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Nepal Earthquake Building Safety Assessment

by Sabina Surana
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On Saturday, April 25, 2015 at 11:56 am (local time), Nepal was struck by a magnitude of 7.8M earthquake as the result of thrust faulting between the subduction of India Plate and the overriding Eurasian Plate. The epicenter of this earthquake was approximately 48 miles northwest of Kathmandu valley. The earthquake was followed by numerous subsequent aftershocks, including the one that measured 7.3M on May 12, resulting in substantial damage to the buildings and infrastructure, as well as landslides at the hills and a massive avalanche on Mt. Everest.

Following this devastating earthquake, I participated in the disaster recovery effort in

Nepal. I was selected as a volunteer with the first team of structural engineers from the United States, deployed by the Global Fairness Initiative (GFI). The team traveled to Nepal at the request of the Nepalese government and with the collaboration of GFI's local partners, Brick Clean Nepal and MinErgy. The primary mission of the team was to perform rapid assessments of damaged buildings in the Kathmandu valley and to assist local authorities and residents in determining whether or not their structures were safe to occupy. The earthquake left lasting emotional devastation on every person in Nepal. Many people are still afraid of going back into their homes for fear that another aftershock may hit, even if their houses have only minor cosmetic damage. As monsoon season is approaching, there is an immediate need for the safety assessment of the buildings, allowing residents to move from tents to their homes.

Traditional Newari houses constructed with brick and mud mortar in Dharmasthali, Kathmandu.

The volunteer structural engineers from the United States were teamed up with local Nepalese engineers to perform the assessments. According to GFI's local director, the team performed safety assessments of 2000 buildings in eight days, including residential houses, schools, hospitals, universities, shopping centers, condominiums, and historic structures. The common, newer building construction types found in the Kathmandu valley are Reinforced Concrete

The side view of Durbar High School in Ranipokari, Kathmandu, one the first high schools to provide modern education in Nepal.

(RC) frames with masonry infill and unreinforced brick masonry walls with concrete floors. The traditional building construction includes bricks with mud mortar and adobe houses. From field observation, most of the RC frame houses with masonry infill performed well during this earthquake. In RC frame constructions, the damage was mostly observed on infill walls and the plaster over infill. More than 90% of adobe houses and brick with mud mortar, however, endured significant structural damage. Significant structure damages to RC frame buildings observed were failure at beam–column interface and column base, soft story collapse. The structural damages that were

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observed on adobe and brick with mud mortar buildings were corner wall separation, out of plane wall collapse, and diagonal shear cracks on mortar or bricks. Some of the significant nonstructural failures included the collapse of structures supporting roof top water tanks, the failure of solar panels and water heater connections to concrete floors, and damage to suspended ceilings and raised access floors.

A native of Nepal, spending 24 years there, Sabina Surana is a project engineer in the structural group at Reid Middleton, with 10 years of experience in the A/E industry. She is a member of the Structural Engineers Association of Washington (SEAW) and is experienced in finite element computer modeling, Anti-Terrorism Force Protection (ATFP) blast analysis and design, and Progressive Collapse Analysis. Sabina is fluent in English, Nepali, Newari, and Hindi languages.

Unreinforced Brick Walls with Cast-in-place Concrete Diaphragm in Balaju, Kathmandu.