Keynote Speech

Tuesday, September 17th, 09:00 - 09:30 **Conference Hall**

Chair: Shyh-Jiann Hwang

Damaging Features of Near-fault Ground Motions

Norman Abrahamson
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Near-fault ground motions that contain velocity pulses have been associated with more severe damage than ground motions that do not contain a velocity pulse. The main concept behind the velocity pulse is that a large amount of energy arrives at the site over a short time interval, leading to greater demands on the structure. Initially, the identification of velocity pulses in recorded ground motions was subjective based on visual inspection of the velocity time series, but more recently, quantitative methods for identifying pulses using wavelet decomposition have been developed (e.g. Shahi and Baker, 2014). While the wavelet decomposition is an objective and repeatable approach, the application requires three parameters to be considered: presence of a pulse, pulse period, and pulse amplitude. The wavelet decomposition method also tends to classify more records as having pulses than just those with a large amount of energy arrives at the site over a short time interval. Alternative measures of the damaging features of near-fault ground motions that are based on the rate of energy input into the structure rather than the current velocity pulse definition are reviewed. The instantaneous power (IP), defined by Zengin and Abrahamson (2019a) as the energy per second in the quarter-cycle of the band-pass filtered velocity time series at the time of the peak velocity, captures key damaging features of near-fault ground motions better than the velocity pulse classification approach. The velocity time series is band-pass filtered around the fundamental period of the structure. This allows the IP to represent the power of the near-fault ground motions that is relevant to the response of the structure. The IP replaces the need to classify near-fault ground motions in terms of presence of a velocity pulse and the pulse period. It is also a much simpler parameter to use than velocity pulse parameters in that it combines the effects of presence of a velocity pulse, the pulse period, and the amplitude of the pulse into a single continuous parameter. A conditional ground-motion model (GMM) for IP, conditioned on the elastic spectral acceleration, in addition to the earthquake magnitude and distance was developed by Zengin and Abrahamson (2019b). An example of how to use the IP GMM with results from standard seismic hazard analyses to select appropriate near-fault time histories for use in dynamic analyses of structures is shown.

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Vibration-control Systems for Super-tall Buildings in Areas of Strong Seismicity

Kazuhiko Kasai

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Much higher level of seismic performance is needed for super-tall buildings due to increased demands for their functional continuities and recognized needs for becoming havens in metropolitan areas. The conventional structural systems can no longer meet the demands, and the vibration control systems using dampers are most commonly used for super-tall buildings in Japan. As the building is taller, however, the dampers are known to deform less, and become less effective at upper stories. This is because the shear drift that produces damper deformation and energy dissipation decreases due to the increased bending (chord) drift at upper stories. The presentation explains this trend, and proposes a simple and reasonably accurate method to predict the shear drift, chord drift, as well as effectiveness of dampers. The method is based on the eigenvalue analysis and static elastic analysis of the frame, typically performed during design stage.

The method is extended also to formulation of a simplified shear-flexure beam model that accurately simulate the global dynamic behavior of the original model. In addition, local mode of deformations of members surrounding the damper can reduce the damper deformation/effectiveness. Another method, therefore, is proposed to account for this trend. Time-history analyses are conducted to show the accuracy of these methods.

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Tzu Chi Disaster Relief Model In 1999 Chi-Chi Earthquake

Powen Yen

CEO, Tzu Chi Foundation, Taiwan

As natural disasters are inevitable, disaster prevention and recovery strategy would be crucial for humanitarian response. For Tzu Chi Foundation, there is 6-Placement model for the disaster response including physiological needs fulfillment, psycho-trauma support, livelihood assistance, education recovery, housing resettlement, and ecological restoration.

The three phases for Tzu Chi disaster response model would be response, recovery and reconstruction. For the 1999 Chi-Chi earthquake, during the emergency response phase, more than 260,000 people were benefited by Tzu Chi distributing 50,000 livelihood kits and 1.3 million hot meals. 12,407 patients were served by Tzu Chi setting up 19 free clinic stations, and around 160 million NTD were distributed for the victims. For the recovery phase, there were 5,000 volunteers mobilized to build 1,776 pre-fabricated housing within 3 month after 921 earthquake. As education is the hope of children, children are the hope of society. Tzu Chi immediately launched “Project Hope 921” in the reconstruction phase. 51 schools were reconstructed not just strong but also environmentally friendly.

Prevention is always better than cure. At every effort, we could have the power to reduce the level of damage. For people in Taiwan who live with a constant threat of dangers like earthquakes and typhoons, disaster risk reduction is very imperative. Therefore, Tzu Chi Foundation works closely with communities and the government to initiate “Project Disaster Reduction” and reconstructed 26 schools to provide a safe, functional and eco-friendly campus for students.

According to the study on the Tzu Chi model within humanitarian relief by Professor Herman Leonard, Business School of Harvard University, Tzu Chi is not driven by plan; instead, it is driven by commitments based on its values. Tzu Chi volunteers are self-mobilized based on the faith to its founder Master Cheng Yen. This may explain Tzu Chi’s recognized mobility and effectiveness in humanitarian relief to the large-scale disaster response.