Development of Earthquake Design Provisions for Building Codes

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Introduction
Earthquake design provisions have changed rapidly and substantially since 1980. So has the process by which they are developed and codified. What was once the franchise of SEAOC and, in particular, the Seismology Committee is now a national effort with rigorous procedures for consensus building and balloting. In this new environment, industry associations and academics play more significant roles than in the past. While individual practicing structural engineers are still essential participants in the code development process, the roles of code officials and professional associations like SEAOC have been reduced. The result is a building code that might become more stable over time and more uniform between jurisdictions, but also one that might lose its adaptability to local conditions and custom. Some also anticipate that new design codes will become even more complex and difficult to apply. This article describes the old code development process and the new one, as well as the organizations and publications that motivated the transition.

California Building Code status. The California Building Code sets minimum requirements for all California jurisdictions. The 2001 edition, which is still in use as of mid-2005, continues to use the 1997 UBC as its model code. The Seismology Committee supports the selection of a new model code because the 1997 UBC is out of date. In 2003, the California Building Standards Commission selected NFPA 5000 as its model code. In March of 2005, the CBSC rescinded that decision (CBSC, 2005), opening the door for adoption of the IBC as the model code for the CBC. The Seismology Committee has taken a position in support of the most current IBC as the model code for the CBC.

The UBC and the Blue Book
Since at least the middle of the eighteenth century, communities around the world have anticipated and responded to damaging earthquakes by adopting special requirements for building design and construction. Equivalent lateral force procedures already in use in many countries by the early 1920s are examples of modern design provisions, which can be said to be marked by rational approximations of earthquake effects as structural loads. More on early code approaches can be found in Geschwind (2001), Holmes (1998), Olson (2003), Strand (1984), and Tobriner (1984).

In 1928, the Pacific Coast Building Officials (a forerunner of the International Conference of Building Officials and, more recently, the International Code Council) published the first edition of the Uniform Building Code (PCBO, 1928). In a non-mandatory appendix, following an approach adopted in Japan and incorporating lessons from the 1906 San Francisco earthquake, the 1927 UBC recommended that structures designed for seismic resistance should have the strength to resist a total lateral force proportional to the building weight. The design lateral forces were to be applied at specific floor levels in each of two orthogonal directions. In addition, the appendix recommended that each structure be firmly bonded and tied together, to assure that it acts as a unit.

For more than sixty years following the publication of the 1927 UBC, California structural engineers, working principally as volunteers through the SEAOC Seismology Committee, led international efforts to develop seismic provisions for building codes. These efforts began formally in the 1940s with separate efforts in northern and southern California (EERI, 1994, p.134-5). In 1959, SEAOC published its *Recommended Lateral Force Requirements* – the first Blue Book – as a joint statewide effort with design procedures that mirrored those in the contemporary UBC; in 1960 came a commentary on preferred seismic design practice (Seismology, 1959; 1960).

Other than prohibitions against the use of unreinforced masonry and requirements for anchoring wood frame construction to foundations, early editions of the Uniform Building Code had few detailing provisions. For the 1967 UBC, however, the Seismology Committee introduced ductile detailing requirements for reinforced concrete frames based on pioneering work by John Blume, a prominent SEAOC member (Blume et al., 1961). Over the next thirty years, the Committee championed a succession of similar enhancements. Table 1 lists some of the criteria and detailing requirements introduced into building codes during this period in response to observed earthquake