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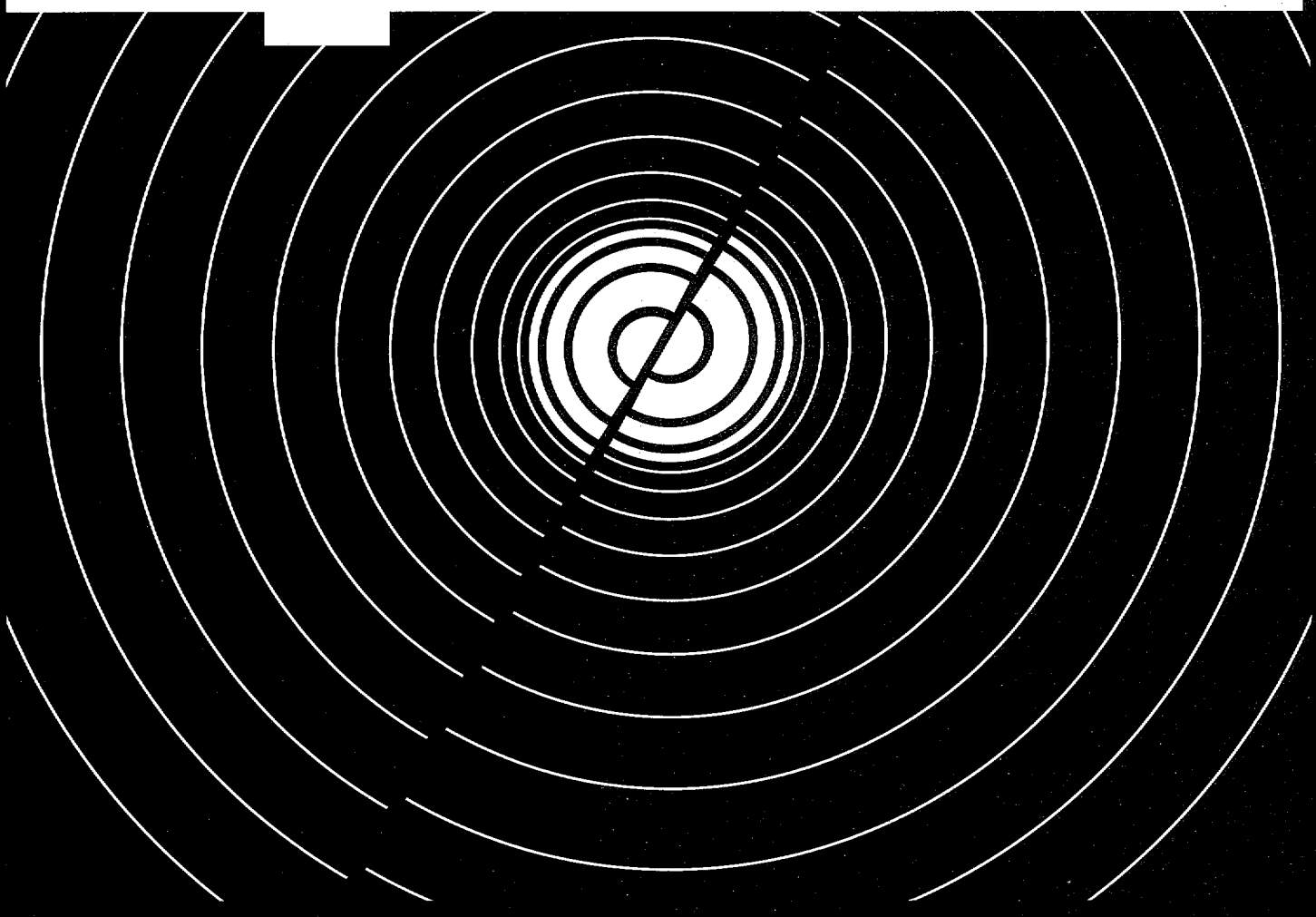
Promoting the Adoption and Enforcement of Seismic Building Codes:

A Guidebook for State Earthquake and Mitigation Managers



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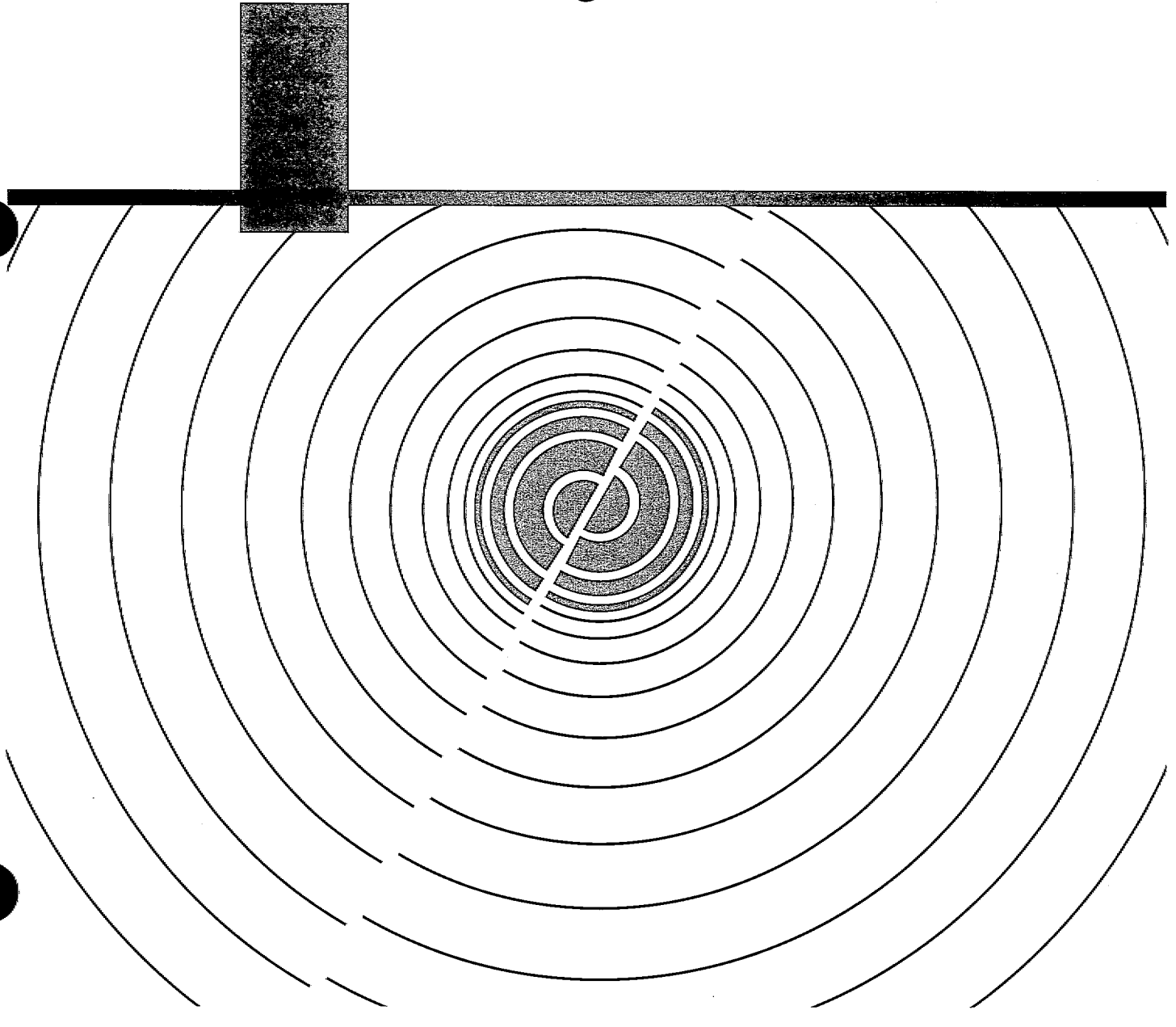

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Contents

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The project team gratefully acknowledges the help of numerous public officials from the six states and six local governments that were the subject of our detailed case studies. Their names are listed in Appendices B and C.

We also appreciate the help of our primary contacts at FEMA, Sheila Donahoe and Elizabeth Lemersal, as well as our numerous reviewers, including Lindsey Carter (SBCCI), Riley Chung (NIST), Susan Dowty (ICBO), Tom Durham (CUSEC), Brian Gore (Mass. Board of Bldg. Regulations and Standards), Cindy Hoover (Seattle Dept. of Construction and Land Use), Mike Mahoney (FEMA), Kathleen Mihelich (BOCA), Ugo Morelli (FEMA), Christopher Rojahn (ATC), James R. Smith (BSSC), Stuart Nishenko (FEMA), Daniel Shapiro (SOH & Associates), Arthur Zeizel (FEMA), and Thomas Zimmerman (Illinois Emergency Management Agency).

Figures and Tables

Chapter 1
How To Use This Book

Purpose

This book provides background information and educational materials to help state officials promote the adoption and enforcement of state and local model building codes that contain the latest seismic provisions. These codes can reduce the damage that will inevitably occur when future earthquakes strike at-risk parts of the country.

Audience

This book is intended for state officials, especially for earthquake program managers and hazard mitigation officers in the emergency management agencies of the states and territories prone to earthquakes. It is designed to help you convince your state and local governments that codes are effective, inexpensive, and a good investment for the future of our communities.

Additionally, this book is designed to be of use to local officials, state legislators, professional organizations, and concerned citizens. Portions of this book are meant to be copied and distributed to these various groups.

Content

Chapters 2 and 3 of this book contain background material on the purpose, function, and effectiveness of building codes in general and seismic codes in particular. Chapters 3, 4, and 5 describe step-by-step processes for adopting state or local codes and for administering codes. Several appendices contain:

- the history and principles of seismic design
- current seismic design practices in the United States
- examples of state building code requirements
- examples of state legislation
- examples of local code administration
- the services of the three model code organizations in the United States
- sources of further information and addresses
- recommended readings
- educational material for making local presentations
- sample press releases for the media
- sample brochures aimed at local audiences
- a glossary of relevant terms

Chapter 2
Why Adopt A Building Code?

Building Codes Protect Public Safety

Building codes regulate building construction and use in order to protect the safety and health of occupants. Codes address structural integrity, fire resistance, safe exits, lighting, and ventilation. Codes also regulate construction materials.

Building codes classify structures by use and apply different standards to each classification. For example, office buildings and residential multi-unit buildings are in separate categories with different performance requirements.

The validity of building codes is based on state police powers, which allow regulation of activities and property to preserve or promote the public health, safety, and general welfare. Zoning ordinances and environmental protection regulations are also founded in police powers.

FIGURE 2.1 The first building codes were designed to improve substandard housing. (Photo: Presidents Commission on Urban Housing, 1968)

Building Codes Have a Long History in the U.S.

Building codes to reduce the loss of life, limb, and property have existed in North America since the seventeenth century. The earliest building regulations addressed problems resulting from dense urban construction, such as rapid spread of fire. New York City, then called New Amsterdam, first regulated chimneys and roofing material in 1648. These regulations were aimed at controlling the destructive force of fire in urban areas, as evidenced by London's 1666 fire, New York's 1835 and 1845 fires, and the great Chicago fire of 1871.

Comprehensive building regulations were introduced in the mid-1800s.[1] Building regulations were of two types: housing codes and building codes. Housing codes were intended to reduce the ill effects of residential overcrowding, and their introduction paralleled Europe's housing and sanitation reform. New York City in the late 1850s adopted a citywide housing code in order to provide air and light into dwellings and reduce the risk of fatal hazards. Chicago followed by passing its initial tenement housing ordinance in 1874. Building codes were later enacted to comprehensively specify construction methods and materials.

In 1905 the National Board of Fire Underwriters published a model

building law aimed at reducing fire risks.[2] The three model building codes used today were initiated between 1927 and 1950. The use of codes spread with the growth of new building across the country, particularly after World War II. By 1960 more than 60 percent of American municipalities had adopted building codes.

Model Building Codes

A model building code is a document containing standardized building requirements applicable throughout the United States. Model building codes are standards specifying the required performance of all structures. They are published by private organizations, whose voting members are government jurisdictions.

It is the policy of the federal government to rely on voluntary standards whenever feasible and to encourage employees to participate in voluntary standards-developing activities (OMB Circ. A-119).

The United States has three prominent model building code organizations: the International Conference of Building Officials (ICBO), which publishes the Uniform Building Code (UBC); the Building Officials and Code Administrators International, Inc. (BOCA), which publishes the BOCA National Building Code (BNBC); and the Southern Building Code Congress International, Inc. (SBCCI), which publishes the Standard Building Code (SBC). Each organization also publishes companion documents covering mechanical work, plumbing, fire protection, electrical work, energy, accessibility, and life safety codes.

Simple one- and two-unit residential structures also are covered by another model building code: the *One- and Two-Family Dwelling Code,* by the Council of American Building Officials (CABO). CABO is composed of the three model building code organizations: ICBO, BOCA, and SBCCI.

In addition to writing and updating the codes, the organizations offer a variety of support services, including such technical services as training seminars, code interpretation, technical and administrative publications, customized consulting, plan-checking services, videos, and software (see Appendix D). Each organization offers certification programs to allow skilled inspectors and plan reviewers to be recognized for their levels of knowledge and experience. For example, BOCA offers certification by examination in twenty-two categories and ICBO in nineteen categories. SBCCI offers four levels of certification in various categories to encourage professional growth through progressive levels of certification.

Membership in model building code organizations is open to governmental officials, private sector building and construction professionals, and students. Each member participates in varying degrees depending on membership classification. For all three organizations only active governmental members may vote. Typically, these are local and state officials responsible for enforcing the building codes.

The model building codes are revised periodically by a democratic process. Each organization allows the public to propose code amendments and hear testimony in meetings organized by the organization, so members and nonmembers are equal participants. Active members of each organization vote on revisions after final testimony is heard during their annual meeting. The content of the codes has become more similar over time, although they still address regional conditions and practices. The newest versions reflect a common code format so that similar topics can be found in consistently numbered chapters among the codes.

Although the code organizations have widespread membership, each organization's model building code

Building Code Timeline

1648	Chimneys and roofing materials regulated to prevent fire in New Amsterdam (now New York City)
1850s	(late) Comprehensive housing regulations introduced in NYC
1874	Tenement housing ordinance passed in Chicago
1905	Model building law published by NBFU
1906	San Francisco earthquake kills 3,000
1927	Uniform Building Code (UBC), with seismic provisions, first published by ICBO
1933	Long Beach earthquake kills 115
1935	Charles Richter devises magnitude scale for earthquakes
1940	Standard Building Code (SBS) published by SBCCI
1949	UBC contains first national seismic hazard map
1950	Basic Building Code (now the BOCA National Building Code) published by BOCA
1960	60% of American municipalities had adopted one of the model codes
1970s	Study of earthquake-resistant design provisions funded by NSF
1971	San Fernando earthquake kills 65
1972	CABO formed
1973	UBC revised because of San Fernando quake
1976	UBC includes new seismic provisions
1978	ATC releases ATC3-06 report
1979	BSSC formed
1985	FEMA releases NEHRP provisions for new buildings
1989	95% of American municipalities covered by codes; Loma Prieta earthquake kills 63
1990	EO 12699 requires all federal agencies to incorporate seismic resistant design in new buildings
1992	All three model codes require seismic designs consistent with NEHRP provisions; Northridge earthquake kills 57
1993	EO12699 provisions take effect
1994	EO 12941 establishes seismic standards for federally owned or leased buildings; ICC formed
2000	ICC codes to be finished

The ABCs of Model Building Codes

Building Officials and Code Administrators International, Inc. (BOCA). BOCA, headquartered in Country Club Hills, Illinois, was formed in 1915. Its first code, the BOCA Basic Building Code now titled the *BOCA National Building Code* (BNBC), was published in 1950 in an attempt to standardize existing codes. The BNBC is revised every three years, most recently in 1996, with a new edition due out in 1999.

International Conference of Building Officials (ICBO). ICBO was formed in 1922 to integrate various design requirements into one code. ICBO published its first model code, the *Uniform Building Code* (UBC), in 1927. ICBO, headquartered in Whittier, California, updates the UBC every three years. The latest edition was published in 1994.

Southern Building Code Congress International, Inc. (SBCCI). The third model building code organization, SBCCI was founded in 1940. Located in Birmingham, Alabama, it publishes the *Standard Building Code* (SBC). The SBC is updated every three years, most recently in 1994.

Council of American Building Officials (CABO). CABO was founded in 1972 by BOCA, ICBO, and SBCCI. The *One- and Two-Family Dwelling Code* applies to the construction, prefabrication, alteration, repair, use, occupancy, and maintenance of detached one- or two-family dwellings and one-family town houses not more than three stories in height.

Further information on these organizations and their services is included in Appendix D.

is predominantly adopted in one portion of the United States (Fig. 2.2). The BNBC is predominantly adopted in the northeast and north central states, the SBC predominates in the southern states east of the Mississippi, and the UBC is predominant in the western states, including Guam (see Figure 2.2).[3]

In addition, BOCA, ICBO, and SBCCI have moved forward on the development of a single model code, the International Building Code. On December 9, 1994, the International Code Council (ICC) was formed to develop a single set of comprehensive and coordinated national codes. The advantages of a single code are numerous. Code enforcement officials, architects, engineers, designers, and contractors can have consistent requirements that can be used across the country and around the world. Manufacturers can put their efforts into innovative products, instead of designing for all three regional codes. To date, the ICC has produced codes that address plumbing, mechanical systems, and private sewage disposal. The goal is for the complete family of international codes to be developed by the year 2000.

Compared to the Benefits, the Costs of Codes Are Small—and Uniform Codes Reduce Costs

There are two costs associated with building codes. One is the cost of additional material and quality of workmanship, and the other is the cost of administration and enforcement. In the studies cited below, research has shown that building codes do not significantly increase building cost, and adoption of statewide codes can help reduce the costs.

Criticism of the cost of building codes in the 1950s and 1960s centered around the inefficiencies of having numerous codes, inconsistently applied. Builders often were required to alter their construction methods and materials from one community to the next, which meant spending more time and money. A survey of Detroit area construction companies in 1966 found that use of nonuniform building codes throughout the metropolitan region increased housing costs approximately 4 to 11 percent.[4] In contrast, a 1953 study in the San Francisco Bay Area found that the restrictive effect of codes had been greatly overemphasized, and that only 1 percent of housebuilding costs could be attributed to code inefficiencies.[5]

University studies[6] based on 1967 and 1970 housing costs found that building codes increased the cost of housing by less than 2 percent, and up to as much as 5 percent for particularly restrictive codes.

To address these issues, the National Commission on Urban Problems in 1968 recommended more uniformity in building codes, including adoption of state building codes.[7] According to a 1989 Federal Trade Commission study, because of the widespread adoption of model codes, differences among codes no longer contribute to higher housing costs.[8] Thus, the impact of codes on housing costs has always been relatively small, and is decreasing as more localities adopt model codes.

Most States and Municipalities Have Building Codes

Constitutionally, states have jurisdiction over regulation of construction. As of 1996, the Institute for Business and Home Safety (formerly IIPLR) reported that 23 states mandate a model code or state code to cover all buildings,[9] relying mostly on local municipal enforcement and administration (Fig. 2.3). An additional 18 states and Washington, D.C., mandate the code for all buildings except one-family dwellings. Ten states do not have state-mandated codes.

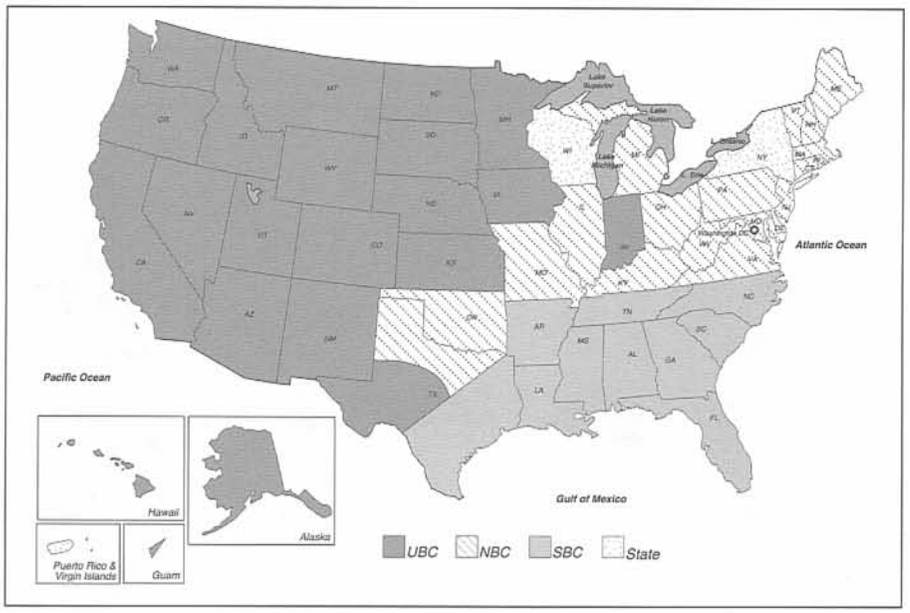
Currently two states, New York and Wisconsin, and one territory, Puerto Rico, have written their own building codes. Other states and territories that enforce statewide codes use one of the model building

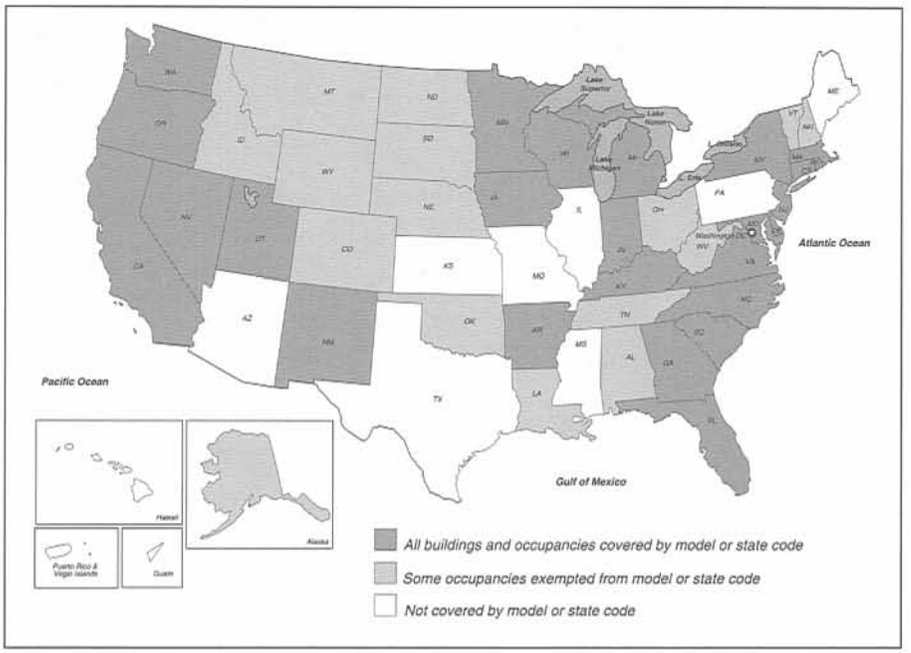
codes described previously. (See Appendix A for a list of current state and territory codes.)

Usually county and local governments adopt a model building code by ordinance. As of 1992, 44,000 local governmental units enforced building codes.[10] The Federal Trade Commission in 1989 estimated that 95 percent of all cities and towns are covered by building codes.[11] These local governments have either adopted a model building code or are covered by a statewide building code.

Codes Are Easy to Adopt

State and local governments usually adopt an entire model building code, though sometimes with minor revisions or deletions. Model building codes save governments the time and cost required to write an original code. They include sections detailing the administrative procedures for plan review, building inspection, plan and building approval, and code enforcement.





Top, FIGURE 2.2 General areas of building construction code influence. (Source: National Conference of States on Building Codes and Standards)

Above, FIGURE 2.3 States with mandatory statewide building codes. (Source: Copyright 1996, Insurance Institute for Property Loss Reduction [now IBHS])

NOTES

1 National Conference of States on Building Codes and Standards Inc., *Directory of Building Codes and Regulations*, Vol. 1, Code Primer, NCSBCS (Herndon, VA), 1989.

2 Ibid.

3 Ibid.

4 Metropolitan Fund, Inc., *A Study of Local Building Codes and Their Administration in the Southeast Michigan Six-County Region*, Public Administration Service (Chicago), August 1966.

5 Maisel, Sherman J., *Housebuilding in Transition*, University of California Press, 1953.

6 For 1967 costs, see Muth, Richard F., and Wetzler, Elliot, "The Effect of Constraints on House Costs," *Journal of Urban Economics*, Vol. 3, 1976, 57-67; for 1970 costs, see Noam, Eli M., "The Interaction of Building Codes and Housing Prices," *AREUEA Journal*, Vol. 10, 1983, 394-404.

7 U.S. National Commission on Urban Problems, *Building the American City*, report to the Congress and the President, House Document No. 91-34, December 1968.

8 Reported by Korman, Richard, "A Much Misunderstood Contraption," *Engineering News-Record*, June 22, 1989, 30-36.

9 Insurance Institute for Property Loss Reduction (now IBHS), *Summary of State-Mandated Codes*, IIPLR (Boston), April 1996.

10 National Conference on States on Building Codes and Standards, *Seismic Provisions of State and Local Building Codes and their Enforcement*, NIST GCR 91599, April 1992.

11 Korman, Richard; see note 8.

Chapter 3
Why Adopt a Seismic Code?

FIGURE 3.1 Most of the building damage in the 1989 Loma Prieta earthquake was to older unreinforced masonry buildings built before the adoption of seismic codes. (Photo: Rob Olshansky)

The term *seismic code* refers to the seismic design requirements included within building codes. In the past, local governments sometimes viewed the seismic sections of the model codes as optional, adopted at local discretion. Now seismic provisions are fully integrated into all three model codes. Local governments should adopt the latest version of a model code in its entirety, including the seismic sections, in order to be operating at the current standard. This point is very important and is emphasized throughout this book.

Seismic Codes Are Effective

Experience with recent earthquakes in the United States and throughout the world shows that seismic codes work. Cities with seismic codes suffer much less damage than those without such codes.

The Loma Prieta earthquake clearly illustrates the effectiveness of seismic codes. Occurring on October 17, 1989, this earthquake measured 7.1 on the Richter scale and was the strongest to affect a U.S. city since the 1964 Alaskan earthquake.[1] It shook the San Francisco Bay Area and killed sixty-three people. Two-thirds of the deaths were a result of the Cypress viaduct collapse. Although the ground-shaking was intense within the metropolitan area, few buildings collapsed. Most of the damage occurred to unreinforced masonry buildings built before the adoption of seismic codes. Nearly all major reinforced concrete structures built after World War II survived without collapse. Even at the quake's epicenter new buildings and buildings located on firm ground suffered little damage. Informed observers attribute the success to the required UBC seismic codes.[2] This example illustrates that code requirements reduced the damage and loss of life during this moderate earthquake.

The 1994 Northridge, California, earthquake shows similar evidence. Almost all the buildings in the affected area were built during the past fifty years under one of the UBC seismic codes. Virtually all buildings, even in the areas of strongest shaking, remained standing and allowed for safe evacuation of occupants. Regrettably, one apartment building collapsed on its residents, and two high-occupancy concrete-frame buildings collapsed, fortunately with no occupants at the time.[3] Still, these three buildings were built under an older version of the UBC code, and damage and life loss would have been immeasurably greater without the seismic-resistant construction prevalent in the San Fernando Valley.

A Kyoto University study of the 1995 earthquake in Kobe, Japan, Richter magnitude 6.9, found that damage to reinforced concrete buildings closely paralleled improve-

ments to seismic provisions in the Japanese building code. More than 55 percent of pre-1970 buildings (old version of code) were severely damaged, compared with no post-1980 buildings (newest version of code). Similarly, steel buildings built before 1970 sustained severe damage, compared with little damage in post-1981 buildings.[4] Ohbayashi Corporation studied buildings it had constructed in Kobe and found that 58 percent of pre-1971 buildings were damaged, compared with 28 percent of 1972-80 buildings and only 16 percent of post-1981 buildings.[5]

In contrast, a Richter magnitude 6.9 earthquake in Armenia in 1988 destroyed entire communities and killed 25,000 people. This disaster has been attributed to several factors: design deficiencies; poor quality of construction; and the earthquake's intensity exceeding that anticipated by the code.[6] Similar problems exist in much of the United States.

Even smaller earthquakes can cause extensive damage where buildings are not designed for seismic shaking. A Magnitude 5.6 earthquake in 1993 at Scotts Mills, Oregon, caused significant structural damage to a number of unreinforced masonry (brick) buildings in the area.[7] A high school building was significantly damaged and vacated, 16 residences and 54 businesses sustained major damage, and the Oregon State Capitol, in Salem, suffered cracking in the rotunda. The estimated damage cost to public facilities alone was nearly $13 million. This earthquake confirmed the susceptibility of unreinforced buildings to severe damage, even in a minor earthquake.

New lessons are learned from every earthquake and incorporated into U.S. seismic codes. For example, the 1985 Mexico City earthquake confirmed that the local soil conditions are as important to building stability as the epicenter location.[8] In response to this new information, ICBO in the 1988 and 1991 UBC editions has emphasized soil conditions by increasing the force requirements according to the type of underlying soil. *The National Earthquake Hazard Reduction Program (NEHRP) Recommended Provisions* (described on page 8) have also taken into account soil conditions in the latest edition.

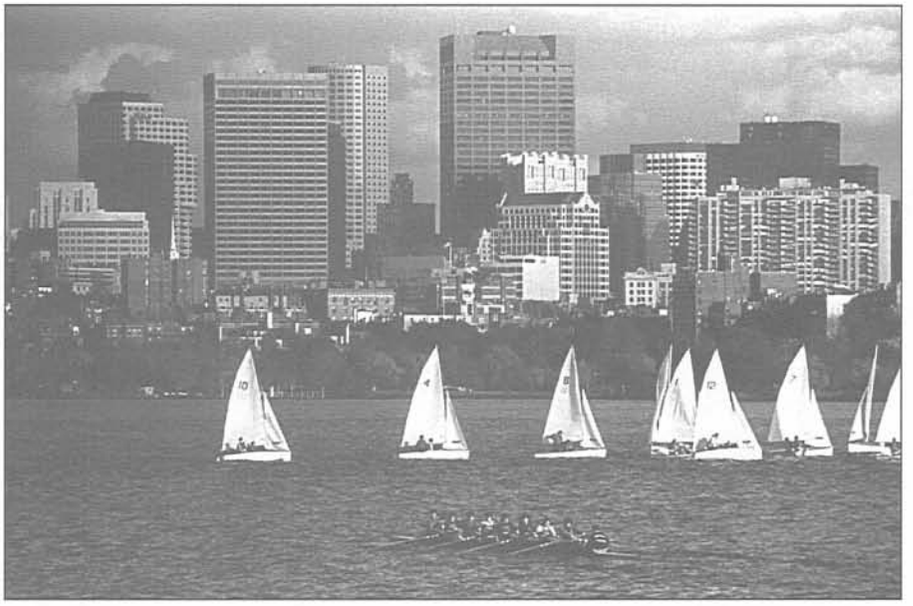


FIGURE 3.2 Lessons about underlying soil conditions learned in the 1985 Mexico City quake can help areas built on fill, such as the Back Bay area of Boston shown above, minimize damage. (Photo: Greater Boston Convention & Visitors Bureau)

Today's Seismic Codes Are Based on More Than Sixty Years of Earthquake Experience

Seismic codes in use now reflect a long history of learning from earthquakes and represent the collective knowledge of hundreds of design and construction professionals. The following is a brief account of that history. See Appendix A for a more detailed account.

The earliest seismic design provisions in the U.S. were introduced in the appendix to the 1927 *Uniform Building Code*, the first edition of the UBC. By the 1950s, some California municipalities had adopted additional seismic-resistant design and material specifications. The 1949 edition of the UBC contained the first national seismic hazard map. After the 1971 San

Earthquake Magnitude and Intensity

Earthquake *magnitude* is a measure of the absolute size of an earthquake so that we may compare earthquakes with one another. Generally speaking, earthquakes that release more energy

- shake for a longer amount of time,
- affect a wider area, and
- produce more violent shaking near the source.

Because we cannot measure the energy released by an earthquake, Charles Richter in 1935 devised a substitute measure—the Richter magnitude scale. The scale is based on what a seismograph would measure; it has no inherent meaning of its own. The Richter scale is logarithmic, and each whole number increase in the scale represents approximately a 31.5-fold increase in energy release: that is, a magnitude 7 earthquake releases about 31.5 times more energy than does a magnitude 6 earthquake. Several different magnitude scales are now in common use, and they all share basic characteristics with the Richter Scale.

Shortly after an earthquake occurs, the *surface wave magnitude or body wave magnitude* is often reported. The scale that most accurately represents the energy of an earthquake is the *moment magnitude scale*. For smaller earthquakes (less than magnitude 6), the scales are nearly identical, but only the moment magnitude scale can distinguish differences among very large earthquakes.

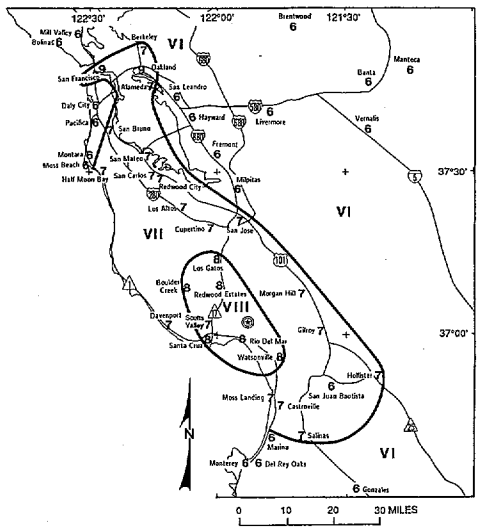


FIGURE 3.3 The Loma Prieta, California, earthquake of 1989 had a magnitude of 7.1, but intensities in the affected area ranged from MMI VII to IX. (Source: USGS Circular 1045, 1989)

Earthquake *intensity* is a measure of the actual shaking experienced at a location. The United States uses the Modified Mercalli Intensity Scale, a twelve-point qualitative scale that describes observable effects of earthquakes. For example, Intensity VIII is described, in part, as "damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures . . . fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned." Whereas magnitude is an inherent quality of an earthquake, intensity generally decreases with greater distance from the earthquake's center. Intensity is a very useful measure because it describes what is most important to society—the degree of damage to structures built by humans.

Fernando earthquake, revisions were made to the 1973 UBC, and new requirements were introduced in the 1976 edition.[9]

Early in the 1970s the National Science Foundation (NSF) funded a project, under the guidance of the National Bureau of Standards (NBS, now the National Institute of Standards and Technology), to evaluate existing earthquake-resistant design provisions. This extensive multi-year project relied on the input of a large number of seismic design experts and resulted in a 1978 report by the Applied Technology Council titled *Tentative Provisions for the Development of Seismic Regulations for Buildings (ATC 3-06).*

Under a contract with the Federal Emergency Management Agency (FEMA), the Building Seismic Safety Council (BSSC, formed in 1979 within the National Institute for Building Sciences, NIBS) revised ATC 3-06 by a consensus of its members. In 1985 FEMA released the *NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings*, commonly called the *NEHRP Provisions*. Although not a code, the *NEHRP Provisions* are designed to provide guidance to the writers of building codes. FEMA and BSSC continue to update the *NEHRP Provisions* every three years, with the latest edition being published in 1994. The 1997 edition is due out in December 1997.

All Three Model Codes Contain State-of-the-Art Seismic Requirements

The past two decades have seen great strides in the knowledge of building responses to earthquakes. Based on the collective efforts of engineers, scientists, and tradespeople, the *NEHRP Provisions* contain seismic design provisions that are technically advanced and widely accepted.

Since 1992 all three model codes require seismic design standards consistent with the *NEHRP*

Modified Mercalli Intensity Scale

Figure 3.4 Percentage of Buildings Expected in Each Damage State for Various Shaking Intensities: Buildings Designed for Seismic Zone 4 under the 1991 UBC

Size of Earthquake (Magnitude)		Expected MMI	Standardized Damage States				
			A	B	C	D	E
6.0-6.5	7.5-8.0		None	Slight	Moderate	Extensive	Complete
Distance to Fault							
30 mi.	50 mi.	VII	60-90%	10-40%	1-5%	<1%	0
5 mi.	40 mi.	VIII	35-60%	35-45%	10-30%	<5%	<1%
1 mi.	30 mi.	IX	25-40%	25-40%	20-40%	3-10%	<2%
—	3 mi.	X	5-25%	5-25%	40-70%	10-30%	<5%

Source: EERI Ad Hoc Committee (see note 12).

MMI VI: Ground-shaking felt by all; some cracked plaster; broken dishes and glassware. (Photo: Caltech EERL)

MMI VII: Disturbance frightens all; cracked chimneys; cracking in unreinforced masonry structures. (Photo: Rob Olshansky)

MMI VIII: Causes near panic; partial collapse of unreinforced masonry structures. (Photo: Rob Olshansky)

MMI IX: General panic; ground-cracking; considerable damage in buildings designed to seismic code. (Photo: J. David Rogers)

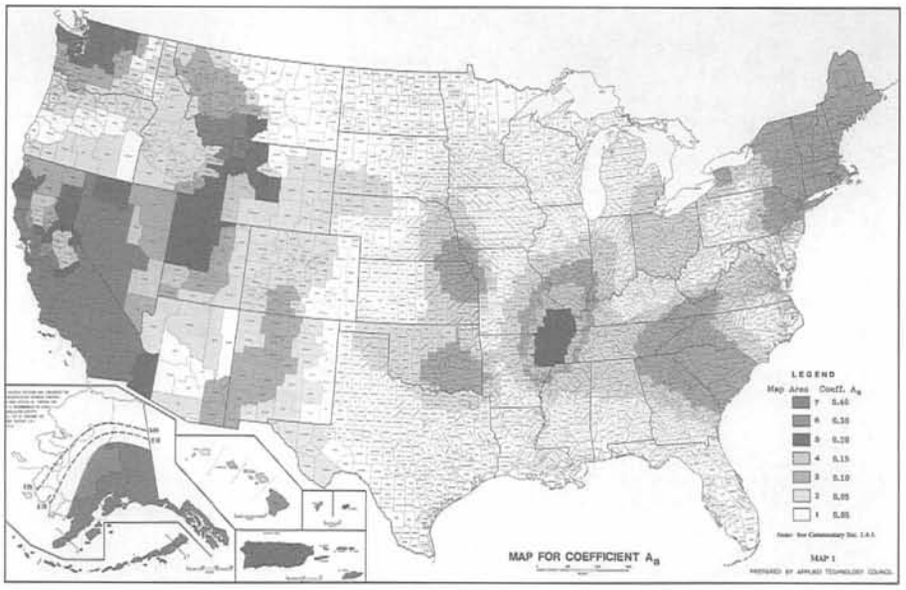


FIGURE 3.5 U.S. seismic hazard map based on effective peak acceleration.

This seismic hazard map, published by the Applied Technology Council in 1978, shows 7 zones of effective peak acceleration with a 10 percent probability of occurring in a 50-year period. Each county is assigned a value. This map became the basis for the first NEHRP Provisions in 1985. (Source: Applied Technology Council, 1978)

Provisions.[10] ICBO has long been a leader in seismic code development; BOCA incorporated the 1988 *NEHRP Provisions* into the 1992 BOCA *Supplement*; and SBCCI incorporated the 1988 *NEHRP Provisions* in the 1992 amendments to the SBC. Thus, all communities **that adopt the most recent editions of these codes** have the most advanced seismic codes available.

The Federal Government Requires Seismic Design for All Its Buildings

Signed in January 1990, presidential Executive Order 12699 required all federal agencies by February 1993 to issue regulations or procedures that incorporate cost-effective seismic safety measures for all *new* federal buildings and buildings that are leased, assisted, or regulated by the federal government. All of the affected federal agencies have adapted one or more minimum standards for seismic safety and have issued the required regulations or procedures.

Because of EO 12699, it is in the best interests of local governments to adopt seismic codes. To best facilitate the possibility of federal financial assistance for new buildings, local governments would be well advised to adopt one of the model codes that have been found to be seismically adequate. For example, the federal agencies providing financial assistance for housing construction (VA, FHA, HUD) all now require adequate seismic design and construction.

In conjunction with EO 12699, Executive Order 12941 (December 1, 1994) directs federal agencies to evaluate *existing* federally owned and leased buildings to identify buildings that are potentially hazardous and to plan for the seismic rehabilitation of those so identified.[11]

Both executive orders are significant in that the federal example encourages state and local governments to make seismic design more prevalent throughout the nation. They also increase the number of experienced seismic designers and contractors.

Seismic Codes Account for Variations in Earthquake Hazard across the U.S.

All the model codes include a seismic hazard map that indicates likely levels of earthquake groundshaking in every part of the United States. The latest adopted maps depict the peak ground acceleration that has a 10 percent probability of being exceeded every fifty years. New maps based on spectral accelerations have recently been issued by the U.S. Geological Survey and are currently under consideration for use in future code editions (see Appendix A).

The code requirements reflect the fact that some places are more prone to earthquakes than others. Sometimes local officials question whether their jurisdiction warrants seismic design. Because of the seismic hazard map in the code, this decision need not be made by individual local officials—the codes themselves require the appropriate level of seismic design (which in some cases is *no* seismic design) for every county in the United States. The zone boundaries are based on probability: a structure on one side of a zone line

is not markedly safer than a structure immediately on the other side. But these maps do represent a consensus of informed scientific opinion on the likelihood of earthquake ground-shaking and its effects. By using these maps as guides to design, we reduce the overall chances of damage to buildings in a region.

Seismic Codes Are Designed to Help Buildings Resist Earthquake Shaking

It is important to understand that seismic codes result in earthquake-*resistant* buildings rather than earthquake-*proof* buildings. Their purpose is to protect life safety by preventing building collapse and allowing for safe evacuation. The contents and interiors of buildings, even those of well-designed buildings, may receive extensive damage, and critical functions of a building may cease. And structural damage may occur from major earthquake ground-shaking. According to the Structural Engineers Association of California, structures built according to a seismic code should:

- resist minor earthquakes undamaged,
- resist moderate earthquakes without significant structural damage even though incurring nonstructural damage, and
- resist severe earthquakes without collapse.[12]

Occasionally even a code-designed building may collapse due to unique site conditions or other factors. A report completed by the Earthquake Engineering Research Institute (EERI) just prior to the Northridge, California, earthquake summarized expected earthquake damage to buildings designed according to the 1991 UBC. It stated, for example, that shaking of Intensity VIII could cause moderate damage (easily repairable) to 10 to 30 percent of code-designed buildings, and extensive damage (long-term closure, difficult to repair) to 0 to 5 percent of code-designed buildings.[13] This was the intensity level experienced by much of the San Fernando Valley in January 1994, and buildings performed generally as expected.

Seismic Codes Reflect Social Judgments Regarding Acceptable Risk and Cost

Seismic design standards reflect society's balancing of the risks versus the costs of designing to withstand that risk. They do this in two ways: by designing for (a) an appropriate-sized event and (b) an appropriate performance goal. Society cannot justify the expense of designing for large but highly improbable events. So we select a ground motion event—called the *design event*—that although large and rare has a reasonable chance (10 percent) of being exceeded during a building's lifetime (50 years). The probability selected reflects society's attitude toward risk.[14] This is similar to the philosophy long used for flood protection: Society is willing to absorb the cost of designing for a 100-year flood, but with the exception of critical facilities it would not make economic sense to design for the 500-year or 1,000-year flood.

The goal of seismic codes is to ensure that buildings will not collapse, thereby killing those inside, if shaken by the design event. Seismic codes are for "life safety" and are not aimed at completely preventing damage to existing buildings (see Fig. 3.4). Additionally, it is important to realize that there is a 10 percent chance of an earthquake occurring that exceeds the design event.

Seismic Codes Are Inexpensive

Seismic codes add relatively little to the costs of a structure. To assess the costs of the *NEHRP Provisions* (seismic provisions), the BSSC in 1985 contracted seventeen design firms from nine U.S. cities to per-

Increase in Cost by Building Type Resulting from Seismic Design

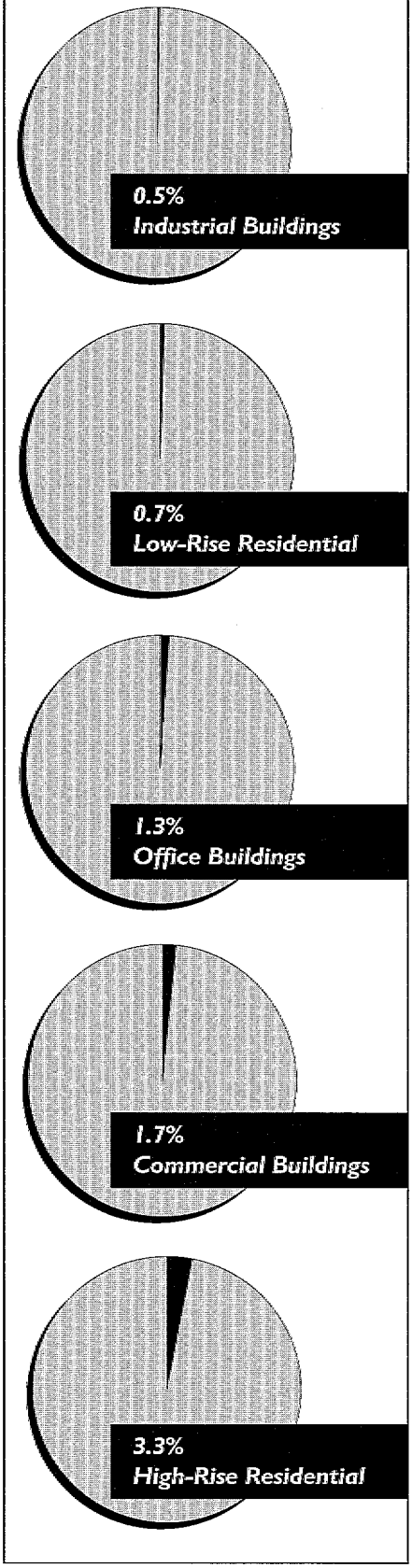


FIGURE 3.6 The extensive damage in Armenia in 1988 can be attributed to the lack of seismic-resistant design and construction. The same limitations are true of existing building stock throughout the United States. (Photo: NOAA)

Damage costs from earthquakes are estimated to be reduced substantially by seismic codes. For a magnitude 8 earthquake affecting Memphis, damage estimates are $10.4 billion without codes and $5.81 billion with codes—a savings of about 50 percent. For a magnitude 6 earthquake, damage estimates are $1.49 billion and $.49 billion, respectively—an even larger savings of about 66 percent.

form two designs for each of several typical building types, first using the existing local code and then using the seismic provisions. They found the average increase in total costs to be 0.7 percent for low-rise residential buildings, 3.3 percent for high-rise residential buildings, 1.3 percent for office buildings, 0.5 percent for industrial buildings, and 1.7 percent for commercial buildings. Cities with previous seismic design provisions in their codes averaged much smaller cost increases (0.9 percent) than did cities with no seismic codes at all.[15]

A 1992 study by the National Association of Home Builders (NAHB) for the Insurance Research Council examined the incremental costs of building single-family residences to 1991 *NEHRP Provisions*. They found that "builders can construct houses providing for life safety in earthquakes at a very reasonable added cost—less than 1 percent of the purchase price of a new home in most instances."[16]

Costs of seismic design can vary. It is easier to provide seismic design for simple-shaped structures, with basic geometric shapes such as a square, and cheaper to do if seismic considerations are integrated into the earliest stages of building design. In certain situations, the costs for the structure are relatively small in proportion to the total project costs. This occurs if the project has expensive contents or high land values. If this is the case, the cost of seismic-resistant design becomes a smaller proportion of the total project cost.

Studies Indicate That the Benefits Outweigh the Costs

A few studies have attempted to look at the costs and benefits of seismic design provisions. The studies generally indicate that the costs of seismic-resistant construction are justified. Such studies, however, cannot easily provide definitive answers. Although the direct costs of codes are relatively easy to estimate, the benefits of codes (future damages and injuries that will not occur) are more problematic. These studies are limited by the number of assumptions that must go into such models and by the difficulty of quantifying life loss, injury, and indirect effects on the economy resulting from an earthquake. Nevertheless, benefit/cost models can provide useful guidance to decision-makers and are being used with increased frequency.

In a 1987 study led by William Schulze of the University of Colorado, the costs of seismic codes in southern California were compared to the benefits of protection from an earthquake on the San Andreas fault. They found costs and benefits roughly equal within the accuracy limits of their model. However, this model was very limited in that it ignored all other southern California earthquake sources and did not consider benefits of reduced emergency services, injuries, and uninterrupted economic activity.[17] A more comprehensive model that would account for these factors would likely find seismic codes in southern California to be worth the cost.

A 1992 study, *Physical Damage and Human Loss: The Economic Impact of Earthquake Mitigation Measures*, funded by the National Committee on Property Insurance (now IBHS),

analyzed the estimated costs and benefits of seismic building codes for Memphis, Tennessee, assuming damage from magnitude 6 and 8 earthquakes in the southern New Madrid fault zone. It found that benefits exceed costs by a factor of 1.8 for the magnitude 6 event and 10.3 for the magnitude 8 event. Moreover, the benefit-cost ratio averaged over a forty-year time horizon, accounting for the expected probability of earthquakes in that time period, was estimated at 3.3. Thus, the expected damage over forty years is more than three times greater than the costs of building to code. Furthermore, the benefits are underestimated because they do not account for the benefits of reducing fatalities, injuries, fire potential, or economic losses. This recent study provides valuable analytic support to the claim that seismic building codes are cost-effective, even in the central United States.[18]

NOTES

1 Bruce A. Bolt, *Earthquakes*, W.H. Freeman and Company (NY), 1993.

2 E.g., Fratessa, Paul F., "Buildings" (chap. 3), in *Practical Lessons from the Loma Prieta Earthquake*, National Academy Press, 1994.

3 Earthquake Engineering Research Institute, "Northridge Earthquake of January 17, 1994," *Earthquake Spectra*, Supplement to Vol. 11, April 1995.

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5 Cited in Shinozuka, Masanobu, "Summary of the Earthquake," in *NCEER Response: Preliminary Reports from the Hyogo-ken Nanbu Earthquake of January 17, 1995*, National Center for Earthquake Engineering Research, State University of New York at Buffalo, January 1995.

6 Wyllie, Loring A., Jr., and John R. Filson, eds., *Armenia Earthquake Reconnaissance Report, Special Supplement to Earthquake Spectra*, Earthquake Engineering Research Institute (Oakland, CA), August 1989.

7 "The March 25, 1993, Scotts Mills Earthquake—Western Oregon's Wake-Up Call," *EERI Newsletter*, Vol. 27, No. 5, May 1993.

8 Esteva, Luis, "Seismic Zoning, Design Spectra and Building Codes in Mexico," in *Proceedings of the Fourth International Conference on Seismic Zonation*, Vol. 1, Earthquake Engineering Research Institute, August 1991.

9 This history of seismic codes comes from a number of sources, most notably: Beavers, James E., "Perspectives on Seismic Risk Maps and the Building Code Process," in *A Review of Earthquake Research Applications in the National Earthquake Hazards Reduction Program: 1977–1987*, Walter Hays, ed., U.S. Geological Survey Open-File Report 88-13-A, 1988, 407-432; Whitman, R.V., and Algermissen, S.T., "Seismic Zonation in Eastern United States," *Proceedings, Fourth International Conference on Seismic Zonation*, Vol. I, Earthquake Engineering Research Institute, 1991, 845-869; Martin, H.W., "Recent Changes to Seismic Codes and Standards: Are They Coordinated or Random Events?" *Proceedings, 1993 National Earthquake Conference*, Vol. II, Central U.S. Earthquake Consortium, 1993, 367-376.

