



## **Prioritizing Multi-Hazard Vulnerability of School Facilities in Developing Countries**

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Schools play a critical role in the education of a community's next generation and one of the most vulnerable components of the society due to their age and their developmental stage. A safer and resilient school can save valuable lives of children, provide a safe haven for the local community, serving as a temporary shelter and helping to bring normalcy back to society in times of disaster. However, like other infrastructure, public school buildings constructed prior to adequate building codes, share structural deficiencies common to other buildings of the same structural types in the same setting, but the above considerations set school buildings apart from their peers in terms of priority for assessment and retrofit.

Taking into consideration the high probability of occurrence for any type of natural hazard in many developing countries, assessing multi-hazard vulnerability of school facilities is an urgent task for the governmental authorities and first responders. Given the large number of existing school sites and their geographical distribution, rapid yet effective tools and approaches are required. Specifically, developing a comprehensive dataset of typical and systematically defined structural typologies for schools, including main structural and non-structural characteristics (e.g., age of construction, number of story, lateral load resisting system and materials, number of occupants), common defects, typical damage associated to multiple natural hazards, is beneficial for disaster management planning and decision making along with prioritization and resource allocation for retrofitting/strengthening plans for such structures.

This study introduces a series of tools for a rapid yet reliable visual multi-hazard vulnerability prioritization of school infrastructure against potentially destructive natural hazards, i.e. earthquake, typhoon, and flood. To this aim, a rapid visual survey form is developed first and implemented in a mobile application to efficiently assist the surveyors. An illustrative application of the developed tools is presented for Cagayan de Oro (Philippines), Turtuk (India), and New Beichuan Town (China), relating the collected data to vulnerability indices to swiftly determine the safety level of the considered buildings.

The proposed tools represent a first step toward a detailed multi-hazard vulnerability assessment framework of school infrastructure. The aim is to allow stakeholders and decision-makers to quickly identify the most vulnerable structures among the surveyed stock, to guide more detailed data collection campaigns and structural assessment procedures (e.g., analytical vulnerability approaches, through fragility and vulnerability relationships), and ultimately to plan further retrofitting/strengthening measures or, if necessary, school replacement/relocation.