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A Nonlinear Static Procedure for the Design and Assessment of Buildings to Tsunami

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Many coastal regions lying on subduction zones are likely to experience the catastrophic effects of cascading earthquake and tsunami observed in recent events. The response of the structure to tsunami is difficult to quantify through damage observations from past events, which often provide information on the combined effects of both perils. Hence, the use of analytical methodologies is fundamental. The authors have recently proposed a nonlinear static pushover procedure for the design and assessment of structures for tsunami within the framework of ASCE 7-16 provisions. The latter offer a comprehensive and practical methodology for the design of structures for tsunami loads and effects. While they provide prescriptive tsunami loading and design requirements, they also permit the use of performance-based analysis tools. However, the specifics of load application protocol, and system and component evaluation are not specified. Through the proposed approach, the user can estimate the effective lateral-resisting capacity of a building. In addition, by applying the component loading procedure, the user can identify the structural elements that may need to be strengthened to meet the code acceptance criteria. For this purpose, a prototypical reinforced concrete multi-storey building exposed to high tsunami hazard in the USA Northwest Pacific coast is assessed. Based on the acceptance criteria of ASCE 7-16 provisions, the lateral-load resisting system needs to be strengthened to resist tsunami loading. Overall, the use of the tsunami nonlinear static analysis procedure is found to significantly reduce the extra-costs associated with tsunami strengthening of the building.