10 As part of implementing EO 12699, the Federal Government reviewed all three model codes to see if they were consistent with the 1988 *NEHRP Provisions*. In 1992 they declared that the following codes meet those provisions: 1991 UBC, 1992 BOCA supplement, and the 1992 SBC amendments. See *Guidelines and Procedures for Implementation of the Executive Order on Seismic Safety of New Building Construction*, ICSSC RP2.1A, NISTIR 4852, June 1992. In a May 17, 1995, Recommendation, the Interagency Committee on Seismic Safety and Construction updated this finding. They found that the 1994 UBC, 1993 BNBC, and 1994 SBC provide a level of seismic safety substantially equivalent to that of the 1991 *NEHRP Provisions*.

11 EO 12941, by adopting the *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings*, by the Interagency Committee on Seismic Safety and Construction (ICSSC), promulgates a set of seismic standards for federally owned or leased buildings. It also establishes five triggers for evaluation and possible mitigation of risks in a building. For example, when there is a change of building function, a building must be evaluated according to the ICSSC standards. See Todd, Diana, ed., *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings, National Institute of Standards and Technology Report NISTIR 5382*, Interagency Committee of Seismic Safety and Construction Recommended Practice 4 (ICSSC RP 4), February 1994.

12 From the 1990 SEAOC Blue Book, cited in EERI Ad Hoc Committee on Seismic Performance, *Expected Seismic Performance of Buildings*, Earthquake Engineering Research Institute, February 1994.

13 EERI Ad Hoc Committee; see note 9.

14 The 10-percent-in-50-year standard is actually an artifact from the initial development of the ATC 3-06 maps. The profession has been moving toward a 2-percent-in-50-year standard as being more reflective of public attitudes toward life safety, and this will be reflected in the 1997 *NEHRP Provisions* (Christopher Rojahn, Executive Director of ATC, March 1997).

15 Building Seismic Safety Council, *Societal Implications: Selected Readings*, FEMA #84, June 1985.

16 National Association of Home Builders, *Estimated Cost of Compliance with 1991 Building Code Requirements*, Insurance Research Council, August 1992.

17 Schulze, William D., et al., "Benefits and Costs of Earthquake Resistant Buildings," *Southern Economic Journal*, Vol. 53, April 1987.

18 Litan, Robert, et al., *Physical Damage and Human Loss: The Economic Impact of Earthquake Mitigation Measures*, The National Committee on Property Insurance (now IBHS), February 1992.

Chapter 4
How States Can Adopt Seismic Building Codes

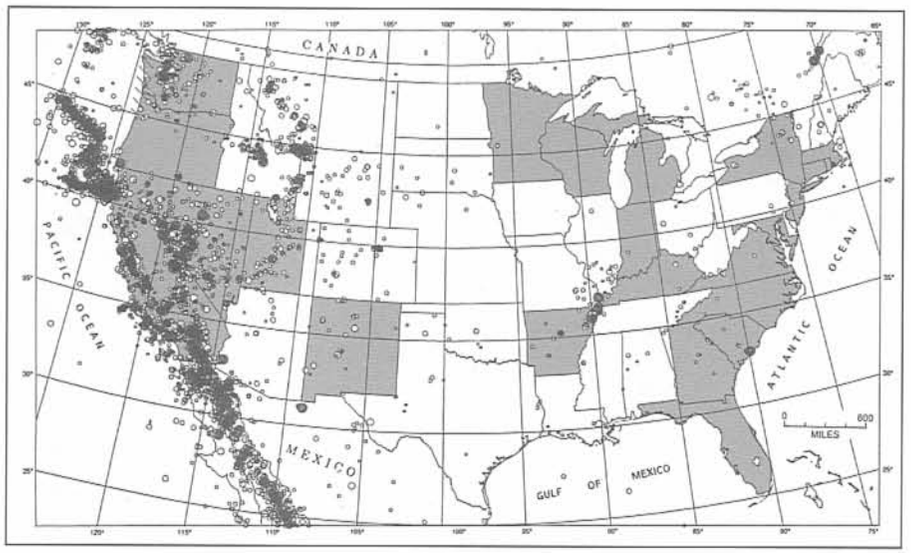


FIGURE 4.1 Historic earthquake locations superimposed on map of states with mandatory building codes for all occupancies. Most states have earthquakes, but not all of them require building codes. (Sources: earthquake locations, USGS, 1989; states with mandatory codes, IIPLR [now IBHS], 1996)

This chapter describes how to adopt a state seismic code. An alternative approach is to encourage the adoption of seismic codes at the local level; that topic is taken up in chapter 5.

Background Information

Code Practices Vary Among the States, From Centralized to Local

All states have a legal right to regulate construction, but not all states exercise this right. Currently forty states and the District of Columbia mandate building code requirements and ten states do not. A statewide code assures a minimum level of protection throughout the state. The most common forms of state building regulation are:

Total preemption. A state agency responsible for building regulations develops the regulations for local implementation and enforcement.

Partial preemption. The state building regulations are minimum standards, and local jurisdictions may adopt equal or more restrictive regulations.

California system. State law directs local jurisdictions to adopt a set of uniform codes for enforcement at the local level; the law only allows amendments reflecting special local conditions.

State Code Requirements: Statutory vs. Administrative

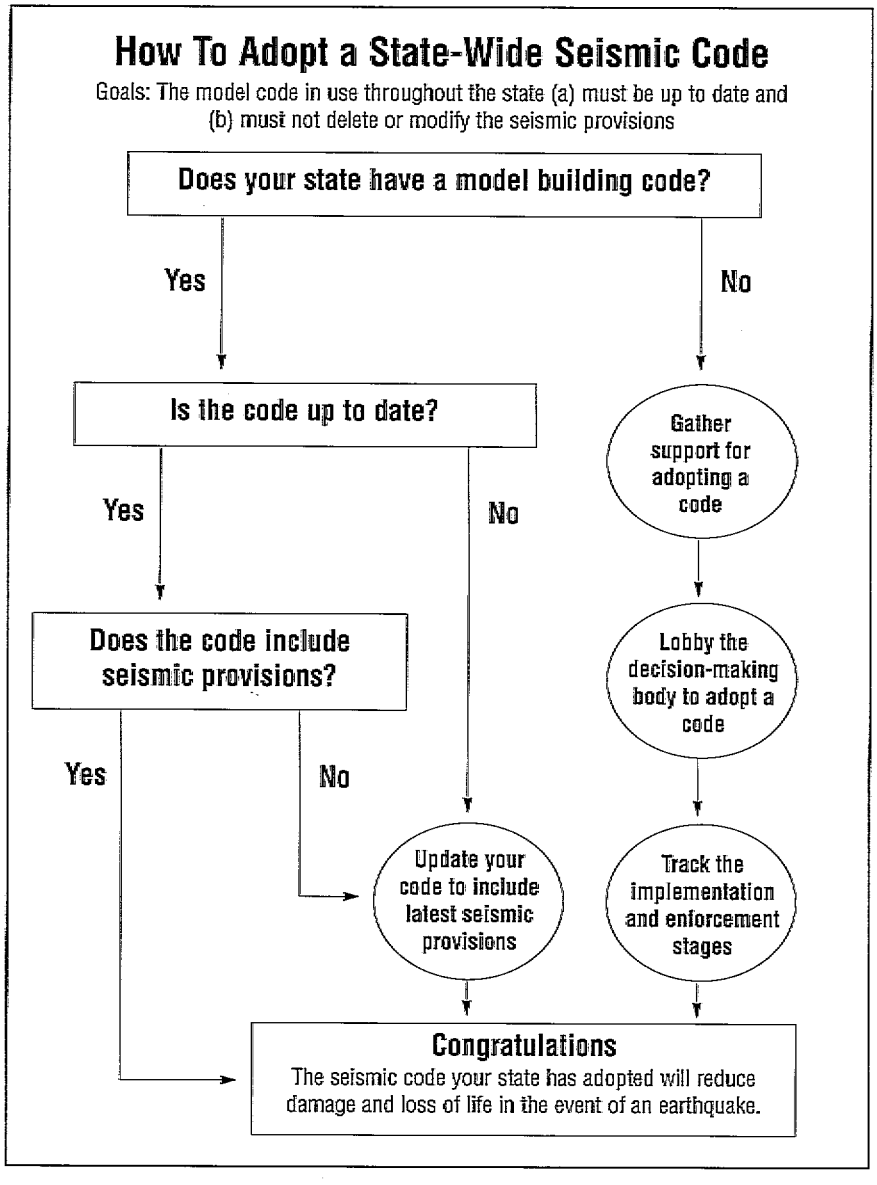
States that mandate building codes describe their powers within either the state's statutes or its administrative code.

Statutory code. Because a state statute is difficult to amend, requiring a building code in statute form assures a degree of permanence and is a statement of the state's long-term commitment to building safety. The best approach is to enact permanent policy statements into a statute and to place the details that need periodic revision into administrative regulations. In order for a building code to become statutory law, a state legislator must sponsor a building code bill, maneuver it through the proper committees, and obtain a positive vote, usually from two houses of the legislature. Once the bill passes, it can be signed by the governor and become law.

Administrative code. Where a building code is required in administrative code, an administrative body, usually a commission or board, is invested with rule-making authority. Additions or revisions to the administrative code do not require legislative approval. An open, public process is required, which is not as involved as statutory reform.

Creating a New Code vs. Adopting a Model Building Code

States may create their own building code or adopt all or parts of an existing recognized model building



code. Because of the complexity, cost, and time of writing an original building code, most states choose to adopt a model building code. By adopting such a code, the state building agency can obtain direct technical assistance from the model building code organization.

Enforcement at State or Local Level

With a statewide building code in place, the state may delegate the enforcement to local governments. Sometimes the state delegates only to those local governments that can prove that they have adequate qualified staff to review plans and provide inspections. This can increase code compliance while avoiding the need for a large state enforcement agency.

Importance of Periodic Updates

Ideally the statute or administrative code provides for the periodic adoption of the most current building code edition. The three model building codes issue new editions every three years. It is important to note that a government must explicitly adopt each new edition of the code. A law cannot state that "the most recent" edition of a code is automatically the operative one. Rather, a law can state an intent to update or can

Virgin Islands Adopt New Building Codes

Over the past ten years, the U.S. Virgin Islands have dealt with a number of serious hurricanes.

Hurricane Hugo struck the Virgin Islands on September 17-18, 1989.[1] This category 4 hurricane caused $3 billion in damage in the Virgin Islands and Puerto Rico. St. Croix and St. Thomas suffered tremendous damage from an unusually prolonged battering of hurricane force winds, with sustained wind speeds estimated at 127 mph at St. Croix and 98 mph at St. Thomas. Some areas were completely devastated. At the time, building construction was governed by the 1972 Virgin Islands Building Code, mandatory throughout the territory. The lateral wind loads in this code were based on sustained wind speeds of 81 mph.

The most damaging hurricane, Marilyn, hit the Virgin Islands on September 15-16, 1995. The storm was officially recorded as a category 3 storm with winds of 110 mph as it passed over St. Thomas. The estimated cost of reconstruction, as of October 1995, was about $3 billion.[2]

After Hurricane Marilyn, FEMA worked with the Territorial Government to assist in the development of building codes incorporating mitigation for all types of structures. In October 1995 the Virgin Islands adopted, by statute, the UBC for public buildings and other structures as well as Chapters 1-7, 10, and 14-35 of the 1994 UBC and Chapters 1-9, 18, 22, and 28-47 of the CABO *One- and Two-Family Dwelling Code* for all other buildings and other structures. FEMA has provided both technical and financial assistance to assist in enforcement, education, and training concerning the new codes.[3]

Overview: Steps Toward Statewide Seismic Provisions

Step 1:
Determine your state's current building code requirement (if any) and develop a strategy for incorporating or initiating current seismic provisions.

Step 2:
Gather support for the proposed changes.

Step 3:
Lobby the decision-making body (state legislature or administrative board or commission) with information explaining why the changes are needed and describing the kind of support you have gathered.

Step 4:
Continue your involvement through the administrative implementation and enforcement stages once the seismic provisions are approved.

mandate that the adopted code must "equal or exceed the standards" of the latest published edition of a code. In any event, the specific published edition of the code must explicitly be adopted as such (with whatever minor revisions the state desires to add).

The following sections describe a step-by-step strategy to achieve statewide seismic provisions.

Step 1: Determine Your State's Current Building Code Requirement (If Any)

The first step in pursuing any strategy to incorporate or initiate seismic provisions is to ascertain what building requirements already exist. You will need to describe deficiencies in the existing code and suggest appropriate actions to correct those deficiencies.

It is important to understand the process followed in your state and learn how to use that process successfully. The process of adopting statewide seismic provisions will vary greatly among states, depending on whether your state currently mandates a building code.

If your state *does* have a code, determine what amendments are needed to incorporate current seismic provisions and pursue these amendments.

If your state *does not* have a code, consider the possibility of introducing a state code that contains current seismic provisions. An alternative is to pursue widespread adoption of seismic provisions in local building codes, although this would be a more resource-intensive effort (see chapter 5).

To ensure the highest level of statewide seismic safety, you should focus your efforts on the two most important points: (a) the code must be up to date and (b) the code must include the latest seismic provisions.

If Your State Does Not Have Building Code Requirements

If your state lacks a building code requirement, you need to take action in order to encourage the adoption of a statewide code. There are several ways to establish an appropriate state building code that contains current seismic provisions.

A new code can be established legislatively or administratively. The best way to ensure long-term safe building practices is to establish the code by statute, using the legislative process. At a minimum, the legislation should specify local adoption of one of the three model codes with seismic provisions. It is much easier to adopt a model code than it is to write an original code. To ensure a minimum level of safety throughout the state, the legislation also must specify a procedure for periodic code updates.

Legislation may be quite detailed or may simply mandate an administrative process of code review and adoption. For example, the legislation may specify the model code to use and the topics to include, or it may leave those decisions to the rule-making board. Examples of legislation are contained in Appendix B; the legislative process is described below in step 3.

You should realize that any legislative enactment of a code requirement also will entail an administrative rule-making process, so you need to understand both processes. The point is this: Where the legislation leaves off, the administrative regulations begin. See step 4 below.

Whether you pursue an administrative or legislated code, always remember your two primary goals: The code in use throughout the state (a) must be up to date (the latest published edition of an accepted model building code) and (b) must not delete or modify the seismic provisions.

If Your State Has a Building Code But Does Not Incorporate Seismic Provisions

Where a state building code exists but does not contain seismic provisions, it should be relatively easy to require seismic design. If the state code is based on one of the three model codes, all of which now contain seismic requirements, all that may be required is adopting the most recent edition of your model code.

There are several ways to incorporate seismic provisions into a code that is not based on one of the three model codes. For example, the seismic provisions can be established by the state, or the state legislature can simply mandate local adoption of any of the model seismic codes. Politically it should be easier to amend an existing state code than to enact a new code.

Statutory code. To amend a code established through legislation, you must find a legislator to sponsor an amendment to the state building act and then work to create support for the proposed changes. Legislative enactment is preferable to revising an administrative code, because statutes are harder to amend or repeal. The legislative process is described below in step 3.

Administrative code. Amending an administrative code to incorporate seismic provisions is typically less cumbersome than amending a statutory code. You should learn the following information about your administrative code: Are the regulations reviewed periodically? When is the next review scheduled? What are the opportunities for public comment?

Whether your state code is established by statute or administrative rule, instituting the revised code will be a multistep process. You will need to plan a strategy before you begin. The strategy should involve steps similar to those for code adoption: gather support, lobby the decision-making body, and monitor implementation and enforcement.

Step 2: Gather Support for Adopting Seismic Provisions

First, get the backing of your department and other relevant state departments and agencies. Identify interest groups whose support you will need and whose arguments you will have to answer. Seek support from a wide range of professional associations. The wider the range of associations, the stronger support will be for your proposed changes. At a minimum you will need the support of representatives from high-earthquake-risk areas. If they do not support the changes, it will be nearly impossible to convince others.

Preparing a sound case for seismic provisions will help to advance your position and generate needed support. Solid arguments in favor of seismic provisions are presented in Step 2 of Chapter 5 and in Appendix G.

To gain support, contact organizations that may be affected by and are interested in code adoption and enforcement in your state. Addresses and phone numbers of several relevant national-scale organizations are included in Appendix E. You should review these lists to get ideas useful for your situation and to identify potential supporting organizations.

Municipal leagues. You can communicate with local governments collectively by means of their professional and lobbying organizations. Every state except Hawaii has a state municipal league. You can find out how to locate the league in your state by contacting the National League of Cities (see Appendix E). Most state leagues probably have a newsletter or magazine, an annual conference, and perhaps

Step 1: Determine Current Code Requirements

- Is the code statutory or administrative?
- Is the code designed by a state agency or by local choice? Is the responsible level of government adequately funded to implement the code?
- Is the code unique to your state or a model code? If it's a unique state code, does the state office provide technical support to local governments to implement the code?
- If it's a model code, which one is it? Has your state modified it? If so, how and to what extent? Which edition is currently adopted? Is it the most recent?
- How is the code updated? How often? By whom? By what process?
- Have all local jurisdictions been granted the authority to adopt and enforce a code?
- Does the code have seismic provisions? Are the model code seismic provisions modified? If so, how and to what extent? Do the seismic provisions reflect the latest *NEHRP Provisions*? (The 1992 SBCCI and BOCA Supplement model codes are the first editions of the codes to incorporate all the *NEHRP Provisions*; the 1991 UBC is also consistent with the *NEHRP Provisions*.) All local codes based on these or subsequent editions are consistent with the *NEHRP Provisions*.

State Seismic Safety Advisory Committees[4]

What Are They?

Seismic safety advisory committees are voluntary bodies selected to advise the state on seismic policy matters. Most often, they are selected by and answerable to the governor, but they also may be advisory to the state legislature. Several states now have such bodies, including Arkansas, Kentucky, Missouri, Oregon, Arizona, Utah, as well as the original one in California.

Advisory committees usually consist of representatives from the following interests: relevant state agencies, universities, utilities, local governments in high-risk areas, technical and professional organizations, energy companies, civic organizations, and sometimes legislators from high-risk areas. Usually the governor's office selects the members, for terms ranging from one year to indefinite. Members are chosen for both their expertise and their interest in reducing seismic hazards. Committee members take their duties seriously, and most work surprisingly hard for little or no money.

What Do They Do?

Seismic safety advisory committees typically meet two to six times per year. In addition, they usually divide up into several subcommittees (e.g., awareness, mitigation, response, public health). These subcommittees often do the real work of the organization. They usually consist of three to six members, who informally communicate and assign tasks throughout the year. Reports of activities in progress are presented at the regular committee meetings. Seismic safety advisory committees serve several functions:

- Make knowledge of local experts available to the legislature and administrative agencies.
- Coordinate the earthquake preparedness activities of state agencies.
- Keep earthquake issues in the public eye.
- Serve as advocates for seismic safety.
- Prepare policy reports and draft legislation.
- Involve people who are interested in and knowledgeable about seismic safety.
- Promote communication between state agencies, local agencies, professional design organizations, and the construction industry.

Case Study in Success: The Arkansas Story

Arkansas formed an Earthquake Advisory Council in 1984, with representatives from state agencies, utilities, universities, hospitals, local agencies, and other interested parties. In the late 1980s, the Council adopted seismic code provisions as a high priority.

Council members drafted a bill and gave public presentations. The bill was introduced in November 1990 (coincident with the aftermath of the Loma Prieta, California, disaster) and cleared the legislature in March 1991—with no opposition votes. Act 1100 requires that all "public structures" be designed to resist seismic forces, in accordance with the minimum requirements of the 1993 revision to the 1991 Standard Building Code or the latest edition with revisions.

Why Do We Need One?

A seismic safety advisory committee can help reduce earthquake hazards in many different ways. The Arkansas Seismic Advisory Committee played a crucial role in drafting and gathering support for the 1991 bill (see Appendix B) that requires all public structures to be designed to resist seismic forces. They can encourage better construction practices, promote earthquake awareness and professional training, provide advice on siting critical public facilities, and help agencies to inventory existing hazards. An active committee can make a real difference in a state's ability to survive the next earthquake.

How Do We Form One?

The easiest way to form a seismic safety advisory committee is by an executive order of the governor. Typically, the idea would be initiated by the governor or by the director of emergency management or geological survey. The governor would then request one of these agencies, in consultation with others, to propose a list of members, all of whom have agreed to serve if selected. The governor's office would then revise and approve the list, and issue the executive order. A seismic safety advisory committee may also be established by the state legislature, with the advantage that the organization becomes more permanent (a disadvantage is that it is much more cumbersome to initiate). The legislature must also consider how to appoint members.

local dinner meetings. Tap into this network:

- Submit an article to their magazine or newsletter.
- Participate in their conferences.
- Organize workshops and invite them.

Building officials. Contact the nearest model building code organization (see Appendix D) to identify nearby jurisdictions with codes and to learn the names of the building officials.

Civil engineers. The American Society of Civil Engineers (ASCE, see Appendix E) is the largest professional organization for civil engineers. The ASCE has sixteen sections divided into branches that cover major metropolitan areas. Many of these groups have regular meetings. ASCE also has twenty-one regional council organizations.

Structural engineers. The ASCE includes structural engineers, and some states have their own professional structural engineers associations. You might also make use of the expertise offered by local members of the Earthquake Engineering Research Institute (EERI, see Appendix E).

Professional engineers. Some states have associations of professional engineers representing licensed engineers in the state, including civil, structural, mechanical, and others. Contact the National Society of Professional Engineers (NSPE, see Appendix E) for information about your state organization.

Architects. The American Institute of Architects (AIA) is the largest professional organization of architects. Contact the national office (see Appendix E) for information on your state or local chapter.

Home builders or contractors. Most states and localities have associations of home builders and building contractors. You will need to meet with them to institute or strengthen codes. Some construction associations, such as the National Association of Home Builders and the Associated General Contractors of America, are members of the Building Seismic Safety Council (NAHB, AGCA, and BSSC, see Appendix E).

City and county managers. Chief administrators of cities and counties belong to the International City/County Management Association (ICMA, see Appendix E). The ICMA has chapters in every state.

Chambers of commerce. Many businesses belong to the Chamber of Commerce. The businesses can be valuable supporters if you convince them of the business disruptions that damaging earthquakes can cause.

The media. The media can be very helpful in educating the public to the benefits of seismic provisions and generating public support for the proposed changes. Try to develop a personal relationship with reporters at major state newspapers and television stations. Offer to provide background information (see Appendix H for sample press releases), and be available for interviews when a newsworthy earthquake elsewhere generates interest in your state.

Finally, do not limit your efforts to potential supporters. You must also identify potential opponents and convince them of the value of your proposed changes. It is better to remove one opponent than to add ten supporters.

Step 3: Lobby the Decision-Making Body

The state legislature or some administrative board or commission has the authority to amend the existing code or adopt a code. You should lobby this decision-making body with information explaining why the changes are needed (i.e., seismic provisions) and describing the kind of support you have gathered.

Step 2: Gather Support for the Proposed Changes

- **Professional engineering and architectural organizations.** Coordinate with organizations such as the American Society of Civil Engineers and the American Institute of Architects. Each group represents a large and influential constituency, and they can lend credible support, expertise, and a network of lobbyists. Letters of support from architecture and engineering associations were very helpful in the enactment of Arkansas' seismic requirement.
- **Building and commerce associations.** Try to gain the support of a building or commerce association. The Masonry Institute of Tennessee, for example, has been very active in promoting seismic design and construction.
- **Local civic organizations.** Meet with local groups and work to gain community support. The League of Women Voters in western Kentucky was instrumental in making earthquakes a public issue in that state.
- **Seismic safety advisory committee.** If your state or locality does not have such a committee, form one. This is a very effective way to keep earthquake issues on the public agenda and can greatly help to initiate new programs and legislation for seismic safety. See page 18.

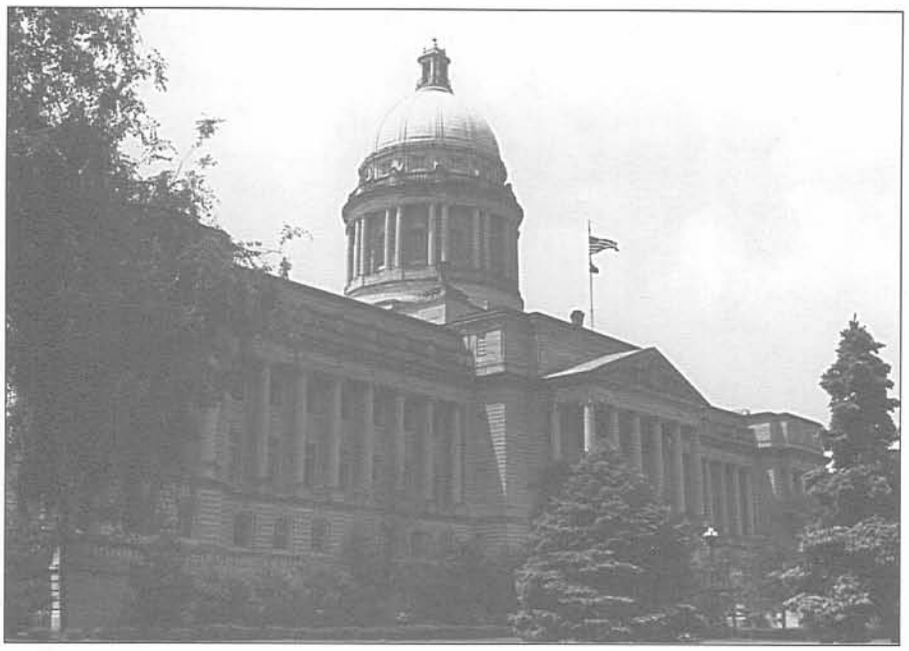


FIGURE 4.2 Kentucky has a statewide building code requirement (state capitol shown above). (Source: Kentucky Legislative Research Commission)

Step 3: Making the Legislative Process Work for You

- Find a member of the legislature to introduce your proposed legislation.
- Gain the support of the Governor's office.
- Research and prepare the draft legislation. Focus on your two main goals: (a) the code must be up to date and (b) the code must include the latest seismic provisions.
- Testify before committee hearings. Be clear, concise, persuasive, and authoritative in your comments.
- Lobby the legislature (both houses) once the bill is reported out of committee.
- Monitor the bill throughout the legislative process, including its final stage in the governor's office.

Implementing changes to the state code may require legislative action. This process can be somewhat involved. The following paragraphs describe how to initiate changes at the legislative level; many of the suggestions given are appropriate for dealing with any decision-making body.

Find a member of the legislature to introduce the bill. You must find a legislator sympathetic to your cause—perhaps he or she lives in an earthquake-prone part of the state or has a reputation for promoting public safety issues. Demonstrate to the legislator that you have built widespread support for the legislation.

Gain the support of the Governor's office. In the end, you will need the Governor to sign the legislation into law. The sooner you can get the Governor's support, the better. Furthermore, many legislators will look to the Governor's office for leadership during the legislative process.

Research and prepare the draft legislation. A legislative research department usually is available to draft the actual bill. If you are able to submit a well-drafted bill or can provide technical support to the legislative staff, their job will be made easier and the process will be facilitated. The more complete your package, the farther it will go through an overworked legislature.

A good strategy is to prepare the bill in advance so that you can move quickly when a window of opportunity opens. Such opportunities typically occur when there is a small earthquake in your state or a disastrous earthquake elsewhere in the world. For example, interest in seismic codes increased in the central and eastern United States following the 1988 Armenian and 1989 Loma Prieta, California earthquakes. Sometimes fires or building collapses cause renewed interest in building code legislation. The statewide building code requirements in both Tennessee and Kentucky (see Appendix B, C) were enacted following fatal fires. At the very least, after the next earthquake scare the state legislature might be willing to pass a statewide seismic design requirement, as Missouri and Arkansas did in 1991 (see Appendix B, C).

Testify before committee hearings. Following its introduction, the bill is assigned to one or more committees. Each committee schedules hearings at which interested organizations and lobbyists may present their comments. The hearing schedule usually is tight. Thus, testimony must be well organized, concise, and effectively presented. You must be able to convince the committee members, in clear and persuasive language, that seismic codes are necessary for the welfare and economic well-being of the state and that voting for the proposed bill will enhance their reputations. Information from this book will help. You should address the following questions:

- What are the chances of a large earthquake happening in your state, and what damage would it do?
- Why is legislation needed?

- How would the legislation affect the state?
- What are its benefits?
- What is the evidence for these supposed benefits?
- What are the costs, and who pays?
- How do the benefits justify the costs?
- Why does your organization support the legislation?
- What other organizations support it?

Remember that dozens of legislative bills are introduced for every one that succeeds, and it's possible that your bill will die in committee, requiring you to begin the process again. If your experience convinces you that legislative approval is not realistic, consider the alternative route of encouraging widespread adoption of local seismic code provisions (see chapter 5).

Lobby the legislature once the bill is reported out of committee. Once the committee recommends the bill to the legislature as a whole, make sure that all the legislators in both houses are provided with complete information about the value of the bill, including documentation of the support you have gathered.

Monitor the bill throughout the legislative process. To succeed, the bill must pass both houses, and the governor must sign it into law. Lacking a positive vote in either house, the bill will die. Once the bill is passed by one house, it moves to the other house, where the process is repeated. Because there may be attempts to amend the bill along the way or in a conference committee of both houses, you must keep monitoring the bill throughout the entire process and maintain support for the bill.

If the bill passes the legislature, the governor may sign or veto it. Again, make sure that the governor's office is provided with complete information about the value of the bill, including documentation of the support you have gathered. If you have done your work well there should be no last-minute opposition, and the governor is likely to sign it into law.

Step 4: The Last Mile: Administrative Implementation and Enforcement

Once you have established the necessary rules changes or statutes and the seismic provisions are approved, continue your involvement through the administrative implementation and enforcement stages.

An administrative department will be directed to develop the rules and regulations for implementation and enforcement. An administrator will need to conduct additional public hearings to consider the proposed rules. You should stay informed of the date(s) of hearings and look for opportunities to present written comments and public testimony.

Draft rules typically will be published for a fixed period of public review. You must stay in touch with the administrator to ensure that you are notified of the review period as soon as it is known and that you receive the draft rules as soon as they are available. There will then be adequate time for you and other supporters to review the proposed rules and provide informed analysis and comments. As with the legislative process, the more persuasive your comments and the more authoritative the commentators, the better your chances for success.

For ongoing enforcement issues see chapter 6, "Improving Code Enforcement."

Step 4: Administrative Implementation and Enforcement Stage

- Organize your support ahead of time. Be prepared to act when the proposed rules are released.
- Find out when the review period will be so that your supporters can be ready.
- Obtain a copy of the draft rules the day they are released.
- Use your supporters to review and comment on the rules.
- Submit written comments and public testimony and be sure your supporters submit comments.
- Be clear, concise, persuasive, and authoritative in your comments.

NOTES

1 Golden, Joseph H., et al., *Hurricane Hugo: Puerto Rico, the U.S. Virgin Islands, and South Carolina*, prepared for the Committee on Natural Disasters, National Research Council, National Academy of Sciences (Washington, DC), 1994.

2 Morrow, B.H., and Ragsdale, A.K., *Early Response to Hurricane Marilyn in the U.S. Virgin Islands*, University of Colorado, Natural Hazards Center, Quick Response Report #82, 1996.

3 Information provided by the Virgin Islands Department of Planning and Natural Resources, Division of Permits.

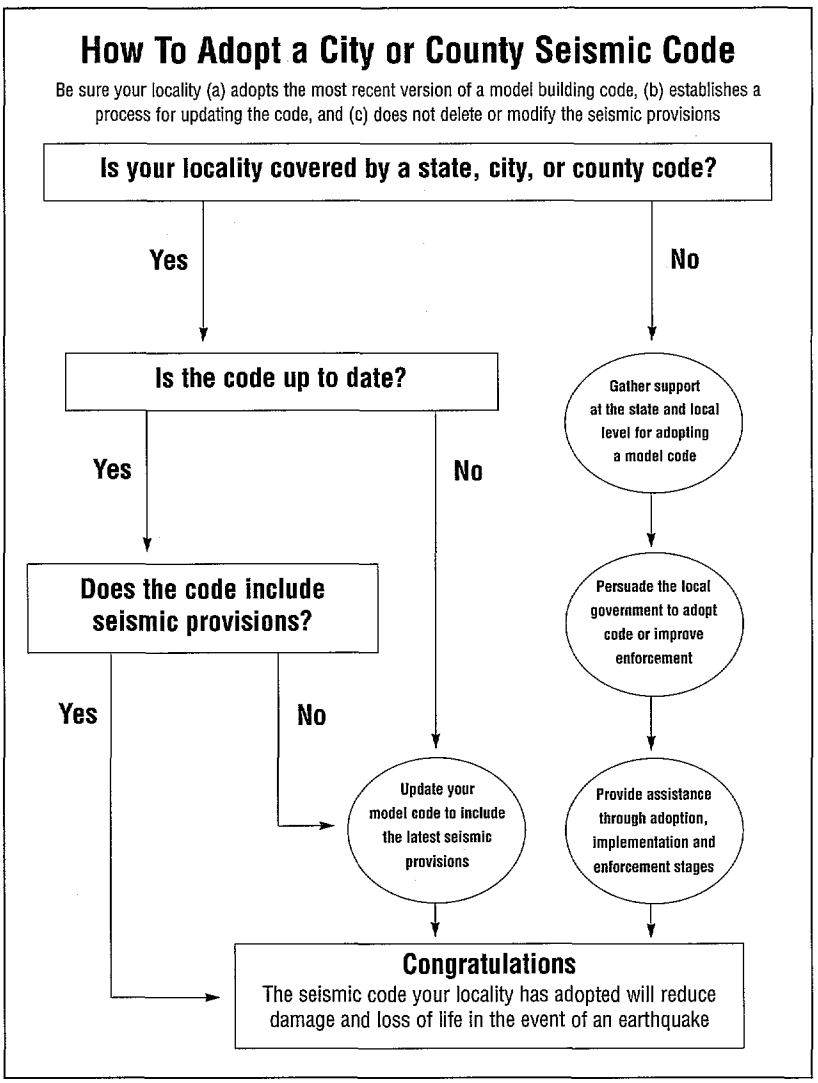
4 Condensed from Olshansky, R., *Reducing Earthquake Hazards in the Central United States: State Seismic Safety Advisory Committees*, prepared by the Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign, and distributed by the Central U.S. Earthquake Consortium, 1992; also see Seismic Safety Commission of California, *Creating a Seismic Safety Advisory Board*, FEMA #266, August 1995.

Chapter 5
How Cities and Counties Can Adopt Seismic Building Codes

This chapter takes up the issues and processes involved in adopting seismic provisions at the city and county level—a viable, albeit time-consuming, alternative to adopting a state seismic code, described in chapter 4.

How To Improve Local Code Requirements

State seismic managers and local officials may find it easiest to adopt seismic provisions through local governmental bodies rather than on the state level. In most cases, localities can take effective action regardless of state requirements.



Step 1: Determine Local Code Practices and Options

Current regulation at the state level will govern options for action at the local level. If your state regulates all local construction, there is little for you to do, although you should satisfy yourself that enforcement is adequate. If your state mandates local adoption of a specified code, check to ensure that the community has complied.

If your state *does not* currently regulate, or if it allows for stricter local regulations, there are numerous options at the local level. The municipality or county can develop its own original code, modify the existing code of a neighboring municipality, or adopt a model building code. If the jurisdiction lacks an adequate code, it is up to the state seismic program manager and local officials to convince the community to initiate a building code.

Statewide inventory of local practices. State seismic program managers should collect information on local practices, to determine which localities within a state are deficient in code adoption and enforcement. At a minimum, communities in the most seismically hazardous parts of the state should be targeted. This information can help identify communities most in need of assistance. Key questions to ask include the following:

- Has a local code been adopted?
- If so, when was it adopted and by what means?

- Is it the latest version?
- Are building permits required?
- How many architects and engineers are on staff?
- What is the name and phone number of the building official?
- What method is used to update the code?
- How frequently is it updated?
- What type(s) of construction are regulated?
- Are seismic requirements part of the current code?

The state of Illinois gathered this kind of information from 300 jurisdictions in the southern part of the state. See their survey instrument in Appendix C.

State seismic managers also can use the information on local code deficiencies to help make an argument to the state for a statewide code (see chapter 4). Documenting the number of communities, or the number of people in communities, without building codes can be a persuasive argument, especially if they are in a seismically vulnerable part of the state.

Authority to adopt a local code. The authority to adopt a local code is usually granted by the state legislature under its police powers, which allow the municipality or county to adopt a building code to promote the public health, safety, and welfare. You need to be sure you have this authority to adopt a code.

Building code regulations are enacted through local ordinances. Municipalities and counties must formally adopt a building code ordinance via a local legislative process. Typically the building code ordinance is drafted, reviewed for legality, proposed, debated through public hearings, and voted on by the city council or county board. Once the ordinance is approved, the municipality or county becomes the enforcement agent.

Model codes are usually the best option. It is highly unlikely that a municipality would have the expertise, budget, or time to develop an original document. Most localities, therefore, identify a model building code in order to make code adoption easy.

If the municipality adopts one of the model building codes, drafting and detailed legal review are not necessary. In addition, each model building code organization supplies a sample ordinance in its code book. These sample ordinances have been used successfully by other municipalities.

The model building code organizations also provide administrative and technical assistance to the municipality during adoption, in addition to other support, such as code provision interpretation, continuing education, and inspector testing and certification (see detailed information in Appendix D). The adoption of a model building code is more than the referencing of a document: It involves becoming a member of a professional organization.

The model building code organizations do not require adoption of codes in their entirety. Specific code sections may be revised to reflect local conditions. The organizations can provide direct assistance in some cases. However, municipalities should be careful that revisions of one section do not adversely affect another section. Remember that through the seismic hazard map the seismic provisions already account for local conditions.

Use of a model code means that the public debate over the code's technical details has already been conducted at the national level. Local opponents questioning technical aspects of the code or the seismic zone maps for your state can be told that the code represents a national consensus of hundreds of engineers and building officials. The maps and the seismic force calculations are

Overview: Steps Toward Local Seismic Provisions

The general steps involved in adopting seismic provisions at the local level are the same as for the state level, with some modifications.

Step 1:
Determine local code practices and what state regulations (if any) govern options for action at the local level.

Step 2:
Gather support at the state and local levels.

Step 3:
Persuade the local government to adopt code or improve code enforcement that includes seismic provisions.

Step 4:
Provide technical assistance throughout the adoption, implementation, and enforcement stages.

Step 1: Determine Local Code Practices and Options

- If your state regulates all local construction, satisfy yourself that enforcement is adequate.
- If your state mandates local adoption of a specified code, ensure that communities have complied.
- If your state does not currently regulate, or if it allows for stricter local regulations, gather information on local code practices and explore your options at the local level.
- Options may include developing an original code, modifying the existing code of a neighboring municipality, or adopting a model building code.
- If a jurisdiction lacks an adequate code, convince the community to initiate a building code.
- Model codes are usually the best option, because of the technical support provided by the code organization.

based on the best current knowledge, are designed by national experts in the field, and are reviewed by committees of engineers and geologists throughout the country. The codes also recognize the realities of local enforcement: The voting members of the model code organizations include the local building officials of your state and region.

Key points. To ensure that a locality has the most current widely accepted standards of seismic design, be sure that it: (a) adopts one of the three model codes, (b) adopts the most recent version of the code, (c) establishes a process for periodic updating of the code, and (d) does not delete or modify the seismic provisions.

Step 2: Gather Support at the State and Local Levels

Wide public support is needed to enact a new community building code. Information gathered in step 1 can help to obtain state support for changing or introducing the local code. It is also important to have the active support of local chapters of professional associations of engineers and architects, such as the National Society of Professional Engineers, American Society of Civil Engineers, and American Institute of Architects. Form partnerships with these organizations (see Appendix E).

Civic groups and local service clubs, such as the League of Women Voters and Rotary Clubs, can provide valuable support. As you pursue contacts in the community, you should also seek support and acceptance by business and construction organizations, such as local businesses, economic development associations, and the Chamber of Commerce. Arrange to give presentations to these groups. Materials for sample workshop presentations are included in Appendix G.

Good rapport with the local media can help your case. Find a receptive reporter and explain the hazards the community faces. Personal relationships work best, as you will need the media's trust if the battle over code adoption gets hot. Even if you do not connect with a particular reporter, there are actions you can take. Send out press releases following earthquakes, to accompany local presentations, or to accompany announcements of state initiatives. Sample press releases are included in Appendix H. Try to be interviewed on a local news or talk program. Send an editorial to the local newspaper. Use material from this book to help make your case!

Opposition typically comes from business and development interests who are afraid that any change in local regulations will scare away new business. A local economy is often somewhat fragile—business people may worry that if their community is perceived as being uncooperative with new business, then economic development will go elsewhere.

To avoid eruption of unexpected controversy during the code-adoption process, you should meet beforehand with the professional, business, and labor organizations likely to be affected. These meetings will be mutually educational. Most of these groups will be surprised to know that the earthquake risk is real, and that seismic codes are widely accepted as a cost-effective technique to reduce hazards. Conversely, you will find that their concerns are genuine and that you may need to design your code implementation process to account for some of their concerns. Try to integrate the concerns of each group into your proposal.

Past experience has shown that initial opponents find that they can live with building codes because codes do not drive business from communities. Businesses have many more important factors than codes

to consider in their location decisions. In the words of one building official, "I've never heard of an industry not coming to town because of seismic requirements."

It is true that local officials tend to respond to short-term concerns and, furthermore, prefer results that are visible and immediate. Still, many localities can be persuaded to accept the model building codes. Anticipating some common objections, you might try the arguments given below.

For elected officials: A damaging earthquake can occur during your term of office. The levels of ground-shaking represented on the code's seismic hazard map have a 0.8 percent chance of occurring in any four-year period at each point on the map (such as the community in question), and about a 2 percent chance of occurring in any eight-year period. But these are the *design events* (see page 10). What about a lesser earthquake? An earthquake half as big as the design event could cause severe damage to many structures not meeting the code and little damage to structures built according to seismic code. Such an event has about a 4 percent chance of occurring in any four-year period and about an 8 percent chance in an eight-year period.

For elected officials: Citizens support seismic codes. Studies in California and the central United States have shown that most citizens support seismic building codes, and that elected officials underestimate this support. For example, in 1984 Arizona State University surveyed residents and officials in the high seismic risk area surrounding the New Madrid fault zone.[1] The survey found that 62 percent of residents believed that seismic building codes for new structures are "very important, " and most supported codes even if substantial costs would be involved. In contrast, support by community leaders was much lower at 37 percent. Furthermore, other studies have shown that community leaders greatly underestimate the public's concerns about earthquakes, mistakenly believing public concern to be less than their own.[2]

In a 1994 telephone survey of residents in six hurricane-prone areas, 91 percent of respondents indicated that builders should be required to follow new, stricter building codes even though it might add 5 percent to the cost of a home.[3]

Codes will not hurt business. Building codes have not hurt the economies of the forty-one states that have them, nor have they hurt the 95 percent of all U.S. cities and towns that have codes. Seismic design adds only approximately 1 to 1.5 percent to the cost of a building, according to a 1985 BSSC study.[4]

Is there a chance that local buildings will be shaken by an earthquake at some point? An earthquake can

A Lesson Learned in Jonesboro, Arkansas

In early 1989 the city of Jonesboro, Arkansas, adopted the 1988 *Standard Building Code* (SBC), the first edition of this code with seismic requirements. The same year representatives of a proposed industrial facility were negotiating with city officials, attempting to win as many concessions from the city as possible. The state was very eager to have the facility. The development representatives asked Jonesboro to revoke the seismic provisions. The city council agreed to do it on October 16, the day before the Loma Prieta, California earthquake. In the words of a city official, this was "bad timing." Because of subsequent public pressure the seismic provisions were restored to the code.

It turns out that the entire controversy was unnecessary. What the development representatives did not know was that the structural engineering firm designing the facility was designing it to the 1988 SBC and had never intended to do otherwise. The plant was, in fact, already consistent with the 1988 SBC and built with the seismic provisions in the code. Jonesboro has continued to grow, with the code in place.

FIGURE 5.1 New construction continues to flourish in Jonesboro. (Source: City of Jonesboro)

Step 2: Gather Support at the State and Local Levels

Address the concerns of potential opponents by emphasizing these key points:

- For elected officials: A damaging earthquake can occur during your term of office.
- For elected officials: Citizens support seismic codes.
- Codes will not hurt business.
- A seismic code will improve successful survival of lives, properties, and businesses in the next earthquake.
- Everyone else is doing it.
- It's easy.
- It's good for the community.

Step 3: Persuade Local Governments to Adopt Code or Improve Code Enforcement

Consider educational programs or incentive programs that will appeal to local governmental officials:

- Sponsor workshops on how to use the codes.
- Buy the code books and distribute them yourself.
- Take local officials on an earthquake field trip.
- Consider ways of subsidizing the cost of joining the model building code organizations.
- Provide relevant information to the decision-making committee.
- Monitor the process from beginning to end.

devastate the small businesses in a community. Following the 1994 Northridge, California, earthquake, thousands of small businesses had to relocate or temporarily shut down. Some never opened again. Such interruptions can be fatal to small businesses. Simply the loss of business activity can affect neighboring businesses that are fortunate to survive the earthquake ground-shaking.

A seismic code will improve successful survival of the next earthquake. People will live and work in these buildings. Codes work. Look at the evidence of relatively low loss of life in the earthquakes in California in 1989 and 1994. Either a community is designed to survive the next earthquake, or it is not.

Everyone else is doing it. The federal government has set an example with Executive Order 12699. Seismic codes are becoming more prevalent at all levels of government, which means two things: (a) a community will not be at an economic disadvantage for attracting new business and (b) if other communities adopt seismic provisions, those that do not have this safeguard in place invite liability.

It's easy. It doesn't take much to start. Call up a code organization, buy the code, develop a fee structure (to pay for administration), and contract with the county or another nearby agency for initial staffing.

It's good for the community. With a seismic code, residents will know that the community is on its way to seismic safety. The code will reduce long-term liability costs. A good code may ultimately improve the community's insurance rating (see chapter 6). A seismic code is not an admission of community weakness, but rather a sign of community strength. It says that the community values safety, takes itself seriously, and wants to survive natural disaster. All communities need a seismic code regardless of hazard. Seismic codes supplied by the building code organizations account for the unique level of hazard in each community. If a community's hazard is low, the code will reflect that. The seismic hazard zone map is based on the latest national scientific evaluation of earthquake risk, representing the consensus of a number of scientific and professional organizations. The code requirements for each community reflect that estimate of hazard.

Step 3: Persuade Local Government to Adopt Code or Improve Code Enforcement

As part of gaining approval of your proposed changes, consider educational programs or incentive programs that will appeal to local governmental officials:

- Sponsor workshops on how to adopt and enforce the codes. Sample workshop materials are provided in Appendix G. These can be supplemented with area maps and with examples of the model codes.
- Buy the code books and distribute them yourself. You can purchase the codes and other materials directly from the model code organizations. If local officials can see the quality of materials and support provided by the model code organizations, they may be less reluctant.
- Take local officials on an earthquake field trip. For the cost of a bus rental and several lunches, you can show local officials nearby earthquake faults, evidence of past earthquakes, areas susceptible to seismic ground failure, and seismically unsafe buildings.
- Consider ways of subsidizing the cost of joining the model building code organizations. In some

cases, state agencies may be willing to subsidize the cost of local code adoption and enforcement.

Previous experience has shown that it helps to cultivate an inside advocate. Find one or more council members sympathetic to your cause and help them to craft persuasive arguments. Inside advocates might be people who have experienced an earthquake or other disaster, have a professional interest in the subject, or are particularly concerned about public safety issues.

Once the proposed ordinance is prepared and introduced, it usually is assigned to a standing committee or subcommittee, which conducts a public hearing. You will need to work with the committee, provide relevant information, and stay informed regarding its scheduled meetings. Proponents must make their presentations clear, concise, and professional. They should provide factual and persuasive responses to the concerns of interest groups in the jurisdiction. Some of the information presented elsewhere in this book can help in preparing presentations (see step 3 in chapter 4).

If the committee recommends that the ordinance be passed, the governing body usually will call the ordinance up for debate. A strong positive vote by the committee will lessen the possibility of a long debate by the governing body.

You should monitor the approval process carefully from beginning to end, and be prepared to testify and provide additional information as needed to ensure approval.

Step 4: Assist Local Governments Throughout the Adoption, Implementation, and Enforcement Stages

The state seismic program manager and local advocates should be prepared to provide technical assistance throughout the code-adoption process, including the implementation and enforcement stages. Assistance may include information on:

- Seismic hazard in the state
- Function and effectiveness of seismic codes
- Elements of code enforcement
- Services provided by the model code organization

Government officials interested in initiating a new code, or improving their code enforcement, may find it useful to obtain a copy of this entire book.

Implementation and enforcement will follow once the code is adopted and the ordinance is assigned to an agency or department, such as the building or engineering department. In many cases, the new code will initiate a building department that had not previously existed.

The building officials then need to revise existing procedures, such as plan review, permit issuance, and inspection. Personnel training must also be updated as required. Staff members should take courses and receive training materials offered by the appropriate model building code organization (see Appendix D).

It will take some time before the department becomes effective at implementing the ordinance. Professional organizations in the community can help this process by monitoring it and informing the building officials of any problems. (See chapter 6, "Improving Code Enforcement.")

Step 4: Assist Throughout the Adoption, Implementation, and Enforcement Stages

- Provide information about seismic hazards in the state, the function and effectiveness of seismic codes, elements of code enforcement, and services provided by the model code organizations.
- Keep informed of implementation milestones.
- Meet periodically with the building official(s).
- Verify that adequate procedures have been introduced for plan review, inspection, and staff training.
- Inform the building officials of any problems.

NOTES

1 Mushkatel, A.H., and Nigg, J.M., "Opinion Congruence and the Formation of Seismic Safety Policies," *Policy Studies Review*, Vol. 6, No. 4, May 1987.

2 E.g., Wyner, A.J., and Mann, D.E., *Preparing for California's Earthquakes: Local Government and Seismic Safety*, Institute of Governmental Studies, University of California at Berkeley, 1986.

3 Insurance Institute for Property Loss Reduction (now IBHS), *Public Opinion Concerning Various Issues Relating to Home Builders, Building Codes and Damage Mitigation*, IIPLR (Boston, MA), 1995.

4 Building Seismic Safety Council, *Societal Implications: Selected Readings*, FEMA #84, June 1985.

Chapter 6
Improving Code Enforcement: A Critical Link

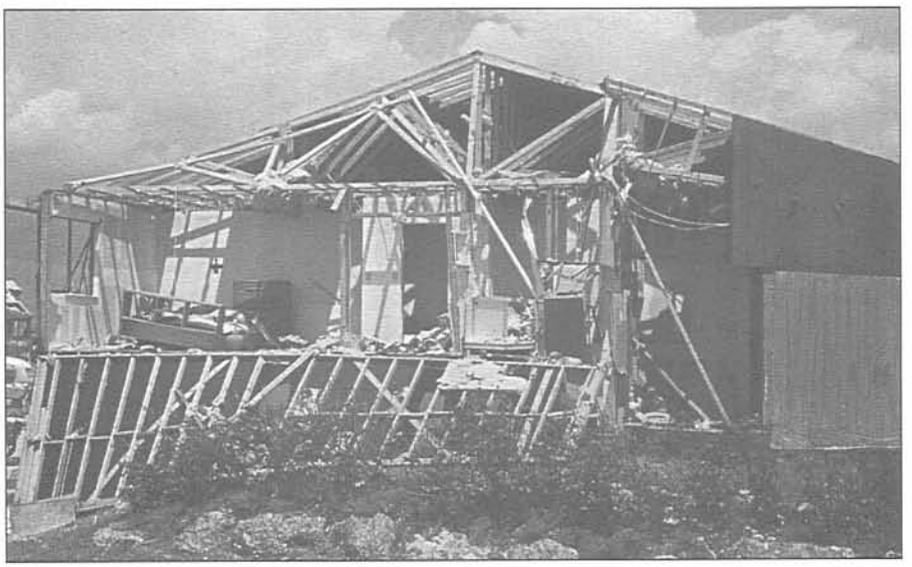


FIGURE 6.1 A substantial portion of the damage from Hurricane Andrew in 1992 was from lack of enforcement of the South Florida Building Code.[1] (Source: FEMA 1993)

A building code is just a book. Enforcement and effective administration of a good code are the keys to achieving the goal of building safer buildings. The information in this chapter applies to any level of government implementing the code, be it state, county, or municipal.

