Major Challenges in Earthquake Risk Reduction in Asia

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A large proportion of existing low-rise buildings in Bangladesh, India, Indonesia, Nepal, China and many other countries in Asia are unreinforced masonry (URM) buildings, which are quite vulnerable to earthquake ground shaking. This is one of the key factors contributing to large social and economic losses in the past earthquake disasters. The first challenge is to find ways to replace these vulnerable non-engineered buildings with stronger engineered buildings. Reinforced concrete (RC) buildings, if properly designed and constructed, can be made much more seismic resistant. However, a large percentage of existing RC buildings are not designed in such way, making them also vulnerable to earthquake. Examples of failure mechanisms of common RC low-rise buildings are presented, and some effective seismic retrofit measures (e.g. column jacketing, buckling-restrained braces) are highlighted in this presentation. These seismic retrofit measures are new for many countries in Asia. How to promote more seismic retrofit of weak RC buildings is, therefore, another challenge. The third challenge is about the seismic risk of high-rise buildings in megacities in Asia. These high-rise buildings are structures with long natural periods, and they are quite vulnerable to long-period earthquake ground motions. Even with a low shaking intensity, such long-period ground motions can cause significant damage to high-rise buildings. Case studies on this issue are presented, and how to incorporate such long-period ground motions into the seismic design process is demonstrated. However, seismic resistant design standards in most countries still do not take into account the effects of long-period ground motions—this is the third challenge. The last challenge to be highlighted in this presentation to about structural analysis procedures for the seismic design of high-rise buildings. The most commonly used procedure by design engineers is the Response Spectrum Analysis (RSA) procedure. The response contributions from many vibration modes can be estimated by this procedure. However, the procedure has recently been found to provide inaccurate and unreliable estimates of various seismic demands in high-rise buildings, especially seismic-induced shear forces in RC walls. A new procedure called 'Modified Response Spectrum Analysis (MRSA) procedure' is then proposed to overcome this problem.