Development of Earthquake Design Provisions for Building Codes

performance. Many other important changes were based on research by universities, the U.S. Geological Survey, and individual practicing engineers. (Additional background on some of these changes is given in individual Blue Book articles and in references such as Degenkolb, 1986.)

By the mid-1980s, the Blue Book and the UBC provisions based on it were recognized around the world as leading references for the design of earthquake-resistant buildings. In the United States, seismic design requirements in the ANSI A58.1 standard (National Bureau of Standards, 1982), the forerunner of ASCE 7, as well as those in codes published by BOCA and SBCCI (see the glossary below) were based on Blue Book recommendations.

Table 1. Recent west coast earthquakes and building code provisions they motivated

Earthquake	UBC Edition	Enhancement
1971 San Fernando	1973	Direct positive anchorage of masonry and concrete walls to diaphragms
	1976	Seismic Zone 4, with increased base shear requirements
		Base shear dependence on site conditions through coefficient *S*
		Occupancy Importance Factor *I* for certain buildings
		Interconnection of individual column foundations
		Special Inspection requirements
1979 Imperial Valley	1985	Diaphragm continuity ties
1985 Mexico City	1988	Requirements for columns supporting discontinuous walls
		Separation of buildings to avoid pounding
		Design of steel columns for maximum axial forces
		Restrictions for irregular structures
		Ductile detailing of perimeter frames
1987 Whittier Narrows	1991	Revisions to site coefficients
		Revision to spectral shape
		Increased wall anchorage forces for flexible diaphragm buildings
1989 Loma Prieta	1991	Increased restrictions on chevron-braced frames
		Limitations on *b/t* ratios for braced frames
	1994	Ductile detailing of piles
1994 Northridge	1997	Restrictions on use of battered piles
		Requirements to consider liquefaction
		Near-fault zones and corresponding base shear requirements
		Revised base shear equations using $1/T$ spectral shape
		Redundancy requirements
		Design of collectors for overstrength
		Increase in wall anchorage requirements
		More realistic evaluation of design drift
		Steel moment connection verification by test

The UBC development process. The UBC, published triennially (with interim supplements) by ICBO, was a model code adopted by local jurisdictions throughout the western U.S., including California and its major cities. For each code cycle, ICBO received proposals for changes and published them in a monograph for public review. Any individual or organization was eligible to submit proposals. ICBO committees, composed of ICBO-member building officials, then held public hearings before voting to reject or accept each proposal.

Building on its historic role, the Seismology Committee was an active participant in this process. One or more Committee representatives typically attended the ICBO hearings to speak in support of SEAOC proposals and to provide a Seismology opinion on changes proposed by others. Often, the Seismology Committee would meet with proponents of competing proposals to negotiate a compromise position prior to the code hearings.