Poor Code Enforcement Results in Deficient Buildings

Recent studies following Hurricanes Hugo and Andrew have shown weaknesses in code enforcement. In 1991 State Farm Insurance Company contracted with SBCCI to evaluate code compliance in twelve randomly selected coastal communities. They found that inspectors and reviewers had little or no training in wind-resistant construction and that there was a general lack of enforcement of adequate connections of windows, doors, and mechanical equipment to the building frame. About half of the communities were not enforcing their own code standards for wind resistance.[2]

Following Hurricane Andrew, reports by a Dade County grand jury and by the Federal Insurance Administration concluded that a substantial portion of the storm's damage was attributable to lack of enforcement of the South Florida Building Code. According to the Insurance Services Office, Inc., at least one-fourth of the record $15.5 billion in insured losses caused by Andrew were because of construction that failed to meet Dade County's code. Thus, even in communities with adequate codes, significant damage can be attributed to poor compliance and enforcement. [3]

In a 1993 study, G.G. Schierle of the University of Southern California found significant problems in quality control of seismic-resistant construction in California. By means of a survey of design professionals and site inspection of 143 projects, the researchers found that key items to resist seismic load are frequently (13 to 72 percent of surveyed units) missing or flawed. Reasons include "inadequate communication, little or no construction observation by design professionals, ignorance, greed, shortsighted false economy, and lack of scrutiny by building inspectors."[4]

Clearly, much effort needs to be spent on improving code enforcement. The weaknesses become apparent only at the moment when resistance is most needed—when the disaster strikes.

Insurers Recognize the Critical Importance of Code Enforcement

The code enforcement problems discovered in the wake of Hurricane Andrew have prompted the insurance industry to initiate a Building Code-Effectiveness Grading Schedule, in order to identify communities with good enforcement practices. It is planned that

property owners in communities with such practices will be rewarded with lowered insurance premiums (see box on page 30). This new system, phased in over a five-year period beginning in 1995, should gain the attention of local officials and property owners and improve the political environment for local support of code enforcement.

Elements of Code Enforcement

Code enforcement and administration consist of five sequential elements. The most important aspects of enforcement are plan review and construction inspection, but effective code administration must consider the entire sequence.

Element 1: Keep the Code Provisions Up To Date

Simply adopting a code is not enough. A code is an active document, evolving to reflect new knowledge and new standards of practice. Once a jurisdiction makes a commitment to use a building code, it must be prepared to update its local code on a regular basis.

Element 2: Ensure That Builders Apply for Permits

Obviously, if builders try to avoid the code-application process, then the code cannot do its job. A jurisdiction must have inspectors out in the field who know the community. The inspector needs to be alert to new construction in his or her jurisdiction and must be aware of current active permits.

In addition, public relations is an important aspect of code enforcement. The building department must cultivate and maintain cordial relations with the building and design community. This can be done by arranging informal meetings, sending written materials to local organizations, speaking to community groups, and maintaining memberships in appropriate trade and professional organizations.

Element 3: Have a Qualified Reviewer Review Plans

Plan review is one of the two points at which the local government can affect the details of building construction. At a minimum, plan review verifies that the design complies with the building code. This is the most cost-effective moment to catch mistakes, before any money is spent on construction. Some jurisdictions may also review structural calculations.

Plan reviewers must be fully knowledgeable about code requirements. The code organizations offer certification programs to recognize the capabilities of plan reviewers. Some jurisdictions use licensed architects and engineers who can go beyond code compliance review and verify calculations and overall building safety. An applicant for a building permit must submit plans for review and approval. The building department can approve, require revisions, or reject the plans. Construction cannot begin until the building department confirms that the plans conform to the building code.

Construction of buildings larger than one- or two-family dwellings usually requires architectural and engineering designs. Architects and engineers must be certified or licensed in order to practice in a state. State statutes require that the licensed professional engineer and/or architect place his or her seal and signature on the designs. The seal and signature signify that the design is at the accepted professional standard, which is typically the most recent version of a model building code or technical document. An added incentive for conformity is the legal liability the engineers and architects assume when the seal and signature are placed on the document.

Need for Better Training of Construction Professionals

A recent study by the Earthquake Engineering Research Institute examined why poor construction practices remain a key cause of earthquake damages. It found that a key problem is deficient training for those who construct and inspect buildings.

Specific findings were: (a) seismic resistance is not currently a priority topic for building officials, inspectors, or the trades, (b) there is a lack of conceptual understanding of building performance in an earthquake, (c) there is inadequate communication among education providers, (d) training materials are inadequate in content, and delivery methods are inefficient, (e) there is a lack of certification and continuing education programs, and (f) there is a need for improved on-the-job training.

The message is clear: We must do a better job of training those individuals whose work is directly linked to the performance of buildings during earthquakes.[5]

Benefits to Communities That Enforce Building Codes

Insurers and lenders have begun to realize that adoption and enforcement of building codes in general, and seismic codes in particular, are in their long-term interest. Accordingly, in 1995 the Insurance Services Office, Commercial Risk Services (ISO/CRS) began to phase in a new Building Code-Effectiveness Grading Schedule. By the end of the decade, this schedule will rate the code-enforcement capabilities of every municipality in the United States.

The insurance industry is developing this new grading schedule to reward communities for promoting property and life safety protection through the use and enforcement of modern codes. The system will be used by property insurers to set differential rates among communities based on code-enforcement practices. Property owners in communities with good code enforcement will pay lower insurance premiums—and owners in communities with poor enforcement will pay more.

The grading schedule measures resources and support available to building code enforcement efforts. It assesses each municipality's support for code enforcement, plan review, and field inspection. The grading process includes interviews with municipal officials, examination of documents, review of training requirements and work schedules, staffing levels, and certification of staff members.

The new system is comparable to the fire protection grading system and the community rating system for flood insurance already used by ISO/CRS. These two systems use a rating scale of one to ten, with one representing the best protection and ten indicating no protection.

For more information, contact the coordinating body, the Institute for Business and Home Safety (formerly IIPLR; address in Appendix E).

Element 4: Ensure That Construction Proceeds According to Approved Plans

An owner receives a building permit to construct according to the approved plans, and it is the legal responsibility of the owner to do so. The builder uses the plans to order materials and construct the building. The owner may hire inspectors or the engineers and architects to oversee key aspects of the construction in order to help verify compliance with the plans. To some extent, all government inspection systems depend on the owner's obligation to construct according to the approved plans, which is inherent in the issuance of a permit.

Element 5: Have a Qualified Inspector Inspect the Construction

Inspection is the second point at which the local government can affect the details of building construction. Inspection verifies whether construction is proceeding according to the approved plans and the conditions of the permit. Inspection is typically required at several key stages in the construction process. The inspector has a powerful enforcement tool called a stop work order. A stop work order is issued to the construction firm if the inspector finds a code violation that must be corrected before any further construction is performed. At final inspection, the building can be approved for occupancy.

Depending on the jurisdiction, inspectors may be municipal employees or contracted tradespeople. In either case, building inspectors must be well qualified. They must know how to read building plans and must be familiar with the code. More importantly, they must be familiar with building practices so they can recognize potential problems. Model code organizations offer certification programs to recognize the capabilities of inspectors.

How to Establish an Effective Building Code Enforcement Program

This section outlines the six steps toward establishing an effective building code program. In addition, detailed case studies of six cities and counties are contained in Appendix C.

Step 1: Adopt a Model Code

The first step in establishing a program is to review and adopt a model building code and join the appropriate code organization. Numerous publications and telephone-assistance services will then be available to help the new program get started. The information provided includes organization charts, descriptions of staff duties, fee structures, suggested procedures, and so on. New members may want to take seminars in plan review and

inspection before officially initiating the code.

New members can request the model code staff to visit and assist in establishing their program (see information in Appendix D). If extensive help is required, the code organization may be hired to provide the needed assistance. It is easy to get started, because the code organizations are set up to effectively and efficiently provide all the support you need.

Step 2: Establish Fee Structures for Permits and Plan Review

Building departments collect fees to pay for the costs of review, inspection, and associated administrative services. The community sets the fee structure based on its needs. Some communities require the building department to be completely self-supporting; others use the fees to offset only a portion of their true costs. Communities with significant experience in code administration can set fees based on previous budgets. Communities just starting out may prefer to use the fee structures suggested by the code organizations.

Plan review fees typically are based on estimated construction value, which depends on building floor area, type of construction, and proposed use. For example, under the BOCA NBC, the suggested building plan review fee for $1 million construction value is $1,250. Review for mechanical work, plumbing, energy conservation, or electrical work is an additional 25 percent each (i.e., each of these additional reviews, if required, costs $312).

Once plans are reviewed, a permit is issued. Typically the building permit requires an additional fee to pay for inspection costs. As with plan review, the fee is based on the estimated construction value. Under the BOCA NBC, additional permits are suggested for mechanical work, plumbing, and so forth, for an additional 25 percent each.

Fee schedules suggested by the three model building code organizations are provided in Appendix D.

Step 3: Institute a Systematic Plan Review System

A review process must serve the needs of the community and the public agencies. Reviews must be done as quickly as possible so as not to unduly disrupt the construction industry. Clearly, smaller projects should be expected to take less time than larger projects. Applicants should be informed up-front of the time required for review so they can plan their design and construction schedule accordingly. Some departments promise turnaround for small projects within a specified number of days. Some jurisdictions offer fast-track reviews for an additional fee.

Plans usually must be circulated to several additional departments for review, such as the planning, public works, and fire departments. It is best to have one department designated as the lead and to require multiple plan copies from the applicant so as to facilitate multi-department reviews.

Applicants should be kept well informed right from the start. Handouts and checklists are very important so that they know what materials to submit and how the plan will be judged.

Step 4: Adopt an Inspection Schedule

Each code has a recommended inspection schedule based on construction milestones. For example, the BOCA NBC suggests the following inspections for residential buildings: footing forms and trenches, basement and foundation wall forms, footing drains and damp proofing, framing, wallboard, and final. Similar schedules exist for

Elements of Code Enforcement

Element 1:
Keep the code provisions up to date.

Element 2:
Ensure that builders apply for permits.

Element 3:
Have a qualified reviewer review plans.

Element 4:
Ensure that construction proceeds according to approved plans.

Element 5:
Have a qualified inspector inspect the construction.

Multi-State Training Program in Southeastern United States

A two-day training course has been developed for building officials in Standard Building Code states that must now enforce the seismic provisions in the latest SBC (NC, SC, MS, TN, AR). The purposes of the course, developed by CUSEC, SBCCI, FEMA, BSSC, and IBHS, are to (a) raise the level of awareness and understanding of the seismic provisions of the SBC and (b) increase understanding and support of building code adoption and enforcement. Building officials in these states can request the course from their state emergency management agency. Instruction is provided jointly by the state earthquake program manager and an SBCCI instructor.

Improving Code Enforcement in Massachusetts

The Massachusetts State Legislature has passed a law requiring that all building inspectors be certified. Inspectors of Buildings or Building Commissioners must complete the CABO exam as well as the BOCA National Code Exam. In addition to these requirements, they must also possess five years of experience in building inspection and construction. The requirements certify adequate education and training to ensure quality construction and compliance with building codes.

Recently state building inspectors took the ATC-20 course, enabling them to assess damage after an earthquake occurs. This training paid off when these inspectors were called upon to estimate damage after a tornado occurred in the state.

A serious fire in Quincy destroyed a retail warehouse and caused an estimated $7 million in damage. In response to this fire, the state initiated new codes covering the use and occupancy of large retail warehouses.

These initiatives demonstrate the importance of updating enforcement and inspection

How To Establish an Effective Building Code Enforcement Program

Step 1:
Adopt a model code.

Step 2:
Establish fee structures for permits and plan review.

Step 3:
Institute a systematic plan review system.

Step 4:
Adopt an inspection schedule.

Step 5:
Maintain a trained, qualified staff.

Step 6:
Be persistent but patient.

electrical and mechanical work and plumbing.

Typically, the builder or owner will call for inspection when each specified milestone is reached. In addition, inspectors occasionally make unannounced inspections based on their judgment of the work progress and the quality of the contractor.

Step 5: Maintain a Trained, Qualified Staff

Qualified staff members are a must. Ideally some staff members would be licensed engineers and architects, but most departments are too small to justify this cost. At a minimum, reviewers and inspectors must have experience in construction, be able to read plans, and be familiar with the code. Training in engineering or architecture is a plus.

Each of the model building code organizations offers certification in a number of categories for inspectors and plan reviewers. More and more building departments are requiring or rewarding certification in order to recognize staff quality.

Step 6: Be Persistent But Patient

You need to realize that a new code will not be implemented in one day. Adequate enforcement takes many years of experience and learning from mistakes. Procedures evolve over time. Building officials, plan reviewers, and inspectors must receive technical training and continuing education, which cannot be done overnight.

Still, once you adopt a code, the code organizations and other professional organizations offer numerous services to teach you what they have learned over the years. The effort is worth it, as seismic codes afford communities a high degree of improved building safety, which will save lives.

NOTES

1 Federal Insurance Administration, *Building Performance: Hurricane Andrew in Florida*, FIA-22, December 1992.

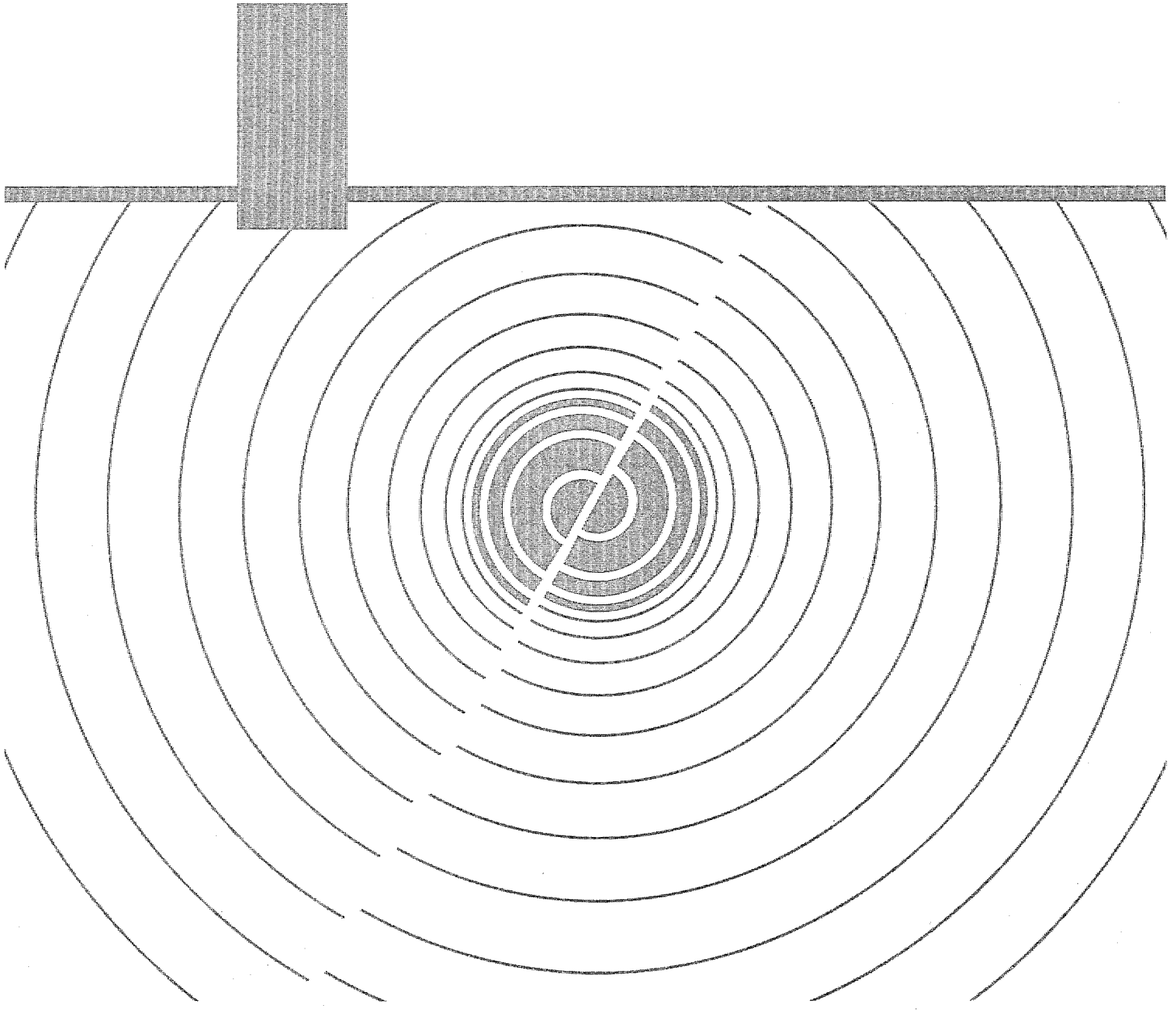
2 Southern Building Code Congress International, *Coastal Building Department Survey*, National Committee on Property Insurance (now IBHS, in Boston), 1992.

3 Federal Insurance Administration, *Building Performance: Hurricane Andrew in Florida*, FIA-22, December 1992.

4 Schierle, G.G., *Quality Control in Seismic Resistant Construction*, report to the National Science Foundation, School of Architecture, University of Southern California, 1993.

5 Earthquake Engineering Research Institute. *Construction Quality, Education, and Seismic Safety.* EERI Endowment Fund White Paper, Oakland, California, April 1996.

Appendix A:
History and Principles of Seismic Design



Appendix A
History and Principles of Seismic Design

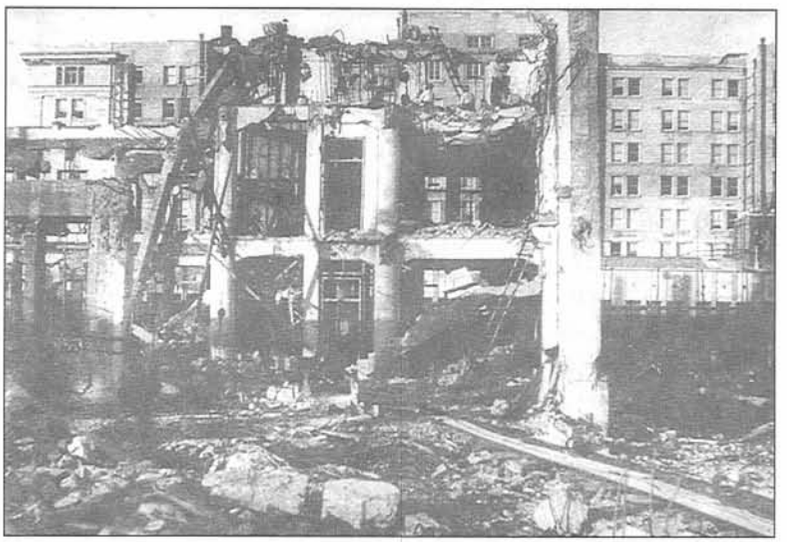


FIGURE A.1 This 8-story reinforced concrete building was one of scores that collapsed during the 1923 Tokyo (Kanto) earthquake. The disaster prompted a limit on building heights. (Source: Carl V. Steinbrugge Collection, Earthquake Engineering Research Center)

History of Seismic Standards

The first quantitative seismic code was developed by an Italian commission following the 1908 Messina-Reggio earthquake, which killed 160,000 people. Following the 1923 earthquake in Kanto, Japan, which killed 140,000 people, the Home Office of Japan adopted a seismic coefficient and a limit on building heights.[1]

First U.S. Seismic Codes: UBC and SEAOC in California

The earliest seismic design provisions in the United States were introduced in the appendix to the 1927 Uniform Building Code (UBC), as a result of the 1925 Santa Barbara earthquake.[2] The 1930 edition included strict specifications for mortar and workmanship on masonry (brick) buildings. However, damage from the Long Beach earthquake of 1933 (Richter magnitude 6.8) proved that unreinforced mortar is unstable in earthquakes. Eighty-six percent of unreinforced masonry buildings in the city of Long Beach experienced either collapse or extensive damage, rendering the buildings useless. Seventy-five percent of schools were heavily damaged. Soon after this earthquake California enacted the Field Act, which specified seismic design forces for school buildings, and the Riley Act, which mandated seismic design for most public buildings throughout the state.

By the 1950s some California municipalities had adopted additional seismic-resistant design and material specifications. UBC was the first model building code to incorporate comprehensive seismic design requirements, though they remained in the appendix for many years. The 1949 edition of the UBC contained the first national seismic hazard map.

In 1957 the Structural Engineers Association of California (SEAOC) began to develop seismic standards for use throughout the state. SEAOC in 1959 published the first edition of *Recommended Lateral Force Requirements and Commentary*, commonly called the *Blue Book*. The *Blue Book* reflected the latest knowledge of seismic design and was used throughout California. The seismic design provisions remained in an appendix to the UBC until the International Conference of Building Officials (ICBO) adopted the *Blue Book* provisions into the main code in 1961. The seismic requirements of the UBC remained largely unchanged, except for some map revisions, until after the 1971 San Fernando earthquake. Revisions were made to the 1973 UBC, and new requirements, based on the work of SEAOC, were introduced in the 1976 edition.

Federal Involvement Expands: The ATC Project

Early in the 1970s the National Science Foundation (NSF) funded a project, under the guidance of the National Bureau of Standards (NBS, now the National Institute of Standards and Technology), to evaluate existing earthquake-resistant design provisions. In 1974 the NBS contracted the project to the Applied Technology Council (ATC). The ATC is a nonprofit corporation established in 1971 to assist the design practitioner in structural engineering. It is guided by a Board of Directors with representatives from various structural and civil engineering organizations. ATC also identifies and encourages research and develops consensus opinions on structural engineering issues.

Over three years ATC published several drafts, which received extensive peer review. In 1978 ATC published the final report titled *Tentative Provisions for the Development of Seismic Regulations for Buildings (ATC 3-06)*. The SEAOC and UBC used the ATC 3-06 report to revise their recommendations and building code.

The NBS in the late 1970s published a *Plan for the Assessment and Implementation of Seismic Design Provisions for Buildings*. This plan analyzed ATC 3-06 and facilitated its development into design standards and building codes.

Further Federal Involvement: NEHRP and the BSSC

In the late 1970s the U.S. Congress passed the Earthquake Hazards Reduction Act of 1977 (PL 95-124), establishing the National Earthquake Hazards Reduction Program (NEHRP), a multi-agency program to fund research and improve practice in reducing earthquake hazards. Since 1977 NEHRP has been the primary source of funding for earthquake research. In 1979 the Federal Emergency Management Agency (FEMA) was established as the lead federal agency for coordinating NEHRP.

The Building Seismic Safety Council (BSSC) was established in 1979 as an independent voluntary body under the auspices of the National Institute of Building Science (NIBS). The purpose of the BSSC is to provide a national forum to foster seismic safety. The concept of the BSSC was developed by the ATC, SEAOC, NIBS, NSF, National Bureau of Standards (now the National Institute of Science and Technology), FEMA, and American Society of Civil Engineers (ASCE). Currently, members of BSSC come from more than fifty organizations, such as the American Consulting Engineers Council, Masonry Institute of America, and American Iron and Steel Institute, all having interest in seismic-related issues.

Under a contract with FEMA, BSSC revised ATC 3-06 through a consensus process of its members. After balloting BSSC members twice and receiving approval, FEMA released the recommendations in 1985 under the title *NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings*, commonly called the *NEHRP Provisions*. The BSSC, with FEMA funding, continues to update the seismic recommendations using a consensus process. The most current edition was published by FEMA in 1994, and the 1997 edition will be published in early 1998.

Federal Buildings: EO 12699 & EO 12941

The federal government, under presidential Executive Order 12699 (January 5, 1990), now requires seismic design for its new buildings. According to the executive order, titled *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction*, federal agencies must by February 1993 require appropriate seismic design and construction standards for new federal and federally assisted,

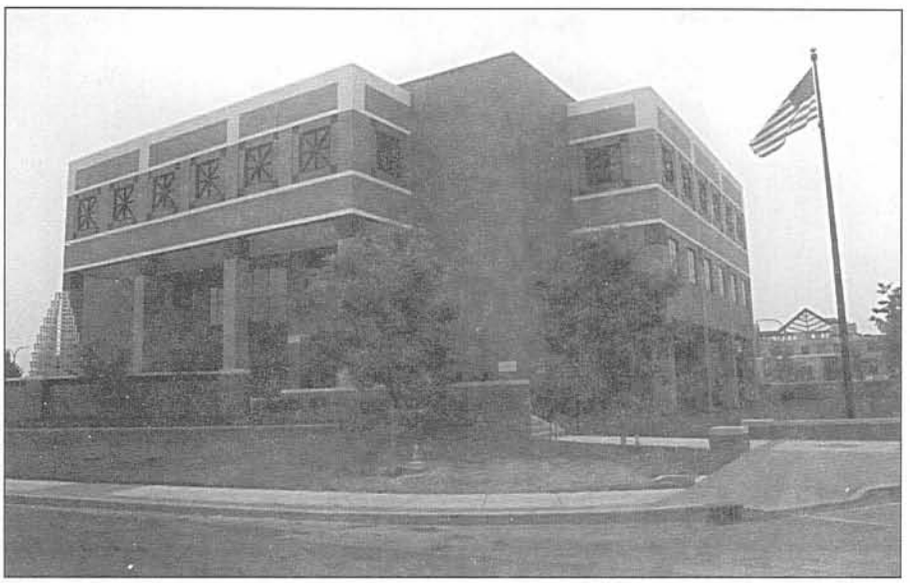


FIGURE A.2 All new federal buildings, such as this federal courthouse in Urbana, Illinois, must be built with seismic design appropriate to the region. (Photo: R. Walker)

leased, and regulated buildings. EO 12699 is significant for state and local governments, because it makes seismic design more prevalent throughout the nation and increases the number of experienced seismic designers and contractors.

Executive Order 12699 is far-reaching, because all new buildings that are owned, leased, or receive federal assistance now must have seismic-resistant design. Also covered are federally regulated or assisted buildings, including single-family homes with Federal Housing Administration or Veterans Administration mortgages.[3]

Under Executive Order 12699, the seismic design provisions used may be those of the municipality or state in which the building is built, so long as the responsible agency or the Interagency Committee on Seismic Safety in Construction (ICSSC) finds that they provide adequately for seismic safety.[4] Accordingly, the ICSSC in 1992 recommended the use of standards and practices that are substantially equivalent to the seismic safety levels in the 1988 *NEHRP Provisions*. Each of the following model codes has been found to provide a level of seismic safety substantially equivalent to the 1988 *NEHRP Provisions*: the 1991 ICBO *Uniform Building Code*, the 1992 *Supplement to the BOCA National Building Code*, and the 1992 *Amendments to the SBCCI Standard Building Code*.

In a May 17, 1995, Recommendation, the Interagency Committee on Seismic Safety and Construction updated this finding. They found that the 1994 UBC, 1993 BNBC, and 1994 SBC provide a level of seismic safety substantially equivalent to that of the 1991 *NEHRP Provisions*. In addition, they found that the National Consensus Standard ASCE 7-93 also provides an acceptable level of seismic safety. Any locality that enforces the current seismic requirements of one of the model codes meets this condition.

The American Society of Civil Engineers' *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-95; see Appendix E for address of ASCE), which supersedes the American National Standards Institute A58.1 standards and subsequent maps adopted for federal use in accord with the order, may be used to determine the seismic hazards in various parts of the country. ASCE 7-95 includes specifications for calculating forces that the building must support, such as earthquake, wind, snow, and building material forces.

Because of EO 12699, it is in the best interests of local governments to adopt seismic codes. To best facilitate the possibility of federal financial assistance for new buildings, local governments would be well advised to adopt one of the model codes that have been found to be seismically adequate. For example, the federal agencies providing financial assistance for housing construction (VA, FHA, HUD) all now require adequate seismic design and construction.

EO 12941, by adopting the *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings*, by the Interagency Committee on Seismic Safety and Construction (ICSSC), promulgates a set of seismic standards for federally

owned or leased buildings. It also establishes five triggers for evaluation and possible mitigation of risks in a building. For example, when there is a change of building function, a building is significantly altered, or it has to be rebuilt following a disaster, the building must be evaluated according to the ICSSC standards.[5]

Federal Agency Practices Prior to EO 12699: Some Examples

Prior to EO 12699, many agencies of the federal government had promulgated their own building regulations for federally owned and funded projects. Because of the influence of the federal agencies' standards, increasing numbers of structures throughout the United States have been built to seismic-resistant standards.

The recognized authorities for highway bridge earthquake-resistant design are the American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA). AASHTO has published *The Standard Specifications for Highway Bridges* since 1931 (see Appendix E for address of AASHTO). AASHTO's expressed purpose for publishing these specifications is to guide the preparation of state specifications. The latest edition was published in 1995, and supplements are released yearly. Although seismic design standards were not incorporated into AASHTO's specifications until 1991, they had been adopted as guidelines since 1983. States must use AASHTO specifications in order to receive federal highway funds.

The federal government, through the Interagency Committee on Dam Safety, has published *Federal Guidelines for Earthquake Analysis and Design of Dams*. These guidelines were created to develop consistency among federal agencies involved in the planning, design, construction, operation, maintenance, and regulation of dams.

The 1971 San Fernando, California, earthquake caused a Veterans Administration hospital to collapse. Since then the VA has required its facilities to be designed with earthquake-resistant provisions, in accordance with a seismic design manual published by the VA Office of Facilities.

FIGURE A.3 Following the collapse of the Veteran's Administration hospital in the San Fernando earthquake of 1971, the VA has required seismic design for all its facilities. The hospital building shown in this photo was constructed in 1925 with concrete frames and concrete floors, and hollow-tile walls. This type of building is known to be hazardous in the event of a strong earthquake. (Source: Engineering Features of the San Fernando Earthquake, California Institute of Technology, EERL, 1971)

Principles of Seismic Design[6]

The Goals of Seismic Design

Seismic design provisions are intended to protect the safety of a building's occupants during and immediately following an earthquake. Building codes are primarily designed to save lives and reduce injuries, not to eliminate property loss. Their purpose is to allow for safe evacuation of a building. Seismic provisions attempt to prevent general failures (total collapse), but allow for local damage (damage to noncritical sections). Therefore, a building in compliance with the code probably will not collapse, but it may be rendered unfit for continued use. According to the Structural Engineers Association of California, structures built

according to a seismic code should resist minor earthquakes undamaged, resist moderate earthquakes without significant structural damage even though incurring nonstructural damage, and resist severe earthquakes without collapse. Building codes are only minimum design standards.

Lateral Earthquake Forces

Today's seismic provisions specify how to calculate the unique earthquake-induced *lateral force*. These are horizontal forces generated by the ground's side-to-side movement in an earthquake.

The purpose of earthquake engineering and earthquake-resistant design is to construct buildings that can resist horizontal forces. This notion is central to seismic building design. All buildings are designed to stand under the vertical forces of gravity, an obvious constraint because it is always present. Less apparent is the need to design for the occasional occurrence of horizontal forces. Many cities have learned the hard way, after it is too late, that their brick or adobe buildings (or concrete and steel buildings not seismically designed) cannot withstand earthquake ground-shaking.

In designing a building, a structural engineer combines the earthquake-induced lateral force with other code-specified forces, such as wind or snow load, to obtain the maximum probable force. The structure is designed based on the maximum combination. The calculated earthquake forces may be less than the wind or snow force.

Buildings that are tall or have unusual shapes require more extensive design analysis. When a building has a complex shape the designer must employ a dynamic structural response analysis, a computer analysis that simulates the building's swaying (side-to-side movement) during an earthquake. The model reflects the building's behavior, conceptually similar to a vibrating string. The dynamic analysis is more accurate than the simple or "static" analysis but is more time-consuming and costly; therefore it is only used for large-scale structures in which many people could be hurt.

The Council of American Building Officials (CABO) has incorporated construction specifications that increase earthquake resistance for one- and two-family dwellings. The CABO *One- and Two-Family Dwelling Code* contains specific requirements for reinforcing chimneys and fireplaces, tying the building frame to the foundation, and providing walls more resistant to earthquake motion (shear walls). These provisions help to prevent chimneys from falling and homes from shifting off their foundation.

Ductility

Another aspect of seismic design is called *ductility*, the flexibility of buildings. In simple terms, buildings are designed to bend rather than break under earthquake forces. Ductility is the ability of a material to deform without fracturing. For example, ductility is an inherent property of steel. Steel will bend significantly before it ultimately fails, which is called ductile failure. Designing an entire structure to be ductile allows for the parts of a building to deflect in an earthquake before they fail.

In contrast to ductile failure, *brittle failure* occurs without prior visual indication. Unreinforced masonry and unreinforced concrete structures are inherently brittle materials. Steel reinforcement transforms concrete's behavior from brittle to ductile. The American Concrete Institute (ACI) through its *Building Code Requirements for Reinforced Concrete (ACI 318-89)* provides specific criteria for structural design of reinforced concrete structures. One provision is the

specification of a minimum amount of reinforcing steel to provide for ductile behavior.

Drift

The codes also try to limit the sway of buildings. This is to prevent nonstructural damage and equipment and inventory damage. Although the structural frame can resist stresses and strains created by *drift*, or horizontal movement of one floor relative to the other, items that are attached to the frame or within its interior may not. The John Hancock Building in Boston in the 1970s had problems caused by excessive drift. Windows crashed to the ground as the building swayed in the wind, until the building was retrofitted to reduce the amount of sway. Damage occurred in Mexico City's 1985 earthquake when swaying buildings pounded into each other. Pounding was a significant factor in 40 percent of the collapsed buildings.[7] The drift was due to inadequate stiffness in building frames and the small distances separating buildings.

Seismic Hazard Maps

All the model codes include a seismic hazard map that indicates likely levels of earthquake ground-shaking and, therefore, potential structural damage in every part of the United States. The hazard map is based on the probability that a specified earthquake intensity will occur during a defined time period.

First Seismic Hazard Map Was Based on Maximum Historic Earthquakes[8]

The first seismic hazard map was published in 1948 by the U.S. Coast and Geodetic Survey and was adopted in the 1949 edition of the UBC, as well as subsequent editions until 1970. In 1969 S.T. Algermissen of the U.S. Geological Survey (USGS) published a seismic hazard map for the contiguous forty-eight states. The original map was created by plotting historical earthquake occurrences and was based only on the recorded maximum earthquake intensities. Because of this, portions of the northeast United States were assigned the same hazard and design requirements as areas in California. This map was the basis for the zoning map in the 1970 UBC, which divided the United States into four zones numbered 0 through 3. A zone 4 was added to California in the 1976 UBC.

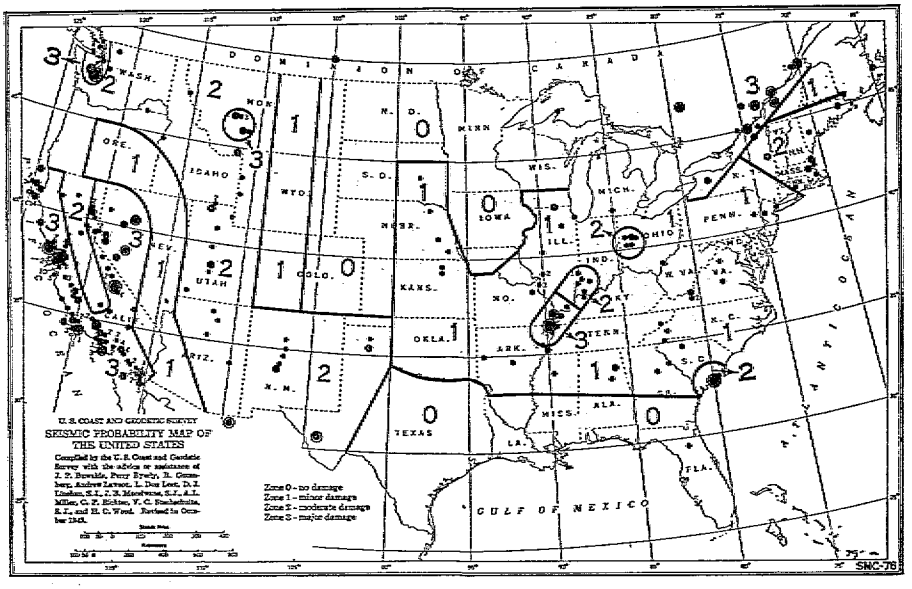


FIGURE A.4 The 1948 seismic hazard map. (Source: U.S. Coast and Geodetic Survey)

1976 Map: Probabilities of Ground-Shaking

In 1976 Algermissen and coworkers refined the map to incorporate the probable frequency of various earthquake intensities. Thus, areas with more frequent earthquakes would be subject to stricter standards of design. They mapped the peak ground acceleration, a measure of the maximum force of earthquake ground-shaking, according to different earthquake intensities expected across the United States. The 1976 map by Algermissen and others depicts the peak ground acceleration that has a 10 percent probability of being exceeded every fifty years. The fifty-year period is typically used as a structure's design lifespan, and 10 percent is consid-

Table A.1 State Codes and Code Influence

State	State Code Name	Basis*	Edition
Alabama	Alabama State Code	SBC	1994
Alaska	Alaska State Code	UBC	1994
Arizona	None		
Arkansas	Arkansas Fire Prevention Code	SBC	1991
California	California Building Code	UBC	1994
Colorado	UBC	UBC	1991
Connecticut	Connecticut State Building Code	BNBC	1992
Delaware	None (done at county level)		
Dist. of Columbia	DC Building Code Supplement	BNBC	1990
Florida	SBC, EPCOT, So. Florida Bldg. Code		1994
Georgia	Georgia State Minimum Std. Bldg. Code	SBC	1994
Hawaii	None (done at county level)		
Idaho	UBC	UBC	1994
Illinois	State (plumbing only)	State	1993
Indiana	Indiana Building Code	UBC	1991
Iowa	Iowa State Building Code	UBC	1991
Kansas	None (uses UBC)	UBC	1991
Kentucky	Kentucky Building Code	BNBC	1993
Louisiana	State Uniform Construction Code	SBC	1991
Maine	None		
Maryland	Model Performance Code	BNBC	1993
Massachusetts	Massachusetts State Building Code	BNBC	1987
Michigan	Building Code Rules	BNBC	1993
Minnesota	Minnesota State Building Code	UBC	1994
Mississippi	None		
Missouri	None		
Montana	Admin. Rules of Montana, Ch. 70	UBC	1994
Nebraska	State Fire Marshall Act	UBC	1979
Nevada	Nevada State Fire Marshall Regulation	UBC	1991
New Hampshire	State Statute	BNBC	1990
New Jersey	State Uniform Construction Code	BNBC	1993
New Mexico	New Mexico Building Code	UBC	1991
New York	Uniform Fire Prevention & Bldg. Code	State	1995
North Carolina	State Building Code	SBC	1994
North Dakota	Century Code	UBC	1994
Ohio	Ohio Basic Building Code	BNBC	1993
Oklahoma	Title 61, Oklahoma Statutes	BNBC	1993
Oregon	Oregon Structural Specialty Code	UBC	1991
Pennsylvania	None		
Rhode Island	State Building Code	BNBC	1990
South Carolina	SBC	SBC	1991
South Dakota	Fire Safety Standards	UBC	1991
Tennessee	SBC	SBC	1994
Texas	None		
Utah	Utah Uniform Building Standards Act	UBC	1994
Vermont	Vermont Fire Prevention & Bldg. Code	BNBC	1987
Virginia	Virginia Uniform Statewide Bldg. Code	BNBC	1993
Washington	State Building Code	UBC	1994
West Virginia	State Building Code	BNBC	1990
Wisconsin	Bldg., Heating, Ventilation & A/C Code	State	
Wyoming	State Code, Ch. 9, Fire Prevention	UBC	1994
Guam	UBC	UBC	
Puerto Rico	Puerto Rico Building Code		
Virgin Islands	UBC	UBC	1994

*Model code on which state code is based.

Sources: Insurance Institute for Property Loss Reduction (now IBHS), April 1996; information on territories was collected by the authors from FEMA and NCSBCS.

ered to be a large enough probability to warrant concern.

It is important to appreciate the probabilistic nature of the Algermissen map. We cannot justify the expense of designing for large but highly improbable events. So we select an event (called the *design event*) that, although large and rare, has a reasonable chance (10 percent) of being exceeded during a building's lifetime (fifty years). The probability selected reflects society's attitude toward risk. This risk acceptance may vary for different uses. Nuclear power plants, for example, are built to much more stringent seismic standards.

It is also important to realize that there is always a chance that an event will exceed the design event—indeed, there is a 10 percent chance of an earthquake that exceeds the design standard. Seismic design standards represent society's balancing of the risks and the costs of designing to withstand that risk.

Finally, one must realize that the zone boundaries themselves are based on probability. There is nothing sacred about the lines on the map; a structure on one side of a zone line is not markedly safer than a structure immediately on the other side. But these maps do represent a consensus of informed scientific opinion of the likelihood of earthquake ground-shaking and its effects. By using these maps as guides to design, we reduce the overall chances of damage to buildings in a region.

ATC Adaptation of the Probabilistic 1976 Map

The ATC revised the 1976 Algermissen map by converting the peak ground acceleration values to effective peak acceleration (EPA) values, another way of describing earthquake ground-shaking. There is no single perfect measure. However, in making the map more user-friendly, it lost accuracy. The effective peak acceleration maps depict peak ground acceleration that has a 5 to 20 percent probability of occurring in a fifty-year period.

From effective peak acceleration, ATC also developed an effective peak velocity map. Effective peak velocity measures the sustained ground movement during an earthquake and is more suitable for building code application to taller buildings. In addition, the ATC maps were revised to follow the boundaries of political jurisdictions to clarify the zones for local building code administration. These maps in ATC 3-06 were used as the basis for the zone map in the *NEHRP Provisions*. A more refined map by the U.S. Geologic Survey appeared in the 1988 *NEHRP Provisions* and has since been adopted by BOCA and SBCCI. The current UBC model building uses similar information for its seismic zone map. The map divides the United States into six earthquake risk zones: 0, 1, 2a, 2b, 3, and 4.

Current Efforts by USGS

The U.S. Geological Survey has recently developed a new generation of seismic hazard maps. These maps are based on the more complete spectrum of ground response to seismic waves, rather than the traditional acceleration and velocity maps. They also use shaking exceedance probabilities of 2 percent and 5 percent in 50 years, in addition to the probability of 10 percent in 50 years that has traditionally formed the basis of seismic hazard maps.[9] The maps currently being balloted for inclusion in the *NEHRP Provisions* are based on the 2 percent in 50 year USGS map, with some changes in high-seismic near-fault areas. The maps will be published with the 1997 edition of the *NEHRP Provisions* and will ultimately be used in the 2000 International Building Code.

NOTES

1 Building Seismic Safety Council, *Improving the Seismic Safety of New Buildings: A Community Handbook of Societal Implications*, FEMA #83, July 1986 edition.

2 This history of seismic codes comes from a number of sources, most notably: Beavers, James E., "Perspectives on Seismic Risk Maps and the Building Code Process," in *A Review of Earthquake Research Applications in the National Earthquake Hazards Reduction Program: 1977–1987*, Walter Hays, ed., U.S. Geological Survey Open-File Report 88-13-A, 1988, 407-432; Whitman, R.V., and Algermissen, S.T., "Seismic Zonation in Eastern United States," *Proceedings, Fourth International Conference on Seismic Zonation*, Vol. I, Earthquake Engineering Research Institute, 1991, 845-869; Martin, H.W., "Recent Changes to Seismic Codes and Standards: Are They Coordinated or Random Events?" *Proceedings, 1993 National Earthquake Conference*, Vol. II, Central U.S. Earthquake Consortium, 1993, 367-376.

3 National Institute of Standards and Technology, *Guidelines and Procedures for Implementation of the Executive Order on Seismic Safety of New Building Construction*, ICSSC RP2.1A, NISTIR 4852, June 1992.

4 Ibid.

5 Todd, Diana, ed., *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings, National Institute of Standards and Technology Report NISTIR 5382*, Interagency Committee of Seismic Safety and Construction Recommended Practice 4 (ICSSC RP 4), February 1994.

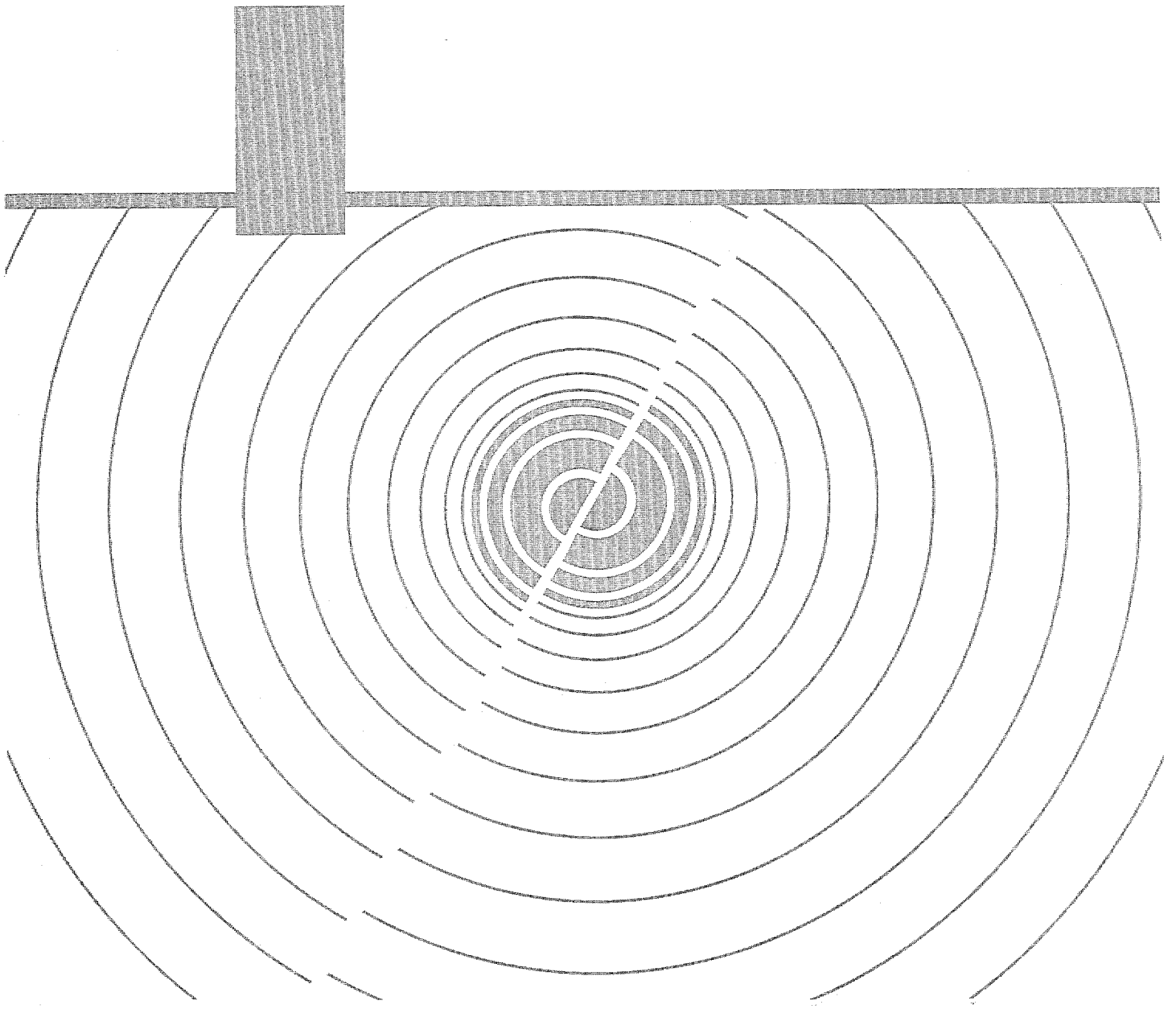
6 This summary of seismic design comes from a number of sources, most notably from the Building Seismic Safety Council: *Improving the Seismic Safety of New Buildings: A Community Handbook of Societal Implications*, FEMA #83, July 1986 edition; *Seismic Considerations for Communities at Risk*, FEMA #83, September 1995 edition; and *Nontechnical Explanation of the NEHRP Recommended Provisions*, FEMA #99, September 1995. Also see EERI Ad Hoc Committee on Seismic Performance, *Expected Seismic Performance of Buildings*, Earthquake Engineering Research Institute, February 1994; and Lagorio, Henry J., *Earthquakes, An Architect's Guide to Nonstructural Seismic Hazards*, John Wiley and Sons, Inc., 1990.

7 Geis, Donald A., et al., "Architectural and Urban Design Lessons from the 1985 Mexico City Earthquake," *Lessons Learned from the 1985 Mexico Earthquake*, Earthquake Engineering Research Institute, 1989, 226-230.

8 The information on seismic hazard maps comes from a number of sources, most notably: Beavers, James E., "Perspectives on Seismic Risk Maps and the Building Code Process," in *A Review of Earthquake Research Applications in the National Earthquake Hazards Reduction Program: 1977–1987*, Walter Hays, ed., U.S. Geological Survey Open-File Report 88-13-A, 1988, 407-432; Whitman, R.V., and Algermissen, S.T., "Seismic Zonation in Eastern United States," *Proceedings, Fourth International Conference on Seismic Zonation*, Vol. I, Earthquake Engineering Research Institute, 1991, 845-869; U.S. Department of the Interior, Geological Survey, *USGS Spectral Response Maps and Their Relationship with Seismic Design Forces in Building Codes*, Open-File Report 95-595, 1995; and Leyendecker, Edgar V., Algermissen, S.T., and Frankel, Arthur, *Use of Spectral Response Maps and Uniform Hazard Response Spectra in Building Codes*, Fifth National Conference on Earthquake Engineering, July 1994.

9 Leyendecker, E.V., et al., *USGS Spectral Response Maps and Their Relationship with Seismic Design Forces in Building Codes*, U.S. Geological Survey Open-File Report 95-596, 1995. The most recent versions are available at http://gldage.cr.usgs.gov/eg/

Appendix B: Examples of Various States' Building Code Practices



Appendix B
Examples of Various States' Building Code Practices

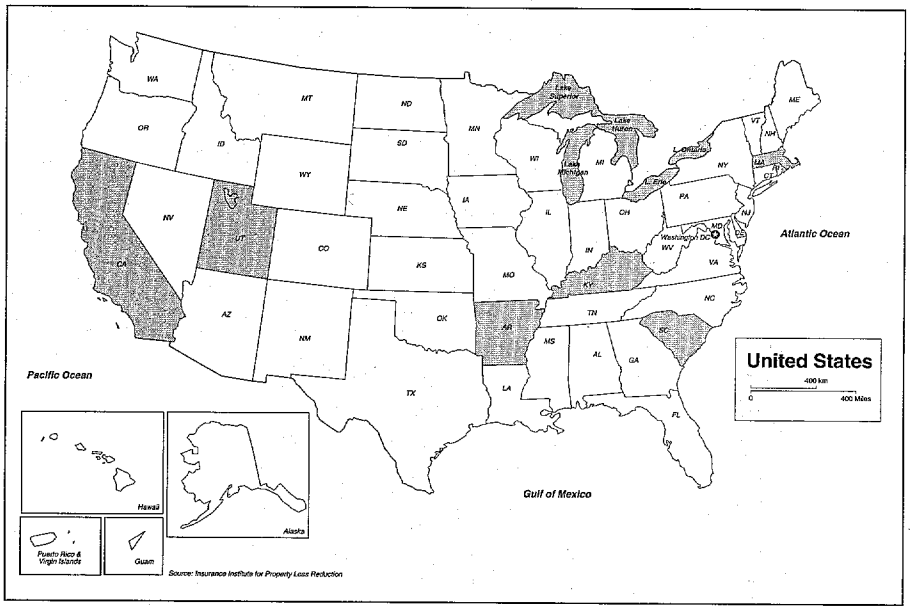


FIGURE B.1 This appendix describes the building code practices of Arkansas, California, Kentucky, Massachusetts, South Carolina, and Utah.

