Seismic retrofitting for school buildings in Taiwan

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ABSTRACT

Reinforced concrete buildings account for 75% of the total floor area in Taiwan. More than three quarters of these existing concrete buildings were constructed before 1999. Because of the less seismic demand and the inadequate seismic detailing, these older reinforced concrete buildings are prone to severe earthquake damage and even collapse. Recent reconnaissance reports revealed that the school buildings with cantilever corridors are the particularly vulnerable structures in Taiwan. School buildings are public constructions which are densely utilized. The number of casualties that can be caused by a collapse due to an earthquake is unimaginable. Therefore, enhancements to the seismic capacities of these school buildings through retrofitting are urgently required.

The 921 Chi-Chi earthquake demonstrated that the safety level of school buildings in Taiwan was of great concern. During this earthquake, more than half of the school buildings in Nantou County were either partially or fully destroyed. Therefore, it is without a doubt that the seismic capacity of the school buildings in Taiwan should be a cause for concern, and that the seismic capacity of the school buildings needs to be urgently improved through retrofitting. However, there are 3,783 public elementary, junior, and senior high schools (including vocational schools) in Taiwan and over 27,000 school buildings. Such a large number of buildings would easily exhaust the available funds if no economically effective method existed, and completing the project within budget would be hard to achieve.

Due to the importance of the safety of the school buildings, the government allocated a budget of USD$ 4 billions to upgrade, from 2009 to 2022, the seismic capacity of public elementary, junior and senior high school buildings. The National Center for Research on Earthquake Engineering (NCREE), entrusted by the Ministry of Education, established a Project Office for Seismic Upgrading of School Buildings to provide technical and administrative assistance to the project. In terms of technical assistance, NCREE provided methods for the school buildings' seismic evaluation and retrofitting. In terms of administrative assistance, the Project Office established operation specifications, gave seminars, popularized good retrofitted examples, and established a data bank.

This school retrofitting project had upgraded the seismic capacities of approximately 10,000 school buildings which accounts about 37% of the total school buildings in Taiwan. The objective of this presentation is to report on the strategy, technology and progress of this seismic retrofitting project for school buildings in Taiwan.

Shyh-Jiann Hwang is a Professor of Civil Engineering at the National Taiwan University, Taipei, Taiwan. He had served as the Director General of National Center for Research on Earthquake Engineering (NCREE) in Taiwan. He received his Master and PhD form the University of California, Berkeley. Dr. Hwang has been awarded the Distinguished Chair Professor of National Taiwan University. He serves as a member of seismic code committee in Taiwan and is very active in Taiwan concrete society. His research interests include shear behavior of reinforced concrete members, and seismic design and retrofitting of reinforced concrete structures. He had been responsible for providing technical supports to a national project that evaluates and retrofits all the non-code compliant school buildings in Taiwan. He is now participating the seismic retrofitting project by phases issued by the Ministry of Interior Affairs. This project is aimed to remove the seismic deficiency of the soft first story as a first priority for the residential buildings.