hybrid approaches

in the era of high-performance computing can be streamlined to check the devastation during one of the most destructive phenomena of nature. The collective conclusion of the published papers highlights the need for cross-border and cross-field collaboration in knowledge exchange and rational solutions. Although much has already been done, Barry Schwartz's famous insight, "more is less", holds true in structural earthquake engineering under the unprecedentedly large dimensions of the propagating issues. The structural earthquake engineering field, as addressed in this Special Issue, awaits more rational, innovative, economical, versatile, and globally localized solutions to protect humankind from earthquake impacts.

Conflicts of Interest: The authors declare no conflict of interest.

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