Code administration varies by state. As noted in chapter 4, some states require local code adoption, some have mandatory state codes, and others have no requirement at all. Typically where there is no comprehensive statewide building code the state regulates through individual standards some of the following: fire safety, building accessibility, manufactured housing, health facilities, swimming pools, schools, and plumbing.

The case examples given below demonstrate the wide range of practices used. States such as South Carolina and California have had building codes with seismic provisions for some time. Other states have recently adopted a statewide building code with seismic provisions. Usually, the move to adopt a statewide building code is in response to a natural disaster or serious fire. This illustrates the point that the best time to act is right after a disaster occurs. Awareness of the need for building codes is highest at this time.

In addition, the examples below describe the variety of practices used in administering codes and enforcement. Even though some states have building codes, their mechanisms for enforcement are poor. This is often the case in smaller communities that do not have an inspection staff and in states that have just adopted statewide codes.

Each state varies, and what works in one state may not work in another. The purpose of these examples is to give you ideas on what has been tried and how such a system might work in your state. The adoption of a statewide building code with seismic provision will save lives when an earthquake or disaster occurs.

The case study information was collected from the National Conference of States on Building Codes and Standards, Inc.,[1] augmented through a series of interviews. A list of interviewees is included at the end of this appendix.

Arkansas

Adoption and Revision

Arkansas' first building code, the Arkansas Fire Protection Code, adopted in 1955, applies to all buildings in Arkansas. The state fire marshal *is part of the state police department*, and is charged with enforcing the Arkansas Fire Prevention Code as well as other functions. Because of the code, the state must adopt the most recent fire and building codes from SBCCI.

The state fire marshal delegates plan review to local fire marshals as is permitted by the code. Local municipalities having building code departments can pass building

codes at least as stringent as the state's.

Code updates are determined administratively. New versions of the SBCCI codes are reviewed by the state fire marshal and a committee of design professionals, fire fighters, and others. The fire marshal's office makes appropriate amendments and sends the proposed code out for public comments. The recommended code is then approved by the state legislative council and sent to the secretary of state. There is no prescribed schedule for code update: The fire marshal determines when the code should be updated. Arkansas, generally, tries to update its code every time a new edition of the Standard Building Code (SBC) is published.

Seismic Requirements

In March 1991 the Arkansas General Assembly chose to emphasize the importance of seismic design by enacting Act 1100, "An Act to Safeguard Life, Health, and Property by Requiring Earthquake-Resistant Design for all Public Structures to be Constructed or Remodeled within the Boundaries of this State Beginning September 1, 1991." Introduction of Act 1100 in the legislature coincided with the aftermath of the Loma Prieta, California, disaster; and the bill passed with no opposition votes. It was signed by the governor on April 9, 1991.

The act requires that all "public structures" (buildings open to the public as well as all public works) be designed to resist seismic forces, in accordance with the minimum requirements of the 1993 revision to the 1991 SBC or the latest edition with revisions.

The act specifies the standard building code seismic zones to be used for each county, interpreted from Algermissen and Hopper's 1984 U.S. Geological Survey map.[2] The structural design must be signed and sealed by a professional engineer. The act does not apply to residential structures of four units or less, nor to agricultural structures. Another key element of the act is that it specifies a penalty of $1,000 per day of violation.

Although the state already has a building code, Act 1100 legislatively underscores that the state requires seismic design, establishes zones more specific than those in the SBC, is self-updating by the most recent published SBC, and sets forth penalties for noncompliance.

Enforcement

Some larger towns (such as West Memphis, Blytheville, and Jonesboro) have building departments and are well equipped to enforce seismic design and construction requirements. However, enforcement can be a problem in smaller communities that do not have inspection staff. Under Act 1100 enforcement mechanisms probably will continue to be poor. Still, the new Act puts much of the responsibility on professional engineers, who enforce the Act by their signatures on plans.

For some types of buildings (hospitals, schools, dormitories, places of assembly, department stores, etc.), the state reviews the plans if there is no local building official. All state buildings or state-funded buildings must be reviewed by State Building Services (the state architect's office). This requirement has only been in existence for the past ten years. A memo of understanding has been established between the Health Department and the Department of Human Services regarding regulations for hospitals and long-term ambulatory care facilities.

Code enforcement and plan review is relatively new in Arkansas. Prior to the 1970s, most enforcement and review was voluntary and conducted by

The Arkansas Earthquake Advisory Council and Act 1100

As mentioned in Chapter 4, seismic advisory councils can help reduce earthquake hazards in many different ways. The Arkansas example proves that point. Established in December 1984, with 17 members, the Earthquake Advisory Council consists of representatives from state agencies, utilities, universities, hospitals, local agencies, and other interested parties. The Council is open to additional members, if they can carry the Council's message to an important constituency.

The Council has been very successful in providing a forum for most of the major constituencies to get together and exchange ideas and alert one another to the latest news in the field. Without the Arkansas Advisory Council, Act 1100 would never have happened. The Council developed the idea several years before the bill was passed, drafted the bill, argued for seismic codes whenever members gave public presentations, and routed it through the legislature. Their strategy was to create both public and professional support.

The bill had been a high priority of the Council since its inception. Refined drafts of the bill had been in progress for about three years, and it was almost ready to be introduced. The timing of the bill coincided with the post-Loma Prieta disaster, and in November 1990 the bill was introduced to the legislature. The bill passed with no opposition votes.

private architects and engineers. The number of staff plan reviewers and inspectors depends on the size of the municipality, its location within the state, and its funding sources. A small city may have two to three inspectors, while a city the size of Little Rock has fifteen to twenty inspectors and six to eight reviewers. Localities most commonly charge for permits, plan reviews, and inspections and are thus capable of supporting a sufficient enforcement system.

FIGURE B.2 This school building sustained severe damage in the 1933 Long Beach, California, quake. (Photo: U.S. Dept. of Commerce, NOAA)

An appeals system is set up within the state's code. If building permits are denied the builder may make an appeal to the commander of the fire marshal section of the Arkansas State Police, then to the appointed state fire marshal, and the head of the Arkansas State Police. If a municipality has a building department, it has the authority to establish a local board of appeals.

California

Adoption and Revision

The first California building laws, enacted by the legislature in 1909, established standards for construction and maintenance of tenement houses within cities in order to ensure the health and safety of the occupants of substandard housing. A combination code in 1923 encompassed tenement houses, hotels, and dwellings. Amendments in 1951 repealed many restrictive requirements and substituted more modern concepts and material ratings.

California has enacted statewide standards for housing, mobile home parks, employee housing, manufactured housing, energy conservation, fire safety, and handicapped access. There are additional standards for state-owned and -regulated facilities. Seventeen state agencies adopting or proposing building standards have specific authority to regulate construction.

Codes are mandated by state law. The legislature mandates, through the Health and Safety Code, certain uniform model codes that are applicable throughout the state. Local jurisdictions enforce the same edition of the model building codes as the state. California uses the Uniform Building Code (UBC) with amendments for general building and seismic codes.

The adoption of updates occurs only with the publishing of a new model building code, which occurs every three years. Proposed revisions are prepared and documented by the adopting state agency. Revisions then go through the state administrative procedures process of publication, public comments, and hearings.

Seismic Requirements

State and local officials in California have years of experience with seismic provisions. California has had seismic provisions since the 1933 Long Beach earthquake. The original regulations, known as the Field Act, covered public schools only. The UBC seismic provisions originated in the work of the Structural Engineers Association of California, and have been refined over the years primarily in response to California practice and experience.

In addition, California requires mitigation of earthquake hazards in unreinforced masonry (brick) buildings. SB 547, enacted in 1986, requires local governments to inventory unreinforced masonry buildings and to establish earthquake hazard mitigation programs, such as retrofit requirements, notification of building owners, and programs to reduce the number of occupants of unsafe buildings.

Enforcement

Local building departments are the primary enforcement agencies in California. The requirements charging local building departments with the administration of codes are stated in the California Health and Safety Code, which is enacted by the state legislature. Fifty-eight counties and 490 cities in the state have their own building departments, with plan review and inspection staff ranging from 1 to 350 people. The quality of enforcement varies. The State Department of Housing and Community Development may assume the responsibility of enforcement if local action is inadequate. Although the quality of local enforcement varies, for over twenty years the state has not had to exercise this option.

Local appeal procedures exist, usually involving a local housing appeals board. The local building official normally sits on the board. If the board upholds the decision of the building official, the appeal may continue to the next level of authority, such as the city council or county board of supervisors, and then, if appropriate, to litigation.

Kentucky

Adoption and Revision

Since October 1979 Kentucky has had a state building code, the *Kentucky Building Code*, which is based on the BOCA NBC. It is administered by the Kentucky Department of Housing, Buildings and Construction, which was legislatively created in 1978 as a response to the Beverly Hills Supper Club fire (this occurred in May 1977, killing 160 and injuring 130). The department combines all functions involved in construction of buildings. The Kentucky Building Code also includes the Kentucky Plumbing Code, Kentucky handicapped accessibility requirements, and Kentucky boiler rules. The department includes the Division of Building Codes Enforcement, the State Fire Marshal's Office, and the Division of Plumbing. Having these programs under one department has simplified coordination of the various codes.

The Board of Housing, Buildings and Construction is responsible for adopting and amending the code. The twenty-member board is appointed by the governor to represent the spectrum of interests related to the building industry.

The *Kentucky Building Code* is updated every three years, following the publication cycle of BOCA. Once the new edition of BOCA is published, the Department of Housing, Buildings and Construction analyzes the changes and takes administrative steps to incorporate BOCA into law within a few months.

Kentucky code requirements are mandatory throughout the state. Local jurisdictions may amend only the fire code, and only to make its requirements more stringent.

Seismic Requirements

Kentucky has always incorporated the latest seismic provisions of the BOCA code. With the 1992 BOCA code, Kentucky's code is now consistent with the *NEHRP Provisions*. As with other states in the eastern half of the country, enforcement and local awareness of seismic requirements still need improvement. Professional training pro-

grams and workshops may be necessary until adequate standards are attained.

Enforcement

Generally speaking, the state is responsible for larger buildings. The state reviews plans, issues permits, and provides inspection for these. The state employs twelve inspectors and nine plan reviewers. Smaller buildings and single-family homes are handled by local agencies. Kentucky has a Building Inspectors Certification Program, mandated by the 1982 General Assembly, under which inspectors must pass appropriate examinations to become certified.

Communities with qualified personnel can petition to manage all building permit functions themselves. Six of the larger cities and counties (including Louisville, Lexington, and Jefferson County) have done so.

The state depends on design professionals to sign and take responsibility for their plans. The department does not have a structural engineer reviewing plans, so it is particularly important for seismic design that a structural engineer sign the plans. The code's implementation depends on having architects and engineers accept responsibility for their designs. This code creates a common standard for building professionals across the state, an aspect very important to a rural state in order to ensure compliance by smaller communities.

Permit applicants may appeal decisions for any reason, and all appeals receive a hearing from a panel selected from among the twenty-member board. This system has been effective in ensuring a fair process.

Massachusetts

Adoption and Revision

In the late 1800s the Massachusetts State Police was empowered to enforce various laws related to building safety. By the early 1900s many local municipalities had promulgated their own building regulations. As a result of the Coconut Grove fire in 1942 (490 dead), a committee appointed by the governor recommended the implementation of a mandatory state building code, but no action was taken. In 1945 a commission again recommended a state uniform building code. Instead, a State Board of Standards was established in the Department of Public Safety with authority to prepare and propose building regulations for adoption by local municipalities.

In 1971 the board of standards adopted and promulgated the State Board of Standards Building Code, which was the 1970 *BOCA Basic Building Code* with certain amendments. In 1972 the legislature established a State Building Code Commission with authority to develop and implement a statewide uniform building code. The first state building code was legislatively adopted in 1975 to consolidate the 351 different codes that existed throughout the state.

The Massachusetts State Building Code is administered by the State Board of Building Regulations. The state uses the *BOCA National Building Code* with many amendments.

Law requires the code to be updated at least every five years, but typically it is updated every two years. Changes to the code are based on local needs rather than BOCA's publication schedule. Every May and November public hearings are held and administered by members of the State Board of Building Regulations. Anyone within or

outside the state can propose changes.

Seismic Requirements

Seismic provisions have been adopted and enforced since the first edition of the state building code in January 1975. Just as with other code provisions, the State Board of Building Regulations votes to adopt seismic provisions and local municipalities enforce them. However, the responsibility for design is placed on registered professionals. Any building 35,000 cubic feet or larger must be designed by a qualified registered professional engineer or architect, and reviewers generally defer to them. Massachusetts also has a structural engineering peer review requirement for certain structures.

The State Board of Building Regulations has several advisory committees, including one for seismic issues. The seismic advisory committee consists of ten structural engineers who volunteer their knowledge and time to adapt BOCA's code to the state of Massachusetts. The board updated their building codes in February 1997 based on the 1993 *BOCA National Building Code* and the 1992 *NEHRP Provisions*.

The Massachusetts Emergency Management Agency and the Board of Building Regulations and Standards have conducted professional development workshops for building officials on seismic construction. Approximately 500 building officials have received ATC-20 training for post-earthquake evaluation of buildings.

Massachusetts recently enacted an amendment regarding seismic safety in existing buildings. Massachusetts has numerous unreinforced masonry buildings that not only existed prior to the adoption of a statewide code but are historical in nature. The amendment requires a seismic study to be conducted on any existing building that experiences a change in use, a change in the occupancy numbers, or is substantially remodeled. The code then provides for the level of seismic upgrading required. This amendment was made effective in February 1997.

Enforcement

Every municipality is required by law to appoint a building commissioner to administer and enforce the state code. Very small towns are permitted to regionalize under legislative provisions, but they must still be overseen by a building commissioner. There are 351 building commissioners within the state.

Since November 1992 Massachusetts law has required the certification of building officials. Certification requires an exam and forty-five hours of continuing education every three years. Because the system grandfathers current officials, it will take approximately ten years for the effects to become apparent in local practice.

The law places enforcement responsibility with local building departments, except for state-owned buildings. Administration of building codes and enforcement for such buildings are conducted by district state inspectors with the Department of Public Safety. There are twelve inspectors throughout the state, each being responsible for thirty to thirty-two cities within their specified jurisdictions. These inspectors also assist local building commissioners and inspectors when necessary.

Massachusetts has more than 600 building officials throughout the state. The actual number of plan reviewers and inspectors for each city depends on the size of municipalities; for example, Boston has twenty-five building officials.

The State Building Code Appeals Board, a three-member board consisting of members of the State Board of Building Regulations staff, holds appeals hearings twice a month. Local appeal boards are permitted by law,

FIGURE B.3 The first building code in South Carolina was a document developed by and for Charleston in 1907. (Photo: The Charleston Area Convention and Visitors Bureau)

but only three or four exist. Most appellants take their appeals to the state. The appeals board hears approximately six to eight cases per hearing. Written decisions are administered within thirty days after the hearing.

South Carolina

Adoption and Revision

South Carolina has no required statewide code. Rather, it permits local use of the *Standard Building Code* (SBC). The first building code within the state of South Carolina was a document developed by and for the city of Charleston in 1907. The city of Columbia followed with its own local building code in 1916. By the mid-1960s a variety of building codes were in use throughout the state with little consistency in construction requirements, causing great confusion among architects, engineers, contractors, and others.

By act of the South Carolina General Assembly on June 21, 1972, the state authorized the SBC as its first state-approved construction document. This legislation allowed voluntary adoption of this uniform code. When local jurisdictions adopt a code, it must be the SBC. Thus, this requirement has gradually phased out all other codes in the state. When adopting the SBC, local jurisdictions must adopt the latest code in print.

The legislation prohibits local amendments to the adopted building code without approval of the South Carolina Building Codes Council. This unique system was intended to develop consistency in construction practices as well as provide design professionals with a single set of methods that would be acceptable to all jurisdictions in the state. Approximately half of the local jurisdictions in the state have adopted the SBC. Codes must be updated within a year of the SBCCI's publication of the revised SBC, which occurs every three years.

Table B.1 South Carolina Code Enforcement

Jurisdiction Population	Avg. No. of Code Enforcement Officers Per Jurisdiction	Avg. Population Per One Code Enforcement Officer
< 1,000	1	485
1,000–10,000	1.38	3,645
10,000–25,000	2	7,472
25,000–50,000	4.8	7,363
50,000–100,000	7.81	9,302
> 100,000	10.86	13,547

Seismic Requirements

Local governments adopt and enforce the seismic requirements of the most recent SBC. Many building inspectors and plan reviewers, however, still are not familiar with the seismic provisions. They often leave compliance to the design engineer who signs and seals the plans. Most municipalities in South Carolina simply have the engineer sign an affidavit or require him or her to take full responsibility for seismic compliance. The code permits this policy.

Larger municipalities have more knowledgeable building code staff. They also have more money to spend on plan reviews. Charleston, for example, pays more attention to seismic provisions than do local governments elsewhere in the state.

Enforcement

The administration of codes is entirely at the local level. Smaller municipalities sometimes contract building code enforcement to a larger county jurisdiction. South Carolina has a total of 327 code enforcement officers, including both plan reviewers and code inspectors. Of that number, 228 are certified professionals. Local jurisdictions determine the necessary number of code enforcement officers based on intensity of local construction activity.

The director of South Carolina's Building Codes and Related Services provided some recent data on distribution of code enforcement personnel, shown in Table B.1.

All appeals go to the local board of appeals, and there is no recourse to the state. If the owner still is unsatisfied, he or she can proceed with legal action against the city or county.

Public building construction is administered by the State Engineers Office, except for public school construction, which is administered by the Office of School Planning, a branch of the Department of Education. Staff members are licensed or registered architects or engineers and are required to pass the Standard Building Code Test.

Utah

Adoption and Revision

Utah adopted the *Uniform Building Code* (UBC) in 1988. Prior to this date each municipality adopted their own code (usually some version of the UBC), and there was inconsistency among jurisdictions.

The code is mandated by state law and administered by the Department of Business Regulation. The state legislature established a Uniform Building Code Commission under the Department of Business Regulation to conduct code updates administratively. The Uniform Building Code Commission meets monthly to consider requests for code amendments. Amendments are published on March 1 and September 1 of each year for changes enacted during the preceding six-month period. Code updates usually occur the year following ICBO's publishing of a new UBC. For example, the 1991 UBC was adopted in January 1992 and the 1994 UBC was adopted in 1995.

Local jurisdictions require state approval to amend the code. The Uniform Building Code Commission determines if proposed local amendments will be adopted or rejected and, if adopted, whether such amendments will be statewide or enforced only by the local jurisdiction.

Seismic Requirements

Seismic provisions have been adopted and enforced statewide since 1988, when the UBC was adopted. Prior to that some cities had no code, while others had already adopted the UBC and thus

had seismic provisions. The UBC seismic requirements have been widely used in Utah since the mid-1970s.

Seismic regulations are adopted by the state, but they are enforced locally. Larger cities, such as Salt Lake City, have adequate knowledge of seismic provisions. However, some smaller municipalities do not adequately enforce the code or do not have qualified personnel. The lack of state oversight is sometimes a problem. Cities and counties do not enforce requirements for school district buildings. Rather, the school districts themselves are expected to meet the requirements of the UBC, which not all are prepared to do.

Enforcement

Local municipalities are fully responsible for the administration of building codes. While the state has no plan reviewers and no building inspectors, everyone who inspects construction projects must be licensed by the state, which ensures a certain level of competency from building code enforcers.

The state board of appeals gets involved with appeals in jurisdictions with no local building code of appeals. Most local municipalities, however, have their own building boards of appeals.

NOTES

1 McIntrye, Marle, ed., *Directory of State Building Codes and Regulations*, 4th ed., National Conference of States on Building Codes and Standards (Herndon, VA), May 1987; and National Conference of States on Building Codes and Standards, *Directory of Building Codes and Regulations, State Directory*, NCSBCS (Herndon, VA), 1994.

2 See the maps by Algermissen and Hopper in *Estimation of Earthquake Effects Associated with Large Earthquakes in the New Madrid Seismic Zone*, Hopper, M.G., ed., U.S. Geological Survey Open-File Report 85-457, 1984, 42-51.

INTERVIEWS

Arkansas:
Parks Hamon, State Building Services, Little Rock (Spring 1994); Dr. James Blacklock, Department of Engineering Technology, University of Arkansas, Little Rock (June 4, 1991); Lt. Ray Carnahan, Commander, Fire Marshal Section, Arkansas State Police, Little Rock (June 3, 1991); Dan Cicirello, Office of Emergency Services, Conway (June 3, 1991); John David McFarland, Chair of Governor's Earthquake Advisory Council and Senior Geologist, Arkansas Geological Commission, Little Rock (June 4, 1991); and Owen Miller, State Legislator, Marked Tree (May 22, 1991)

California:
Ed King, Chief of Housing Standards, Division of Codes and Standards, Department of Housing and Community Development, Sacramento (Spring 1994)

Kentucky:
Jack M. Rhody, Director, Division of Building Code Enforcement, Department of Housing, Buildings and Construction, Frankfort (Spring 1994); Mike Lynch, Division of Disaster and Emergency Services, Department of Military Affairs, Frankfort (May 2, 1991); Charles Cotton, Commissioner, Department of Housing, Buildings and Construction, Frankfort (May 2, 1991); and Professor Mike Cassaro, School of Engineering, University of Louisville (May 3, 1991).

Massachusetts:
Brian Gore, State Building Code Regulation, Boston (Spring 1994)

South Carolina:
Gary Wiggins, Director, South Carolina Building Codes and Regulatory Services, Columbia (Spring 1994)

Utah:
Lawrence Reavely, Department of Civil Engineering, University of Utah (Spring 1994); and Roger Evans, City of Salt Lake City, Building Permits (Spring 1994)

Appendix B: Sample Enabling Acts:

Arkansas
Kentucky
South Carolina
Utah

Arkansas

Arkansas Act 1100 (1991)—*Requiring Earthquake Resistant Design*

As Engrossed: 3/15/91 3/26/91

State of Arkansas
78th General Assembly
Regular Session, 1991
By: Representative O. Miller

HOUSE BILL 1577

For An Act To Be Entitled

"AN ACT TO SAFEGUARD LIFE, HEALTH AND PROPERTY BY REQUIRING EARTHQUAKE RESISTANT DESIGN FOR ALL PUBLIC STRUCTURES TO BE CONSTRUCTED OR REMODELED WITHIN THE BOUNDARIES OF THIS STATE BEGINNING SEPTEMBER 1, 1991."

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF ARKANSAS:

SECTION 1. It is the purpose of this act to protect the public by requiring that all public structures be designed and constructed to resist destructive forces when an earthquake occurs in the New Madrid Seismic Zone.

SECTION 2. Definitions. Whenever used in this act, unless a different meaning clearly appears from the context:

(a) "Owner" shall mean any agency of the state, county, city, township, town, village, or private entity, partnership, business or corporation.

(b) "Public Structure" means any building intended, or adaptable, for public employment, assembly, or any other use if it will be open to the public. Also included in this definition are certain building types as defined under the term "Public Works" projects.

(c) "Public Works" means works, whether of construction or adaptation, undertaken and carried out by the national, state, county, school district, or municipal authorities, and designed to serve some purpose of public necessity, use, or convenience; such as public buildings, road, aqueducts, parks, and all other fixed works constructed for public use. The term relates to the construction of public improvements and not to their maintenance or operation.

(d) "Add to" shall mean adding to existing buildings or structures more than four thousand (4000) square feet in gross floor area and all areas of increased building height.

(e) "Alter", "retrofit", and "remodel" means any alteration or repair of a building which when completed will increase the market value of the building by one hundred percent (100%) or more.

(f) "Seal" means the Arkansas seal issued to signify certification of registration to practice architecture or engineering.

(g) "Seismic" means pertaining to an earthquake or earth tremor (vibrations).

(h) "Structural Elements" shall mean all structural load carrying members of a building or structure required to transmit loads (forces) within the building or between the building and the ground.

SECTION 3. Seismic Zones Established. Areas within the boundaries of this State shall be divided into zones of anticipated damage that will occur in various locations with respect to the New Madrid Seismic Zone.

(a) Zone 3. Area of greatest anticipated seismic damage shall include the following counties: Clay, Greene, Craighead, Mississippi, Poinsett, Cross, Crittenden, St. Francis, Randolph, Lawrence, Jackson, Woodruff, and Lee.

(b) Zone 2. Area of moderate anticipated seismic damage shall include the following counties: Sharp, Independence, White, Lonoke, Prairie, Arkansas, Monroe, Phillips, Fulton, Izard, Stone, and Cleburne.

(c) Zone 1. Area of low anticipated seismic damage shall include all remaining counties within the boundaries of this State.

SECTION 4. Design Requirements. Hereafter, neither the state, any county, city, township, village or private entity shall construct, add to, alter, retrofit, or remodel any public structure unless the structural elements are designed to resist the anticipated forces of the designated seismic zone in which the structure is located. Design loads and seismic design requirements shall be, as a minimum, those listed in the chapter of Minimum Design Loads and Referenced Chapters from the Standard Building Code, 1988 or latest edition with revisions.

All construction plans for public buildings and structures shall comply with Arkansas Code 17-14-101 through 17-14-311. The design of structural elements of public buildings and structures shall be performed by a professional engineer registered in the State of Arkansas who is competent in seismic structural design according to current standards of technical competence. The structural plans of each public building or structure shall bear the Engineer's Arkansas seal and signature and a statement of reference to what Seismic Zone the structure is designed to satisfy.

SECTION 5. Exemptions. Certain building types such as single family residential, duplexes, triplexes, fourplexes, and agricultural structures shall not be included in the requirements of act.

SECTION 6. Violations and Penalties. Any owner knowingly constructing a public building with this State after September 1, 1991, without complying with the provisions of this act shall be guilty of a Class A misdemeanor and shall upon conviction, be sentenced to pay a fine of not less than one thousand dollars ($1,000). Each day of such unlawful construction practice shall constitute a distinct and separate offense.

SECTION 7. All provisions of this act of a general and permanent nature are amendatory to the Arkansas Code of 1987 Annotated and the Arkansas Code Revision Commission shall incorporate the same in the Code.

SECTION 8. If any provision of this act or the application thereof to any person or circumstance is held invalid, such invalidity shall not affect other provisions or applications of the act which can be given effect without the invalid provision of application, and to this end the provisions of this act are declared to be severable.

SECTION 9. All laws and parts of laws in conflict with this act are hereby repealed.

Approved by Governor Bill Clinton, April 9, 1991.

Kentucky

Kentucky Revised Statutes

CHAPTER 198B
HOUSING, BUILDINGS AND CONSTRUCTION—BUILDING CODE

198B.010. Definitions. — As used in this chapter, unless otherwise provided:

(1) "Assembly occupancy" means the occupancy or use of a building or structure or any portion thereof by a gathering of persons for civic, political, travel, religious, social or recreational purposes, including among others:

(a) Armories;
(b) Assembly halls;
(c) Auditoriums;
(d) Bowling alleys;
(e) Broadcasting studios;
(f) Chapels;
(g) Churches;
(h) Clubrooms;
(i) Community buildings;
(j) Courthouses;
(k) Dance halls;
(l) Exhibition rooms;
(m) Gymnasiums;
(n) Hotels;
(o) Lecture rooms;
(p) Lodge rooms;
(q) Motels;

(r) Motion picture theaters;
(s) Museums;
(t) Night clubs;
(u) Opera houses;
(v) Passenger stations;
(w) Pool rooms;
(x) Recreation areas;
(y) Restaurants;
(z) Skating rinks;
(aa) Television studios;
(bb) Theaters.

(2) "Attic" means the space between the ceiling beams of the top habitable story and the roof rafters.

(3) "Basement" means that portion of a building the average height of which is at least half below grade, which is ordinarily used for purposes such as storage, laundry facilities, household tools shops, and installation and operation of heating, cooling and ventilating facilities, but which is not ordinarily used for purposes of general household habitation.

(4) "Building" means any combination of materials, whether portable or fixed, which comprises a structure or non-mine underground area affording facilities or shelter for any human occupancy, whether infrequent or regular. The word "building" shall be construed wherever used herein as if followed by the words "or part or parts thereof and all equipment therein" unless the context clearly requires a different meaning. "Building" shall also mean swimming pools constructed below grade on site, but not swimming pools assembled above grade on site. "Building" shall not mean a mobile home, or a farm dwelling or other farm buildings and structures incident to the operation and maintenance of the farm if such farm structures are located outside the boundary of a municipality and are not used in the business of retail trade or used as a place of regular employment for ten (10) or more people or structures used in the storage or processing of timber products. This chapter shall not apply to any single family dwelling except those sold or constructed under a trade or brand name.

(5) Any city, county or urban-county government of the Commonwealth may extend, by ordinance, the application of this chapter to those single family dwellings exempted under subsection (4) of this section, but may not enforce any building code other than the uniform state building code on such dwellings.

(6) Nothing in this chapter shall be construed to exempt single family dwellings from those provisions of the uniform state building code that relate to the national electric code and the state plumbing code.

(7) "Business occupancy" means the occupancy or use of a building or structure or any portion thereof for the transaction of business, the rendering or receiving of professional services, or the displaying , selling or buying of goods, wares, or merchandise, or the housing of vehicles of transportation, except where occupancy is of high hazard, including among others:
(a) Banks;
(b) Barber shops;
(c) Beauty parlors;
(d) Department stores;
(e) Garages;
(f) Markets;
(g) Service stations;
(h) Offices;
(i) Stores;
(j) Radio stations;
(k) Telephone exchanges;
(l) Television stations.

(8) "Certified building inspector" means a person who has been certified by the department as having successfully completed the test requirements provided by KRS 198B.090 to practice as a city, county, or state building inspector within the Commonwealth.

(9) "Certified plans and specifications inspector" means a person who has been certified by the department as having successfully completed the test requirements provided by KRS 198B.090 to practice as a city, county, or state plans and specifications inspector within the Commonwealth.

(10) "Certified plumbing inspector" means a person who has been certified by the department as having successfully completed the test requirements provided by KRS 198B.090 and 318.140, or 318.090 to practice as a city, county, or state plumbing inspector within the Commonwealth.

(11) "Commissioner" means the commissioner of housing, buildings and construction.

(12) "Construction" means the erection, fabrication, reconstruction, substantial alteration or conversion of a building, or the installation of equipment therein, but shall not include the ordinary repair of a building or structure.

(13) "Department" means the department of housing, buildings and construction.

(14) "Educational occupancy" means the occupancy or use of a building or structure or any portion thereof by persons assembled for the purpose of learning or of receiving education instruction, including among others:
(a) Academies;
(b) Care centers;
(c) Colleges;
(d) Kindergartens;
(e) Libraries;
(f) Pre-schools;

Kentucky

(g) Relocatable classroom units;
(h) Schools;
(i) Seminaries;
(j) Universities.

(15) "Equipment" means facilities or installations, including but not limited to, heating, electrical, ventilating, air conditioning, and refrigerating facilities or installations.

(16) "High hazard occupancy" means the occupancy or use of a building or structure or any portion thereof that involves highly combustible, highly flammable or explosive materials or which has inherent characteristics that constitute a special fire hazard, including among others:
(a) Aluminum powder factories;
(b) Charging or filling stations;
(c) Distilleries;
(d) Dry cleaning plants;
(e) Dry dyeing plants;
(f) Explosive-manufacture, sale or storage;
(g) Flour and feed mills;
(h) Gasoline bulk plants;
(i) Grain elevators;
(j) Lacquer factories;
(k) Liquefied petroleum gas;
(l) Mattress factories;
(m) Paint factories;
(n) Pyroxylin-factories, or warehouses;
(o) Rubber factories.

(17) "Industrial occupancy" means the occupancy or use of a building structure or any portion thereof for assembling, fabricating, finishing, manufacturing, packaging or processing operations, except for occupancies of high hazard, including among others:
(a) Assembly plants;
(b) Creameries;
(c) Electrical substations
(d) Factories;
(e) Ice plants;
(f) Laboratories;
(g) Laundries;
(h) Manufacturing plants;
(i) Mills;
(j) Power plants;
(k) Processing plants;
(l) Pumping stations;
(m) Repair garages;
(n) Smokehouses;
(o) Workshops.

(18) "Industrialized building system" means any structure or component thereof which is wholly or in substantial part fabricated in an off-site manufacturing facility for installation or assembly on a permanent foundation at the building site.

(19) "Institutional occupancy" means the occupancy or use of a building or structure or any portion thereof by persons harbored or detained to receive medical, charitable or other care or treatment, or by persons involuntarily detained, including among others:
(a) Asylums;
(b) Homes for the aged;
(c) Hospitals;
(d) Houses of correction;
(e) Infirmaries;
(f) Jails;
(g) Nursing homes;
(h) Orphanages;
(i) Penal institutions;
(j) Reformatories;
(k) Sanitariums;
(l) Nurseries.

(20) "Mobile home" means the mobile home as defined in KRS 227.550(9).

(21) "Ordinary repair" means any nonstructural reconstruction or renewal of any part of an existing building for the purpose of its maintenance, or decoration, and shall include, but not be limited to, the replacement or installation of nonstructural components of the building such as roofing, siding, windows, storm windows, insulation, drywall or lath and plaster, or any other replacement, in kind, that does not alter the structural integrity, alter the occupancy or use of the building, or affect, by rearrangement, exitways and means of egress; but shall not include additions to, or alteration of, or relocation of any standpipe, water supply, sewer, drainage, gas, soil, waste, vent or similar piping, electric wiring or mechanical equipment, including furnaces and hot water heaters or other work affecting public health or safety.

(22) "Story" means that part of a building comprised between a floor and the floor or roof next above which is not a basement or an attic.

(23) "Physically handicapped person" means a person confined to a wheelchair; a person who uses braces or crutches; a person who because of the loss of a foot or leg or because of an arthritic, spastic, pulmonary or cardiac condition, walks with difficulty or insecurity; a person who suffers from a faulty coordination or palsy; a person who is blind or whose sight is so impaired that, functioning in a public area, he is insecure or exposed to danger; a person whose hearing is so impaired that he is unable to hear warning signals; and a person whose mobility,

flexibility, coordination and perceptiveness are significantly reduced by aging.

(24) "Facility for physically handicapped person" means any convenience or device which facilitates the health, safety or comfort of a handicapped person, including, but not limited to, ramps, handrails, elevators, and doors. (Enact. Acts 1978, ch. 117, sec. 1, effective June 17, 1978; 1980, ch. 361, sec. 1, effective July 15, 1980; 1982, ch. 189, sec. 1, effective July 15, 1982; 1982, ch. 308, sec. 1, effective July 15, 1982.)

198B.020. Board of housing, buildings and construction. — (1) There is hereby created the Kentucky board of housing, buildings and construction within the Kentucky department of housing, buildings and construction comprised of twenty (20) members to include: the commissioner of the department, one (1) local government fire chief selected by the governor from a list of three (3) submitted by the Kentucky firemen's association; the executive director of the Kentucky housing corporation; the commissioner of the department of health services, cabinet for human resources; the attorney general or any assistant attorney general he may designate to represent the interests of consumers; one (1) professional homebuilder selected by the governor from a list of three (3) submitted by the home builders association of Kentucky; one (1) registered architect selected by the governor from a list of three (3) submitted by the Kentucky society of architects; one (1) registered structural engineer selected by the governor from a list of three (3) submitted by the Kentucky society of professional engineers; one (1) registered electrical engineer selected by the governor from a list of three (3) submitted by the Kentucky society of professional engineers; one (1) citizen member selected by the governor to represent the interests of low and moderate income housing consumers within the Commonwealth of Kentucky; one (1) citizen member at large; one (1) practicing general contractor selected by the governor from a list of three (3) submitted by the Kentucky association of general contractors; one (1) practicing code administrator selected by the governor from a list of three (3) submitted by codes administrators association of Kentucky; one (1) realtor selected by the governor from a list of three (3) submitted by the Kentucky association of realtors; one (1) member selected by the governor from a list of three (3) submitted by the Kentucky state building trades council; one (1) member selected by the governor from a list of three (3) submitted by the mechanical contractors association; one (1) electrical contractor member selected by the governor from a list of three (3) submitted by the national electrical contractors association; and one (1) retailer member selected by the governor from a list of three (3) submitted by the Kentucky retail federation.

(2) Except for the commissioner of the department, the commissioner of the department of health services, the executive director of the Kentucky housing corporation and the attorney general or his designee who shall serve on the board during the term of their existing office and shall be voting members, board members shall be appointed for four (4) year terms, except that initially four (4) shall be appointed for two (2) year terms, four (4) shall be appointed for three (3) year terms, and six (6) shall be appointed for four (4) year terms. No board member shall be appointed for more than one (1) successive term except as provided in subsection (3) of this section. The governor shall, within the limitations of this subsection, set the length of term of each of the initial appointees to the board.

(3) Vacancies occurring on the board among those members appointed by the governor shall be filled by seeking nominations as in subsection (1) of this section from the organization which originally nominated the member who is to be replaced. A replacement for a board member shall be appointed immediately upon the expiration of the departing board member's term of service. Should a board member vacate his position on the board prior to the expiration of his term, his replacement shall be appointed for the period of the unexpired term. Should the unexpired term be less than two (2) years, the person selected to fill the unexpired term may subsequently be appointed to one (1) successive four (4) year term.

(4) Members may be removed from the board by the governor for unethical conduct or for failure to attend three (3) or more successive meetings of the board without reasonable cause.

(5) The board shall meet at least quarterly, and the first meeting shall occur no later than August 31, 1978. Before assuming their duties, members of the board shall take an oath as specified in section 228 of the Constitution of Kentucky.

(6) The commissioner of the department shall serve as chairman of the board. The board may elect from its members other officers as are required to conduct its business, except that neither the commissioner of the department for health services, the executive director of the Kentucky housing corporation nor the attorney general or his designee shall be elected to office on the board.

(7) The board may adopt such rules, regulations and bylaws as are necessary to conduct its internal business.

(8) No member of the board may vote on any matter which will result in his direct or indirect financial gain.

Kentucky

(9) Those members of the board who are not salaried governmental employees shall be compensated for their time when attending board meetings or attending to official duties as directed by the board at the rate of fifty ($50) per day. All board members shall be compensated for expenses incurred in the conduct of board business. (Enact. Acts 1978, ch. 117, sec. 2, effective June 17, 1978; 1980, ch. 82, sec. 1, effective July 15, 1980; 1982, ch. 270, sec. 1, effective July 15, 1982; 1986, ch. 331, sec. 32, effective July 15, 1986.)

198B.030. Department of housing, buildings and construction. — (1) There is hereby created the Kentucky department of housing, buildings and construction within the cabinet for public protection and regulation. The governor shall appoint a commissioner to head the department by July 1, 1978. The commissioner shall receive for his services such compensation as the governor shall determine.

(2) The commissioner may employ sufficient staff to carry out the functions of his office. Neither the commissioner nor any member of his staff shall be employed, either directly or indirectly, in any aspect of the building industry as regulated by this chapter while employed by the department of housing, buildings and construction.

(3) The department shall serve as staff for the board of housing, buildings and construction as established by this chapter, and shall perform all budgeting, procurement, and other administrative activities necessary to the functioning of this body. The board shall prescribe the duties of the commissioner in addition to those duties otherwise delegated to it by the governor or prescribed for him by law.

(4) The department may enter into contracts with the federal government, other agencies of state government or with its subdivisions, or with private profit or nonprofit organizations in order to effect the purposes of this chapter.

(5) Subject to the direction of the board of housing, buildings and construction, the commissioner shall cooperate with the agencies of the United States and with the governing bodies and housing authorities of counties, cities, and with nonprofit organizations and area development districts in relation to matters set forth in this chapter, and in any reasonable manner that may be necessary for the state to qualify for, and to receive grants or aid from such agencies. To these ends and subject to the direction of the board, the commissioner shall have the power to comply with each condition and execute such agreements as may be necessary, convenient, or desirable.

(6) Nothing in this chapter shall preclude any other agency, board, or officer of the state from being designated as the directing or allocating agency, board, or officer for the distribution of federal grants and aid, or their performance of other duties to the extent necessary to qualify for and to receive grants and aid for programs under the administration of the department.

(7) The commissioner is authorized to receive, for and on behalf of the state, the department, and the board of housing, buildings and construction, from the United States and agencies thereof, and from any and all other sources, grants and aid and gifts made for the purpose of providing, or to assist in providing, any of the programs authorized by this chapter, including expenses of administration. Al such funds shall be paid into the state treasury and credited to a trust and agency fund to be used by the department in carrying out the provisions of this chapter. No part of this fund shall revert to the general fund of the Commonwealth. (Enact. Acts 1978, ch. 117, sec. 3, effective June 17, 1978.)

198B.035. Transfer of other agency functions to department. — There are hereby transferred and vested in the Department of Housing, Buildings and Construction, office of the Fire Marshal or its successor agency, all functions, powers and duties, funds, personnel, equipment and supplies now vested in the Commission on Fire Protection Personnel Standards and Education (KRS Chapter 95A), and in the Department of Public Safety as follows:

Fire department aid (KRS 17.210 to 17.270); safety glazing (KRS 17.410 to 17.440 and 17.990); boiler safety (KRS Chapter 236); dry cleaning and dyeing (KRS Chapter 228); fire prevention and protection (KRS 227.200 to 227.410); and transportation of hazardous substances (KRS Chapter 234). (Enact. Acts 1974, ch. 74, Art. V, sec. 20; 1980, ch. 188, sec. 243, effective July 15, 1980.)

198B.040. General powers and duties of the board. — The Kentucky board of housing, buildings and construction shall have the following general powers and duties:

(1) To conduct or cause to be conducted studies to determine the needs of the building industry of Kentucky;

(2) To conduct or cause to be conducted or participate in studies of the costs of the various factors of building construction and uses of buildings; and to

recommend programs and procedures which will minimize the cost of buildings, including the use of energy, while maintaining safety, durability and comfort;

(3) To administer regulatory legislation relating to buildings and construction;

(4) To assume administrative coordination of the various state construction review programs and to cooperate with various federal, state and local agencies in the programs as they relate to buildings and construction;

(5) To assume administration and coordination of various state housing programs to include:

(a) Devising and implementing procedures, in conjunction with the department of local government, for attaining and maintaining an accurate count of the housing inventory in Kentucky, including information on the age, physical condition, size, facilities and amenities of such housing, and housing constructed and demolished each year;

(b) Designing programs coordinating the elements of housing finance, production, maintenance and rehabilitation for the purpose of assuring the availability of safe, adequate housing in a healthful environment for all Kentucky citizens;

(c) Establishing or causing to be established public information and educational programs relating to housing, to include informing Kentucky citizens about housing and housing related programs that are available on all levels of government;

(d) Designing and administering, or participating in the design and administration of educational programs to prepare low income families for home ownership, and counseling them during their early years as home-owners;

(e) Promoting educational programs to assist sponsors in the development and management of low and moderate income housing for sale or rental;

(f) Cooperating with various federal, state and local agencies in their programs as they relate to housing;

(g) Conducting or causing to be conducted studies to determine the housing preferences of Kentucky citizens and the present and future housing requirements of the state;

(6) To recommend state building industry policies and goals to the Kentucky general assembly;

(7) To adopt and promulgate a mandatory uniform state building code, and parts thereof, which shall establish standards for the construction of all buildings, as defined in KRS 198B.010, in the state;

(8) To issue regulations providing for the proper construction of public water purification plants, other than the water treatment equipment and systems in such plants, provided, however, that any such regulations must require that applications for permits to build public water purification plants will be submitted by the department to the natural resources and environmental protection cabinet for that cabinet's comments. Any such regulations shall require the natural resources and environmental protection cabinet's comments to be completed and submitted to the department within sixty (60) days;

(9) To issue regulations providing for the proper construction of sewage treatment plants, other than the sewage treatment equipment and systems in such plants, provided, however, that any such regulations must require that applications for permits to build sewage treatment plants will be submitted by the department to the natural resources and environmental protection cabinet for that cabinet's comments. Any such regulations shall require the natural resources and environmental protection cabinet's comments to be completed and submitted to the department within sixty (60) days; and

(10) To issue regulations for the safe installation and operation of plumbing and plumbing fixtures. (Enact. Acts 1978, ch. 117, sec. 4, effective June 17, 1978.)

198B.050. Uniform state building code. — (1) Within one (1) year from its initial meeting, after adequate notice in accordance with KRS Chapter 13A, the board shall adopt and promulgate a mandatory uniform state building code which shall establish standards for the construction of all buildings, as defined in KRS 198B.010, in the state. The code shall provide that the review and approval, as necessary, of building plans for conformance with the uniform state building code prior to construction approval shall be conducted only by the department of a local government or governments delegated such responsibilities by this chapter, and any exceptions to this policy shall be explicitly stated in the code.

(2) The code shall be comprehensive and shall include but not be limited to provisions for general construction; structural quality; mechanical systems to include heating, cooling, and ventilation; electrical systems; and life safety from hazards of fire, explosion, and other disasters, whether caused by acts of nature or man. The code shall encompass the Kentucky State Plumbing Code promulgated pursuant to KRS 318.130, boiler rules and regulations issued pursuant to KRS 236.030, and the national electrical code.

(3) This code shall be designed after and may be selected from the models offered by such model code agencies as the Building Officials and Code Administrators, International, Inc.; the International Conference of Building Officials; the Southern

Kentucky

Building Code Congress; and other nationally recognized organizations which may include governmental agencies. The code shall:

(a) Provide uniform standards and requirements for construction and construction materials;

(b) To the extent practicable, set forth standards, specifications and requirements in terms of performance objectives, so as to facilitate the use of new technologies, techniques, and materials. The code shall not discriminate in favor of particular suppliers' materials, techniques, or technologies;

(c) Protect the public health, safety, and welfare within the state.

(4) Adoption of a code shall include provisions for the continuing review of, and the board shall adopt when deemed justified to fulfill the purposes of this chapter, new materials, technologies, and techniques in the building industry. The board may adopt a model code promulgated by a model code agency only if that agency provides a method for democratic participation by the board and any local governments which may enforce the code, in a continuing review and possible adoption of new materials, technologies, and techniques in the building industry.

(5) The board shall issue regulations, after notice in accordance with KRS Chapter 13A, which are necessary to implement the uniform state building code or to carry out any other responsibility assigned to said board by this chapter.

(6) The board shall monitor the effectiveness of agencies designated by local governments to enforce the provisions of the uniform state building code.

(7) If the board determines that any agency is not enforcing the provisions of the uniform state building code, it shall direct the department to determine where deficiencies exist. The department shall require the local government to correct the deficiencies within sixty (60) days and report to the department its method of correcting the deficiencies.

(8) If the local government fails to correct the deficiencies, the department shall recommend to the board that the department be permitted to preempt the local program as provided for in KRS 198B.060(4).

198B.060. Economic security and public welfare. — (9) The board shall provide for the supply, including amendments and revisions thereto, of sufficient copies of the uniform state building code for all interested parties. (Enact. Acts 1978, ch. 117, sec. 5, effective June 17, 1978; 1982, ch. 308, sec. 2, effective July 15, 1982.)

South Carolina

An act to amend Chapter 9, Title 6, Code of Laws of South Carolina, 1976, relating to building codes, so as to revise the requirements and methods of adoption, the application, scope, and exceptions, and for the enforcement of these codes; to provide for appointment of building officials and establishment of building programs; to provide for adoption of building codes and standards by state agencies, and the application of local ordinances, regulations, and standards to certain state and school district construction projects, and to farm structures; to provide for the membership and duties of the South Carolina Building Codes Council and for the duties of the State Fire Marshal and State Engineer in connection with certain projects; to amend the 1976 Code by adding Chapter 8 to Title 6 so as to provide for building codes enforcement officers and for their functions, duties, and registration; by adding Section 38-7-35 so as to provide that the first one hundred fifty thousand dollars of revenue collected pursuant to Section 38-7-30 must be used for the purpose of implementing the training, certification, and continuing education program for building codes enforcement officers; to amend Chapter 75 of Title 38 by adding Article 8 so as to provide for the Advisory Committee to the Director and the South Carolina Building Codes Council and Loss Mitigation Grant Program; to provide that Chapter 10 of Title 6 is not applicable in counties or municipalities that fully have implemented building codes required by Section 6-9-10; and to declare the public policy of South Carolina pertaining to maintaining reasonable standards of construction in this state.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF SOUTH CAROLINA:

Building codes revised

SECTION 1. Chapter 9, Title 6 of the 1976 Code is amended to read:

CHAPTER 9

Building Codes

Section 6-9-10. All municipalities, as defined by Section 5-1-20, and counties in this State shall adopt building, energy, electrical, plumbing, mechanical, gas, and fire codes, referred to as building codes in this chapter, relating to the construction, livability, sanitation, erection, energy efficiency, installation of equipment, alteration, repair, occupancy, or removal of structures located within their jurisdictions and promulgate regulations to implement their enforcement. The municipality or county may adopt only the national, regional, or model codes provided in Section 6-9-50.

With the exception of structures used primarily for offices, storage, warehouses, shop areas, or residential housing, nothing in the building codes or regulations applies to electric cooperatives, the Public Service Authority, or to a public utility corporation subject to regulation by the authorities of the South Carolina Public Service Commission or the Liquefied Petroleum Gas Board.

To the extent that federal regulations preempt state and local laws, nothing in this chapter shall conflict with the federal Department of Housing and Urban Development regulations regarding manufactured housing construction and installation.

South Carolina

Section 6-9-20. Municipalities and counties may establish agreements with other governmental entities of the State to issue permits and enforce building codes in order to provide the services required by this chapter. The South Carolina Building Codes Council may assist in arranging for municipalities, counties, or consultants to provide the services required by this chapter to other municipalities or counties if a written request from the governing body of the municipality or county is submitted to the council. If a municipality or county determines that it is unable to arrange for services for any annual period at costs totally within the schedule of fees recommended in the appendixes to the building codes referred to in Section 6-9-50, the municipality or county shall submit an affidavit to the council to be exempt from the requirements of this chapter. If such an affidavit is submitted, the municipality or county is exempt from the requirements of this chapter, which exemption is effective until such time as it becomes financially feasible for a county or municipality to provide the services, or five years, whichever is less. A county or municipality may renew its affidavit at the end of five years and at each five-year interval thereafter if it makes another determination that it cannot arrange for services at costs totally within the schedule of fees recommended in the building codes referred to in Section 6-9-50.

Section 6-9-30. Each county shall appoint a building official or contract with other political subdivisions as authorized in Section 6-9-20 so that the unincorporated area of the county is under the jurisdiction of a building official. Each municipality shall appoint a building official or contract for a building official within the municipal limits. Based on the needs established by each municipality or county, the building official or appointing authority may appoint and employ other personnel and assistants necessary to perform the required inspections and duties and may prescribe fees for construction permits and inspections. The appointment of a building official and the establishment of a building inspection program for all municipalities and counties must be accomplished according to the following dates and populations based on the population figures of the latest official United States Census:

(1) municipalities and counties with a population above 70,000: one year after the effective date of this provision;

(2) municipalities and counties with a population of 35,000 to 70,000: two years after the effective date of this provision;

(3) municipalities and counties with a population under 35,000: three years after the effective date of this provision.

Section 6-9-40. The building codes and standards referenced in Section 6-9-50 must be adopted within six months after the establishment of a building inspection department. State agency adoption of a building code or regulation permitted by this chapter must be accomplished in accordance with the Administrative Procedures Act.

