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Structural Health Monitoring-Integrated Structural Reliability Based Decision Making

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Abstract : Monitoring concepts for structural systems have been investigated by researchers for decades since such tools are quite convenient to determine intervention planning of structures. Despite the considerable development in this regard, the efficient use of monitoring data in reliability assessment, and prediction models are still in need of improvement in their efficiency. More specifically, reliability-based seismic risk assessment of engineering structures may play a crucial role in the post-earthquake decision-making process for the structures. After an earthquake, professionals could identify heavily damaged structures based on visual observations. Among these, it is hard to identify the ones with minimum signs of damages, even if they would experience considerable structural degradation. Besides, visual observations are open to human interpretations, which make the decision process controversial, and thus, less reliable. In this context, when a continuous monitoring system has been previously installed on the corresponding structure, this decision process might be completed rapidly and with higher confidence by means of the observed data. At this stage, the Structural Health Monitoring (SHM) procedure has an important role since it can make it possible to estimate the system reliability based on a recursively updated mathematical model. Therefore, integrating an SHM procedure into the reliability assessment process comes forward as an important challenge due to the arising uncertainties for the updated model in case of the environmental, material and earthquake induced changes. In this context, this study presents a case study on SHM-integrated reliability assessment of the continuously monitored progressively damaged systems. The objective of this study is to get instant feedback on the current state of the structure after an extreme event, such as earthquakes, by involving the observed data rather than the visual inspections. Thus, the decision-making process after such an event can be carried out on a rational basis. In the near future, this can give wing to the design of self-reported structures which can warn about its current situation after an extreme event.

Keywords : condition assessment, vibration-based SHM, reliability analysis, seismic risk assessment
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