University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

ENGINEERING SEMINAR

Performance-based Seismic Design of Nonstructural Building Components: The Next Frontier of Earthquake Engineering

Andre Filiatrault, PhD, P.Eng.
Professor of Structural Engineering
Dept. of Civil Structural and Environmental Engineering,
University at Buffalo, State University of New York, Buffalo

Abstract

With the development and implementation of performance-based earthquake engineering, harmonization of performance levels between structural and nonstructural components becomes vital. Even if the structural components of a building achieve a continuous or immediate occupancy performance level after a seismic event, failure of architectural, mechanical or electrical components can lower the performance level of the entire building system. This reduction in performance caused by the vulnerability of nonstructural components has been observed during recent earthquakes worldwide. Moreover, nonstructural damage has limited the functionality of critical facilities, such as hospitals, following major seismic events. The investment in nonstructural components and building contents is far greater than that of structural components and framing. Therefore, it is not surprising that in many past earthquakes, losses from damage to nonstructural components have exceeded losses from structural damage. Furthermore, the failure of nonstructural components can become a safety hazard or can hamper the safe movement of occupants evacuating buildings, or of rescue workers entering buildings. In comparison to structural components and systems, there is relatively limited information on the seismic design of nonstructural components.

Basic research work in this area has been sparse, and the available codes and guidelines are usually, for the most parts, based on past experiences, engineering judgment and intuition, rather than on objective experimental and analytical results. Often, design engineers are forced to start almost from square one after each earthquake event: to observe what went wrong and to try to prevent repetitions. This is a consequence of the empirical nature of current seismic regulations and guidelines for nonstructural components. This presentation summarizes current knowledge on the seismic design and analysis of nonstructural building components, identifying major knowledge gaps that will need to be filled by future research. In particular, the seismic provisions for nonstructural components included in the American Society of Civil Engineers (ASCE) 7-10 along with the Federal Emergency Management Agency (FEMA) E-74 Guidelines for the reduction of the risks of nonstructural earthquake damage will be discussed. Finally, considering recent trends in earthquake engineering, the presentation explores how performance-based seismic design might be conceived for nonstructural components, drawing on recent developments made in the field of seismic design and hinting at the specific considerations required for nonstructural components including the use of Building Information Modeling (BIM).

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