Section 6-9-50. (A) Municipalities and counties shall adopt by reference only those provisions of the latest editions of the following nationally known codes and the standards referenced in the codes for regulation of construction which directly relate to building and safety standards within their respective jurisdictions: Standard Building Code, Standard Gas Code, Standard Plumbing Code, Standard Mechanical Code, the Standard Fire Prevention Code, as published by the Southern Building Code Congress International, Inc., the Model Energy Code, as published by the Council of American Building Officials, and the National Electrical Code, as published by the National Fire Protection Association. The appendixes of the codes provided in this section may be adopted as needed by a municipality or county, but this fact must be referenced by name or letter designation in the adoption ordinance. However, the provisions of the codes referenced in this section which concern the qualification, removal, dismissal, duties, responsibilities of, and administrative

procedures for all building officials, deputy building officials, chief inspectors, other inspectors, and assistants do not apply unless they have been adopted by the municipal or county governing body.

(B) The governing body of a county may not enforce that portion of a nationally recognized fire prevention code it has adopted which may regulate outdoor burning for forestry, wildlife, and agricultural purposes as regulated by the South Carolina Forestry Commission.

(C) A residential building is considered in compliance with the Building Envelope Requirements of the Model Energy Code if:

(1) it is built in compliance with prescriptive standards issued by the South Carolina Residential Builders Commission, in consultation with the State Energy Office, based on computer models of the Model Energy Code including, but not limited to, options developed by Pacific Northwest National Laboratories for South Carolina's climatic zones, or

(2) if double pane or single pane with storm windows are used for window glass and in the case of ceilings, exterior walls, floors with crawl space, and heating and air conditioning duct work, the determination of the minimum thermal resistance ratings (R-value) is:

(a) R-30 for ceilings, except for ceiling/roof combinations, which must be at least R-19;

(b) R-13 for exterior walls;

(c) R-19 for floors with crawl space;

(d) R-6, or the installed equivalent, for heating and air conditioning duct work not located in conditioned space.

Section 6-9-60. (A) Municipalities and counties may adopt by reference only those provisions of the latest editions of the following nationally known codes and the standards referenced in the codes for regulation of construction which directly relate to building and safety standards within their respective jurisdictions: Standard Housing Code, Standard Existing Building Code, Standard Swimming Pool Code, the Standard Excavation and Grading Code, as published by the Southern Building Code Congress International, Inc., and the One and Two Family Dwelling Code, as published by the Council of American Building Officials. The appendixes of the codes provided in this section may be adopted as needed by a municipality or county, but this fact must be referenced by name or letter designation in the adopting ordinance. However, the provisions of the codes referenced in this section which concern the qualification, removal, dismissal, duties, responsibilities of, and administrative procedures for all building officials, deputy building officials, chief inspectors, other inspectors, and assistants do not apply unless they have been adopted by the municipal or county governing body. If a county or municipality adopts the One and Two Family Dwelling Code, the One and Two Family Dwelling Code shall take precedence over the Standard Building Code for dwellings as defined in the Standard Building Code. If a municipality or county contends that the codes authorized by this chapter do not meet its needs due to local physical or climatological conditions, the variations and modifications must be submitted for approval to the South Carolina Building Codes Council of fifteen members which is established in this section.

(B) Members of the council must be appointed by the Governor for terms of four years each and until a successor is appointed and qualifies. The council shall consist of (1) an architect registered in South Carolina, (2) a municipal administrator, manager, or elected official, (3) a county administrator, manager, or elected official, (4) a representative of the electrical industry who is either an engineer or master electrician registered in South Carolina, (5) a general contractor licensed in South Carolina, (6) a residential home builder licensed in South Carolina, (7) a disabled person, (8) a representative of the mechanical and gas industries who is either an engineer registered in South Carolina or a master mechanic, (9) a representative of the plumbing industry who is either an engineer registered in South Carolina or a master plumber, (10) a representative

South Carolina

designated by the State Engineer of the Budget and Control Board, (11) a structural engineer registered in South Carolina, (12) a representative of the general public who is not in the practice of home or safety inspection, construction, or building, who does not have any financial interest in these professions, and who does not have any immediate family member in these professions, (13) a representative designated by the State Fire Marshal, (14) a representative from the Manufactured Housing Institute of South Carolina who shall serve as a nonvoting member, and (15) a representative designated by the Director of the State Energy Office of the Budget and Control Board who shall serve as a nonvoting member. A vacancy must be filled in the manner of the original appointment for the unexpired portion of the term. The primary function of the council is to decide to what extent a jurisdiction may vary from the series of codes listed in this chapter in the establishment of construction standards. The council shall monitor the adoption of building codes by municipalities and counties to ensure compliance with this chapter. Members of the council shall receive mileage, subsistence, and per diem as provided for other state boards, committees, or commissions for attendance at board meetings called by the chairman. The council shall elect from its members a chairman, vice-chairman, and secretary. The council shall adopt regulations consistent with this chapter. Meetings may be called by the chairman on his own initiative and must be called by him at the request of three or more members of the council. All members must be notified by the chairman in writing of the time and place of meeting at least seven days in advance of the meeting. Seven members constitute a quorum. All meetings are open to the public. At least two-thirds vote of those members in attendance at the meeting constitutes an official decision of the council.

Section 6-9-65. (A) For purposes of this section, 'farm structure' means a structure which is constructed on a farm, other than a residence or a structure attached to it, for use on the farm including, but not limited to, barns, sheds, and poultry houses, but not public livestock areas. For purposes of this section, 'farm structure' does not include a structure originally qualifying as a 'farm structure' but later converted to another use.

(B) The governing body of a county or municipality may not enforce that portion of a nationally recognized building code it has adopted which regulates the construction or improvement of a farm structure. The standards published by the Federal Emergency Management Agency for the National Flood Insurance Program shall apply.

(C) The provisions of this section do not apply unless before constructing a farm structure the person owning the property on which the structure is to be constructed files an affidavit with the county or municipal official responsible for enforcing the building code stating that the structure is being constructed as a farm structure. The affidavit must include a statement of purpose or intended use of the proposed structure or addition.

(D) This section does not affect the authority of the governing body of a county or municipality to issue building permits before the construction or improvement of a farm structure.

Section 6-9-70. (A) A person found to be in violation of the building codes or regulations adopted pursuant to the provisions of this chapter must be fined, by civil fine, in an amount not more than two hundred dollars. Each day the violation continues is a separate offense. However, this provision does not prevent a county or municipality from exercising its authority to impose by ordinance criminal sanctions of a fine of not more than two hundred dollars or imprisonment for not more than thirty days in lieu of the civil penalties required by this provision.

(B) However, before being charged with a second violation, an individual must be given seven calendar days to remedy the violation if in the opinion of the inspector or official it does not place the public in imminent danger or create an emergency situation. Each day a violation continues is a separate offense if the inspector or official determines the situation places the public in imminent

danger or creates an emergency situation. In a situation which does not place the public in imminent danger or create an emergency situation, if in the opinion of the inspector or official no substantial progress is made toward correcting the violation by the end of the seventh calendar day, each day the violation continues thereafter is considered a separate offense.

Section 6-9-80. For a violation of the building codes or regulations adopted pursuant to this chapter, the local building officials, municipal or county attorneys, or other appropriate authorities of a political subdivision, or an adjacent or neighboring property owner who would be damaged by the violation, in addition to other remedies, may apply for injunctive relief, mandamus, or other appropriate proceeding.

Section 6-9-90. Notwithstanding any other provision of law, the governing body of a county or municipality may impose fees necessary to implement and continue the programs required by this chapter upon a vote of a simple majority of the governing body unless (1) a super majority vote is required by local ordinance, or (2) prior to December 1, 1998, the General Assembly specifically amends, repeals, or otherwise affects this law by direct reference to this section, or (3) after November 30, 1998, the General Assembly provides otherwise by law.

Section 6-9-100. The provisions of this chapter are cumulative to other local ordinances and do not limit the authority of counties or municipalities.

Section 6-9-110. (A) A county, municipal, or other local ordinance or regulation which requires the purchase or acquisition of a permit, license, or other device utilized to enforce any building standard does not apply to a:

(1) state department, institution, or agency permanent improvement project, construction project, renovation project, or property; or

(2) school district facility, permanent improvement project, construction project, renovation project, or property which is reviewed and approved by the State Department of Education; except that the State Department of Education or a local school district may direct that the local ordinance or regulation apply to a particular facility, project, or property.

(B) After successful completion of all requirements, the State Fire Marshal shall certify personnel of the State Engineer's Office of the Budget and Control Board designated by the State Engineer. The certified personnel and deputy state fire marshals, including resident state fire marshals, have exclusive jurisdiction over state buildings, including schools, in the exercise of the powers and jurisdictional authority of the State Fire Marshal under Sections 23-9-30, 23-9-40, and 23-9-50.

Section 6-9-120. Nothing in this chapter affects water or sewer systems in this State.

Section 6-9-130. Buildings must be inspected according to the codes in effect for the locality on the date of the issuance of the building permit.

Building Codes Council membership terms

SECTION 2. Members of the South Carolina Building Codes Council serving in office on the effective date of this act whom the Governor determines possess those qualifications required by Section 6-9-60 and, if applicable, represent an entity required to be represented by Section 6-9-60 shall continue to serve until their current terms of office expire. The terms of all other members shall expire on the effective date of this act at which time, their successors shall be appointed by the Governor in the manner provided by Section 6-9-60.

Building Codes Enforcement Officers

South Carolina

SECTION 3. Title 6 of the 1976 Code is amended by adding:

CHAPTER 8
Building Codes Enforcement Officers

Section 6-8-10. When used in this chapter 'building codes enforcement officer' means a person employed by a public entity who is primarily responsible for the overall inspection or enforcement of applicable building code requirements within the jurisdiction of the employer.

Section 6-8-20. (A) The South Carolina Building Codes Council is responsible for the registration of building codes enforcement officers pursuant to this chapter. The council or its designated representatives may conduct hearings and proceedings required by law or considered necessary by the council. The Department of Labor, Licensing and Regulation shall employ and supervise personnel necessary for the administration of this chapter. The council may promulgate regulations for the proper enforcement of this chapter.

(B) The council shall keep a record of its hearings and proceedings and a register of applications for the certificates of registration showing the date of application, name, qualifications, and addresses of the business and residence of the applicant and whether the certificate is approved or denied. The council shall publish biannually during odd-numbered years the applications in the register which are approved. Applicants and registrants shall notify the council of changes in required information within ten days of a change.

Section 6-8-30. (A) Certificates of registration may be issued without examination to building codes enforcement officers employed in codes enforcement on the effective date of this chapter only for the position and locality held at the time of registration pursuant to this section. This registration is valid for two years and may be renewed.

(B) Upon initial employment by a political subdivision, an individual must be granted a provisional certificate of registration without examination which is valid for one year from the date of issuance. The provisional certificate of registration may not be renewed.

Section 6-8-40. No person may practice as a codes enforcement officer in this State unless registered as provided in this chapter. A person violating the provisions of this chapter is guilty of a misdemeanor and, upon conviction, must be fined not more than two hundred dollars or imprisoned not more than thirty days. Each day the violation continues is a separate offense.

Section 6-8-50. If the council has reason to believe that a person is violating or intends to violate a provision of this chapter, in addition to other remedies, it may order the person immediately to refrain from the conduct. The council may apply to the court of common pleas for an injunction restraining the person from the conduct. The court may issue a temporary injunction ex parte not to exceed ten days and upon notice and full hearing may issue other orders in the matter it considers proper. No bond is required of the council by the court as a condition to the issuance of an injunction or order pursuant to this section.

Section 6-8-60. (A) A person desiring to be registered as a building codes enforcement officer as required by this chapter shall apply upon a form prescribed by the council.

(B) An applicant shall furnish satisfactory proof to the council of valid certification by a recognized code organization or testing agency in the general or special capacity in which he desires to be registered. Special certificates of registration authorize the registrant to practice in the named specialty only. General certificates of registration are not restricted. The council or its designated representatives shall review the guidelines employed by the organization or agency

in order to determine their continued compatibility with the requirements considered by the council to be consistent with this chapter.

(C) A local jurisdiction may impose additional requirements upon a person employed as a building codes enforcement officer in its jurisdiction.

Section 6-8-70. (A) A certificate of registration is valid for two years and expires on July first of each odd-numbered year unless renewed before that date. Renewal of all registrations must be based upon a determination by council of the applicant's participation in approved continuing education programs. The council must promulgate regulations setting forth the continuing education requirements for building codes enforcement officers. A person failing to make timely renewal of his certificate is not registered unless qualified in the manner provided for new registrants and may not practice until registered in accordance with this chapter.

(B) Funding for the certification, training, and continuing education of building code enforcement officers must be appropriated to the Department of Labor, Licensing and Regulation in the manner provided in Section 38-7-35.

Building Codes Enforcement Officers' training

SECTION 4. The 1976 Code is amended by adding:

Section 38-7-35. (A) The first one hundred and seventy-five thousand dollars of the revenue collected annually pursuant to Section 38-7-30 must be transferred to the Department of Labor, Licensing and Regulation for the purpose of implementing the training, certification, and continuing education program for building codes enforcement officers as provided in Section 6-8-70 and by law.

(B) The Department of Labor, Licensing and Regulation shall report annually to the Chairman of the Senate Finance Committee and the Chairman of the House Ways and Means Committee detailing actual program expenditures including, but not limited to, the number of instructors employed, the number of training sessions conducted, and the number of certifications issued. This report must be submitted to the respective chairmen no later than January fifteenth of each year.

(C) One hundred thousand dollars of the revenue collected annually pursuant to Section 38-7-30 must be transferred to the Department of Insurance for the purpose of implementing the program as provided in Section 38-75-480.

(D) Subsection (C) of this section ceases to be of any force or effect after June 30, 2002.

Advisory committee to Building Codes Council

SECTION 5. Chapter 75 of Title 38 of the 1976 Code is amended by adding:

ARTICLE 8
Advisory Committee to the Director and the South Carolina Building Codes Council and Loss Mitigation Grant Program

Section 38-75-470. The Director of Insurance shall appoint an advisory committee to the director and the South Carolina Building Codes Council to study issues associated with the development of strategies for reducing loss of life and mitigating property losses due to hurricane, earthquake, and fire. The advisory committee also must consider the costs associated with these strategies to individual property owners. The advisory committee must include:

(1) one representative from Clemson University involved with wind engineering;

South Carolina

(2) one representative from an academic institution involved with the study of earthquakes;
(3) one representative from the Department of Insurance;
(4) one representative from an insurer writing property insurance in South Carolina;
(5) one representative from the Department of Commerce;
(6) one representative from the Federal Emergency Management Association;
(7) one representative from the Homebuilders Association;
(8) one representative from the Manufactured Housing Institute of South Carolina;
(9) one representative from the State Fire Marshal's office;
(10) two at-large members appointed by the director; and
(11) two at-large members appointed by the Governor.

Members shall serve for terms of two years and shall receive no per diem, mileage, or subsistence. Vacancies must be filled in the same manner as the original appointment.

Within thirty days after its appointment, the advisory committee shall meet at the call of the Director of Insurance. The advisory committee shall elect from its members a chairman and a secretary and shall adopt rules not inconsistent with this chapter. Meetings may be called by the chairman on his own initiative and must be called at the request of three or more members of the advisory committee. All members shall be notified by the chairman of the time and place of the meeting at least seven days in advance of the meeting. All meetings must be open to the public. At least two-thirds vote of those members in attendance at the meeting shall constitute an official decision of the advisory committee.

Section 38-75-480. (A) There is established within the Department of Insurance a loss mitigation grant program. Funds may be appropriated to the grant program, and any funds so appropriated shall be used for the purpose of making grants to local governments or for the study and development of strategies for reducing loss of life and mitigating property losses due to hurricane, earthquake, and fire. Grants to local governments shall be for the following purposes:

(1) implementation of building code enforcement programs including preliminary training of inspectors; and

(2) conducting assessments to determine need for and desirability of making agreements to provide enforcement services pursuant to Section 6-9-60.

Funds may be appropriated for a particular grant only after a majority affirmative vote on each grant by the advisory committee.

(B) The Department of Insurance may make application and enter into contracts for and accept grants in aid from federal and state government and private sources for the purposes of:

(1) implementation of building code enforcement programs including preliminary training of inspectors;

(2) conducting assessments to determine need for and desirability of making agreements to provide enforcement services pursuant to Section 6-9-60; and

(3) study and development of strategies for reducing loss of life and mitigating property losses due to hurricane, earthquake, and fire.

Exemptions to building codes requirements

SECTION 6. Chapter 10 of Title 6 of the 1976 Code is not applicable in counties or municipalities which have fully implemented building codes as required in Section 6-9-10, as amended by this act.

Public policy as to building codes

SECTION 7. The public policy of South Carolina is to maintain reasonable standards of construction in buildings and other structures in the State consistent with the public health, safety, and welfare of its citizens. To secure these purposes, a person performing building codes enforcement must be certified by the South Carolina Building Codes Council, and this act is necessary to provide for certification.

To clarify the intent of the General Assembly and address questions which might arise or have arisen with respect to provisions of the nationally known codes which have been or are in place, only those portions or provisions of the nationally known building and safety codes which relate to building standards and safety are binding upon any state or local governmental entity or agency which adopts the building and safety codes authorized or required by Chapter 9 of Title 6 of the South Carolina Code of Laws.

Time effective

SECTION 8. This act takes effect upon approval by the Governor.

Approved the 13th day of June, 1997.

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South Carolina

CODE OF LAWS OF SOUTH CAROLINA 1976 ANNOTATED
CHAPTER 9.
BUILDING, HOUSING, ELECTRICAL, PLUMBING AND GAS CODES

§ 6-9-10. Authorization for and scope of codes and regulations.

The governing body of any incorporated municipality or county in this State is authorized to adopt building, housing, electrical, plumbing, and gas codes relating to the construction, livability, sanitation, erection, equipment, alteration, repair, occupancy, or removal of buildings and structures located within its jurisdiction and promulgate regulations to implement the codes.

The codes and the implementing regulations may embrace matters such as the preparation and submission of plans and specifications; the issuance of permits; standards governing the kind, quality, and performance of materials, equipment, and workmanship; the establishment of fire zones; fireproofing; means of egress and ingress; floor-area-per-occupant requirements; sanitary facilities and proceedings for the correction of unsafe, unsanitary, or inadequate structures.

The codes and regulations may only be adopted by reference to national, regional, or model codes listed in § 6-9-60 and to certain special provisions approved by the South Carolina Building Code Council. Nothing in these codes or regulations may extend to or be construed as being applicable to the regulation of the design, construction, location, installation, or operation of equipment or facilities used in the generation, transmission, distribution, or communication of a public or private utility or electric or telephone membership cooperatives, other than buildings used primarily for offices or residential housing nor to equipment or facilities already subject to regulation by the Liquefied Petroleum Gas Board.

HISTORY: 1977 Act No. 173 § 1; 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT
The 1977 amendment inserted the words "lightning protection systems design and installation," in the first paragraph of this section.

The 1984 amendment made grammatical changes in this section and deleted "lightning protection systems design and installation" codes from the list of codes in the first paragraph.

§ 6-9-20. Regional agreements.

County and municipal bodies are authorized to establish regional agreements with other political subdivisions of the State to issue building permits and enforce building, electrical, plumbing, gas, housing, and other codes in order to more effectively carry out the provisions of this chapter.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EDITOR'S NOTE
Section 2, Act 481 of 1984 purported to amend this section. It is, however, identical with the contents appearing in the bound volume.

§ 6-9-30. Employment of inspectors and assistants.

The county and municipal governing bodies may appoint building, electrical, plumbing, gas, and housing inspectors and employ other assistants as they may consider necessary and may prescribe fees or charges for permits and inspections.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT
The 1984 amendment made grammatical changes which did not affect the substance of this section.

§ 6-9-40. Notice and hearing required before adoption of code or regulations.
Prior to adoption of any of the codes or regulations permitted in this chapter, the governing body shall hold public hearings on the codes or regulations. Not less than fifteen days' notice of the time and place of the hearings must be published in a newspaper of general circulation in the county.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT
The 1984 amendment made grammatical changes which did not affect the substance of this section.

§ 6-9-50. Area of application of county codes.
County governing bodies have the authority to establish codes and promulgate regulations under this chapter for the entire unincorporated area of the county or for any specified portion of the unincorporated area.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT
The 1984 amendment made grammatical changes which did not affect the substance of this section.

§ 6-9-60. Adoption and modification of certain standard codes by reference; creation, membership, meetings and functions of South Carolina Building Code Council.
Municipalities or counties are authorized to adopt by reference only the latest editions of the following nationally known codes for regulation of construction within their respective jurisdictions: Standard Building Code, Standard Housing Code, Standard Gas Code, Standard Plumbing Code, Standard One and Two Family Dwelling Code, Standard Mechanical Code, Standard Fire Prevention Code, Standard Swimming Pool Code, Standard Excavation and Grading Code, National Electrical Code, and National Fire Protection Association Gas Codes.

Should any city, town, or county contend that the codes authorized by this chapter do not meet its needs due to local physical or climatological conditions, the variations and modifications must be submitted for approval to a South Carolina Building Code Council of thirteen members which is established in this section. Members of this council must be appointed by the Governor. The council shall include an architect, representatives from the Municipal Association of South Carolina, the South Carolina Association of Counties, the Building Officials' Association of South Carolina, South Carolina Building Trade Council, a representative from the electric utility industry, a representative of the Carolinas Branch of the Associated General Contractors of America, Inc., representatives from the gas, electric, and plumbing industries, a representative of the Home Builders Association of South Carolina, a handicapped person, and the Chief Engineer of the State Budget and Control Board. At least one member of the council must be a member of each of the congressional districts, to be appointed, if positions become vacant, in the order provided below or as resignations occur. The primary function of the council is to decide to what extent any jurisdiction may vary from the series of codes listed in this section in the establishment of standards. The council shall monitor the adoption of building codes by cities and counties to insure compliance with this chapter.

Of the members initially appointed by the Governor, four shall serve for terms of two years, four shall serve for four years, and five shall serve for terms of six years. After the initial appointment, all appointments are for terms of six years.

Members of the council shall receive mileage, subsistence, and per diem as provided for other state boards, committees, or commissions for attendance at board meetings called by the chairman. The council shall elect from its appointive members a chairman and secretary. The council shall adopt regulations not inconsistent with this chapter.

Meetings may be called by the chairman on his own initiative and must be called by him at the request of three or more members of the council. All members must be notified by the chairman in writing of the time and place of meeting at least seven days in advance of the meeting. Seven members constitute a quorum. All meetings are open to the public. At least two-thirds vote of those members in attendance at the meeting constitutes an official decision of the council.
HISTORY: 1977 Act No. 173 § 2; 1978 Act No. 629; 1984 Act No. 481, § 2; 1993 Act No 181 § 64, eff February 1, 1994.

South Carolina

EFFECT OF AMENDMENT
The 1977 amendment substituted the words ", National Fire Protection Association Gas Codes, Underwriters' Laboratories Lightning Protection Code and Lightning Protection Institute Installation Code" for the words "and National Fire Protection Association Gas Codes" in the first paragraph of this section.

The 1978 amendment substantially rewrote this section.

The 1984 amendment added the last sentence of the second paragraph, rewrote the fourth paragraph, and also made grammatical changes which did not affect the substance of this section.

The 1993 amendment consolidated the former five paragraphs of this section into a single paragraph; and deleted provisions regarding the Division of General Services of the State Budget and Control Board providing personnel for enforcement of these laws and regulations and for carrying out the duties of the council.

§ 6-9-65. Regulation of construction or improvement of farm structure; authority to issue building permits.

(A) For purposes of this section, "farm structure" means a structure which is constructed on a farm, other than a residence or a structure attached to it, for use on the farm, including but not limited to, barns, sheds, and poultry houses, but not public livestock areas. For purposes of this section, "farm structure" does not include a structure originally qualifying as a "farm structure" but later converted to another use.

(B) The governing body of a county or municipality may not enforce that portion of any nationally recognized building code it has adopted which regulates the construction or improvement of a farm structure. Standards for flood plain management by the Southern Building Code Congress International apply.

(C) The provisions of this section do not apply unless prior to constructing a farm structure the person owning the property on which the structure is to be constructed files an affidavit with the county or municipal official responsible for enforcing the building code stating that the structure is being constructed as a farm structure. The affidavit must include a statement of purpose or intended use of the proposed structure or addition.

(D) This section does not affect the authority of the governing body of a county or municipality to issue building permits prior to the construction or improvement of a farm structure.

HISTORY: 1987 Act No. 24 § 1, eff April 13, 1987.

§ 6-9-70. Penalties for violation of code or regulation.

The violation of any of the codes or regulations adopted pursuant to the provisions of this chapter is declared to be a misdemeanor, and any person violating the codes or regulations is guilty of a misdemeanor and, upon conviction, must be punished by a fine not to exceed one hundred dollars or imprisonment of not more than thirty days. Each day the violation continues is a separate offense.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT
The 1984 amendment made grammatical changes which did not affect the substance of this section.

§ 6-9-80. Mandamus and injunctive relief for violation of code or regulation.

In case of any violation of or proposed violation of the codes or regulations adopted pursuant to this chapter, the South Carolina Building Code Council, the building inspectors, municipal or county attorneys, or other appropriate authority of the political subdivision, or any adjacent or neighboring property owner who would be damaged by the violation may, in addition to other remedies, apply for injunctive relief, mandamus, or other appropriate proceeding to prevent, correct, or abate the violation or threatened violation.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT

The 1984 amendment added "the South Carolina Building Code Council" and also made grammatical changes which did not affect the substance of this section.

§ 6-9-90. Appropriations and expenditures.

County or municipal governing bodies are authorized to appropriate and expend funds to implement the provisions of this chapter.

HISTORY: 1984 Act No. 481, § 2, eff June 20, 1984.
EDITOR'S NOTE
Section 2, Act 481 of 1984, purported to amend this section. It is, however, identical with the provisions appearing in the parent volume.

§ 6-9-100. Provisions of chapter shall be cumulative; use of other codes adopted prior to effective date.

The provisions of this chapter are cumulative to other authority of counties and municipalities and do not limit the authority of counties and municipalities.

A city or county that has adopted any of the national, regional, or model codes or any other code prior to May 1, 1982, may continue its use.

HISTORY: 1982 Act No. 351, § 3, eff May 10, 1982; 1984 Act No. 481, § 2, eff June 20, 1984.
EFFECT OF AMENDMENT
The 1982 amendment substituted "May 1, 1982" for "June 21, 1972" in the second paragraph.

The 1984 amendment made grammatical changes which did not affect the substance of this section.

§ 6-9-110. Inapplicability to state property of local ordinances which require permits, etc., as means of enforcing building standards.

In no event may any county, municipal, or other local ordinance or regulation which requires the purchase or acquisition of a permit, license, or other device utilized to enforce any building standard be construed to apply to any state department, institution, or agency permanent improvement project, construction project, renovation project, or property.

HISTORY: 1982 Act No. 466 Part II § 28, eff June 15, 1982; 1984 Act No. 481, § 2, eff June 20, 1984; 1986 Act No. 347, § 6, eff March 4, 1986.
EFFECT OF AMENDMENT
The 1984 amendment made grammatical changes which did not affect the substance of this section, including deletion of the phrase "Notwithstanding any other provision of law," from the first sentence.

The 1986 amendment deleted a provision relative to inapplicability to state projects of local ordinances which prescribe building standards, deleted a provision relative to mutually agreed upon inspections of state-owned buildings by local officials, and made grammatical changes.

Utah

CHAPTER 56
UTAH UNIFORM BUILDING STANDARDS ACT
Effective May 5, 1997

58-56-1. Short title.
This chapter is known as the "Utah Uniform Building Standards Act."

58-56-2. Chapter administration.
The provisions of this chapter shall be administered by the Division of Occupational and Professional Licensing.

58-56-3. Definitions.
In addition to the definitions in Section 58-1-102, as used in this chapter:
(1) "ANSI" means American National Standards Institute, Inc.
(2) "Code(s)" means the NEC, building code, mechanical code, or plumbing code as defined in this section and as applied in context.
(3) "Commission" means the Uniform Building Code Commission created under this chapter.
(4) "Compliance agency" means an agency of the state or any of its political subdivisions which issue permits for construction regulated under the codes, or any other agency of the state or its political subdivisions specifically empowered to enforce compliance with the codes.
(5) "Factory built housing" means manufactured homes or mobile homes.
(6) "HUD code" means the Federal Manufactured Housing Construction and Safety Standards Act.
(7) "Installation standard" means the standard adopted and published by the National Conference of States on Building Codes and Standards (NCSBCS), for the installation of manufactured homes titled "The Standard for Manufactured Home Installations", the accompanying manufacturer's instructions for the installation of the manufactured home, or such equivalent standard as adopted by rule.
(8) "Local regulator" means each political subdivision of the state which is empowered to engage in the regulation of construction, alteration, remodeling, building, repair, and other activities subject to the codes adopted pursuant to this chapter.
(9) "Manufactured home" means a transportable factory built housing unit constructed on or after June 15, 1976, according to the Federal Home Construction and Safety Standards Act of 1974 (HUD Code), in one or more sections, which, in the traveling mode, is eight body feet or more in width or 40 body feet or more in length, or when erected on site, is 400 or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning, and electrical systems. All manufactured homes constructed on or after June 15, 1976, shall be identifiable by the manufacturer's data plate bearing the date the unit was manufactured and a HUD label attached to the exterior of the home certifying the home was manufactured to HUD standards.
(10) "Factory built housing set-up contractor" means an individual licensed by the division to set up or install factory built housing on a temporary or permanent basis. The scope of the work included under the license includes the placement and or securing of the factory built housing on a permanent or temporary foundation, securing the units together if required, and connection of the utilities to the factory built housing unit, but does not include site preparation, construction of a permanent foundation, and construction of utility services to the near proximity of the factory built housing unit. If a dealer is not licensed as a factory built housing set up contractor, that individual must subcontract the connection services to individuals who are licensed by the division to perform those specific functions under Title 58, Chapter 55, Utah Construction Trades Licensing Act.
(11) "Mobile home" means a transportable factory built housing unit built prior to June 15, 1976, in accordance with a state mobile home code which existed prior to the Federal Manufactured Housing and Safety Standards Act (HUD Code).

(12) "Modular unit" means a structure built from sections which are manufactured in accordance with the construction standards adopted pursuant to Section 58-56-4 and transported to a building site, the purpose of which is for human habitation, occupancy or use.
(13) "NEC" means the National Electrical Code.
(14) "Opinion" means a written, nonbinding, and advisory statement issued by the commission concerning an interpretation of the meaning of the codes or the application of the codes in a specific circumstance issued in response to a specific request by a party to the issue.
(15) "State regulator" means an agency of the state which is empowered to engage in the regulation of construction, alteration, remodeling, building, repair, and other activities subject to the codes adopted pursuant to this chapter.
(16) "Unlawful conduct" as defined in Section 58-1-501 includes:
(a) engaging in the sale of factory built housing without being registered with the division as a dealer, unless the sale is exempt under Section 58-56-16; and
(b) selling factory built housing within the state as a dealer without collecting and remitting to the division the fee required by Section 58-56-17.

58-56-4. Adoption of building codes - Amendments.
(1) As used in this section:
(a) "Agricultural use" means a use which relates to the tilling of soil and raising of crops, or keeping or raising domestic animals, for the purpose of commercial food production.
(b) "Not for human occupancy" means use of a structure for purposes other than protection or comfort of human beings, but allows people to enter the structure for maintenance and repair, and for the care of livestock, crops, or equipment intended for agricultural use which are kept there.
(2) Subject to the provisions of Subsections (4) and (5), the following are adopted as the construction standards to which the state and each political subdivision of this state shall adhere in building construction, alteration, remodeling and repair, and in the regulation of building construction, alteration, remodeling and repair:
(a) a building code promulgated by a nationally recognized code authority;
(b) the National Electrical Code promulgated by the National Fire Protection Association;
(c) a plumbing code adopted by a nationally recognized code authority; and
(d) a mechanical code promulgated by a nationally recognized code authority.
(3) The division, in collaboration with the commission, shall adopt by rule the edition of the NEC or code and specific edition of the codes described in Subsections (1)(a), (c) and (d) to be used as the standard and may adopt by rule successor editions of any adopted code.
(4) The division, in collaboration with the commission, may adopt amendments to the adopted codes to be applicable to the entire state or within a political subdivision only in accordance with 58-56-7.
(5) Except in a residential area, a structure used solely in conjunction with agriculture use, and not for human occupancy, is exempted from the permit requirements of any building code adopted by the division, however, unless otherwise exempted, plumbing, electrical, and mechanical permits may be required when that work is included in the structure.

58-56-5. Building Code Commission - Composition of Commission - Commission duties and responsibilities.
(1) There is established a Uniform Building Code Commission to advise the division with respect to the division's responsibilities in administering the codes under this chapter.
(2) The commission shall be appointed by the executive director who shall submit his nominations to the governor for confirmation or rejection. If a nominee is rejected, alternative names shall be submitted until confirmation is received. Following confirmation by the governor, the appointment shall be made.
(3) The Commission shall consist of eleven members who shall be appointed in accordance with the following:
(a) one member shall be from among candidates nominated by the Utah League of Cities and Towns and the Utah Association of Counties;

Utah

(b) one member shall be a licensed building inspector employed by a political subdivision of the state;
(c) one member shall be a licensed professional engineer;
(d) one member shall be a licensed architect;
(e) one member shall be a fire official;
(f) three members shall be contractors licensed by the state, of which one shall be a general contractor, one an electrical contractor, and one a plumbing contractor;
(g) two members shall be from the general public and have no affiliation with the construction industry or real estate development industry; and
(h) one member shall be from the Division of Facilities Construction Management, Department of Administrative Services.

(4) (a) Except as required by Subsection (b), as terms of current commission members expire, the executive director shall appoint each new member or reappointed member to a four-year term.
(b) Notwithstanding the requirements of Subsection (a), the executive director shall, at the time of appointment or reappointment, adjust the length of terms to ensure that the terms of commission members are staggered so that approximately half of the commission is appointed every two years.
(5) When a vacancy occurs in the membership for any reason, the replacement shall be appointed for the unexpired term.
(6) No commission member may serve more than two full terms, and no commission member who ceases to serve may again serve on the commission until after the expiration of two years from the date of cessation of service.
(7) A majority of the commission members shall constitute a quorum and may act in behalf of the commission.
(8) (a) (i) Members who are not government employees shall receive no compensation or benefits for their services, but may receive per diem and expenses incurred in the performance of the member's official duties at the rates established by the Division of Finance under Sections 63A-3-106 and 63A-3-107.
(ii) Members may decline to receive per diem and expenses for their service.
(b) (i) State government officer and employee members who do not receive salary, per diem, or expenses from their agency for their service may receive per diem and expenses incurred in the performance of their official duties from the board at the rates established by the Division of Finance under Sections 63A-3-106 and 63A-3-107.
(ii) State government officer and employee members may decline to receive per diem and expenses for their service.
(c) (i) Local government members who do not receive salary, per diem, or expenses from the entity that they represent for their service may receive per diem and expenses incurred in the performance of their official duties at the rates established by the Division of Finance under Sections 63A-3-106 and 63A-3-107.
(ii) Local government members may decline to receive per diem and expenses for their service.
(9) The commission shall annually designate one of its members to serve as chair of the commission. The division shall provide a secretary to facilitate the function of the commission and to record its actions and recommendations.
(10) The duties and responsibilities of the commission are to:
(a) recommend to the director the adoption by rule of the edition of the NEC, and the specific codes and editions of the codes described in Subsections 58-56-4(1)(a), (c) and (d) adopted pursuant to this chapter;
(b) recommend to the director the adoption by rule of amendments to the NEC, the building code, the mechanical code, and plumbing code adopted pursuant to this chapter;
(c) offer an opinion regarding the interpretation of or the application of any of the codes adopted pursuant to this chapter upon a formal submission by a party to the matter in question which submission must clearly state the facts in question, the specific code citation involved and the position taken by all parties;
(d) act as an appeals board as provided in 58-56-8(3);

(e) establish advisory peer committees on either a standing or ad hoc basis to advise the commission with respect to building code matters, including a committee to advise the commission regarding health matters related to the UPC; and
(f) assist the division in overseeing code related training in accordance with Section 58-56-9 of this chapter.

58-56-6. Building codes - Division duties and responsibilities.
(1) The division shall administer the adoption and amendment of the NEC, the building code, the mechanical code, and the plumbing code adopted under Section 58-56-4 pursuant to this chapter; but, shall have no responsibility or duty to conduct inspections to determine compliance with the codes, issue permits or assess building permit fees.
(2) Administration of the NEC, the building code, the mechanical code, and the plumbing code adopted under Section 58-56-4 by the division shall include:
(a) receiving recommendations from the commission and thereafter adopting by rule the editions of the codes and amendments to the codes;
(b) maintaining and publishing for reference on a current basis the editions of the code in force and amendments thereto; and
(c) receiving requests for amendments and opinions from the commission, scheduling appropriate hearings and publishing the amendments to the codes and the opinions of the commission with respect to interpretation and application of the codes.

58-56-7. Code amendments - Commission recommendations - Division duties and responsibilities.
(1) The division, with the commission, shall establish by rule the procedure and manner under which requests for amendments to codes shall be:
(a) filed with the division; and
(b) recommended or declined for adoption.
(2) The division shall accept from any local regulators, state regulators, state agencies involved with the construction and design of buildings, the contractors, plumbers, or electricians licensing boards, or from recognized construction-related associations a request for amendment to the NEC, the building code, the mechanical code, or the plumbing code adopted under Section 58-56-4.
(3) The division or the commission on its own initiative may make recommendations to the commission for amendment to the NEC, the building code, the mechanical code, or the plumbing code adopted under Section 58-56-4.
(4) On May 15 and November 15 of each calendar year, or the first government working day thereafter if either date falls on a weekend or government holiday, the division shall convene a public hearing, as a part of the rulemaking process, before the commission concerning requests for amendment of the codes, recommended by the division and commission to be adopted by rule. The hearing shall be conducted in accordance with the rules of the commission.
(5) Within 15 days following completion of the hearing under Subsection (4) or (5), the commission shall provide to the division a written recommendation concerning each amendment.
(6) The division shall consider the recommendations and promulgate amendments by rule in accordance with Title 63, Chapter 46a, Utah Administrative Rulemaking Act and as prescribed by the director.
(7) The decision of the division to accept or reject the recommendation of the commission shall be made within 15 days after receipt of the recommendation.
(8) All decisions of the division pertaining to adoption of a code edition or amendments to any code, which are contrary to recommendations of the commission, may be overridden by a two-thirds vote of the commission according to a procedure to be established by rule.
(9) (a) Amendments with statewide application:
(i) shall be effective on the January 1 or July 1 immediately following the public hearing; or
(ii) may be effective prior to the dates in Subsection (i) if designated by the division and the commission as necessary for the public health, safety, and welfare.

Utah

(b) Amendments with local application only shall be effective on a date to be determined by the division and the commission.
(c) In making rules required by this chapter, the division shall comply with he provisions of Title 63, Chapter 46a, Administrative Rulemaking Act, the provisions of that chapter shall have control over this section in case of any conflict.
(10) The commission shall study the necessity of an engineer's stamp on all building permits. This study shall be reported to the Business and Labor Interim Committee by November 1996.

58-56-8. Compliance with codes - Responsibility for inspections - Appeals.
(1) The responsibility for inspection of construction projects and enforcement of compliance with provisions of the codes shall be with the compliance agency having jurisdiction over the project and the applicable codes.
(2) A finding by a compliance agency that a licensed contractor, electrician, or plumber has materially violated the provisions of a code in a manner to jeopardize the public health, safety, and welfare and failed to comply with corrective orders of the compliance agency shall be furnished in writing to the division by the compliance agency. It shall be the responsibility of the compliance agency to conduct a primary investigation to determine that, in fact, there has been a material violation of the provisions of the code jeopardizing the public interest and provide the report of investigation to the division.
(3) Each compliance agency shall establish a method of appeal by which a person disputing the application and interpretation of a code may appeal and receive a timely review of the disputed issues in accordance with provisions of the National Electrical Code, the building code, the mechanical code, or the plumbing code adopted under Section 58-56-4. If a compliance agency refuses to establish a method of appeal, the commission shall act as the appeals board and conduct a hearing within 45 days. The findings of the commission shall be binding. An appeals board established under this section shall have no authority to interpret the administrative provisions of the codes nor shall the appeals board be empowered to waive requirements of the codes.

58-56-8.5 Building Inspector Licensing Board.
(1) There is created a Building Inspector Licensing Board consisting of four building inspectors and one member of the general public.
(2) The board shall be appointed and serve in accordance with Section 58-1-201.
(3) The duties and responsibilities of the board shall be in accordance with Sections 58-1-202 through 58-1-203. In addition, the board shall designate one of its members on a permanent or rotating basis to:
(a) assist the division in reviewing complaints concerning the unlawful or unprofessional conduct of a licensee; and
(b) advise the division in its investigation of these complaints.
(4) A board member who has, under Subsection (3), reviewed a complaint or advised in its investigation is disqualified from participating with the board when the board serves as a presiding officer of an administrative proceeding concerning the complaint.

58-56-9. Qualifications of inspectors - Contract for inspection services.
(1) Effective July 1, 1993, all inspectors employed by a local regulator, state regulator, or compliance agency to enforce provisions of the codes adopted pursuant to this chapter shall:
(a) meet minimum qualifications as established by the division in collaboration with the commission or be certified by a nationally recognized organization which promulgates codes adopted under this chapter, or pass an examination developed by the division in collaboration with the commission;
(b) be currently licensed by the division as meeting those minimum qualifications; and
(c) be subject to revocation or suspension of their license or may be placed on probation if found guilty of unlawful or unprofessional conduct.
(2) A local regulator, state regulator, or compliance agency may contract for the services of a licensed inspector not regularly employed by the regulator or agency.

(3) (a) The division shall use the monies received in Subsection (4) to provide education regarding the codes and code amendments to:
(i) building inspectors; and
(ii) individuals engaged in construction-related trades.
(b) All funding available for the building inspector's education program shall be nonlapsing.
(4) Each compliance agency shall charge a 1% surcharge on all building permits issued and shall transmit 80% of the amount collected to the division to be utilized by the division to fulfill the requirements of Subsection (3). The surcharge shall be deposited as a dedicated credit.

58-56-10. Repealed.

58-56-11. Standards for specialized buildings.
(1) This chapter shall not be implied to repeal or otherwise affect authorities granted to a state agency to make or administer standards for specialized buildings, as provided in Title 26, Chapter 21, Title 62A, Chapter 2, and Title 64, Chapter 13, or authorities granted to a state agency by statute to make or administer other special standards. In the event of a conflict between such special standards and codes adopted pursuant to this chapter, the special standards shall prevail.
(2) The provisions of this chapter do not apply to the administration of the statutes described in Subsection (1).

58-56-12. Factory built housing units.
Factory built housing unit construction, permit issuance for set-up, set-up and set-up inspection shall be in accordance with the following:
(1) Manufactured homes:
(a) manufactured homes constructed, sold, or set-up in the state shall be constructed in accordance with the HUD code;
(b) manufactured homes set-up in the state shall be installed in accordance with the "installation standard" defined in Section 58-56-3;
(c) the authority and responsibility for the issuance of building permits for the modification or set-up of manufactured homes within a political subdivision of the state shall be with the local regulator within that political subdivision; and
(d) the inspection of modifications to or set-up shall be conducted and approvals given by the local regulator within the political subdivision in which the set-up takes place.
(2) Mobile homes:
(a) mobile homes sold or set-up in the state shall be constructed in accordance with the mobile home construction code in existence in the state in which the mobile home was constructed at the time the mobile home was constructed;
(b) mobile homes set-up in the state shall be installed in accordance with the "installation standard" defined in Section 58-56-3;
(c) the authority and responsibility for the issuance of building permits for the modification of or set-up of mobile homes within a political subdivision of the state shall be with the local regulator within that political subdivision; and
(d) the inspection of, modification to, or set-up shall be conducted and approvals given by the local regulator within the political subdivision in which the set-up takes place.

58-56-13. Modular units.
Modular unit construction, set-up, issuance of permits for construction or set-up, and set-up shall be in accordance with the following:
(1) construction and set up shall be in accordance with the building standards adopted pursuant to Section 58-56-4, or equivalent standards adopted by rule;
(2) the responsibility and authority for plan review and issuance of permits for construction, modification, or set-up shall be that of the local regulator of the political subdivision in which the modular unit is to be set-up;

Utah

(3) the inspection of the construction, modification of, or set-up of a modular unit to determine conformance with the provisions of this chapter and the issuance of approvals shall be the responsibility of the local regulator in the political subdivision in which the modular unit is to be set-up or is set-up; and
(4) nothing in this section shall preclude a local regulator from contracting with a qualified third party for the inspection or plan review provided in this section, or the state from entering into an interstate compact for third party inspection of the construction of modular units.

58-56-14. Modification of factory built housing units and modular units.
(1) Any modification to factory built housing units shall be made in accordance with the following:
(a) Prior to set-up, modification to a manufactured home or mobile home prior to installation or set-up of the unit for habitation shall be made in accordance with the HUD code.
(b) After set-up:
(i) modification to a manufactured home or mobile home after installation or set-up of the unit for habitation, which modification does not include the addition of any space to the existing unit or the attachment of any structure to the existing unit shall be made in accordance with the HUD code; and
(ii) modification to a manufactured home or mobile home after installation or set-up of the unit for habitation, which modification includes the addition of any space to the existing unit or the attachment of any structure to the unit shall be made as follows:
(A) modifications to the existing unit shall be in accordance with the HUD code; and
(B) additional structure outside of the existing unit shall be in accordance with the Utah Uniform Building Standards Act.
(2) Any modification to modular housing units shall be made in accordance with the Utah Uniform Building Standards Act.

58-56-15. Factory built housing and modular units - Division responsibility.
The division:
(1) shall maintain current files with respect to the HUD code and amendments thereto with respect to manufactured homes and the "installation standard" defined in Section 58-56-3 with respect to installation of factory built housing; and will provide at reasonable cost such information to all compliance agencies, local regulators, or state regulators requesting such information;
(2) shall provide qualified personnel to advise compliance agencies, local regulators, and state regulators regarding the standards for construction and set-up, construction and set-up inspection, and additions or modifications to factory built housing;
(3) may regularly inspect the work of all factory built housing manufacturers in the state during the construction process to determine compliance of the manufacturer with the applicable standards of the HUD code or the American National Standards Institute, Inc. or equivalent standards adopted by rule; and upon a finding of any substantive deficiency furnish a written finding of such deficiency to the standards agency;
(4) is hereby designated as the state administrative agency and shall act as such for all purposes under the provisions of the HUD code; and
(5) may inspect the work of all modular unit manufacturers in the state during the construction process to determine compliance of the manufacturer with the Utah Uniform Building Standard Act for those units to be installed within the state; and upon a finding of any substantive deficiency issue a corrective order to the manufacturer with a copy to the local regulator in the state's political subdivision in the unit is to be installed.

58-56-16. Registration of dealers.
(1) Each person engaged in the sale of factory built housing in the state shall annually register with the division as a "dealer" and shall pay an annual registration fee of $15.
(2) Subsection (1) does not apply to:

(a) a person not regularly engaged in the sale of factory built housing who is selling a unit he owns for his own account;
(b) a principal broker licensed under Title 61, Chapter 2, Division of Real Estate; or
(c) a sales agent or associate broker licensed under Title 61, Chapter 2, Division of Real Estate, sells factory built housing as an agent for, and under the supervision, of the licensed principal broker with whom he is affiliated.

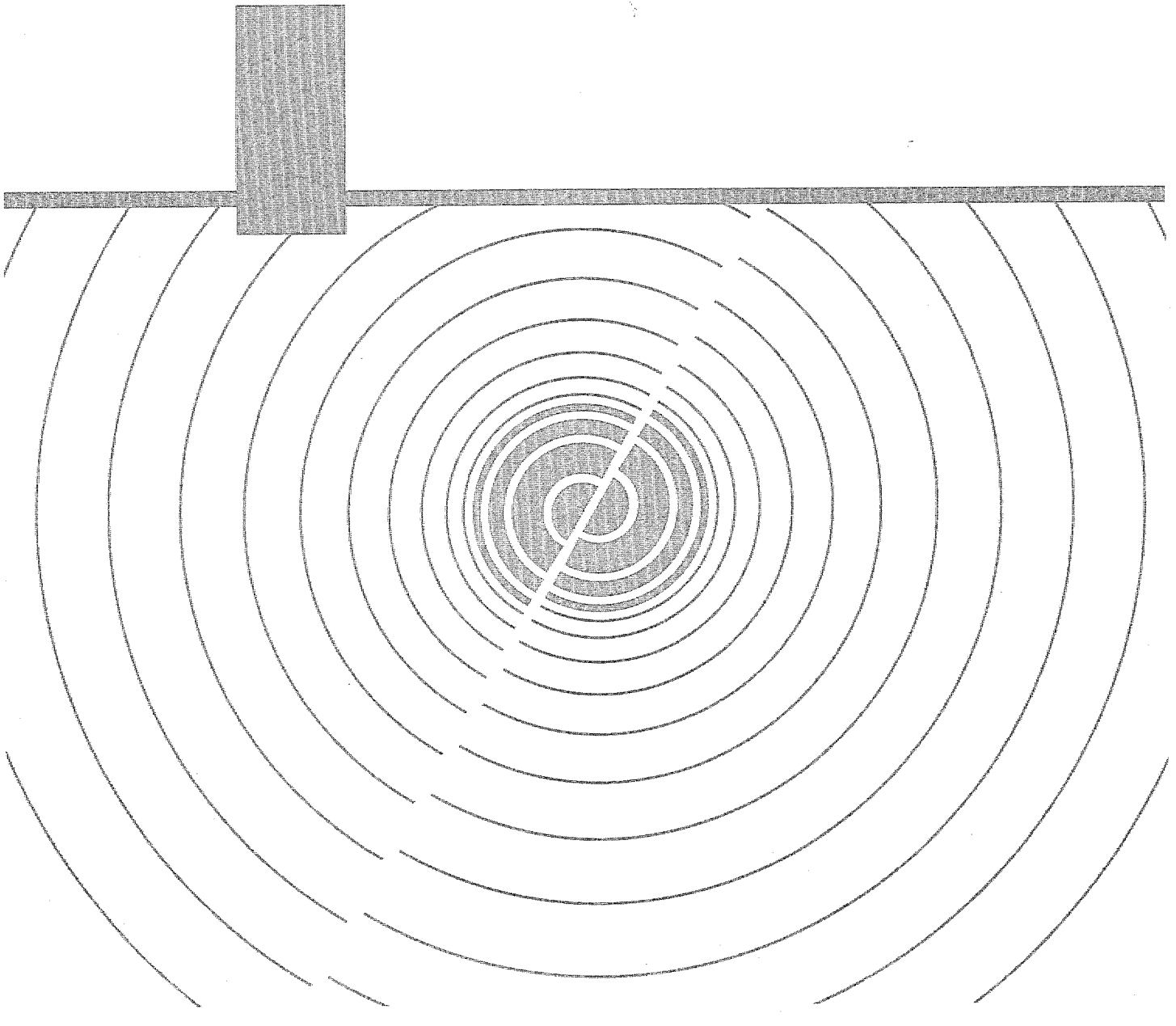
58-56-17. Fees on sale - Escrow agents - Sales tax.
(1) Each dealer shall collect and remit a fee of $75 to the division for each factory built home the dealer sells that has not been permanently affixed to real property. The fee shall be payable within 30 days following the close of each calendar quarter for all units sold during that calendar quarter. The fee shall be deposited in a restricted account as provided in Section 58-56-17.5.
(2) Any principal real estate broker, associate broker, or sales agent exempt from registration as a dealer under Section 58-56-16 who sells a factory built home that has not been affixed to real property shall close the sale only through a qualified escrow agent in this state registered with the Insurance Department or the Department of Financial Institutions.
(3) Each escrow agent through which a sale is closed under Subsection (2) shall remit all required sales tax to the state.

