InFocus

thoughts from a member of the Editorial Board

Existing Buildings and the Codes

By Richard Hess, S.E., SECB

Why do we need a special building code for existing buildings? Before the IBC, the building codes in use generally required repairs, alterations and additions to be made in accordance with provisions for new buildings, with certain exceptions: 1) for no change in occupancy category; 2) relatively low cost; and 3) no lessening of the vertical or lateral load resisting capacity. Extreme climatic events were generally not considered when hazardous conditions were being evaluated.

This article discusses some of the milestones in the development of the building code provisions for existing structures subject to seismic risk. A future article will document the development of building code provisions for other extreme events, such as hurricanes and flooding, which are now coalescing into a code for all existing buildings.

The Long Beach, California earthquake of 1933 caused many failures of unreinforced brick buildings (URM). Many of these buildings were public schools, which, fortunately, were unoccupied at the time. This resulted in building codes in California requiring all masonry buildings in earthquake-prone areas to be reinforced to specified minimum standards. However, no requirements for the retrofit of existing buildings were initiated.

A second major turning point was the San Fernando, California earthquake of 1971, which caused a great deal of damage to buildings such as unreinforced masonry, concrete tilt-up wall with flexible diaphragm, and nonductile concrete frame buildings.

In 1971, the Applied Technology Council (ATC) was formed through the efforts of the Structural Engineers Association of California (SEAOC) as a non-profit corporation able to obtain funds for needed research to develop consensus opinions on structural engineering issues in a non-proprietary format.

Because of the damage experienced in these earthquakes and the recognition that this could occur in other regions of the country with less frequent occurrence intervals for an earthquake, the Building Seismic Safety Council (BSSC) was established in 1979 to promote national earthquake hazard mitigation regulation provisions. One result was the preparation of the series of books for the Federal Emergency Management Agency, FEMA. While the original thrust was for improved building codes for new buildings, it became evident that different provisions would be required for retrofitting existing buildings to withstand these forces.

In 1983 the National Science Foundation awarded ATC a grant to develop methods for evaluating the seismic strength of existing buildings. The result was *ATC 14: Evaluating the Seismic Resistance of Existing Buildings*, published in 1987.

Expanding on information developed in ATC 14, BSSC developed the *NEHRP Handbook for the Seismic Evaluation of Existing Buildings*, FEMA 178, in 1992. An article in the "Codes and Standards" section of the November 2004 issue of STRUCTURE®, by Darrick B. Hom and Chris D. Poland, described the development of *FEMA 310: Handbook for the Seismic Evaluation of Buildings – A Prestandard* (1998) which was an expansion of FEMA 178 by the SEI/ASCE Standards Committee on Seismic Rehabilitation of Existing Buildings, and which has become ASCE/SEI 31-03.

In 1992, FEMA authorized the ATC to begin work on *ATC 33: NEHRP Guidelines for the Seismic Rehabilitation of Buildings*. This was an outgrowth of ATC 14 and ATC 172 (1989), and was meant to be to future existing building codes what the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* was for new-building building codes; in other words, a generalized standard that would encompass all types of buildings. This has gone through versions called FEMA 273 and 356, and will become the standard ASCE 41 in the near future.

Other members of SEAOC were working to provide actual building code provisions for local jurisdictions. In 1977, Subdivision 80 of the Long Beach City Building Regulations required the rating of all URMs into three categories, with a timetable to either repair or demolish them. A similar ordinance was passed by the City of Los Angeles in 1981, and the 1985 L.A.B.C. contained Division 88: *Earthquake Hazard Reduction in Existing Buildings*, accompanied by a mandatory retrofit ordinance for URM buildings.

These engineers then turned their attention to tilt-up concrete wall buildings with flexible roof diaphragm, multistory light frame buildings with soft or weak stories, nonductile concrete frame buildings, and residential buildings on hillsides or without foundation anchorage. Code provisions for the tilt-up buildings became mandatory after the Northridge earthquake in 1994 in Los Angeles. These provisions were added to the *1997 Uniform Code for Building Conservation* (UCBC) that was first published in 1991 by the International Conference of Building Officials (ICBO), and were later included in the *2006 International Existing Building Code*.

Unlike the FEMA/ATC documents, these focused on specific weaknesses in classes of buildings that were known to result in a great many life-threatening failures rather than requiring the evaluation of the entire building, which could be harder to enforce.

This distinction should be considered in any existing building code, because the retrofit of existing buildings requires field observation, understanding of construction practices, and a great deal of judgment, and should be treated differently from new building design.▪

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