58-56-17.5. Factory Building Housing Fees Restricted Account.
(1) There is created within the General Fund a restricted account known as "Factory Built Housing Fees Account."
(2) (a) The restricted account shall be funded from the fees the dealer collects and remits to the division for each factory built home the dealer sells as provided in Subsection 58-56-17(1).
(b) The division shall deposit all monies collected under Subsection 58-56-17(1) in the restricted account.
(c) The restricted account shall be used to pay for education and enforcement of the Uniform Building Standards Act, including investigations and administrative actions and the funding of additional employees to the amount of the legislative appropriation.
(d) The restricted account may accrue interest which shall be deposited into the restricted account.

58-56-18. Repealed.

UTAH UNIFORM BUILDING STANDARDS ACT
Title 58, Chapter 56
Utah Code Annotated 1953
As Amended by
Session Laws of Utah 1997
Issued May 5, 1997
Division of Occupational and Professional Licensing
State of Utah

Appendix C: Examples of Building Code Administration by Local Governments



Appendix C
Examples of Building Code Administration by Local Governments

In order to illustrate the variety of local code administration practices, this appendix contains information from interviews conducted with officials from six cities and counties. The six examples include a large and small jurisdiction from each of the three code regions.

These case examples demonstrate the variety of practices used by jurisdictions across the United States. The seismic code requirements, plan review process, enforcement and inspection, procedures and fee schedules vary in each of these examples. The information presented here is to provide you with ideas on how to use model building codes in your locality.

Cities and counties in states that have adopted a model building code seem to have an advantage in that they can derive support from the state level. Cities in states with no codes find it harder to keep professionals in the building industry current with their code. This should be kept in mind as you convince your local governments to adopt a code or add seismic provisions. The lessons provided in the examples should help you in this process.

This section also provides an in-depth review of how each jurisdiction deals with enforcement, inspection, and review. Without these elements, the model building code will be ineffective. The six examples cover this in depth and will provide you with a starting point in your area. This information is critical in having a model building code that saves lives.

The case study information was collected primarily through a series of interviews. A list of interviewees is included at the end of this appendix.

Carbondale, Illinois (BOCA, Small)

Carbondale is a city of 25,000 people located in southern Illinois. The city has one inspector, who also serves as the plan reviewer for the city. The Department of Building and Neighborhood Services' total annual budget is $378,000. This office handles commercial and multifamily construction.

Table C.1 Overview of Local Building Code Administration by Local Governments

City/County	Population	Model Code	State Code Requirement	# of Inspectors
Carbondale, IL	25,000	BNBC	No building code req.	1
St. Louis County, MO	1,001,000	BNBC	No building code req.	10
Jonesboro, AK	50,000	SBC	Yes, Act 1100 (1991)	2
Memphis/Shelby Co., TN	850,000	SBC	Yes, since 1982	21
Pacifica, CA	40,000	UBC	Yes, since 1933	2
Clark County, NV	417,000	UBC	Yes, Nev. State Fire Marshal Reg.	79

Seismic Code Requirements

The city uses the *BOCA National Building Code* (BNBC), which incorporates seismic provisions.

Carbondale enforces the latest BOCA seismic building codes and standards. Seismic-resistance standards have always been required in Carbondale, and the city has been involved in a process of educating construction and design professionals as to the importance of seismic design, primarily through cooperation with the media. The media has assisted in stressing the potential danger of noncompliance. Ten years ago seismic provisions were not taken seriously by contractors, but practice is now much improved.

Carbondale's greatest limitation in enforcing building and seismic codes is the state of Illinois' weak support for requiring architects and engineers to stay current with codes. The state has no building code requirement, although the state does require seismic design of state-funded buildings. The state also requires licensing of structural engineers, who must demonstrate knowledge of seismic design. Carbondale makes sure its architects and engineers are following the rules, but most small cities in Illinois do not have the same ability, and the state is not assisting them.

Plan Review Process

Application must include building details as well as a site plan showing the location of the building on the site, lighting, disabled access, parking requirements, and water and sewer requirements. Building plans are required to be sealed by a professional, registered structural engineer from Illinois. The Department of Building and Neighborhood Services distributes the plans to other departments for review and approval. These other municipal departments include the Departments of Water and Sewer, Development Services, Fire, Police, Public Works/Engineering, and Planning. The plan is checked not only for compliance with the BNBC but also for other requirements, such as zoning, disabled access, electrical codes, and so forth.

FIGURE C.1 Main corner in downtown Carbondale, Illinois, a city of 25,000 people. Carbondale uses the BOCA National Building Code, which incorporates seismic provisions. (Photo: Planning Services Division, City of Carbondale)

Upon review and approval from these departments, the plan is sent back to Building and Neighborhood Services, and a meeting is scheduled with the owner of the proposed site and a representative of each department. Final approval must be received from the city council. Once the plan has been approved, a building permit can be issued. The director of Development Services stamps and approves the final permit.

A plan review usually takes a month from submission of the necessary documents to final approval. Following review, a building permit can usually be issued in two or three days to one week, depending on the complexity of the building.

If an applicant wants to appeal a decision, he or she first talks to staff members and can then appeal to the Building Code Board of Appeals. The owner must first pay a $15 fee to schedule a hearing. Carbondale uses the appeals process outlined in the BNBC.

Code Enforcement and Inspection

The present plan reviewer has experience in the construction trade, has three years toward an engineering degree, and has been certified by the Council of American Building Officials and BOCA for building inspector, building code official, and master code official. He is only responsible for nonstructural reviews. Architects and engineers are responsible for structural requirements. If any questions arise during the review process, the city requests the calculations of the architects or engineers for verification. The inspector states that BOCA is very supportive in answering or clarifying questions, as is the state architect's office.

Inspections are scheduled with the on-site construction manager depending on the progress of work. The required inspections include:

1. Designated location of building
2. Footing forms and steel
3. Foundation steel and anchor bolts
4. Framing
5. Rough electrical
6. Mechanical
7. Plumbing (by state plumbing inspector)
8. Final inspection

A few rough inspections to check for fire walls, plumbing, electrical, and mechanical requirements may be conducted prior to the final inspection. On larger construction sites unannounced visits may occur. The cost of inspections is covered by the building permit fee.

The number of staff members is adequate for the amount of work, except during summer construction. During this busier time, the inspector requests the assistance of housing inspectors in Carbondale.

Fee Schedule

Fees are established by the Department of Building and Neighborhood Services. The site plan review costs $25. Building and electrical permit fees vary depending on the valuation of the building: $2 for every $1,000 of final construction costs. Plumbing fees are $14 plus $2 for every fixture in the building.

Additional costs are associated with noncompliance or postponement of construction requirements. In order to occupy a building prior to completion of site items, the owner must post a performance bond in the amount of the uncompleted items. If building code requirements are not met, the building inspector can stop work or issue an appearance in court. Court judges then set the fines. An owner may pay up to $500 for a first offense. If the violation is not corrected after the first guilty finding, a fine of $500 per day for every day of violation is set.

St. Louis County, Missouri (BOCA, Large)

The jurisdiction of St. Louis County covers the unincorporated area plus several municipalities that contract with the county for code enforcement. The county has ten inspectors per discipline (e.g., building, plumbing, mechanical, electrical) and nine plan reviewers in the building code review section. Two of these nine are licensed engineers and two are licensed architects. The supervisor of the building code review section is a licensed architect. Other plan review staff members have degrees in engineering or architecture. The annual budget for the permit division (including application processing and plan review staff) of the Public Works Department is $1,780,000.

Seismic Code Requirements

St. Louis County's seismic enforcement began with the adoption of the 1987 *BOCA National Building Code* in 1988. The 1993 BNBC was adopted in April 1994. New commercial structures are the projects that are primarily affected by seismic regulations, and single-family homes are exempt.

Missouri has no statewide building code requirement. It does, however, require seismic design in the 47 counties considered most seismically hazardous. The Geologic Hazard Preparedness Act (1990) requires that all new private buildings larger than 10,000 square feet and all new public buildings in the counties must "comply with the standards for seismic design and construction" of the BNBC or UBC.

Plan Review Process

Prior to submitting an application for a building permit, a preliminary meeting with plan reviewers is available. Applicants can also submit their plans for a preliminary review. This eases the review process, especially for larger projects.

Applications for a building permit are submitted to the Permit Application Center of the Permits Division, which serves as the central point within the submittal process. Four sets of complete drawings are required. The building code reviewer acts as the lead person in coordinating reviews from other review sections within the department. The building reviewer releases the projects back to the Permit Application Center, which coordinates approvals from outside departments and agencies and awards the permit once all requirements are met. Plan reviewers compute the permit fees based on estimated construction costs. Each plan reviewer has the authority to sign off on permits.

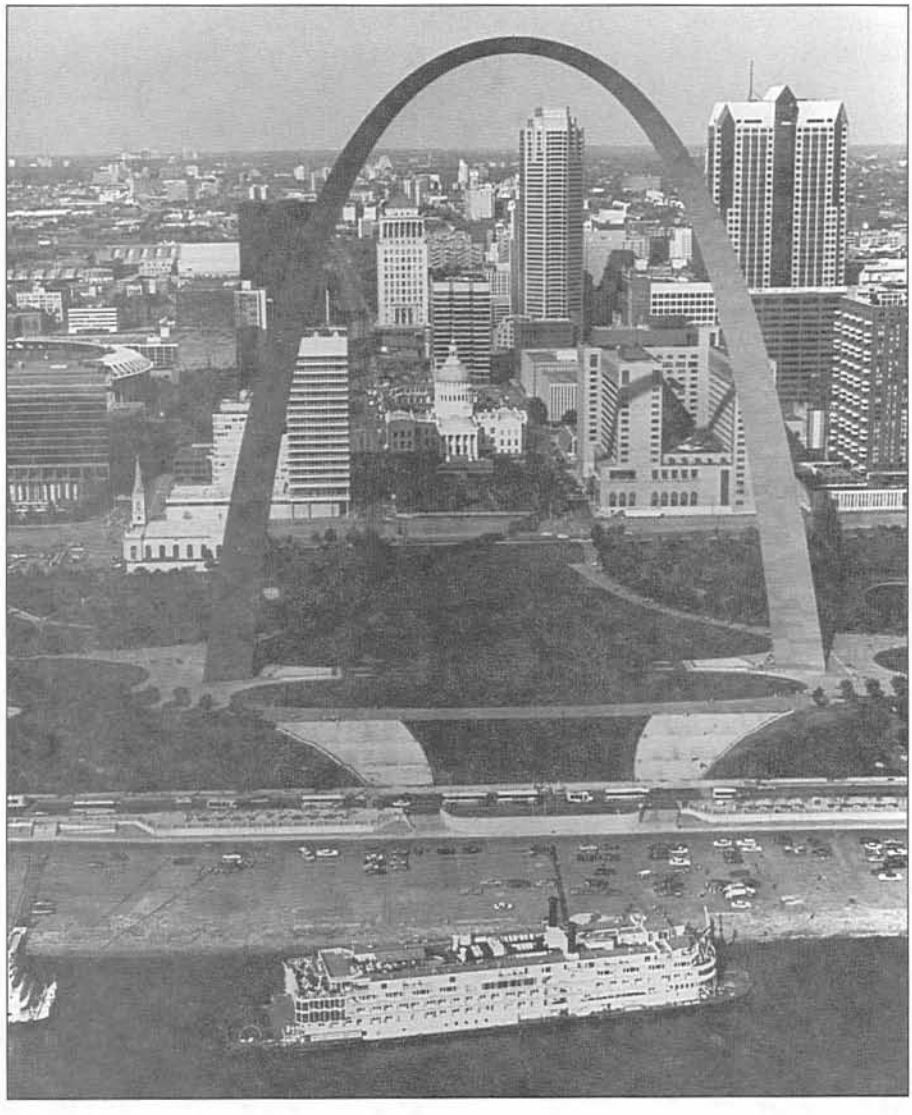


FIGURE C.2 The City of St. Louis, as well as St. Louis County, Missouri, is protected by the BOCA National Building Code. (Photo: St. Louis Convention and Visitors Commission)

The first round of review, which results in each discipline's request for revisions, takes about five to ten working days. Once revisions are requested, the process is normally accomplished in three to four weeks, unless the design team is slow in responding.

There are two different appeals processes for someone who disagrees with a code requirement or decision. First, all individual plan reviewers have the authority to grant alternative solutions or equivalencies that would provide equal standards. Second, if the problem is beyond the plan reviewer's latitude or expertise, the director and/or the deputy of the Public Works Department can

review the decision. If the problem is not resolved, it is referred to the board of appeals, an appointed body of five citizens, four of whom must either be licensed professionals or have construction experience.

Code Enforcement and Inspection

Regarding seismic enforcement, structural calculations are requested and reviewed for compliance. Enforcement is left primarily up to the structural engineers, who stand behind their calculations and designs with their signature. Many staff are still learning about the seismic requirements, as are design professionals in the area. Some of the larger firms have experience in California, so they are familiar with seismic design.

All new entry-level plan review staff members must have at least a college degree in a related field. The county is in the process of encouraging all plan reviewers to become certified within the next two to three years under the BOCA certification exams and to work toward their professional licenses. This drive for certified plan reviewers is due to the insurance industry's code effectiveness grading schedule, as described in chapter 6. In addition, staff attend local AIA- and BOCA-sponsored seminars.

The inspection process is a computerized call-in system in which contractors call to request an inspection. Unannounced visits do not normally occur. The types of inspections conducted include excavation (before the pouring of footings), forms of foundations, foundation, rough framing, rough frame-in for each of the disciplines, and a final inspection for each of the disciplines. There are also special inspections that are conducted by outside professionals. These professionals must be certified and approved by the inspection staff. Larger commercial projects require several inspection visits for each category. Inspection costs are covered by the application fee. However, if an inspector is called out for something that is not ready for inspection, a charge of $25 is assessed. There is also a $500 minimum penalty or 1 percent of the project cost (whichever is greater) when violations occur, such as working without the proper permit, not following the approved plans, or not following code. Work load often exceeds staff availability, especially in inspections.

The department publishes a quarterly newsletter for the public. The newsletter details department procedures, code interpretations, code questions and answers, and enforcement policies. The newsletter is sent to professional organizations, who then distribute them to local municipalities and neighboring areas, such as St. Charles, Jefferson County, and Arnold. The county is trying to improve standards in the region.

Unfortunately budget cutting and reorganization have resulted in reduced personnel levels. However, a benefit is that the average quality and performance of staff have improved. The department enjoys strong support by county government in its goal of attaining code compliance.

Jonesboro, Arkansas (SBCCI, Small)

The Jonesboro Department of Planning and Inspection has two building inspectors and one plan reviewer for a city population of 50,000. Jonesboro is in an unusual building boom and has just recently added the second inspector. The department has an annual budget of $300,000.

Seismic Code Requirements

The Standard Building Code applies to all buildings in Arkansas. Code updates are determined administra-

tively, by the State Fire Marshal. The importance of seismic design is underscored by Act 1100 (1991), which requires that all public structures be designed to resist seismic forces, in accordance with the latest SBC. It establishes zones more specific than those in the SBC, is self-updating, and sets forth penalties for noncompliance. It puts much of the responsibility on professional engineers, who enforce the Act by their signatures on plans.

Jonesboro enforces seismic building requirements. The municipality is in seismic zone 3. Jonesboro and the state of Arkansas have found that the state's relatively new seismic requirements have not stifled construction, as many builders and designers had feared. New construction has increased dramatically, and the state has experienced none of the problems anticipated. Today, seismic enforcement is taken very seriously and is viewed as a priority. Architects, engineers, and the building enforcement officials are making sure that every plan approved complies with seismic regulations.

Architects in Arkansas are beginning to become more knowledgeable of seismic provisions and back up Jonesboro officials in their decisions. Jonesboro staff members try to be alert to stamps by unqualified engineers and contact the state board if necessary. Jonesboro staff members attribute their success to their reliance on a written code upon which to base decisions. This reduces the use of personal opinions and political pressure to make exceptions.

Plan Review Process

An applicant for a building permit must submit a plan stamped by an architect and structural engineer. The structural engineer makes a statement regarding compliance with building and seismic codes. For single-family homes, duplexes, and triplexes the department does not need as much detail, and the state has exempted these residential uses from seismic regulations. The department conducts all plan reviews, as well as zoning and fire inspections. Training for reviewers and inspectors is provided by SBCCI's services and certification programs.

FIGURE C.3 New construction in Jonesboro falls under the statewide Arkansas Standard Building Code. (Photo: City of Jonesboro)

It normally takes four to five days for permit approval. Jonesboro recommends that architects and engineers consult with the department before the application is submitted. This reduces problems and speeds the formal review process. Permits for residential structures are issued within one visit.

If an applicant wishes to appeal a decision, he or she contacts the board of appeals. The board consists of local citizens familiar with construction issues. The board is rarely used for building code appeals, however, since disputes arise more often from electrical and plumbing problems. A major way that building staff reduce potential problems is through the services of SBCCI. SBCCI has a phone consultation service to help determine if a ruling is accurate. This service is independent of the community, thereby providing professional, objective, and consistent advice.

Code Enforcement and Inspection

One of the inspectors acts as the building official. His or her signature must accompany the signatures of

electrical, plumbing, and mechanical inspectors on a sheet passed along with the plans prior to issuing the permit.

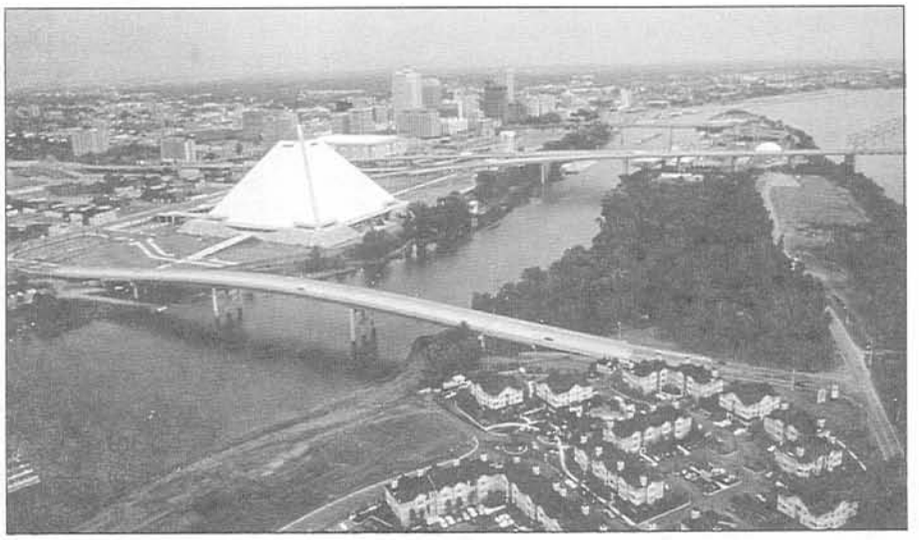
The inspection process is structured around three scheduled visits. The contractors and/or owner must contact the building officials when they reach the stages of foundation, framing, and final inspection. The electrical inspector also has scheduled reviews. Unannounced visits occasionally occur, typically for projects involving an untrustworthy contractor or for very large projects.

Fee Schedule

There is no initial application fee. A final permit fee based on construction valuation is charged after the plans have been reviewed and accepted. Jonesboro uses the SBCCI chart for estimating the average cost of each building type.

The fees for all building inspections are included in the permit fee. The building officials have authority to write citations to courts in case of noncompliance or postponement of construction. The building inspectors use the citation as a last resort, preferring to resolve problems more cooperatively. Stop work orders may be issued when a project does not have the proper permit for work being constructed.

FIGURE C.4 Aerial view of downtown Memphis. (Photo: Memphis Convention & Visitors Bureau)



Memphis, Tennessee (SBCCI, Large)

Memphis and Shelby County Building Departments were consolidated in February 1984. Since that date, the department has functioned as the Memphis and Shelby County Office of Construction Code Enforcement (CCE). CCE issues construction permits and trade licenses for all of Shelby County's unincorporated areas and the incorporated areas of Memphis, Germantown, Arlington, and Lakeland. Its jurisdiction area encompasses 850,000 residents.

The state of Tennessee has had a mandatory state building code since 1982. The state uses the latest version of the SBC and supports a staff of plan reviewers and inspectors. The state allows local governments to adopt and implement the SBC themselves, provided that the locally adopted version is not more than six years old.

CCE operates under the Division of Planning and Development, which is a joint city/county division. CCE is funded totally by fees for permits, licenses, exams, and reinspection fees. The fiscal year 1990-91 budget totaled $5,684,324, including personnel, operation, and maintenance. The department is staffed with 123 employees, including clerical, field inspectors, plan reviewers, supervisors, and administrators.

CCE has six plan reviewers, eighteen building inspectors, three senior building inspectors, and one building chief. There are twelve mechanical inspectors with one senior and chief. Plumbing and electrical units both have eighteen inspectors, two seniors, and a chief. CCE reviews 143 plans per month.

Seismic Code Requirements

Memphis enforces seismic building codes and standards. Obtaining seismic provisions was a four-year-long struggle. Seismic codes were adopted in Memphis in April 1990

and gave professionals and the community a one-year grace period to comply. According to the building official, the added costs have proven to be minimal, as projected by NEHRP reports. The building department has had numerous seminars to train engineers, architects, and contractors about the seismic regulations. With the 1994 Standard Building Code, Memphis was brought up to a seismic zone 3 designation.

Implementation of seismic design has been a slow process, involving the training of builders, design professionals, and department staff. In some ways the community still is resistant to seismic design, which makes it difficult for the city/county to be able to expend resources for training. But much progress has been made over the past few years, and seismic design is becoming more widely accepted.

Plan Review Process

The first step in the process for obtaining a residential building permit is to present an application, two copies of the site plan, and one copy of the floor plan to the clerk specialist A. This clerk calculates the permit fee (based on square footage), verifies the proper zoning, enters the information onto the computer, and then refers the application and plans to the plan reviewer. The plan reviewer checks for proper zoning, legality of the lot, setback requirements, building code requirements, and subdivision requirements. The plan reviewer then approves or rejects the permit application. With approval by the plan reviewer, the clerk issues the permit and routes the applicant to the cashier.

An application for a permit for a commercial building is required to be accompanied by four complete sets of plans; one set of specifications signed, sealed, dated, and drawn to scale by an architect or engineer who is licensed by the state of Tennessee; and a plans review fee. The application is entered by the clerk specialist A. The plans are given to the clerk specialist B, who routes the plans to the Building Plans Review Section, building inspector, city or county fire department, Plumbing Section, Mechanical Safety Section, city traffic engineer, and public works or the county engineer. A copy of each review is returned to the clerk specialist B. The clerk copies the reviews of each section, and the total review is mailed to all parties listed on the application (i.e., owner, architect, and contractor). It normally takes one to three weeks to receive a permit, depending on the size of the job. The staff levels in Memphis/Shelby County are usually adequate for the workload. The load varies, however, and it is not always possible to plan ahead.

If someone wishes to appeal a building code decision or has other requests, he or she may contact the building official. Problems are usually settled without requiring a formal meeting of the board of appeals, although that mechanism is available if needed.

Code Enforcement and Inspection

Memphis/Shelby County seeks Standard Building Code (SBC) certification in plan reviewers and building inspectors, but it is not mandatory. The building inspector, however, must be certified. The city cannot afford licensed engineers as plan reviewers, though it would be desirable.

The Office of Construction and Code Enforcement has a monthly volume of 4,170 inspections. The building inspection process is initiated by a call from the contractor or owner. Memphis conducts reinspections on every job (foundation, slab, final, etc.) every month to check on progress. The inspections are covered by the application fee. Permits and inspections are programmed on a mainframe computer, which gener-

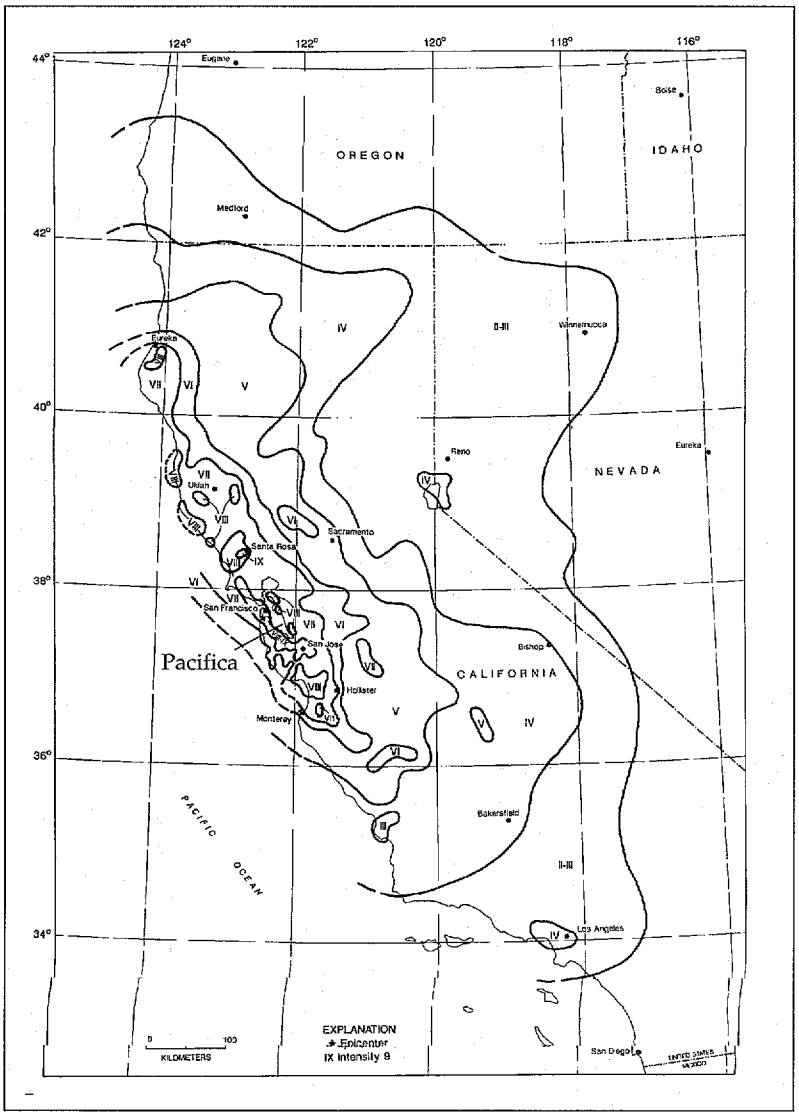


FIGURE C.5 The City of Pacifica, California, is located close to the San Andreas Fault, in an area that was severely shaken by the great San Francisco Earthquake of 1906. (Source: U.S. Geological Survey Professional Paper 1527, 1992)

ates monthly management reports regarding permits, inspections, and fees.

Memphis/Shelby County seeks to work with applicants by scheduling predesign conferences and offering other services. No new procedures are enforced without advance notice to practitioners.

If noncompliance or postponement of construction occurs, the department has standard actions it may take. The first step is to issue a courtesy citation, which cites the specific code violations and date of abatement. It requires abatement within thirty days or else a summons to court will be administered. Generally this achieves compliance.

The building official says that the news media have been very helpful in getting accurate information out to the public. The building department has developed a working relationship with the media, which has helped to reduce the potential for negative publicity. The department has worked at developing a professional, open process and cooperative relations with the public and the building community. These aspects are very important in this potentially contentious field.

Pacifica, California (ICBO, Small)

Pacifica has one plan reviewer and two building inspectors for a population of 40,000. The Building Department's annual budget is approximately $300,000. Staff levels are adequate for the work load, although the summer construction season can get quite busy.

Seismic Code Requirements

Seismic provisions have been part of the code since Pacifica's incorporation in 1956. Seismic design and enforcement are among the highest priorities facing the building department, because Pacifica is located in seismic zone 4 and is quite close to numerous active faults.

California has had seismic provisions since the 1933 Long Beach earthquake. Currently, the state uses the UBC and has refined the code over the years to reflect practices and experiences in California.

Plan Review Process

The process of seismic enforcement starts with plan review. To receive a building permit one first must submit plans and documents to the planning, engineering, and building departments. The planning department checks for compliance with zoning ordinance regulations. The engineering department reviews for

off-site issues, such as setbacks and sidewalks. The building department handles reviews of plumbing, electrical, structural, and mechanical elements. Once all approvals are received, the building official signs the building permit. The average time to receive permit approval is three weeks.

If an applicant wishes to appeal a decision, she or he first talks with the building official. There is a board of appeals, but its power is limited. The building official has the final word on code compliance.

Code Enforcement and Inspection

When the building permit is issued, applicants are given a job card that details the inspection process and schedule. The owner must schedule at least twenty-four hours ahead of when they wish to be inspected. Building inspectors occasionally conduct unannounced visits on large projects.

During construction there are specific inspections for seismic compliance, such as the nailing schedule and hold-down systems. Staff training concentrates on ensuring that the building official, reviewers, and inspectors are knowledgeable about seismic provisions. Field staff also work at educating contractors on the purposes behind the code provisions.

The initial permit fees cover inspections, except for reinspections: the third visit on the same issue requires an additional fee. Stop work orders are administered when someone is working without a permit, and these can result in a charge of ten times the initial permit fee. Some lenience is given to homeowners, who may be unaware of the permit requirements.

The only formal training requirement for plan reviewers and inspectors is certification from ICBO. Staff reviewers are also recommended to have engineering training.

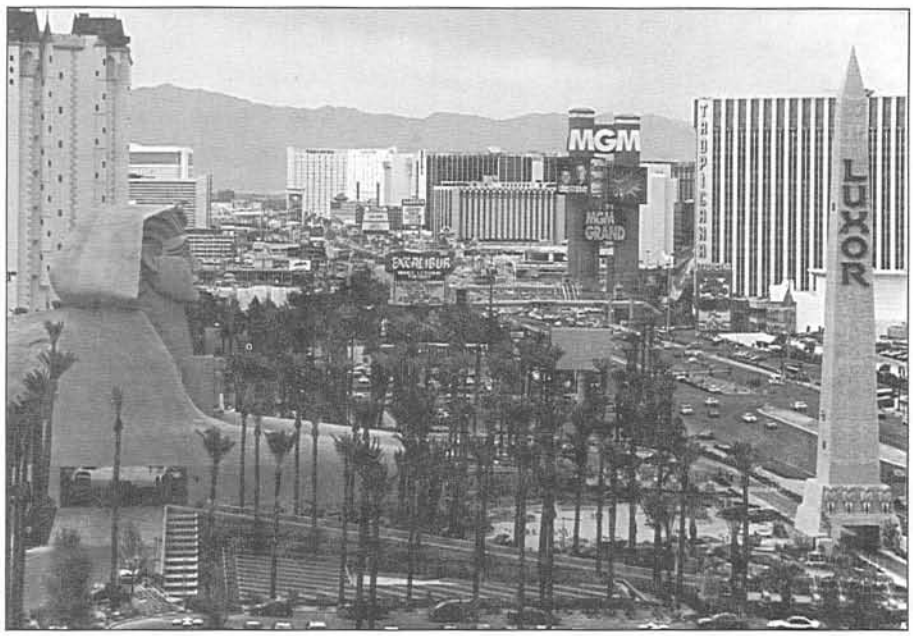


FIGURE C.6 Large parts of Las Vegas fall under the jurisdiction of the Clark County Department of Building. (Photo: Las Vegas Convention and Visitors Authority)

Fee Schedule

The building official sets the permit fees using the *Uniform Building Code*'s (UBC) Chapter 3 fee schedule. The Uniform Administrative Code sets the fees for plumbing, electrical, and mechanical permits. The engineering reviewers set their own fees based on an hourly rate.

Clark County, Nevada (ICBO, Large)

The Clark County Department of Building regulates construction in the unincorporated areas of the county, a jurisdiction with a population of 417,000. It includes many areas adjacent to Las Vegas, including the huge hotels on the Las Vegas Strip. Clark County is one of the most active construction areas in the country, with growth continuing at about five percent per year.

Including direct supervisors, the county has seventy-nine building inspectors and fourteen plan reviewers, several of whom are engineers and architects. The department's approximate annual budget is $10,000,000, including a $500,000 plan review contract to supplement staff. The department consists of the Plan Check Division, Inspection

Division, and Permit Application Center.

Seismic Code Requirements

The county adopted the ICBO *Uniform Building Code* approximately forty years ago and has always used its seismic provisions. Clark County is in seismic zone 2 and integrates seismic and structural reviews. Seismic provisions and dynamic loads, such as wind and snow, are evaluated in the structural analysis. Staff members are familiar with seismic enforcement through plan review and inspection. The department also is involved with state and national seismic committees.

Nevada has adopted the 1991 UBC as the statewide code. They allow local amendments to be more restrictive than the state code, but not less restrictive. Most localities used some version of the UBC before the state adopted the UBC.

Plan Review Process

The process for receiving a building permit is as follows. First an application must detail the scope and type of construction activity, identify the principal design professional for the project, and include site plans. The Department of Building manages the review and distributes copies to each department, such as planning, fire, and public works, to make sure it meets county code requirements.

Plan reviewers are continually trained so as to remain abreast of current building code and enforcement policies. Checklists, supervisor critiques, and inspection classes are a few of the ways reviewers are audited.

The amount of time it takes to get a permit approved varies by the size of the project. Single-family dwellings take approximately three weeks from the time the application is submitted to the final permit approval. Commercial projects can take about four to six weeks. The numerous large hotels of Las Vegas take much longer to obtain a permit.

Plan reviewers have permission as part of their assignment to sign all permits, after which their supervisors critique. The director gets involved when problems arise or when there is a need for complex interpretations.

Problems or complaints regarding permit denial are first handled administratively. One of the two designated plan check supervisors first tries to resolve the problem. If unresolved, it goes to the director of the Department of Building, who serves as the building official. Finally, the applicant may file a complaint with the board of appeals, which is appointed by the county commissioners to make interpretations of the code and grant appeals.

Code Enforcement and Inspection

Inspections are scheduled as required by the Department of Building and the code to check on different phases of construction, such as foundation, slab, framing, roofing, sheathing, and so on. The inspections are arranged after the builder contacts the department to notify it of the readiness of the construction. Inspections must be conducted before further construction can continue. Certain projects require continual or special inspection. If required, the owner of the site/project must hire an outside inspector or testing agency that has been pre-approved by the Department of Building. This organization conducts all required inspections and deals with structural requirements such as concrete, steel, masonry, soils, and grading issues. The owner of the site/project pays directly for third-party inspection services.

The Department of Building will sometimes conduct unscheduled inspection visits, most commonly for large projects that require such attention. Inspection costs by the

department are covered by the permit fee.

Although the department's workload has increased substantially, the department has incorporated methods for adjusting to these heavy loads, such as hiring more plan checkers and using third-party inspectors. The approved third-party inspector agencies total about fifty firms with about 350 certified inspectors.

Fee Schedule

Clark County's permit fee schedule is slightly less than ICBO's guide. The fee schedule is based on the value of project construction. The plan review fee is 65 percent of the building permit fee derived from the chart. Fast-track projects or projects requiring phased design and construction are charged a higher cost for plan review. Subsequent review of resubmitted plans requires an additional fee. The building permit fee is charged upon issuance of the permit. The fees are only used to fund the services for which they are charged. The funds are placed in an enterprise fund and do not go into the county's general account.

Noncompliance or postponement of construction require additional costs. The Department of Building does not usually charge for additional reinspection on the same issue until the third visit. This charge is $45. If a "red tag" or stop order is issued, an investigation is conducted and the owner is charged a fee ranging from $120 to $2,000. The charge is based on the cost of work at completion of the investigation. The department also can cite a project as a misdemeanor. Finally, the department can file a complaint with the contractors board if a contractor has abused his or her position.

INTERVIEWS

Carbondale, Illinois:
Steve Larson, City of Carbondale (Spring 1994)

St. Louis County, Missouri:
Dave Casl, Building Permit Division, Department of Public Works, Clayton (Spring, 1994)

Jonesboro, Arkansas:
Joe D. Tomlinson, Department of Planning and Inspection (Spring 1994)

Memphis, Tennessee:
Terry Hughes, Building Official, Memphis and Shelby County Construction Code Enforcement (October 16, 1991; Spring 1994); William Walmsley, Director of Engineering, Department of Commerce and Insurance, Division of Fire Prevention, Nashville (May 7, 1991)

Pacifica, California:
Steve Branvold, Plans Examiner and Building Official (Spring 1994)

Clark County, Nevada:
Robert Weber, Director, Department of Building (Spring 1994)

Survey Instrument

The following pages reproduce a form used by the Illinois Emergency Management Agency to survey communities' building code practices in southern Illinois. Such an inventory is an essential first step toward targeting municipalities or regions for code adoption or improving code enforcement. The data can also be used to help encourage the state to adopt a statewide code.

The Illinois survey, which was accomplished by a graduate student assistant over the course of one summer, began with the identification of 300 municipalities and counties in the area of highest seismic hazard. Using the Illinois Municipal League directory, a master list was created of the addresses, contact phone numbers, and populations of all relevant jurisdictions. Most of the surveys were completed by telephone. Counties were surveyed first, so that they could also confirm the list of cities, towns, villages, and townships within the county. This ensured that all jurisdictions were adequately identified. Where available, the building inspector was surveyed. In jurisdictions without building codes, the mayor or city clerk was surveyed. In small communities, where no telephone response was received after several tries, the surveys were mailed out, using systematic survey procedures. The data were analyzed using spreadsheet software.

The survey concluded that 78 percent of the municipalities have not adopted building codes. Fortunately, most of the larger municipalities, where most of the new construction is occurring, are covered by codes. Still, municipalities encompassing 31 percent of the population of southern Illinois are not protected by building codes. Of the communities that have codes, most have adopted the most recent version; but some have not; and several communities have a code but no building department to enforce it.

By use of the spreadsheet database, the data could be sorted by various characteristics, providing the Emergency Management Agency with an easy way of identifying communities with adoption or enforcement deficiencies. The data were sorted in nine different ways: (a) addresses of all communities, (b) municipalities without building codes, (c) municipalities with building codes, (d) code updating methods of municipalities, (e) building permit use in municipalities with codes, (f) municipalities with codes but no building departments, (g) types of construction regulated by municipal building departments, (h) building departments' plan review standards, and (i) building department staff composition.

Copies of the full report, *Seismicity and Building Code Use in Southern Illinois*, by Lisa C. Morrison, October 1995, may be obtained for the cost of copying by contacting the Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign, (217) 333-3890.

Southern Illinois Building Code Survey: Survey Form

Opening:

My name is _____ . I am conducting a survey on building codes in Southern Illinois for the Illinois Emergency Management Agency.

a. Could you direct me to someone with information about _____ (jurisdiction's) building codes?

b. Can I take a few moments of your time to ask you about building codes in _____ (the jurisdiction)?

The Survey:

1. **Jurisdiction:** _____

2. **Has _____ (jurisdiction) adopted any building codes?**

   (If yes, continue. If no, go to 3.)

   a. What is the name of the building code in use? _____

   b. What was the year of the last revision? _____

   c. How are the building codes updated? _____

   _____

   _____

   d. Is a building permit required prior to construction? _____

   _____

   e. If yes, is a licensed architect or engineer's seal required on an applicant's construction document to obtain a building permit? _____

   _____

3. a. **Does _____ (jurisdiction) have a code enforcement authority or building department to regulate building codes?**

   (If yes, continue. If no, go to end.)

   b. What is the department name? _____

   What is the department address? _____

   _____

What is the telephone number? _____

c. What types of construction does the department regulate (residential, commercial, etc.)? _____

_____

d. Is a plan review by the building department required for obtaining a building permit? _____

If yes, who performs the review? _____

_____

If yes, does the reviewer have any of the following?

BOCA Certification _____ ICBO Certification _____

Professional Engineer's License _____ SBCCI Certification _____

Professional Architect's License _____ Other Certification _____

e. During construction, who ensures compliance with the building code?

_____

f. How many staff members are employed by the building department?

_____

g. How many of the following does the building department have?

Architects _____ Certified Planners _____

Engineers _____ Field Inspectors _____

4. *(If no to 2 and 3) Is new construction regulated in any way?* _____

_____

5. **a. Could I have you name?** _____

b. Title? _____

c. Mailing Address? _____

_____

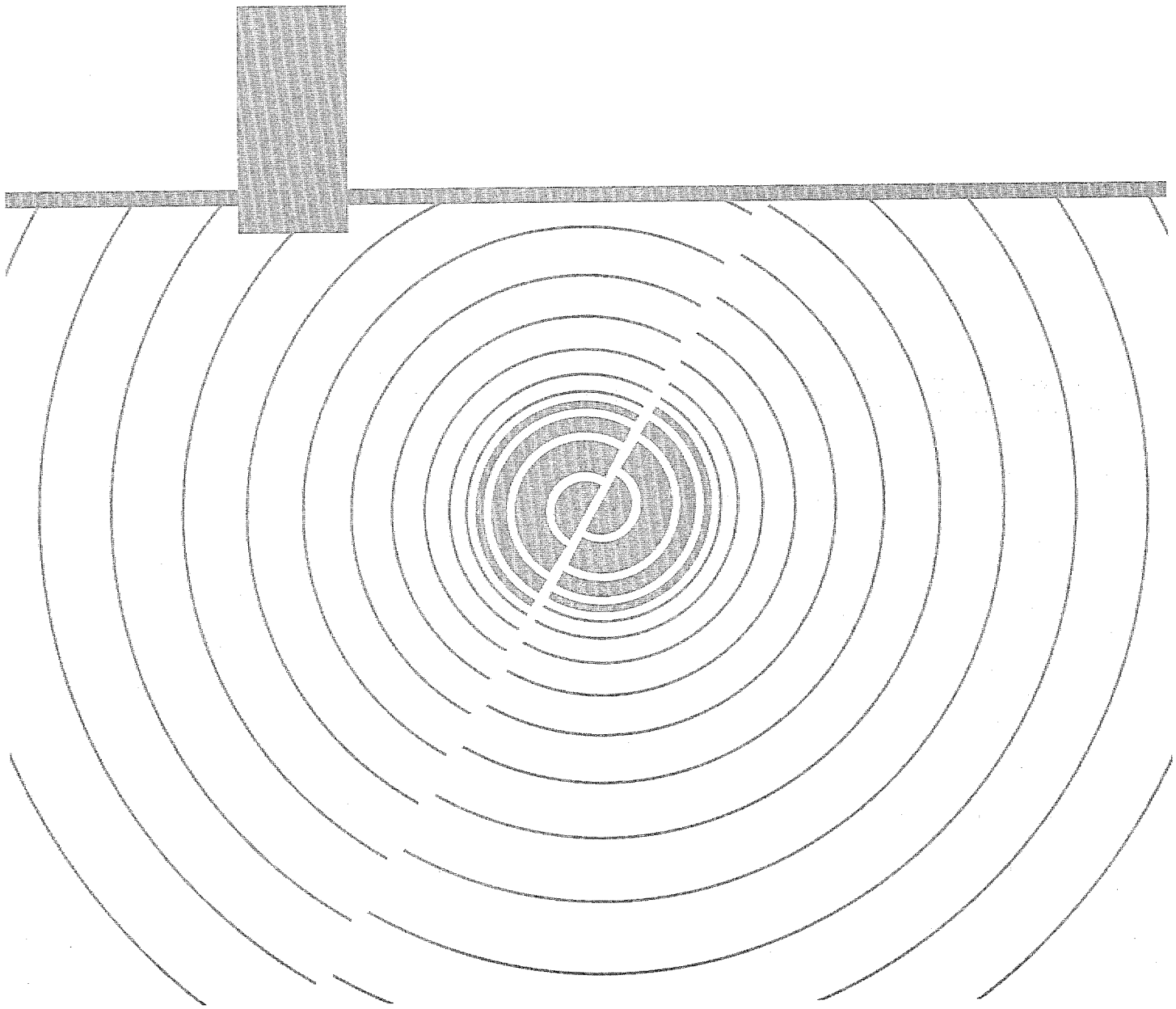
_____

d. Phone Number? _____

Closing:

That completes our survey. Thank you for your time.

Appendix D: Model Code Organizations: Services and Resources Offered



Appendix D
Model Code Organizations: Services and Resources Offered

Building Officials and Code Administrators International, Inc. (BOCA)

History

Building Officials and Code Administrators International, Inc., was founded in 1915 to provide a forum for the exchange of knowledge and ideas concerning building safety and construction regulation. Their resulting code, the *BOCA National Building Code*, was first published in 1950. BOCA is a not-for-profit service organization dedicated to professional code administration and enforcement for the protection of public health, safety, and welfare. BOCA is the nation's oldest professional association for construction code officials and currently serves a membership that includes both public administrators and a wide variety of building and construction professionals.

Goals and Objectives

BOCA's primary activities are the publication of the national codes and the provision of technical, educational, and informational services relating to all specialty areas of code administration and enforcement.

Membership

Membership in BOCA is available to a wide variety of government officials and building industry professionals. There are thirteen classifications of members; however, the primary memberships pertain to governmental and individual units. Membership services include code interpretations and code change publications in addition to other services and publications.

Active membership (governmental) is open to governmental units, departments, or bureaus that administer, formulate, or enforce laws, ordinances, rules, or regulations relating to construction, fire safety, property maintenance, development, or land use. Dues for active members are: in communities with populations 50,000 and fewer, $120; 50,001 to 150,000, $180; and more than 150,000, $240.

Associate membership (individual) is open to an employee or representative of an active member or a student. Dues are $25.

Other membership categories for professionals, companies, and individuals range from dues of $20 to $400.

Seismic Code Education and Training

The three model code organizations offer publications, seminars, and videos on seismic codes and seismic design. For more information, contact the model code organizations listed in this appendix.

Seminars
- Earthquake Design Requirements, BOCA
- Earthquake Regulations, ICBO
- Design of Concrete Buildings for Earthquakes and Wind Forces, ICBO
- Seismic Training Program for Building Officials, SBCCI

Publications
- Commentary to the 1993 *BOCA National Building Code* provides an in-depth explanation of the seismic provisions, BOCA
- Design of Concrete Buildings for Earthquake and Wind Forces, ICBO
- Recommended Lateral Force Requirements and Commentary 1990 (SEAOC Blue Book), ICBO
- Commentary on Appendix Chapter 1 of the UBC-ICBO Training Manual, ICBO
- Seismic Training for Building Officials, SBCCI

Educational Services
- All three code organizations assist in conducting seminars, workshops, and short courses on code content, enforcement, and administration.

What Happens When One Joins BOCA?

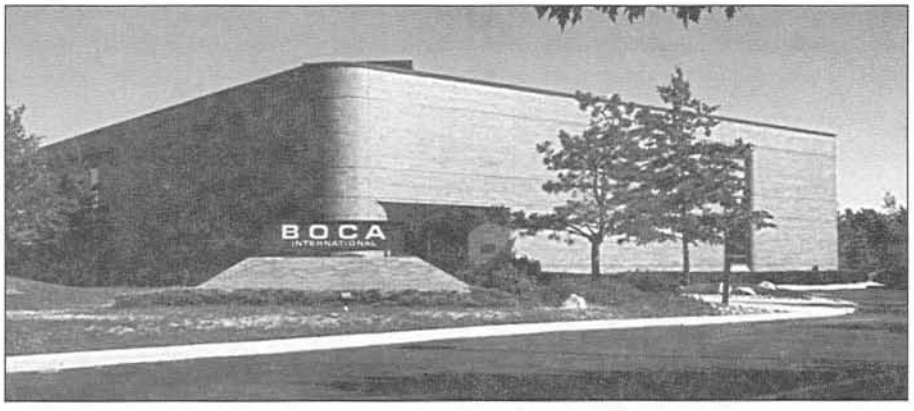
The first step in joining is to call and request a membership form. A new member adopting the code for the first time can request that a BOCA staff member visit his or her site and assist in establishing the program. Advice is offered on a limited basis. The additional costs for new member assistance in code adoption depends on the size of community of the new member, the member's jurisdiction, and the activities being conducted by BOCA staff. The new member may need to hire BOCA to evaluate and establish code formats and procedures if extensive help is needed. Many new members simply take the code book and follow its recommendations with limited assistance from BOCA. All *BOCA National Codes* have sample adoption ordinances printed in the front of the code book.

Code Development/Amendment Process

Each of the *BOCA National Codes* is updated and republished every three years. The *BOCA National Codes* are amended through a democratic public hearing and revision procedure that allows all interested parties the opportunity to both propose changes to code provisions and argue the change proposals. Change proposals are voted on at the organization's annual conference. This procedure guarantees the inclusion of technological advances and current knowledge in the codes.

Technical Services

BOCA's Technical Services Department offers a variety of technical services to BOCA members and to building industry firms and manufacturers. These services include plan examination, technical consultations, and special studies. Product and system evaluation assistance is available through cooperation with BOCA Evaluation Services, Inc. Code interpretations are available to BOCA members at no charge.



BOCA's headquarters office is located in Country Club Hills, Illinois (photo: BOCA)

Professional Development Services

BOCA seminars and correspondence courses are available at reduced member prices. Programs address building, mechanical, plumbing, and electrical inspection; fire prevention; plan review; and a wide variety of specialized seminar topics.

BOCA's Professional Development Services Department strives to promote effective code enforcement by fostering the education and professional development of code users. The department pursues ongoing development of a comprehensive curriculum based on the *BOCA National Codes* and related documents, emphasizing responsiveness to the needs of local, state, and federal agencies. BOCA educational programs address the technical, administrative, and legal areas of code enforcement and are available for individuals with entry-level through advanced skills. BOCA's training programs and products reflect modern instructional design concepts and are available in a variety of media formats.

BOCA annually conducts approximately 300 days of on-location

Building Officials and Code Administrators International, Inc. (BOCA)

Headquarters
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795
tel: 708-799-2300
fax: 708-799-4981
email: member@bocai.org
http://www.bocai.org

Publications Order Department: ext. 242 or 248
Certification Secretary: ext. 334
Plan Review Fax: 708-799-0310

Regional Offices
BOCA has four regional offices that complement the organization's headquarters in making responsive model building code services available to all members across a far-reaching geographic area.

1245 S. Sunbury Rd., Suite 100
Westerville, OH 43081-9308
tel: 614-890-1064
fax: 614-890-9712

Towne Centre Complex
10830 East 45th Street, Suite 200
Tulsa, OK 74146-3809
tel: 918-664-4434
fax: 918-664-4435

One Neshaminy Interplex, Suite 201
Trevose, PA 19053-6338
tel: 215-638-0554
fax: 215-638-4438

6 Omega Terrace
Latham, NY 12110-1939
tel: 518-782-1708
fax: 518-783-0889

BOCA Certification Programs

Certification is achieved in twenty-four categories by successful completion of one or more examinations. These categories include:

- Building Inspector
- Building Plans Examiner
- Electrical Inspector
- Electrical Plans Examiner
- One- and Two-Family Dwelling Electrical Inspector
- Mechanical Inspector
- Mechanical Plans Examiner
- Plumbing Inspector
- Plumbing Plans Examiner
- One- and Two-Family Dwelling Combination Inspector
- One- and Two-Family Building Inspector
- One- and Two-Family Mechanical Inspector
- One- and Two-Family Plumbing Inspector
- Elevator Inspector
- Combination Commercial Inspector
- Building Code Official
- Electrical Code Official
- Mechanical Code Official
- Plumbing Code Official
- Master Code Official
- Fire Inspector I
- Fire Inspector II
- Property Maintenance and Housing Inspector

seminars on a wide variety of code-enforcement subject areas. Training products include video seminars, audio cassette courses, home study workbooks, seminar-related workbooks, and correspondence courses.

Seminars

BOCA seminars provide members with information on the latest in codes and code enforcement and assist in developing new strategies, skills, and knowledge. Seminars provide technical information as well as practice and application exercises on the most contemporary and critical topics in code enforcement.

BOCA offers a seminar titled *Earthquake Design Requirements*. The goal of this seminar is to learn how to identify and apply earthquake design requirements, and to help code officials and design professionals understand the impact of the requirements on their jobs. Fees for this seminar are $99 for BOCA members and $149 for nonmembers. These fees are representative of the seminar fees charged by BOCA.

Any organization or institution, whether a member of BOCA or not, can contract a specific seminar to be administered at their specified site location. This is often done by regional BOCA chapters. No set number of participants is required. BOCA can also customize seminars on special topics. However, this service is expensive due to the cost of paying BOCA staff to develop a new topic.

Certification Programs

BOCA's Professional Development Services Department has promoted the recognition and certification of professional code officials, who by completion of proctored examinations demonstrate knowledge in the *BOCA National Codes*.

Evaluation Services

BOCA Evaluation Services, Inc. (BOCA-ES) distributes code compliance evaluation reports of proprietary construction materials, products, and systems. Each BOCA-ES report describes the product, its performance, and limitations of acceptance under the *BOCA National Codes*.

Publications

BOCA's Publication Development produces and distributes the *BOCA National Codes* and a variety of documents critical to the successful, knowledgeable code user. BOCA offers a wide variety of forms, permits, and enforcement aids; code commentaries, textbooks, and handbooks regarding code administration and enforcement; and numerous specialized workbooks to complement BOCA's many educational programs. BOCA's technical reference and educational materials include a publication on earthquake design requirements. In addition the commentary to the 1993 *BOCA National Building Code* provides an in-depth explanation of the seismic provisions. Substantial price discounts on all publications and services are offered to members.

Membership directory. A directory listing names, addresses, and phone numbers of all BOCA members by category is available. BOCA's articles of association and bylaws are also published in the directory.

Periodicals. *The Building Official and Code Administrator Magazine* is BOCA's bimonthly journal. Subjects include fire safety, construction methods, innovative technology, regulatory activity, construction efficiency and economy, code official professional development, and technical and administrative aspects of code enforcement. The magazine also publishes interpretation requests that have been reviewed by the Code Interpretation Committee.

The *BOCA Bulletin* is a bimonthly newsletter that provides members with news reports between regular issues of the BOCA magazine. It includes items of national interest regarding code enforcement as well as announcements and technical material pertaining to various meetings, seminar offerings, and model code revision activities.

Computer Products

BOCA offers the following products: Complete Building Department Software used to process permits, track new construction inspections, property maintenance inspections, and fire-incident inspections and reporting. There is an electronic product containing code test called CodeSearch. For automated plan review of the *BOCA National Building Code,* explore the Plan Review System Software. Additionally, BOCA's Property Maintenance Management System (PMMS) is an automated property maintenance complaint tracking system.

Discussion of the BOCA National Building Codes

BOCA's complete model building code services program is dedicated to the improvement of construction regulations, and the effective administration, organization, and enforcement of these regulations by professionally staffed state and local governmental units.

To accomplish this BOCA provides a complete and coordinated model building code services package, the backbone of which is the *BOCA National Code* series.

The 1993 *BOCA National Building Code* includes a modified version of the 1991 *NEHRP Recommended Provisions for the Development of Seismic Regulations for New Building.* BOCA uses the 1991 NEHRP Provisions as the technical basis for this section because of its use of nationwide input to develop design criteria. This code section represents state-of-the-art design criteria for seismic design. These provisions minimize the hazard to life for all buildings, increase the expected performance of higher-occupancy buildings as compared to ordinary buildings, and improve the capability of essential facilities to function during and after an earthquake.

The International Conference of Building Officials (ICBO)

History

The International Conference of Building Officials was founded in 1922. ICBO is a nonprofit service corporation owned and controlled by its member cities, counties, states, and federal agencies. The ICBO codes have been widely adopted throughout the United States and in many locations abroad. ICBO has ninety-six local, district, state, and student chapters that provide members with opportunities to meet regularly on a regional basis.

Goals and Objectives

ICBO Mission Statement: "The International Conference of Building Officials is dedicated to public safety in the built environment worldwide through development and promotion of uniform codes and standards, enhancement of professionalism in code administration, and facilitation of acceptance of innovative building products and systems." Goals include:

1. Publication, maintenance, and promotion of the Uniform Building Code (UBC) and related documents.

2. Investigation and research of principles underlying safety to life and property in the construction, use, and location of buildings and related structures.

3. Development and promulgation of uniformity in regulations pertaining to building construction.

The International Conference of Building Officials (ICBO)

Central Office
5360 South Workman Mill Road
Whittier, CA 90601-2298
tel: 562-699-0541
fax: 562-699-8031

ICBO Order Department:
800-284-4406 or
562-692-4226
fax: 562-692-3853
ICBO Computer Services:
562-699-0541 ext. 264
Plan Review Fax:
562-692-3425
ICBO ES, Inc.:
562-695-4694

Regional Offices
ICBO has five regional offices with full support services in evaluation, education, plan checking, code consultation, and code interpretation:

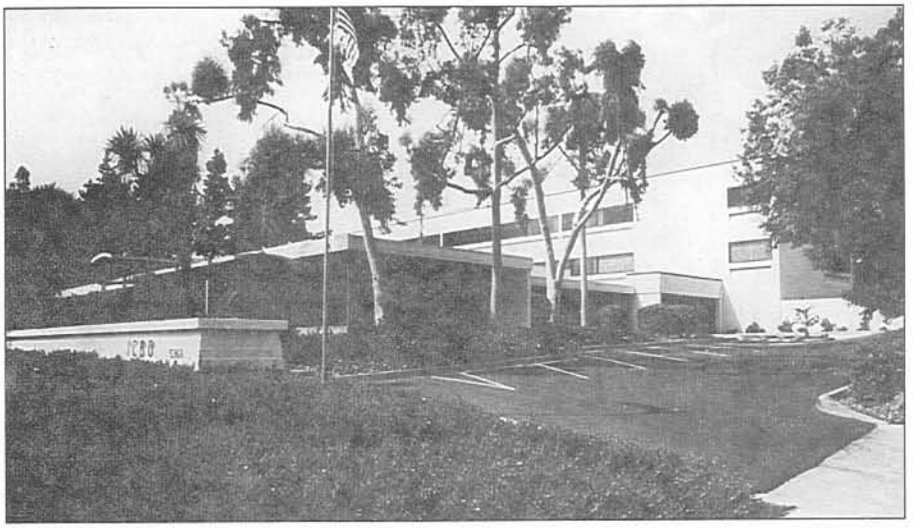
Northern California Regional Office
6130 Stoneridge Mall Road,
Suite 120
Pleasanton, CA 94588
tel: 800-336-1963 or 510-734-3080
fax: 510-463-3295

Austin Regional Office
9300 Jollyville Road, Suite 101
Austin, TX 78759-7455
tel: 512-794-8700
fax: 512-343-9116

Indianapolis Regional Office
7998 Georgetown Road, Suite 900
Indianapolis, IN 46268
tel: 317-879-1677
fax: 317-879-0966

Kansas City Regional Office
290 Northeast 60th St., Suite 206
Gladstone, MO 64119
tel: 816-455-3330
fax: 816-454-8887

Seattle Regional Office
2122 112th Avenue, Northeast,
Suite B-300
Bellevue, WA 98004
tel: 800-231-4776
fax: 425-637-8939



The Central Office of the International Conference of Building Officials is located in Whittier, California. (Photo: ICBO)

4. Advancement of professional skills of those engaged in the administration and enforcement of building laws.

5. Formulation of guidelines for the administration of building and safety departments.

Membership

Membership in ICBO is open to all governmental units as well as all other segments of the building construction industry. There are fifteen membership classifications. The primary memberships are governmental, of which there are two classes.

Class A is a governmental unit or agency engaged in the administration or formulation of laws and ordinances relating to building construction. The annual dues for a city with a population of 10,000 or less is $85. The annual dues for a city of population greater than 10,000 is $195.

Governmental individual is an individual responsible for the enforcement or administration of laws and ordinances relating to building construction. The annual dues are $60.

Both types of members receive a copy of each new edition of the UBC and annual supplements in the years between publication. Interpretations of the codes and plan examination services are also available to these members.

Other memberships are available to students, professionals, and certified individuals at costs that range from $20 to $95. Corporations and associations may join at rates ranging from $150 to $500.

What Happens When One Joins ICBO?

When a governmental unit joins ICBO, the organization sends a representative to orient the new member. The ICBO representative will present a packet with basic information on the organization and its services and procedures. If the new member has never before had a building code in place, ICBO asks that they schedule a meeting with architects and local professionals to meet with the ICBO representative. The representative explains the code information and policies to all affected parties and the city council. The new member can then use the conference services office, chapter, or another nearby ICBO member for assistance when questions or problems arise. These member organizations provide an interactive and helpful network. Once the code is implemented ICBO will review the department to ensure all is well. As long as the new member requests basic orientation information, ICBO will provide services free of charge. However, any assistance leaning more toward training, for example the updating of codes, requires payment.

Code Development/Amendment Process

ICBO's codes are published in a three-year cycle. This cycle, as developed by ICBO members, permits gradual adaptation while allowing inclusion of the latest technological advances. Anyone interested in maintaining or improving the codes may submit change proposals. Code change proposals are discussed in public hearings that

allow the concerns of the construction industry, design professionals, building officials, and other related segments of society to be heard. After ICBO's code staff of structural, civil, fire protection, and mechanical engineers analyze the proposals' impact on the code, the proposals are published as a separate part of *Building Standards* magazine. Thus, all members and subscribers to ICBO services are informed of the code change proposals. Proposed changes with committee recommendations are voted on at ICBO's annual conference. Approved changes become a part of the next edition of the code.

Educational Services

ICBO provides a variety of specialized programs through its Education Department to assist in developing and maintaining adequate training and continuing programs to keep pace with the changing construction industry.

Seminars

ICBO seminars are offered throughout the United States. All course instructors are ICBO technical staff personnel or other nationally recognized instructors. Some seminars are offered only to ICBO members. The cost for members averages about $95 for a one-day program; the average cost for nonmembers is $125 per day.

Participants in ICBO-sponsored seminars earn Continuing Education Units (CEUs). ICBO complies with the standards established by the International Association for Continuing Education and Training and maintains transcript records.

Several special-interest seminars are available to individuals seeking to expand their knowledge of the design or plan review and inspection provisions found in the UBC.

Videos

ICBO videos provide training and information without the expense of seminar participation. These videos are designed, developed, and produced by ICBO to provide basic training in the field of building construction or inspection. Some video subjects include light-frame construction, fire-resistant protection, a guide to revisions of the 1997 Uniform Building Code, and earthquake protection.

Certification Programs

The ICBO Voluntary Certification Program was initiated in 1973 as a means to encourage professionalism among inspection and plan check personnel through a comprehensive test of knowledge of codes, standards, and practices necessary for competent practice. Use of the certification program has greatly expanded in the private sector, with its need for qualified special inspectors, as well as in a number of states that are considering statewide mandatory ICBO certification of construction inspectors.

The program is administered by ICBO through its Certification Department. ICBO does not offer exam-preparation seminars. Knowledge for the exams is obtained through professional experience and professional development education. Prior to the exams ICBO provides all registered participants with a *Candidate Bulletin*, which describes each exam in detail (i.e., suggested reference materials, an outline of topics stressed on the exam, and sample questions).

Examinations are administered three times a year, and much more frequently through computer-based testing centers. Dates and test locations are listed in *Building Standards* magazine.

Assistance

ICBO offers management studies, operational reviews, and analyses to provide counsel in areas such as budgeting, staffing, work evaluation, and ordinance preparation.

ICBO Certification Categories

Certification is offered for:

Code Enforcement Inspectors

- Building Inspector
- Electrical Inspector
- Mechanical Inspector
- Combination Inspector
- Combination Dwelling Inspector
- CABO One- and Two-Family Dwelling Inspector
- Light Commercial Combination Inspector Elevator Inspector

Plan Examiners

Special Inspectors

- Reinforced Concrete Special Inspector
- Prestressed Concrete Special Inspector
- Structural Masonry Special Inspector
- Structural Steel/Welding Special Inspector
- Spray-Applied Fireproofing Special Inspector

Uniform Fire Code Inspectors

Company Officer Fire Code Inspectors

Underground Storage Tank Inspectors

- Installation/Retrofitting
- Decommisioning
- Tank Tightness Testing
- Cathodic Protection

Evaluation Service

The ICBO codes are designed to encourage the development of new building products and innovative building systems through the examination and evaluation of basic research and product testing. ICBO's evaluation service gives communities access to an expert staff of trained engineers at minimal cost and allows proponents of new building products or systems to gain recognition by building enforcement agencies.

Plan Review Services

The ICBO offers its own plan review services to jurisdictions desiring access to ICBO staff expertise. ICBO charges a portion of the permit fee, allowing the jurisdiction to retain a percentage for administrative costs. Turnaround time is less than two to four weeks.

Publications

The Uniform Building Code. Publication of the UBC and its related volumes remains ICBO's primary function. In each of the two years between publication of the codes, a supplement is issued containing changes approved at the most recent annual conference. An analysis of these changes is published every three years along with the major new edition of the codes.

Membership roster. This publication contains a description of each category of membership and a complete listing of all ICBO members. Also included is an explanation of the history of the conference, the functions of the various departments, and available services. Other features include publications, information, a chapter directory, and the conference bylaws.

Technical reference and educational materials. ICBO develops texts and course materials for use in connection with community college curricula and higher-level courses in building construction technology and inspection. These materials have also proved to be valuable to building officials in the effective administration of their departments.

Periodicals. *Building Standards* is ICBO's official periodical. It is published bimonthly and contains articles of technical, educational, and administrative importance as well as code interpretations, current building valuation data, education offerings, job opportunities, a complete calendar, chapter news, and other features. It is published in newsletter form in alternate months. Code-change reports are published as magazine supplements, beginning with proposed changes and including the reports of the code development committees and action taken by the membership at the annual conference.

Automated/Computer Products

Products offered by ICBO are available in 3" and 5 1/4" disk format, PC and Macintosh versions. Manuals and handbooks are available in current WordPerfect, Microsoft Word, and ASCII file formats. Technical information and software products include:

- Uniform Codes on CD-ROM (Code Express)
- UBC Application/Interpretation Manual (electronic version)
- Handbook to the 1994 Uniform Building Code (electronic version)
- UBC Checklist
- Code Change Assistant
- Electronic Building Department Forms
- Product Information Retrieval System (PIRS)

Southern Building Code Congress International, Inc. (SBCCI)

History

The Southern Building Code Congress International, Inc. was founded in 1940 as a nonprofit, internationally recognized model building code organization. The organization is dedicated to serving state and local governments and the building industry through the promulgation and maintenance of the performance-based *Standard Codes* and by providing technical and educational support services. The first publication of the SBC was in 1945.

The original governmental membership of forty southern cities has grown to more than 2,300 city, county, state, and provincial governments and agencies in the United States and other countries. Additional membership in the organization includes more than 8,000 engineers, architects, home builders, contractors, trade associations, and manufacturers.

Goals and Objectives

The stated objectives of the SBCCI are:

1. To develop, maintain, and promote the adoption of the *Standard Codes* and other related documents.
2. To promote uniformity in building regulations through the adoption of the *Standard Codes* and to encourage uniformity in the application, interpretation, and enforcement of these codes.
3. To study, review, and advance the principal fundamentals of safety in building construction.
4. To advance the professional skills of those engaged in the administration and enforcement of building regulations.
5. To advise and assist in the administration of building codes and ordinances.
6. To research, develop, and publish educational materials, including but not limited to testing and certification of code enforcement personnel.
7. To perform other functions as deemed relevant to or desirable for the attainment of these objectives.

Membership

The membership categories of SBCCI are structured to allow participation by anyone interested in building code development and enforcement. There are fifteen individual classifications of members within six categories. However, the primary membership category is that of the active member.

An **active member** is a government unit or agency engaged in the administration, formulation, and enforcement of codes and ordinances relating to building construction. A single active membership provides all of a community's departments or divisions charged with code enforcement with access to a single source of services. The

The Southern Building Code Congress International, Inc., was founded in 1940. Its current headquarters are located in Birmingham, Alabama. (Photo: SBCCI)

Southern Building Code Congress International, Inc. (SBCCI)

Headquarters Office
900 Montclair Road
Birmingham, AL 35213-1206
tel: 205-591-1853
fax: 205-592-7001
TDD: 205-599-9742
email: info@sbcci.org
http://www.sbcci.org

Southwest Regional Office
9420 Research Boulevard
Echelon III, Suite 150
Austin, TX 78759
tel: 512-346-4150
fax: 512-346-4227

Southeast Regional Office
4303 Vineland Road, Suite F-7
Orlando, FL 32811
tel: 407-648-9632
fax: 407-648-9702

Eastern Regional Office
1200 Woodruff Road, Suite G-26
Greenville, SC 29607
tel: 864-281-1006
fax: 864-281-1030

following is a schedule of active member dues:

Population of Jurisdiction	Annual Fee
<5,000	$40
5,001-10,000	$55
10,001-25,000	$75
25,001-50,000	$100
50,001-100,000	$125
100,001-200,000	$150
200,001-300,000	$200
>300,000	$250

Other membership categories exist for corporations, colleges, individuals, students, etc. Dues for these membership categories range from $15 to $275.

What Happens When One Joins SBCCI?

The materials received by new members are discussed in the following text, as are the available services for assistance. SBCCI does offer initial assistance in establishing the code and enforcement guidelines for new members. At a certain point the new member contracts for services and is charged a fee. Regional chapters assist many new members and help distribute information needed at first.

Administration

General policy and major financial decisions for SBCCI are made by an elected board of directors consisting of a president, vice-president, immediate past president, and five directors. The implementation of board policy and the daily management of the organization are the responsibility of the chief executive officer. A full-time professional staff of more than 70 employees provides member services, publication work, and recordkeeping.

Code Development/Amendment Process

Proposed changes to the SBC and supplements are submitted in writing to the office of the chief executive officer together with supporting evidence by the first weekday of March of each year for consideration during that year. The board of directors schedules an open public meeting to receive comments from interested persons and to review the proposed code changes. The report and recommendations of the code committee are published by SBCCI and distributed prior to the opening of the annual conference. At the annual conference code changes are considered and acted upon.

Educational Services

SBCCI sponsors educational programs at various locations throughout its primary coverage area. Courses provide instruction on the technical aspects of the SBC and general knowledge required for effective code enforcement. There are also courses for building department management and the legal aspects of code administration. These educational programs are offered as home study courses, video programs, and classroom presentations.

In addition to the scheduled courses, the SBCCI's educational staff is available to assist in planning and conducting seminars, workshops, and short courses on the various code provisions as well as on code enforcement and department administration. This assistance is available to all membership categories.

Videos

SBCCI offers a series of videotapes designed to assist in using and understanding the SBC. Videos currently available include such topics as wind loads, electrical inspections, and software tutorials.

Certification Program

The SBCCI certification program for code enforcement and administration professionals is a voluntary program that permits these professionals to demonstrate their knowledge in various areas of code enforcement through a written, statistically validated examination. The examination fee for SBCCI members is $95 per examination; and for nonmembers, $135 per examination.

Objectives of the program are:

1. Give recognition to those who have achieved a level of knowledge in their profession.
2. Enhance the professionalism of the code enforcement and administration profession.
3. Assist in the evaluation of code enforcement personnel in their knowledge of the codes.

The program is graduated so that an individual can demonstrate professional growth through progressive levels of certification.

Contractor Testing Service

This relatively new service enables the Education Department to assist governing bodies by ensuring that building contractors of all varieties have passed minimum competency requirements before being licensed. The Contractor Testing Program offers a range of standard examinations for structural, plumbing, electrical, and mechanical contractors at both the master and journeyman levels.

Chapter Training

SBCCI encourages and recognizes the establishment of regional, state, and local chapter organizations of its members and offers training to these groups.

Administrative Services

Departmental analyses. The SBCCI professional staff will provide on-site analyses of existing building departments. The staff will also provide on-site assistance to jurisdictions wishing to establish a code-enforcement program and inspection department. These analyses include but are not limited to evaluations of workloads, permit processing techniques, inspection techniques, job descriptions, and/or computer needs.

Computer services. The SBCCI maintains a full-time staff of computer professionals to advise state, county, and local governments and design professionals on the use and application of computers in code enforcement and building construction. The SBCCI is continuing to develop generic software called Standard Soft, specifically designed for use by building departments and design professionals. Modules currently available include the permit, inspection and plan review modules.

Technical Services

Code interpretations. The SBCCI technical staff will provide consultation either in writing or by telephone on questions regarding the meaning and intent of the *Standard Codes* to all membership categories.

Engineering consulting services. SBCCI's professional engineering staff provides technical consulting services to members. Through consultation with SBCCI engineers, members can often solve code-related engineering problems. This service is particularly valuable to small- and medium-sized towns and cities that may have limited technical staffs.

Publications

The Standard Codes. Besides the *Standard Codes*, the SBCCI has developed a comprehensive set of model construction codes available to local governments. These codes, known as the Standard Codes, include the following:

SBCCI Certification Levels and Areas

Four levels and separate areas of certification are available as follows:

Level 1 Certification

- Housing Rehabilitation Inspector
- Zoning and Property Standards Inspector
- Residential Electrical Inspector
- Coastal Construction Inspector
- Building Inspector
- Mechanical Inspector
- Commercial Electrical Inspector
- Plumbing Inspector
- Fire Inspector I
- Fire Inspector II
- One- and Two-Family Dwelling Inspector
- Commercial Combination Inspector
- Electrical Inspector

Level 2 Certification

- Housing Rehabilitation Code Enforcement Officer
- Building Plan Examiner
- Electrical Plan Examiner
- Plumbing Plan Examiner
- Mechanical Plan Examiner
- Fire Safety Plan Examiner
- Electrical Inspector

Level 3 Certification

- Chief Building Code Analyst
- Chief Electrical Code Analyst
- Chief Plumbing Code Analyst
- Chief Mechanical Code Analyst
- Chief Fire Prevention Code Analyst

Level 4 Certification

- Code Enforcement and Administration Professional

Three Model Building Code Organizations: Sample Fee Schedules

All three of the model building code organizations provide suggested fee schedules for members. These are intended to be adopted and modified by member code enforcers to fit their individual circumstances. All schedules are much more complex than could fit here; each schedule is updated regularly and is available to organization members. The following information is current as to the date of this book and is presented to give readers an idea of the approximate fees involved.

BOCA Fee Schedule

Building permit fee. The *BOCA National Codes* do not include provisions that mandate a specific permit fee schedule. This is at the sole discretion of the adopting jurisdiction. However, BOCA has provided a mechanism whereby local jurisdictions can customize their fees based on their specific jurisdiction.

Plan review fee. The fee charged by local jurisdictions for their plan review services is tyically built into the permit fee.

The plan review fee is based on the estimated construction value calculated in accordance with the Permit Fee Schedule (construction value = gross area x gross area modifier x type of construction factor) published biannually in the *BOCA Magazine*. For buildings valued up to $1 million, the building plan review fee is 0.0015 of the building's valuation ($100 minimum). Thus, for a typical commercial structure with a total construction cost of $100,000, this fee structure would result in a plan review fee of $150.

Fee reductions may be given for buildings such as large warehouses or indoor recreational facilities because of their plan review simplicity. Reductions may also be given to buildings with repetitive floor plans (e.g., high-rise).

In addition, mechanical, plumbing, energy, and electrical plan review fees are each 25 percent of the building code plan review fee. The sprinkler review fee is based on the number of sprinkler heads (e.g., 1-100 heads costs $150).

ICBO Fee Schedule

Building permit fees. ICBO's permit fee is based on the total value of all construction work, finish work, painting, roofing, electrical, plumbing, heating, air conditioning, elevators, fire-extinguishing systems, and any other permanent equipment. A fee schedule or table is provided to ICBO members. For our example of a typical commercial structure with a total construction cost of $100,000, ICBO's permit fee is $580 for the first $50,000 and $6.25 for each additional $1,000. This results in a permit fee of $892.50. Any project that has not first secured a permit prior to beginning construction, will be charged an investigation fee.

Plan review fee. ICBO also suggests a plan review fee equal to 65 percent of the building permit fee. This would create a plan review fee of $580 for our typical commercial structure. Therefore, the total fee costs for this project would be $1,473.

SBCCI Fee Schedule

Building permit fees. Permit fees are based on the total determined construction value of a project. A fee schedule or table is provided for SBCCI members. For a typical commercial structure with a construction cost of $100,000, the permit fee is $460.

If for any reason a permit is not obtained prior to beginning work on a project, a penalty fee will be assessed that is double the original permit fee amount. Full compliance with the code must also be met in addition to payment of the penalty fee. SBCCI has a set moving fee of $100 for any building or structure. Demolition fees are based on total cubic feet.

Plan-checking fees. SBCCI requires a plan-checking fee equal to half the permit fee for any proposed project that has total construction costs in excess of $1,000. This cost is in addition to the permit fee.

- Standard Plumbing Code
- Standard Mechanical Code
- Standard Gas Code
- Standard Fire Prevention Code
- Standard Existing Buildings Code
- Standard Housing Code
- Standard Swimming Pool Code
- Standard Amusement Device Code
- Standard Unsafe Building Abatement Code

Two codes that SBCCI has a part in developing and updating are:

- CABO One- and Two-Family Dwelling Code
- CABO Model Energy Code

Membership directory. A directory lists names, addresses, and phone numbers of all SBCCI members by category. SBCCI's bylaws are also published in the directory.

Technical reference and educational materials. Numerous workbooks and manuals provide technical and administrative assistance to members in understanding the use of the codes and in preparing for certification examinations.

Periodicals. Each month SBCCI members receive either an issue of *Southern Building* magazine or the organization's newsletter, *SBCCI Newsbriefs*. These publications are mailed six times a year on alternate months. Both publications keep the membership informed of developments in the fields of code enforcement and construction technology as well as the activities of SBCCI.

Other publications. SBCCI also produces instructional slides, microfiche, application and administration forms and labels.

Building Seismic Safety Council (BSSC)

The BSSC and its member organizations are valuable resources for increasing the use of seismic codes. The list of member organizations, below, shows the breadth of support for seismic safety issues nationwide and identifies potential sources of information and support in promoting the use of seismic codes.

General Information

The BSSC was established in 1979 under the auspices of the National Institute of Building Sciences to deal with the complex issues involved in promulgating seismic construction standards on a nationwide basis. It is an independent, voluntary membership body representing a wide variety of building community interests. It currently (1997) has sixty-three member organizations.

BSSC provides a national forum that fosters improved seismic safety provisions. It does this by:

- Promoting the development of seismic safety provisions suitable for the entire country;
- Promoting the adoption of seismic safety provisions in voluntary standards and model codes;
- Assessing progress in implementation of seismic provisions;
- Identifying opportunities for improving seismic safety regulations;
- Promoting training and educational courses for the building community (see Appendix E for address);
- Advising government bodies on research and implementation; and
- Reviewing research and practice and recommending changes to seismic design practice.

The BSSC plays an integral role in the periodic development of the *NEHRP Provisions*, which are used as a resource document by the model building code organizations. It has also been involved in the forthcoming *Guidelines for the Seismic Rehabilitation of Buildings* (FEMA #273 & #274), which deal with existing buildings.

Member Organizations

AFL-CIO Building and Construction Trades Department

AISC Marketing, Inc.

American Concrete Institute

American Consulting Engineers Council

American Forest and Paper Association

American Institute of Architects

American Institute of Steel Construction

American Insurance Services Group, Inc.

American Iron and Steel Institute

American Plywood Association

American Society of Civil Engineers

American Society of Civil Engineers–Kansas City Chapter

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

American Society of Mechanical Engineers

American Welding Society

Applied Technology Council

Associated General Contractors of America

Association of Engineering Geologists

Association of Major City Building Officials

Bay Area Structural, Inc.*

Brick Institute of America

Building Officials and Code Administrators International, Inc.

Building Owners and Managers Association International

Building Technology, Incorporated*

California Geotechnical Engineers Association

Canadian National Committee on Earthquake Engineering

Concrete Masonry Association of California and Nevada

Concrete Reinforcing Steel Institute

Earthquake Engineering Research Institute

General Reinsurance Corporation*

Institute for Business and Home Safety (formerly Insurance Institute for Property Loss Reduction)

Insulating Concrete Form Association

Interagency Committee on Seismic Safety in Construction

International Conference of Building Officials

Masonry Institute of America

The Masonry Society

Metal Building Manufacturers Association

National Association of Home Builders

National Concrete Masonry Association

National Conference of States on Building Codes and Standards

National Council of Structural Engineers Association

National Elevator Industry, Inc.

National Fire Sprinkler Association

National Institute of Building Sciences

National Ready Mixed Concrete Association

Permanent Commission for Structural Safety of Buildings*

Portland Cement Association

Precast/Prestressed Concrete Institute

Rack Manufacturers Institute

Seismic Safety Commission (California)

Southern Building Code Congress International

Southern California Gas Company*

Steel Deck Institute, Inc.

Steel Joist Institute*

Steven Winter Associates, Inc.*

Structural Engineers Association of Arizona

Structural Engineers Association of California

Structural Engineers Association of Central California

Structural Engineers Association of Colorado

Structural Engineers Association of Illinois

Structural Engineers Association of Northern California

Structural Engineers Association of Oregon

Structural Engineers Association of San Diego

Structural Engineers Association of Southern California

Structural Engineers Association of Utah

Structural Engineers Association of Washington

U.S. Postal Service*

Western States Clay Products Association

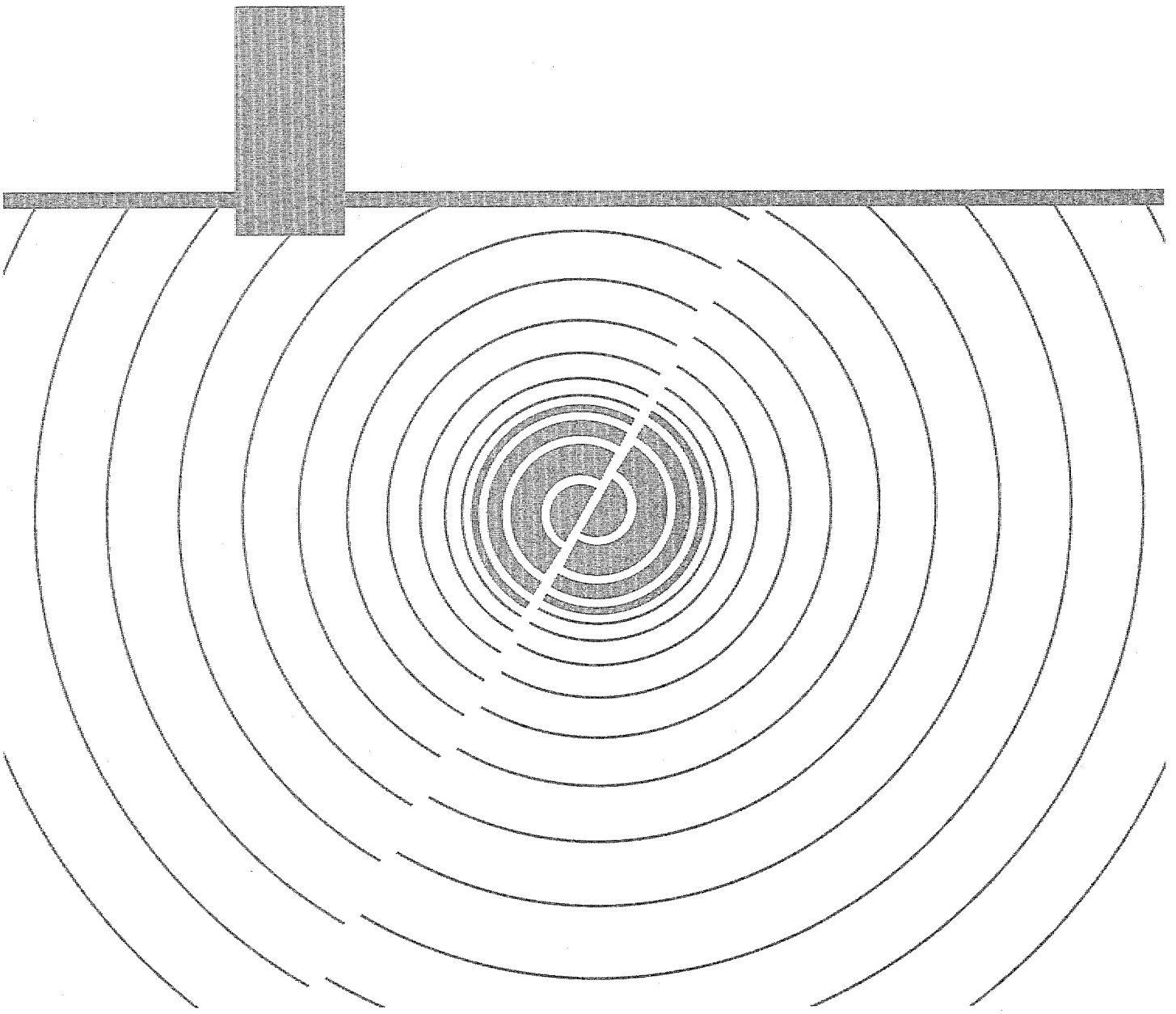
Western States Council Structural Engineers Association

Westinghouse Electric Corporation*

Wire Reinforcement Institute, Inc.

**Affiliate (nonvoting) members.*

Appendix E: Organizations Involved in Seismic Safety: Contact Information



Appendix E
Organizations Involved in Seismic Safety: Contact Information

Listed are several organizations that can provide further information on codes or seismic design. Most of them offer lists of publications (see Appendix F). In addition, the professional organizations have directories of members and local chapters.

Code Organizations

These are the publishers of the model building codes used in the United States. More complete information on these organizations and their services is included in Appendix D.

Building Officials and Code Administrators, International, Inc. (BOCA)
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795
(708) 799-2300
fax: 708-799-4981
http://www.bocai.org

Council of American Building Officials (CABO)
5203 Leesburg Pike, Suite 708
Falls Church, VA 22041
(703) 931-4533
fax: (703) 379-1546
http://www.cabo.org

International Conference of Building Officials (ICBO)
5360 South Workman Mill Road
Whittier, CA 90601-2298
(562) 699-0541
fax: (562) 699-8031
Customer Service and Publications: (800) 284-4406
http://www.icbo.org

Southern Building Code Congress International (SBCCI)
900 Montclair Road
Birmingham, AL 35213-1206
(205) 591-1853
fax: (205) 592-7001
TDD: (205) 599-9742
email: info@sbcci.org
http://www.sbcci.org

Multi-State Earthquake Organizations

These organizations are consortia of officials from several states. Each one has a number of useful publications and, because they specialize in seismic safety issues, can help to put you in touch with key officials in your own state.

Central United States Earthquake Consortium (CUSEC)
2630 E. Holmes Rd.
Memphis, TN 38118
(901) 544-3570
fax: (901) 544-0544
email: cusec@ceri.memphis.edu
http://gandalf.ceri.memphis.edu/~cusec/index.html

Northeast States Emergency Consortium (NESEC)
607 North Ave., Suite 16
Wakefield, MA 01880
(617) 224-9876
fax: (617) 224-4350
email: NESEC@serve.com
http://www.serve.com/NESEC

Western States Seismic Policy Council (WSSPC)
121 Second Street, 4th Floor
San Francisco, CA 94105
(415) 974-6422
fax: (415) 974-1747
http://vishnu.glg.nau.edu/wsspc.html

Federal Agencies

All these agencies are excellent sources of publications, slides, and videos regarding earthquakes and seismic safety. Key publications are listed in Appendix F.

Federal Emergency Management Agency Mitigation Directorate (FEMA)
500 C. Street, SW
Washington, DC 20472
(202) 646-4622
http://www.fema.gov

FEMA Publications Center
(800) 480-2520

FEMA Region I
442 J. W. McCormack Post Office and Courthouse Building
Boston, MA 02109-4595
(617) 223-9540
Mitigation Directorate: (617) 223-9559

FEMA Region II
Mitigation Division
26 Federal Plaza, Room 1351
New York, NY 10278-0002
(212) 225-7200
fax: (212) 225-7262

FEMA Region III
Liberty Square Building, 2nd Floor
105 South 7th Street
Philadelphia, PA 19106-3316
(215) 931-5528
fax: (215) 931-5501

FEMA Region IV
Mitigation Division
Koger Center–Rutgers Building
3003 Chamblee-Tucker Road
Atlanta, GA 30341
(770) 220-5400
fax: (770) 220-5440

FEMA Region V
175 West Jackson Blvd., 4th Floor
Chicago, IL 60604-2698
(312) 408-5500
fax: (312) 408-5551

FEMA Region VI
Federal Regional Center
800 North Loop 288
Denton, TX 76201-3698
(940) 898-5123
Mitigation Directorate: (940) 898-5165

FEMA Region VII
2323 Grand Blvd., Suite 900
Kansas City, MO 64108-2670
(816) 283-7002
fax: (816) 283-7018

FEMA Region VIII
Denver Federal Center, Building 710
Box 25267
Denver, CO 80225-0267
(303) 235-4800

FEMA Region IX
Building #105
P.O. Box 29998
Presidio of San Francisco
San Francisco, CA 94129
(415) 923-7100
fax: (415) 923-7112

FEMA Region X
Federal Regional Center
130 228th Street, SW
Bothell, WA 98021-9796
(206) 487-4600
Mitigation Directorate: (207) 487-4682

National Geophysical Data Center
National Oceanic & Atmospheric Administration
325 Broadway, Mail Code EIGC
Boulder, CO 80303-3328
(303) 497-6826
http://www.ngdc.noaa.gov

National Institute of Standards and Technology (NIST)
Buildings and Fire Research Laboratory
Building 226, Room B216
Gaithersburg, MD 20899
(301) 975-5900
http://www.nist.gov

U.S. Geological Survey, Information Services (Publications)
Box 25286
Denver, CO 80225
(800) 435-7627

USGS Office of Earthquakes, Volanoes & Engineering
12201 Sunrise Valley Drive
M.S. 905
Reston, VA 20192
(703) 648-4000
http://www.usgs.gov

345 Middlefield Road
M.S. 870
Menlo Park, CA 94025
(415) 853-8300

USGS National Earthquake Information Center
Denver Federal Center
M.S. 967, Box 25046
Denver, CO 80225
(303) 273-8500
fax: (303) 273-8450
http://wwwneic.cr.usgs.gov or http://earthquake.usgs.gov

State Seismic Safety Advisory Committees

Several states have created seismic safety advisory boards. If your state, or a neighboring state, has one, they can be good sources of basic seismic safety information about your region.

Arizona
Arizona Council for Earthquake Safety
Arizona Dept. of Emergency & Military Affairs
Div. of Emergency Services
5636 E. McDowell Rd.
Phoenix, AZ 85008
(602) 231-6238
fax: (602) 231-6263

Arkansas
Arkansas Earthquake Advisory Council
Arkansas Office of Emergency Services
P.O. Box 758
Conway, AR 72033
(501) 329-5601
fax: (501) 730-9754

California
Seismic Safety Commission
1900 K St., Suite 100
Sacramento, CA 95814
(916) 322-4917
fax: (916) 322-9476

Hawaii
Hawaii State Earthquake Advisory Board
Office of the Director of Civil Defense
3949 Diamond Head Road
Honolulu, HI 96816-4495
(808) 733-4300
fax: (808) 733-4287

Illinois
Illinois Earthquake Advisory Board
Illinois Emergency Management Agency
110 E. Adams Street
Springfield, IL 62701-1109
(217) 782-4448
fax: (217) 785-6043

Indiana
Indiana Seismic Safety Advisory Board
Indiana State Emergency Management Agency
IN GOVT CTR South/302 W. Washington St., Room E208
Indianapolis, IN 46204
(317) 232-3986
fax: (317) 232-3895

Kentucky
Governor's Earthquake Hazards & Safety Technical Advisory Panel
Kentucky Div. of Disaster & Emergency Services
EOC Building, Boone Center
Frankfort, KY 40601-6169
(502) 564-8611
fax: (502) 564-8614

Mississippi
Mississippi Seismic Advisory Panel
Mississippi Emergency Management Agency
P.O. Box 4501, Fondren Station
Jackson, MS 39216
(601) 352-9100
fax: (601) 352-8314

Missouri
Missouri Seismic Safety Commission
Missouri Emergency Management Agency
P.O. Box 116
Jefferson City, MO 65102
(573) 526-9101
fax: (573) 634-7966
http://eas.slu.edu/seismic safety/

Nevada
Nevada Earthquake Safety Council
Div. of Emergency Management
2525 S. Carson Street
Carson City, NV 89711
(702) 687-4240
fax: (702) 687-6788

Oregon
Oregon Seismic Safety Policy Advisory Committee
595 Cottage St., NE
Salem, OR 97310
(503) 378-2903
fax: (503) 588-1378

Puerto Rico
Comision de Seguridad Contra Terremotos
State Civil Defense
P.O. Box 9066597
San Juan, PR 00906-6597
(787) 724-0124

Tennessee
Tennessee Seismic Safety Advisory Panel
Tennessee Emergency Management Agency
Tennessee EOC
3041 Sidco Dr.
Nashville, TN 37204-1502
(615) 741-0001
fax: (615) 242-9635

Utah
Utah Earthquake Advisory Board
University of Utah Seismograph Stations
University of Utah
135 South, 1460 East
Room 705
Salt Lake City, UT 84112
(801) 581-6274
fax: (801) 585-5585

Washington
Washington State Seismic Safety Advisory Committee
Washington State Dept. of Natural Resources
Geology & Earth Resources Division
P.O. Box 47007
Olympia, WA 98504-7007
(360) 902-1000
fax: (360) 902-1785

Libraries

All the references cited in Appendix F can be located at at least one of these libraries. The libraries are set up to respond to public requests for information. They can lend materials through interlibrary loan or, for a fee, can photocopy excerpts from documents. In some cases, you can search their collections online through their internet web sites.

Center for Earthquake Research & Information
University of Memphis
Campus Box 526590
Memphis, TN 38152-6590
(901) 678-2007
fax: (901) 678-4734
http://www.ceri.memphis.edu

Earthquake Engineering Research Center
University of California at Berkeley
1301 S. 46th Street
Richmond, CA 94804-4698
(510) 231-9403
fax: (510) 231-9461
email: eerclib@nisee.ce.berkeley.edu
http://nisee.ce.berkeley.edu

Earthquake Engineering Research Library
California Institute of Technology
Mail Code 104-44
Pasadena, CA 91125
(818) 395-4227
fax: (818) 568-2719
email: eerlib@cco.caltech.edu
http://www.eerl.caltech.edu/library/library.html

National Center for Earthquake Engineering Research
c/o Science and Engineering Library
SUNY–Buffalo
304 Copen Hall
Buffalo, NY 14260-2200
(716) 645-3377
fax: (716) 645-3379
http://nceer.eng.buffalo.edu

Natural Hazards Research & Applications Information Center
University of Colorado
Campus Box 482
Boulder, CO 80309-0482
(303) 492-6818
fax: (303) 492-2151
email: hazctr@colorado.edu
http://www.colorado.edu/hazards/

Resource Organizations for Developing Code-Adoption Strategies

These professional and trade organizations represent key groups whose support you will need in trying to promote the adoption of seismic building codes. These national offices can refer you to the local or regional affiliate nearest you.

American Institute of Architects (AIA)
1735 New York Avenue, NW
Washington, DC 20006
(202) 626-7300
http://www.aia.org

American Planning Association
1776 Massachusetts Ave., NW
Suite 400
Washington, DC 20036-1997
(202) 872-0611
fax: (202) 872-0643
http://www.planning.org

American Society of Civil Engineers (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
(800) 548-2723
http://www.asce.org

Associated General Contractors of America
1957 E Street, NW
Washington, DC 20006
(202) 393-2040
fax: (202) 347-4004
http://www.agc.org

International City/County Management Association (ICMA)
777 North Capitol Street, NE
Suite 500
Washington, DC 20002-4201
(202) 289-4262
fax: (202) 962-3500
http://www.icma.org

National Association of Home Builders
1201 15th Street, NW
Washington, DC 20005
(202) 822-0200
fax: (202) 822-0559
http://www.nahb.com

National Society of Professional Engineers (NSPE)
1420 King Street
Alexandria, VA 22314
(703) 684-2800
fax: (703) 836-4875
http://www.nspe.org

National League of Cities (NLC)
1301 Pennsylvania Avenue, NW
Suite 550
Washington, DC 20004
(202) 626-3000
fax: (202) 626-3043
http://www.cais.com/nlc/

Structural Engineers Association of California
555 University Avenue, Suite 126
Sacramento, CA 95825
(916) 427-3647
fax: (916) 568-0677
http://www.seaoc.org

The United States Conference of Mayors
1620 I Street, NW
Washington, DC 20006
(202) 293-7330
fax: (202) 293-2352
http://www.usmayors.org/uscm

Additional Organizations

These university, nonprofit, and trade organizations all have publications related to building codes or seismic safety. Some of them are instrumental in promoting the adoption of seismic building codes, and could provide valuable support to your efforts.

American Association of State Highway & Transportation Officials
444 N. Capitol Street, NW, Suite 249
Washington, DC 20001
(202) 624-5800
fax: (202) 624-5806

American Institute of Architects (AIA)
1735 New York Avenue, NW
Washington, DC 20006
(202) 626-7300
http://www.aia.org

American Society of Civil Engineers (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
(800) 548-2723
http://www.asce.org

Applied Technology Council (ATC)
555 Twin Dolphin Drive, Suite 550
Redwood City, CA 94065
(415) 595-1542
fax: (650) 593-2320
http://www.atcouncil.org

Building Seismic Safety Council (BSSC)
1090 Vermont, NW, Suite 700
Washington, DC 20005
(202) 289-7800
fax: (202) 289-1092
http://www.nibs.org

Earthquake Engineering Research Institute (EERI)
499 14th Street, Suite 320
Oakland, CA 94612-1934
(510) 451-0905
fax: (510) 451-5411
email: eeri@eeri.org
http://www.eeri.org

Institute for Business and Home Saftey (formerly Insurance Institute for Property Loss Reduction)
73 Tremont Street, Suite 510
Boston, MA 02108-3910
(617) 722-0200
fax: (617) 722-0202

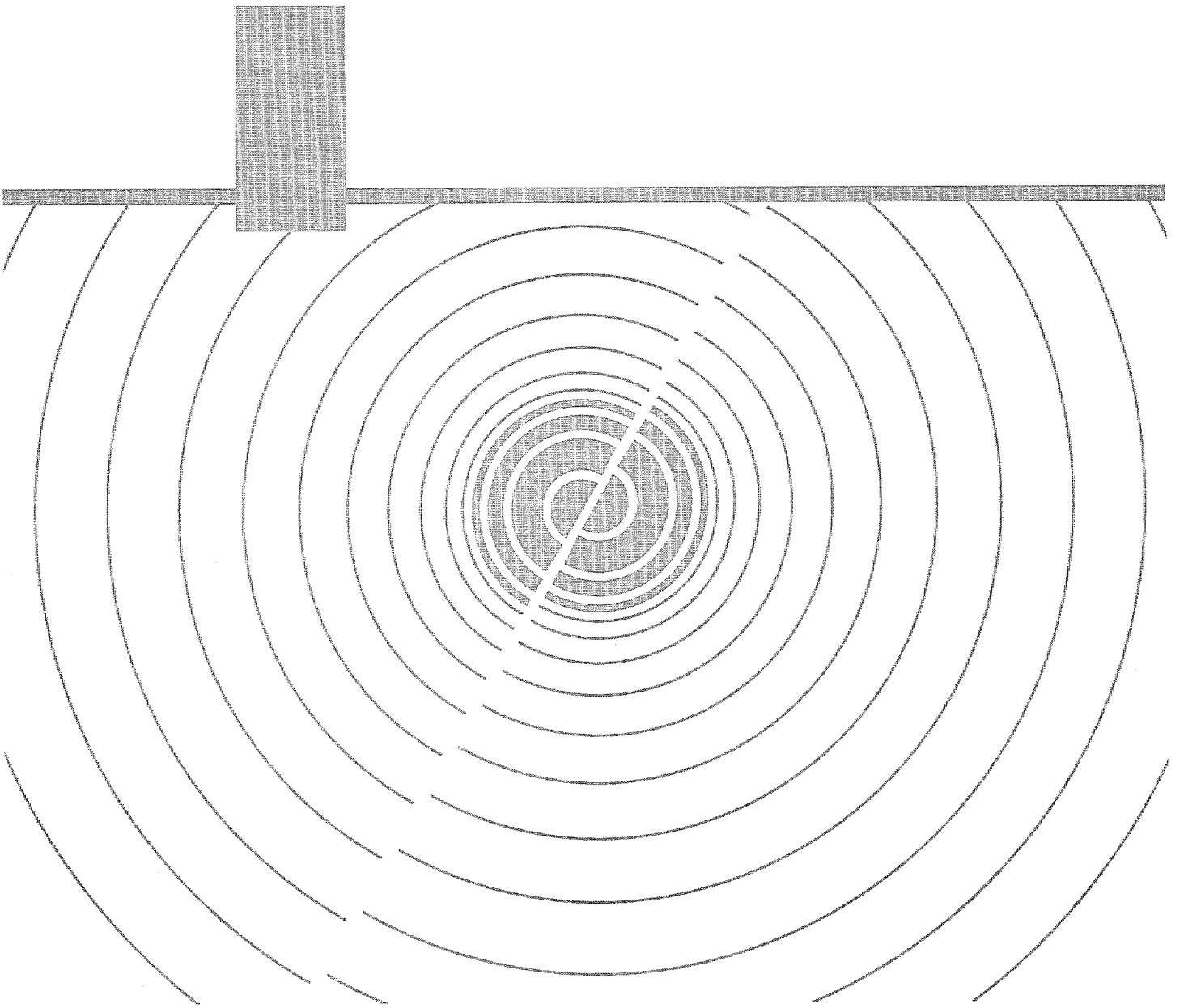
National Conference of States on Building Codes and Standards, Inc. (NCSBS)
505 Huntmar Park Drive, Suite 210
Herndon, VA 20170
(703) 437-0100
fax: (703) 481-3596

National Institute of Building Sciences
1090 Vermont, NW, Suite 700
Washington, DC 20005
(202) 289-7800
fax: (202) 289-1092
http://www.nibs.org

Seismological Society of America
201 Plaza Professional Building
El Cerrito, CA 94530
(510) 525-5474
fax: (510) 525-7204

Southern California Earthquake Center
University of Southern California
University Park
Los Angeles, CA 90089-0742
(213) 740-5843
fax: (213) 740-0011
email: SCECinfo@usc.edu
http://www.scec.org

Appendix F
Recommended Readings and Resources



Appendix F
Recommended Readings and Resources

References Cited

Listed below are all the references cited in this report as sources of information. All the documents produced by agencies and organizations may be ordered directly from the organizations (see Appendix E). Many of the Building Seismic Safety Council's publications are available at no charge from FEMA. All FEMA publications are available at no charge and may be ordered through FEMA's Publication Center (call 800-480-2520).

Beavers, James E. "Perspectives on Seismic Risk Maps and the Building Code Process," in *A Review of Earthquake Research Applications in the National Earthquake Hazards Reduction Program: 1977–1987*, Walter Hays, ed., U.S. Geological Survey Open-File Report 88-13-A, 1988, 407-432

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Building Seismic Safety Council. *Improving the Seismic Safety of New Buildings: A Community Handbook of Societal Implications*, FEMA #83, July 1986.

Building Seismic Safety Council. *Nontechnical Explanation of the NEHRP Recommended Provisions*. FEMA #99, September 1995.

Building Seismic Safety Council. *Seismic Considerations for Communities at Risk*, FEMA #83, September 1995.

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Earthquake Engineering Research Institute. "Loma Prieta Earthquake Reconnaissance Report," *Earthquake Spectra*, Supplement to Vol. 6, May 1990.

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Lagorio, Henry J. *Earthquakes, An Architect's Guide to Nonstructural Seismic Hazards*, John Wiley and Sons, Inc., 1990.

Leyendecker, Edgar V., Algermissen, S.T., and Frankel, Arthur. *Use of Spectral Response Maps and Uniform Hazard Response Spectra in Building Codes*, Fifth National Conference on Earthquake Engineering, July 1994.

Leyendecker, E.V., et al., *USGS Spectral Response Maps and Their Relationship with Seismic Design Forces in Building Codes*, U.S. Geological Survey Open-File Report 95-596, 1995. The most recent versions are available at http://gldage.cr.usgs.gov/eg/

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National Conference of States on Building Codes and Standards Inc. *Directory of Building Codes and Regulations*, Vol. 1, Code Primer, NCSBCS (Herndon, VA), 1989.

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National Institute of Standards and Technology. *Guidelines and Procedures for Implementation of the Executive Order on Seismic Safety of New Building Construction*, ICSSC RP2.1A., NISTIR 4852, June 1992.

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Todd, Diana, ed., *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings, National Institute of Standards and Technology Report NISTIR 5382*, Interagency Committee of Seismic Safety and Construction Recommended Practice 4 (ICSSC RP 4), February 1994.

U.S. Department of the Interior, Geological Survey. *USGS Spectral Response Maps and Their Relationship with Seismic Design Forces in Building Codes*, Open-File Report 95-595, 1995.

U.S. National Commission on Urban Problems. *Building the American City*, report to the Congress and the President, House Document No. 91-34, December 1968.

Whitman, R.V., and Algermissen, S.T.. "Seismic Zonation in Eastern United States," *Proceedings, Fourth International Conference on Seismic Zonation*, Vol. I, Earthquake Engineering Research Institute, 1991, 845-869

Wyllie, Loring A., Jr., and Filson, John R., eds. *Armenia Earthquake Reconnaissance Report, Special Supplement to Earthquake Spectra*, Earthquake Engineering Research Institute (Oakland, CA), August 1989.

Wyner, A.J., and Mann, D.E. *Preparing for California's Earthquakes: Local Government and Seismic Safety*, Institute of Governmental Studies, University of California at Berkeley, 1986.

Recommended Readings

These readings are particularly recommended to help you understand about earthquakes, how ground-shaking affects buildings, and how seismic building codes work.

American Institute of Architects. *Buildings at Risk: Seismic Design Basics for Practicing Architects*, AIA/ACSA Council on Architectural Research, February 1992.

Applied Technology Council. *Rapid Visual Screening of Buildings for Seismic Hazards: A Handbook*. ATC-21 Report, published by FEMA as FEMA #154, 1988.

Berg, Glenn. *Seismic Design Codes and Procedures*, Earthquake Engineering Research Institute, Monograph Series, 1983.

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Buckle, Ian G., Jirsa, James, et al. *Mitigation of Damage to the Built Environment*, Monograph 2, 1993 National Earthquake Conference, Central U.S. Earthquake Consortium (Memphis, TN), 1993.

Building Seismic Safety Council. *A Nontechnical Explanation of the 1994 NEHRP Recommended Provisions*, FEMA #99, September 1995.

Building Seismic Safety Council. *NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings*, 1994 Edition, Part 1: Provisions, Part 2: Commentary, FEMA #222A, FEMA #223A, May 1995.

Building Seismic Safety Council. *Seismic Considerations for Communities at Risk*, FEMA #83, September 1995 ed.

Earthquake Engineering Research Institute. *Expected Seismic Performance of Buildings*, February 1994.

Earthquake Engineering Research Institute. *Reducing Earthquake Hazards: Lessons Learned from Earthquakes*, EERI Publication No. 86-02, November 1986.

Lagorio, Henry J. *Earthquakes, An Architect's Guide to Nonstructural Seismic Hazards*, John Wiley and Sons, Inc. (NY), 1990.

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Stover, Carl W., and Coffman, Jerry L. *Seismicity of the United States, 1568–1989* (rev. ed.), U.S. Geological Survey Professional Paper 1527, 1993.

Sources of Earthquake Slides and Videos

The following organizations have extensive collections of slides, photos, and videos of the effects of earthquakes. They can be valuable resources for your public presentations. In some cases, the images may be accessed online or by CD-ROM.

Earthquake Engineering Research Center (EERC)
University of California at Berkeley
1301 S. 46th Street
Richmond, CA 94804-4698
(510) 231-9403
eerclib@berkeley.edu

Earthquake Engineering Research Institute (EERI)
499 14th Street, Suite 320
Oakland, CA 94612-1934
(510) 451-0905

National Geophysical Data Center
National Oceanic & Atmospheric Administration
325 Broadway, Mail Code EIGC
Boulder, CO 80303-3328
(303) 497-6826

September 1996

EARTHQUAKE HAZARDS REDUCTION SERIES

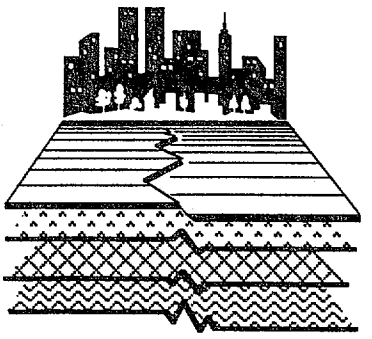
PUBLICATION NUMBER	TITLE
46	Earthquake Safety Checklist
48	Coping with Children's Reactions to Earthquakes
74	Reducing the Risk of Nonstructural Earthquake Damage: A Practical Guide
75	Preparedness for People with Disabilities (Brochure)
76	Preparedness in High-Rise Buildings (Brochure)
77	The Planning Process (Brochure)
83	Seismic Considerations for Communities at Risk
84	Societal Implications: Selected Readings
87	Guidelines for Local Small Businesses
88	Guidebook for Developing a School Earthquake Safety Program
88A	Earthquake Safety—Activities for Children (Teacher's Package)
99	Improving Seismic Safety of New Buildings: A Non-Technical Explanation of NEHRP Provisions
113	Family Earthquake Safety Home Hazard Hunt and Drill
140	Guide to Application of the NEHRP Recommended Provisions in Earthquake-Resistant Building Design
149	Seismic Considerations: Elementary and Secondary Schools
150	Seismic Considerations: Health Care Facilities
151	Seismic Considerations: Hotels and Motels
152	Seismic Considerations: Apartment Buildings
153	Seismic Considerations: Office Buildings
154	Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook
155	Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation
156	Typical Costs for Seismic Rehabilitation of Existing Buildings, Second Edition, Volume I - Summary
157	Typical Costs for Seismic Rehabilitation of Existing Buildings, Second Edition, Volume II - Supporting Documentation
159	Earthquake—A Teacher's Package for K-6
172	NEHRP Handbook of Techniques for the Seismic Rehabilitation of Existing Buildings
173	Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings, Supporting Report
174	Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings, A Handbook
176	Estimating Losses from Future Earthquakes—Panel Report (A Non-Technical Summary)
177	Estimating Losses from Future Earthquakes (Panel Report and Technical Background)
178	NEHRP Handbook for Seismic Evaluation of Existing Buildings
182	Landslide Loss Reduction: Guide to State and Local Governments
192	Estimated Future Losses, St. Louis, MO
192A	Estimated Future Losses, St. Louis, MO—Executive Summary
200	Loss Reduction Provisions of a Federal Earthquake Insurance Program - A Final Report
201	Loss Reduction Provisions of a Federal Earthquake Insurance Program - Summary Report
202	Earthquake Resistant Construction of Electric Transmission and Telecommunication Facilities Serving the Federal Government
212	Utah Multihazard Planning Demonstration Project—A Case Study Report
216	Financial Incentives for Seismic Rehabilitation of Buildings—An Agenda for Action - Volume 3 - Application Workshop Report
219	How to Help Children After a Disaster—A Guidebook for Teachers
220	School Intervention Following a Critical Incident—Project COPE
222	NEHRP Recommended Provisions for the Development of Regulations for New Buildings, Part I - Provisions, 1991 Edition
222	NEHRP Maps
223	NEHRP Recommended Provisions Commentary, Part II, 1991 Edition
222.A	NEHRP Recommended Provisions for the Development of Regulations for New Buildings, Part I, Provision, 1994 Edition

222.A NEHRP Maps
223.A NEHRP Recommended Provisions Commentary, Part II, 1994 Edition
224 Seismic Vulnerability and Impact of Disruption of Lifelines in the United States
225 Inventory of Lifelines in the Cajon Pass, California
226 Collocation Impacts on the Vulnerability of Lifelines During Earthquakes with Applications to the Cajon Pass, California
227 A Benefit-Cost Model for Seismic Rehabilitation of Buildings, Volume I: A User's Manual
228 A Benefit-Cost Model for the Seismic Rehabilitation of Buildings, Volume II: Supporting Documentation
232 Home Builders Guide for Earthquake Design
233 Earthquake Resistant Construction of Gas and Liquid Fuel Pipeline Systems Serving, or Regulated by, the Federal Government
237 Seismic Rehabilitation of Buildings, Phase I: Issues, Identification and Resolution
238 Seismic Safety: Of Federally and Federally Assisted Leased or Regulated New Building Construction - Volume 1
239 Seismic Safety: Of Federally and Federally Assisted Leased or Regulated New Building Construction - Volume 2
240 Earthquake Preparedness—What Every Child Care Provider Should Know
241 Identification and Reduction of Nonstructural Earthquake Hazards (For Schools)
249 Assessment of the State-of-the-Art Earthquake Loss Estimation Methodologies
253 Seismic Sleuths—Earthquake Curriculum for 7-12 Grades
254 Seismic Retrofit Incentive Programs—A Handbook for Local Governments
255 Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model, Volume 1 - A User's Manual
256 Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model, Volume 2 - Supporting Documentation
260 Seismic Safety of New Federal Buildings
266 Creating a Seismic Safety Advisory Board
267 Interim Guidelines: Evaluation, Repair, Modification, and Design of Welded Steel Moment Frame Structures
280 Strategy for National Earthquake Loss Reduction
L-111 Safety Tips for Earthquakes
L-143 Preparedness in Apartments and Mobile Homes
L-193 Tsunami, The Great Waves in Alaska
L-194 Tsunami, The Great Waves on the West Coast
Benefit/Cost Model for Federal Buildings—Supporting Documentation
Brochure: Seismic Safety of Federal and Federally Leased Assisted or Regulated New Building Construction
Earthquake Safety, Poster 14
E.O. 12699 Brochure
Poster #6 Blueprint for Earthquake Survival

The publications are free of charge. Copies may be requested by writing to the following address:

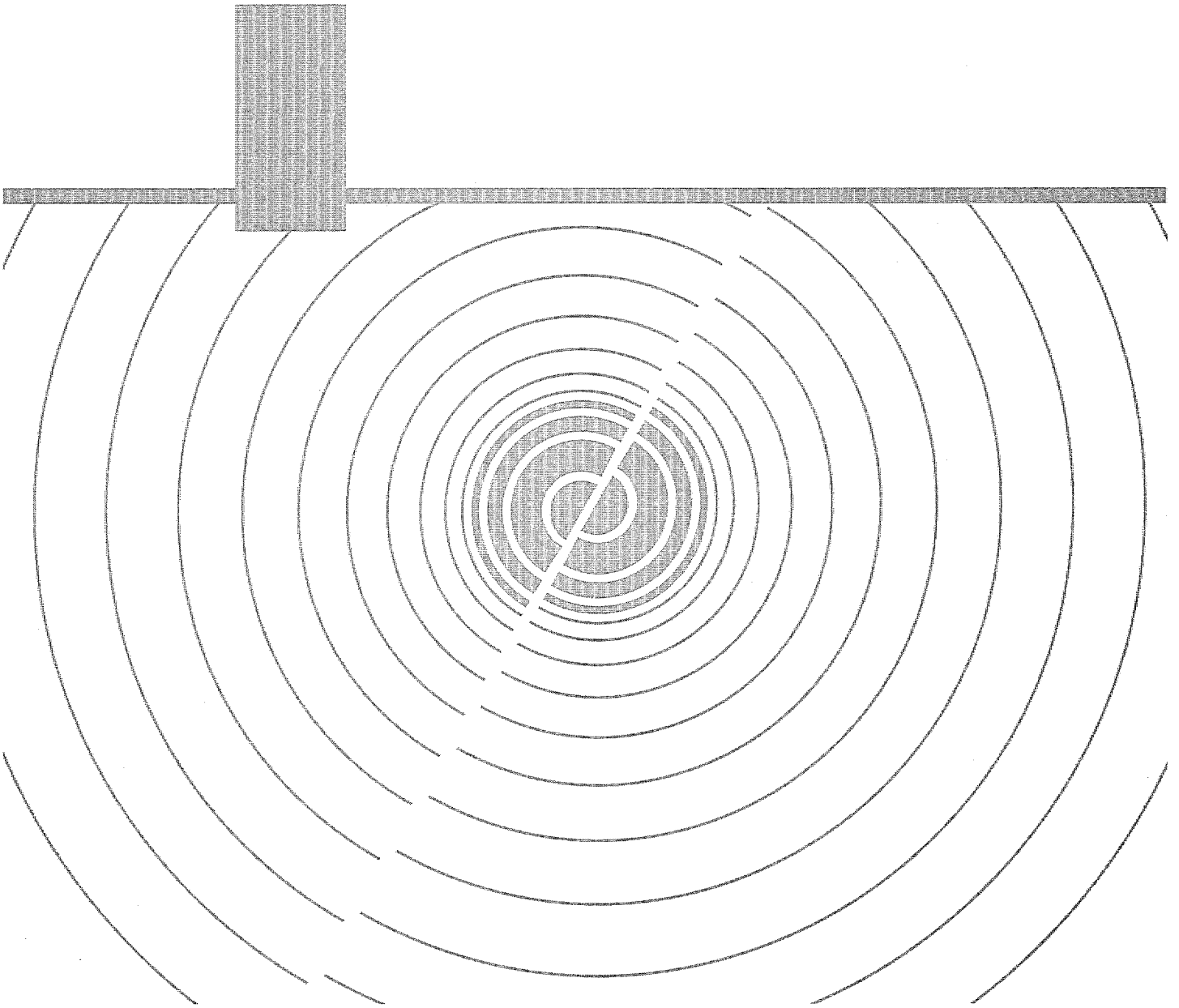
Federal Emergency Management Agency
P.O. Box 2012
Jessup, MD 20794-2012

Or Call 1-800-480-2520



EARTHQUAKE HAZARDS REDUCTION SERIES

Appendix G
Sample Workshop Presentations



Appendix G
Sample Workshop Presentations

Planning Your Presentation

There is a great deal of material to cover in the half-day workshop. It is important that you establish control and keep your presentation on track in order to cover all the material. At the same time, allow enough flexibility to respond to specific local concerns. Remember that you can follow up with individuals after the workshop or at a later date.

Assigning groups. It will save time and minimize confusion if you prepare an efficient method of dividing participants into groups for the group exercises. One method is to have people count off numbers and then divide into groups according to their number. Alternatively, you might assign groups on a geographic basis or try to create interdisciplinary groups. The best group size is generally 3-7 people.

Sign-in sheets. For follow-up you will want the attendees' names, addresses, and telephone numbers. Providing a sign-in sheet at the beginning of the workshop is a simple way to obtain this information.

Information For Workshop Leader

This Appendix includes material to help you present workshops on adopting and enforcing seismic building codes. It includes outlines for a sample half-day workshop and a one-hour workshop. The half-day workshop is best suited for gatherings of professionals, either at a conference or at a specialty seminar that you organize. The audience would have some initial concerns about seismic safety but little knowledge about how to adopt or enforce seismic building codes. The one-hour workshop is best suited for audiences who need to be introduced to these ideas and convinced of the need for addressing seismic safety.

Target Audience

Candidate participants for these workshops include (a) municipal officials (e.g., planning, building, engineering, emergency services, city council); (b) potential allies in the fields of architecture and engineering; and (c) community leaders whose influence and support can assist in adopting improved seismic safety provisions.

Purpose

The purposes of these workshops are to (a) introduce the community's risk for earthquake damage, (b) demonstrate the effectiveness, ease, and low cost of seismic codes, and (c) outline the critical elements of effective code enforcement.

Goals

Participants should leave the workshop with a clearer understanding of why they need seismic codes in their community, how they can adopt and improve enforcement, and where they can go for assistance. The group exercises (half-day workshop) are designed so that participants begin developing strategies to introduce or enhance seismic protection in their community.

When and Where to Present the Workshops

These workshops can be conducted as part of a systematic campaign to improve adoption and enforcement of seismic codes. You can announce them with press releases (using Appendix H), and workshop participants can help distribute the brochures in Appendix I to their colleagues.

A survey of code practices (see end of Appendix C) can help you to identify specific areas of weakness in various parts of your state. This can help you to determine appropriate topics and locations for the workshops.

Workshops, particularly the one-hour ones, could also be used to build on the increased awareness that often follows an earthquake, either a small earthquake nearby or a large newsworthy one elsewhere in the world. A combination of workshops and press releases could emphasize the value of seismic building codes to mitigate losses from future earthquakes.

Half-day workshops might be given for:

- A gathering of officials from several neighboring communities. This could be in a region with code adoption or compliance problems. You should also invite officials from communities with good code practices.

- A session at a conference of municipal officials.
- A session at a conference of local code officials (but delete the section on the purpose of building codes).

One-hour workshop presentations might be given to:

- A conference of municipal officials, architects, or engineers.
- City Council study sessions.
- Civic groups, such as Rotary, Kiwanis, or League of Women Voters.

Support Materials

Materials in this Appendix include an outline of topics for two workshop presentations (half-day and one-hour), along with suggested timing, directions for when to use the provided handouts and overheads, and key information points to make. The additional pages provided include visual aids that may be copied onto transparency sheets and used with an overhead projector. Transparencies are a quick and inexpensive way to visually enhance your presentation.

Some of the overheads also may be photocopied and distributed as handouts. A number of topical handouts, which summarize key concepts from the workshop and from the text of this book, are also included.

Color images can provide additional impact to the workshop presentation. A selection of images is available at various web sites, such as FEMA and the Earthquake Engineering Research Center (see Appendix E); you may download these without charge and use a vendor to transfer the images from your disk to color slides or transparencies. The National Geophysical Data Center and EERI also have sets of color slides that are available for purchase. Additional factual support for all these visual materials can be found in the body of this book.

This Appendix also includes a list of selected notable earthquakes from 36 states (see Handout b). This list is a good starting point for identifying historic earthquakes from your region. These tangible examples can enhance your presentation.

Equipment

Check to make sure that an overhead projector is available at the workshop site. If you are providing your own overhead projector, it's wise to bring an extra light bulb. Always plan to bring a extension cord and an outlet adapter. A projection screen is not essential, as you can project your overhead onto any blank, light-colored wall.

If you are using slides, it is best to provide your own slide carousel with the slides arranged in presentation sequence. You may also need to provide your own slide projector.

Follow-up

The group exercises will provide a record of the community's thinking and plans about seismic safety. Collect the handouts completed in the group exercises. You may want to summarize the main points and later send a copy to the workshop participants or other municipal officials. The material can also form the basis of any local efforts stemming from the workshop.

If possible, you should try to follow up with a tour of local building stock designed with seismic provisions. A comparison to unsafe buildings would also be useful. A knowledgeable building official, engineer, or architect should lead this tour.

Presentation Tips

- Check to make sure that an overhead projector is available at the workshop site.
- If you are providing your own overhead projector, it's wise to bring an extra light bulb.
- Always plan to bring a extension cord and an outlet adapter.
- If using a computer projection system, bring back-up overheads in case you have equipment problems.
- If you are using slides, it is best to provide your own slide carousel with the slides arranged in presentation sequence.

Half-Day Workshop

® **8:00 Introduction** (15 mins.)

DEFINE PURPOSE: Today we're going to talk about earthquakes and how they can affect communities. Very few parts of the United States are completely free of potential earthquake damage.

This morning's presentation will cover three main areas: SHOW OVERHEAD 1.

1. Community risk for damage from earthquake activity.
2. Purpose of building codes, and how they help to protect the community from seismic risk.
3. Importance of following through by enforcing the building code, and how this too can benefit the community.

ASK: How many damaging U.S. earthquakes can they name?

SHOW OVERHEAD 2: Known historic earthquakes in 47 states with MMIs of VI-VIII.

USE HANDOUTS: A) Seismic hazard map; B) Historic earthquakes in 36 states.

SHOW OVERHEAD 3: Seismic hazard map. This map shows the seismic hazards for the entire United States.

LOCATE COMMUNITY ON MAP AND EXPLAIN THE LOCAL SEISMIC RISK.

POINTS TO MAKE: Many times, if a community hasn't recently experienced any kind of ground-shaking, people tend to think an earthquake just isn't going to happen. It seems like it takes a good earthquake to shake people up. Unfortunately, it's a little late to prepare after the earthquake. And this map, using the best scientific information available, says this community could be made safer and more secure by preparing now for future earthquake hazards.

® **8:15 Part 1: Community Risk** (15 mins.)

USE HANDOUT C: MMI scale explanation, descriptions of effects of various MMIs.

GOAL: Explain what it is that earthquakes do and how they can damage and destroy buildings.

- Explain the idea of lateral forces, ductility, and drift. SHOW OVERHEAD 4.
- Explain the Modified Mercalli Intensity Scale (describes effects, not magnitude). SHOW OVERHEADS: 5) MMI scale explanation; 6) MMI chart.
- Describe effects on buildings of MMI VI, VII, VIII, IX. SHOW OVERHEADS 7-15: Effects and images of typical damage associated with each MMI.
- Focus on *local* MMI potential and show additional damage images. SHOW maps and images of historic local earthquakes, and, if maps are available, anticipated earthquakes. A good source of information is USGS Professional Paper 1527; Handout B is a list, taken from that publication, of example earthquakes from 36 states.

® **8:30 Group Exercise** (20 mins.)

USE HANDOUT D: Group Exercise #1 – Community Earthquake Risk

DIRECTIONS FOR GROUPS: We've seen the MMI potential for this community. I'd like you to divide into groups and think about how this community might be affected by an earthquake of that scale.

- Describe handout. Ask groups to:

  Imagine the MMI shaking appropriate to this community

  Rate community buildings for seismic safety

  Identify whether buildings were built to seismic codes (see Hints below)

  Decide where would you most like to be during an earthquake

  Decide where would you least like to be during an earthquake

- Ask each group to report their results.
- Summarize results.
- Collect completed handouts for later follow-up.

Hints for Exercise #1

HINT 1: The main purpose of this exercise is to raise participants' level of concern, and make them want to find out the answers to these questions. Participants will not be sure how to decide which buildings are most dangerous.

You should give them some hints: SHOW OVERHEAD 16.

- Brick or stone buildings.
- Older buildings (especially large, multistory older buildings).
- Buildings with irregular shapes.
- Buildings that appear to be top-heavy or with open first floors (carports, all windows).
- "Tilt-up" low-rise light industrial buildings (one-story warehouse-like buildings common in industrial or office parks since the 1960s).

HINT 2: Participants will not know which buildings were built to seismic codes. They may be able to make educated guesses, based on the age of buildings, if they know the status of the community's code.

HINT 3: Once they identify potentially unsafe buildings, they should also pay attention to building *function*. Some buildings—**critical structures**—would seriously affect the community if they collapsed or were severely damaged: SHOW OVERHEAD 17.

Structures are deemed critical if they (a) are needed immediately after an earthquake (fire and police stations), (b) house needy populations (schools, hospitals, nursing homes), or (c) can have off-site effects (structures with flammable or toxic materials).

® **8:50 Part 2: Purpose and History of Building Codes** (15 mins.)

USE HANDOUTS: E) Purpose and history of building codes; F) Model building codes

POINTS TO MAKE: The safest and most cost-effective way to guard against earthquake damage is to construct buildings that are designed to withstand seismic events. These building specifications are contained in the model building codes.

- Cover purpose and history of building codes: SHOW OVERHEAD 18.

Suggested HANDOUT: Consider handing out photocopies of Appendix D.

- Outline the model building codes: SHOW OVERHEAD 19.
  - Easy to adopt
  - Easy to update
  - Documentation is provided
  - Technical support is provided
- General cost information.
- Explain current code situation in state.

® **9:05 Break** (15 mins.)

® **9:20 Part 2 continued: Purpose and History of Seismic Code Provisions** (15 mins.)

USE HANDOUTS: G) Purpose of seismic codes provisions; H) Seismic codes are effective; I) Seismic codes are inexpensive.

Discuss seismic provisions in the building codes:

- Purpose of seismic codes provisions: SHOW OVERHEAD 20.
- History of seismic codes (becoming the national norm): SHOW OVERHEAD 21.
- Executive Order 12699.
- Seismic codes are effective: SHOW OVERHEAD 22.
- Seismic codes are inexpensive: SHOW OVERHEAD 23.
- Benefits outweigh the costs: SHOW OVERHEAD 24.
- All model codes contain seismic provisions appropriate to the community's level of risk.

® **9:35 Group Exercise** (15 mins.)

USE HANDOUT J: Group Exercise #2 – Responding to Arguments Against Seismic Codes

DIRECTIONS FOR GROUPS: We've seen how new construction built to seismic standards can help protect the community from earthquake damage. I'd like you to divide into groups again. This time, I want you to discuss the arguments against introducing seismic codes in this community and think about how you might respond.

- Describe handout:
  - List the local arguments against seismic codes
  - How might you respond to these arguments?
  - Consider who is likely to oppose having seismic codes
  - Consider who is likely to support having seismic codes?
- Ask each group to report their results.
- Summarize results.
- Collect completed handouts for later follow-up.

® **9:50 Arguments in Favor of Seismic Codes** (5 mins.)

USE HANDOUT K: Arguments in favor of seismic codes

- Present arguments in favor of seismic codes: SHOW OVERHEAD 25.

® **9:55 Break** (15 mins.)

® **10:10 Part 3: Importance of Enforcement, Following Through** (30 mins.)

USE HANDOUTS: L) Enforcing the seismic code: a critical link; M) Five elements of effective code enforcement

POINT TO MAKE: Having a building code with current seismic provisions is the first part of a two-part process. The second part is following through and making sure the code is enforced.

- Explain how poor enforcement results in deficient buildings. SHOW OVERHEAD 26.
- Give incentives for enforcement (code effectiveness grading schedule).
- Five elements of effective code enforcement: SHOW OVERHEAD 27.
  - Code provisions must be up to date
  - Builders must apply for permits
  - A qualified reviewer must review building plans
  - Construction should proceed according to approved plans
  - A qualified inspector must inspect the construction
- Discuss an example of plan review and inspection fees (see box in Appendix D, page 112).

- Enforcement example: Use one or two of the case examples in Appendix C (page 85) to explain how enforcement could be done in this community.

® **10:40 Group Exercise** (20 mins.)

NOTE: Workshop leader selects topic for group exercise.

USE HANDOUT N or O: Group Exercise #3a OR 3b – Action Plan for Adoption OR Enforcement

DIRECTIONS FOR GROUPS: I'd like you to divide into groups again. This time, I want you to develop action plans to: (a) adopt a building code with current seismic provisions for this community
OR (b) improve enforcement of the building code in this community.

- Describe handout for subject A (adoption):

  Develop a ten-point action plan that will result in a building code for this community
- OR describe handout for subject B (enforcement):

  Develop a ten-point action plan that will result in improved code enforcement for this community

- Ask each group to report their results.
- Summarize results.
- Collect completed group handouts for later follow-up.

® **11:00 Part 3 continued: Steps for Adoption or Enforcement of Seismic Codes** (10 mins.)

USE HANDOUT P or Q: Steps for Adoption OR Enforcement of Seismic Codes

- Discuss how these steps relate to the 10-point action plans they developed. SHOW OVERHEAD 28 or 29.

® **11:10 Recap** (30 mins.)

- Review the three group exercises:

  Community Earthquake Risk

  Responding to Arguments Against Seismic Codes

  Action Plan for Adoption/Enforcement
- Describe follow-up actions: The next step.
- Questions/feedback:

  Any questions?

  Reaction to the workshop presentation? Is the information relevant to them?

  What additional help would they like from the state?

NOTE: You may want to develop a short questionnaire to solicit participant feedback.

Finally, be sure to have copies of the brochures available for participants to help deliver.

One-Hour Workshop

® **1:00 Introduction** (5 mins.)

DEFINE PURPOSE: Today we're going to talk about earthquakes and how they can affect communities. Very few parts of the United States are completely free of potential earthquake damage.

This morning's presentation will cover three main areas: SHOW OVERHEAD 1.

1. Community risk for damage from earthquake activity.
2. Purpose of building codes, and how they help to protect the community from seismic risk.
3. Importance of following through by enforcing the building code, and how this too can benefit the community.

® **1:05 Community Risk** (10 mins.)

ASK: How many damaging U.S. earthquakes can they name?

USE HANDOUTS: A) Seismic hazard map; B) Historic earthquakes in 36 states

SHOW OVERHEAD 3: seismic hazard map. This map shows the seismic hazards for the entire United States.

USE HANDOUT C: MMI scale explanation, descriptions of effects of various MMIs:

- Explain Modified Mercalli Intensity Scale (describes effects, not magnitude). SHOW OVERHEAD 5.
- Focus on *local* MMI potential and show additional damage images. SHOW: maps and images of historic local earthquakes, and, if maps are available, anticipated earthquakes. A good source of information is USGS Professional Paper 1527; HANDOUT B is a list, taken from that publication, of example earthquakes from 36 states.

® **1:15 Purpose and History of Building Codes** (5 mins.)

USE HANDOUTS: E) Purpose and history of building codes; F) Model building codes

POINT TO MAKE: The safest and most cost-effective way to guard against earthquake damage is to construct buildings that are designed to withstand seismic events. These building specifications are contained in the model building codes.

- Purpose and history of building codes: SHOW OVERHEAD 18.

® **1:20 Seismic Code Provisions** (10 mins.)

USE HANDOUTS: G) Purpose of seismic code provisions; H) Seismic codes are effective; I) Seismic codes are inexpensive

DISCUSS: seismic provisions in the building codes.

- Purpose of seismic codes provisions: SHOW OVERHEAD 20.
- History and of seismic codes (becoming the national norm: Executive Order 12699): SHOW OVERHEAD 21.
- Seismic codes are inexpensive: SHOW OVERHEAD 23.
- Benefits outweigh the costs: SHOW OVERHEAD 24.
- All model codes contain seismic provisions appropriate to the community's level of risk.

® **1:30 Code Adoption** (10 mins.)

USE HANDOUT P: Steps for adoption of seismic codes

- Steps for adoption of seismic codes: SHOW OVERHEAD 28.
- Current code situation for this locality and nearby areas.
- How the community can adopt a code.

® **1:40 Group Response** (10 mins.)

ASK: What is their reaction so far? Do they have any specific concerns or questions? Any objections?

USE HANDOUT K: Arguments in favor of seismic codes

- Present arguments in favor of seismic codes: SHOW OVERHEAD 25.

® **1:50 Code Enforcement** (5 mins.)

USE HANDOUTS: L) Enforcing the seismic code: a critical link; M) Five elements of effective code enforcement; Q) Steps for enforcement of seismic codes

POINT TO MAKE: Having a building code with current seismic provisions is the first part of a two-part process. The second part is following through and making sure the code is enforced.

- Five elements of effective code enforcement: SHOW OVERHEAD 27.
  - Code provisions must be up to date
  - Builders must apply for permits
  - A qualified reviewer must review building plans
  - Construction should proceed according to approved plans
  - A qualified inspector must inspect the construction
- Discuss steps for enforcement: SHOW OVERHEAD 29.

® **1:55 Questions and Challenges** (5 mins.)

- Questions/feedback:
  - Any questions?
  - Reaction to the workshop presentation? Is the information relevant to them?
  - What other groups do they think could benefit from this presentation?

NOTE: You may want to develop a short questionnaire to solicit participant feedback.

Finally, be sure to have copies of the brochures available for participants to help deliver.

List of workshop handouts and overheads

Use this list to organize your presentation materials:

OVERHEADS:

1. Three Main Areas Covered
2. Known Historic Earthquakes in 47 States
3. U.S. Seismic Hazard Map
4. Seismic Design Concepts (lateral forces, ductility, and drift)
5. Modified Mercalli Intensity Scale (explanation with MMI maps)
6. Modified Mercalli Intensity Scale (chart)
7. MMI VI* Effects
   Photo Caption: Paint store affected by the San Fernando earthquake, 1971.
8. MMI VII* Effects
   Photo Caption: Sidewalk in downtown, Oakland, California, 1989. Loma Prieta earthquake. (Photo: Rob Olshansky)
9. MMI VIII* Effects
   Photo Caption: Downtown, Oakland, California, 1989. Loma Prieta earthquake. (Photo: Rob Olshansky)
10. MMI VIII* Damage
    Photo Caption: Bakery, Watsonville, California, 1989. Loma Prieta earthquake. (Photo: Rob Olshansky)
11. MMI VIII* Damage
    Photo Caption: Classroom, Coalinga, California, 1983. (Photo: EERI)
12. MMI VIII* Damage
    Photo Caption: House damaged in the Loma Prieta earthquake, 1989 (Photo: EERI)
13. MMI IX* Effects
    Photo Caption: Collapse of I-880, Oakland California, 1989. Loma Prieta earthquake. (Photo: J. David Rogers)
14. MMI IX* Damage
    Photo Caption: Strip mall, Northridge, California, 1994. (Photo: Rob Olshansky)
15. MMI IX* Damage
    Photo Caption: Northridge, California, 1994. (Photo: Rob Olshansky)
16. Characteristics of Dangerous Buildings
17. Identifying Critical Structures
18. Purpose and History of Building Codes
19. Model Building Codes
20. Purpose of Seismic Code Provisions
21. Seismic Building Code Timeline
22. Seismic Codes are Effective
23. Seismic Codes are Inexpensive
24. Studies Indicate That the Benefits of Seismic Codes Outweigh the Costs
25. Arguments in Favor of Seismic Codes
26. Poor Code Enforcement Results in Deficient Buildings (Hurricane Andrew)
27. Five Elements of Effective Code Enforcement
28. Adopting Seismic Code Provisions
29. Establishing an Effective Building Code Enforcement Program

HANDOUTS:

a. U.S. Seismic Hazard Map (same as Overhead 3)
b. Historic Earthquakes in 36 States
c. MMI Scale (explanation, descriptions of effects of various MMIs)
d. Group Exercise #1 – Community Earthquake Risk
e. Purpose and History of Building Codes
f. Model Building Codes
g. Purpose of Seismic Code Provisions
h. Seismic Codes are Effective
i. Seismic Codes are Inexpensive
j. Group Exercise #2 – Responding to Arguments Against Seismic Codes
k. Arguments in Favor of Seismic Codes
l. Enforcing the Seismic Code: A Critical Link
m. Five Elements of Effective Code Enforcement
n. Group Exercise #3a – Action Plan for Adoption
o. Group Exercise #3b – Action Plan for Enforcement
p. Adopting Seismic Codes
q. Steps for Enforcement of Seismic Codes

Suggested handouts or overheads not included in this appendix:

1. Maps and images of historic *local* earthquakes, and, if maps are available, anticipated earthquakes. A good source of information is USGS Professional Paper 1527.
2. Consider handing out photocopies of Appendix D.
3. Develop a short questionnaire to solicit participant feedback.

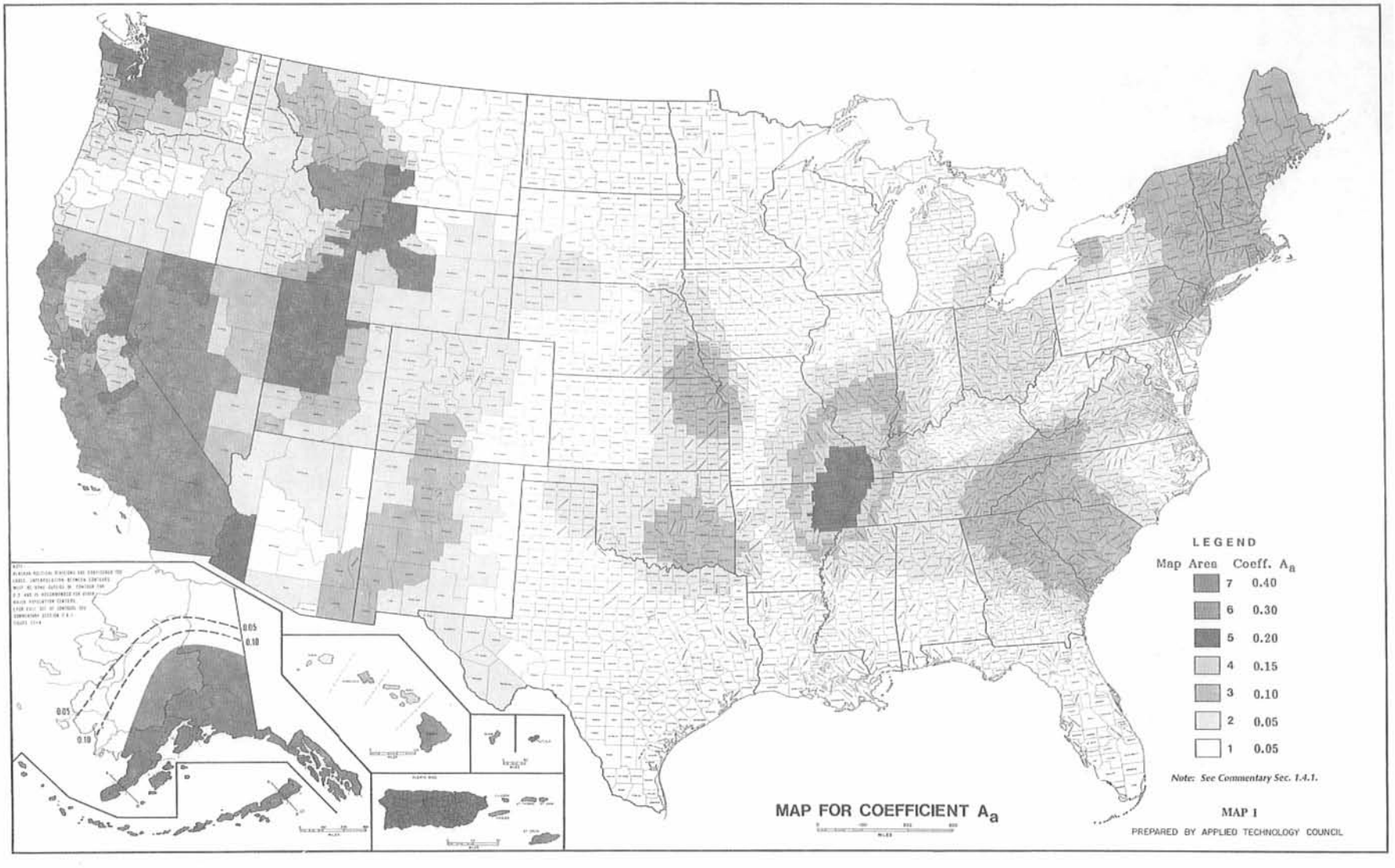
Three Main Areas Covered

1. Community risk for damage from earthquake activity

2. Purpose of building codes, and how they help to protect the community from seismic risk

3. Importance of following through by enforcing the building code, and how this too can benefit the community

Seismic Hazard Map



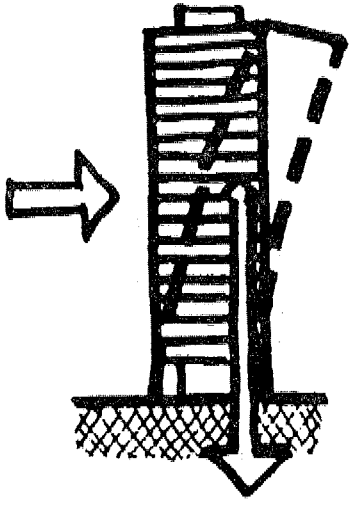
Known Historic (1568-1989) Earthquakes in 47 States

State	Number of Quakes With Reported Maximum MMI of: VI	VII	VIII+
Alabama	5	7	
Alaska	41	21	13
Arizona	11	3	1
Arkansas	8	3	2
California	329	131	66
Colorado	19	2	—
Connecticut	2	1	—
Delaware	—	1	—
Florida	2	—	—
Georgia	5	—	—
Hawaii	30	13	10
Idaho	12	4	2
Illinois	18	12	—
Indiana	5	2	—
Kansas	4	2	—
Kentucky	8	1	—
Louisiana	1	—	—
Maine	7	2	—
Massachusetts	8	7	3
Michigan	1	1	1
Minnesota	3	—	—
Mississippi	2	—	—
Missouri	14	2	3
Montana	35	4	5
Nebraska	4	2	—
Nevada	28	10	8
New Hampshire	7	2	1
New Jersey	5	1	—
New Mexico	29	7	—
New York	16	6	2
North Carolina	5	2	—
North Dakota	1	—	—
Ohio	9	5	1
Oklahoma	9	2	—
Oregon	10	1	—
Pennsylvania	7	1	—
Rhode Island	1	—	—
South Carolina	17	2	1
South Dakota	6	—	—
Tennessee	12	2	—
Texas	7	1	—
Utah	31	8	5
Vermont	1	—	—
Virginia	12	1	1
Washington	37	6	3
West Virginia	1	—	—
Wyoming	8	1	—

Source: U.S. Geological Survey, Professional Paper 1527, 1993.

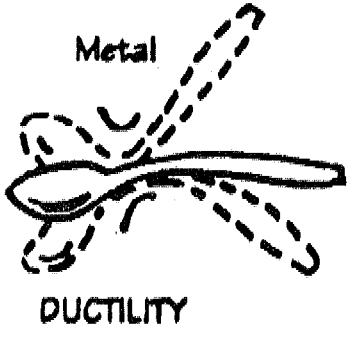
Note: This list includes only earthquakes that affected human settlements.

Seismic Design Concepts



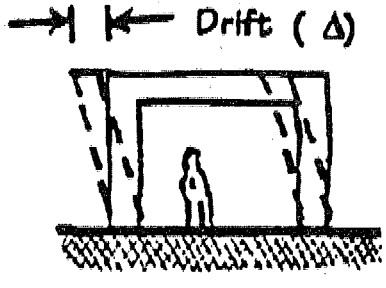
Lateral forces

Earthquakes exert sideways forces on buildings. Seismic design strengthens buildings to withstand lateral forces.



Ductility

This property allows structures to bend before they break. Seismic design makes buildings ductile to avoid catastrophic collapse.

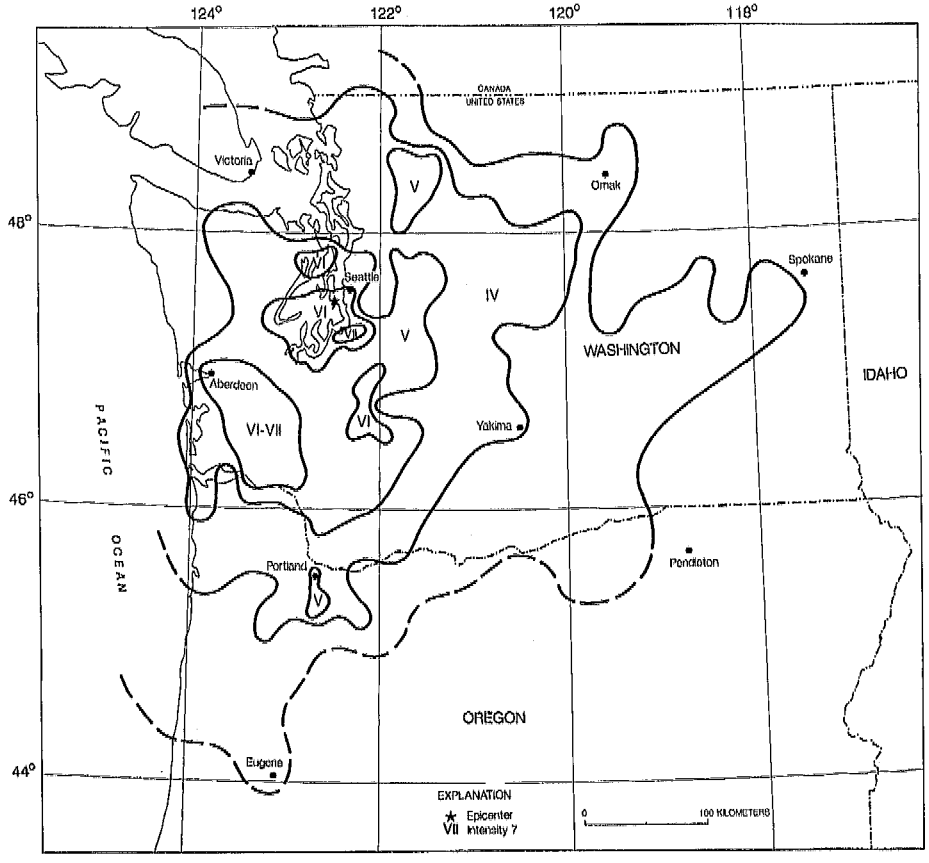


Drift

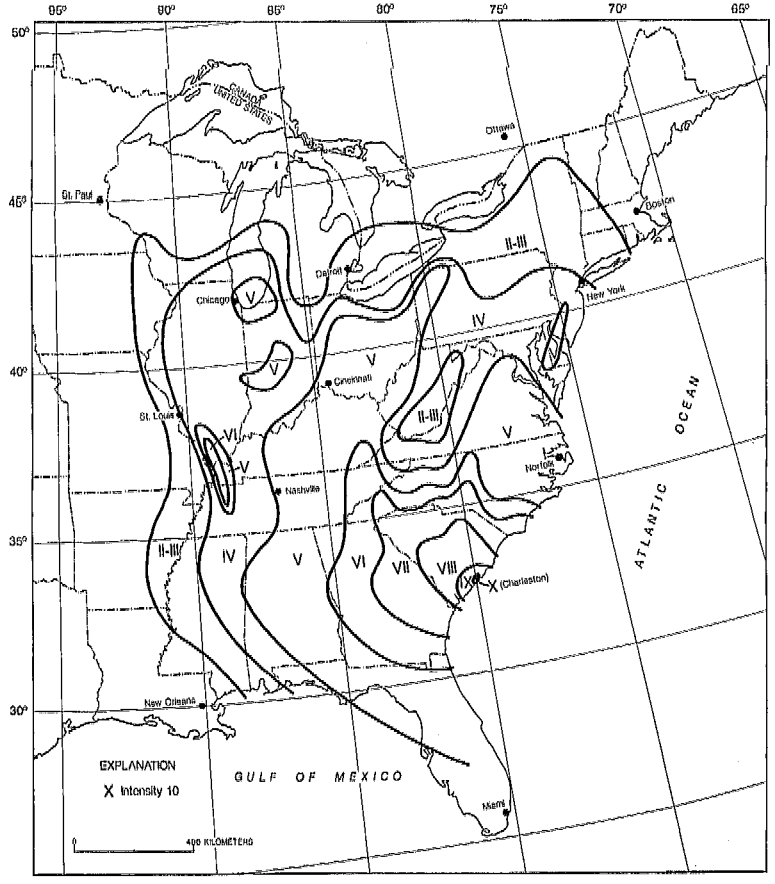
Structures can withstand sideways movement (drift), but their contents or neighboring buildings can be damaged. Seismic design limits drift.

Modified Mercalli Intensity Scale

The Modified Mercalli Intensity Scale is a qualitative scale that describes the effects of earthquake shaking. Because shaking decreases with distance from the center of an earthquake, the intensity also decreases with distance. Larger earthquakes have higher shaking intensity near the source, and shake a larger area.



Northwest Washington earthquake, Nov. 13, 1939.
(Maps: U.S. Geological Survey, Professional Paper 1527, 1993)



Charleston, South Carolina earthquake, Sept. 1, 1886

Modified Mercalli Intensity Scale

The Modified Mercalli Intensity Scale is a qualitative scale that describes the effects of earthquake shaking.

Size of Earthquake (Magnitude)		Expected MMI	% Seismically Designed Buildings Damaged, According to Standardized Damage States				
			A	B	C	D	E
6.0-6.5	7.5-8.0		None	Slight	Moderate	Extensive	Complete
Distance to Fault							
30 mi.	50 mi.	VII	60-90%	10-40%	1-5%	<1%	0
5 mi.	40 mi.	VIII	35-60%	35-45%	10-30%	<5%	<1%
1 mi.	30 mi.	IX	25-40%	25-40%	20-40%	3-10%	<2%
-	3 mi.	X	5-25%	5-25%	40-70%	10-30%	<5%

Source: EERI Ad Hoc Committee

Overhead 6

MMI – VI Effects

Felt by all people, indoors and out

People move about unsteadily

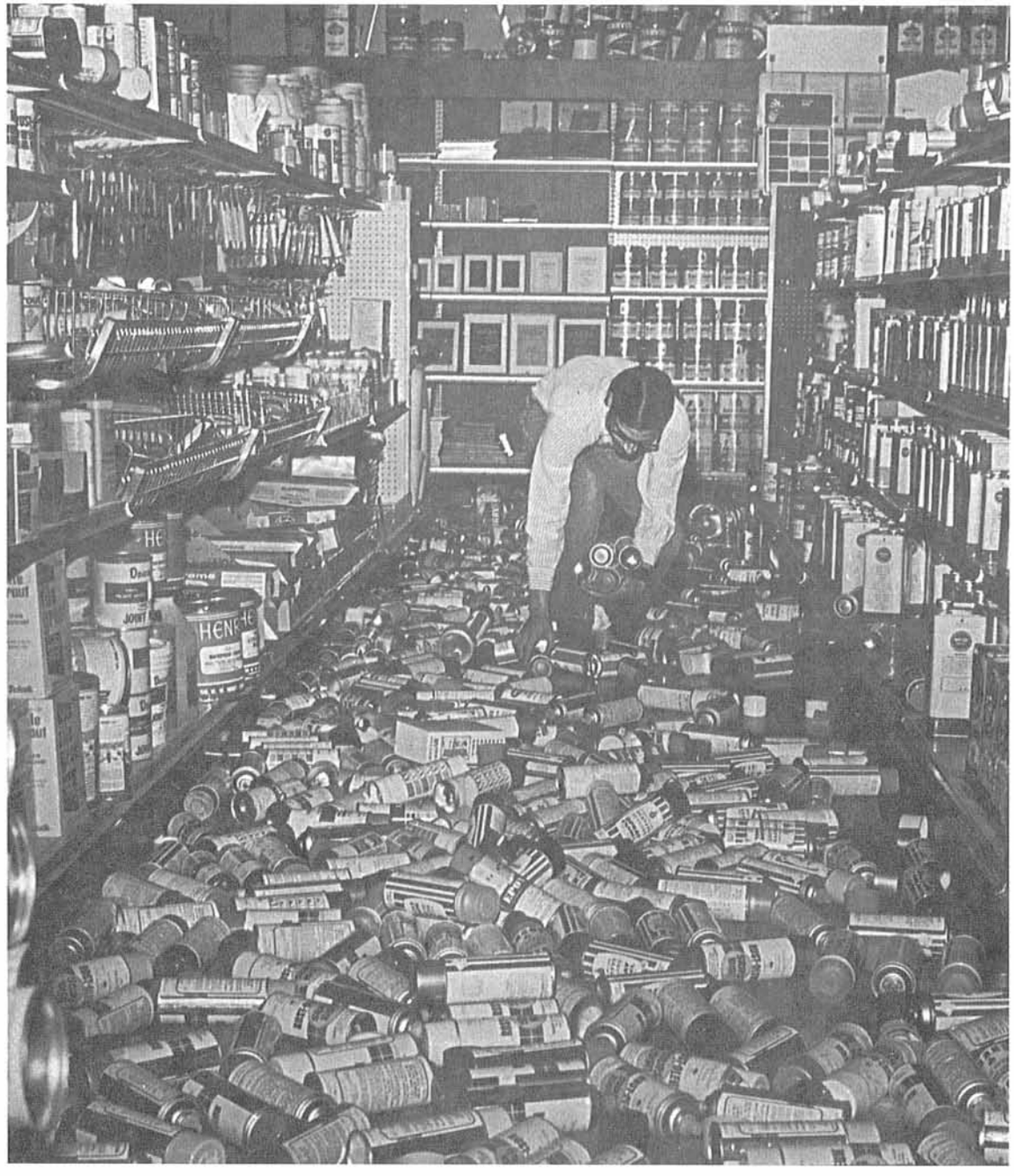
Some plaster cracks; fine cracks appear in chimneys

Dishes, glassware, and windows break

Books and pictures fall

Some furniture overturns

Objects fall from shelves



MMI – VII Effects

Most people are frightened, general alarm

Many people find it difficult to stand

Water is disturbed and muddied

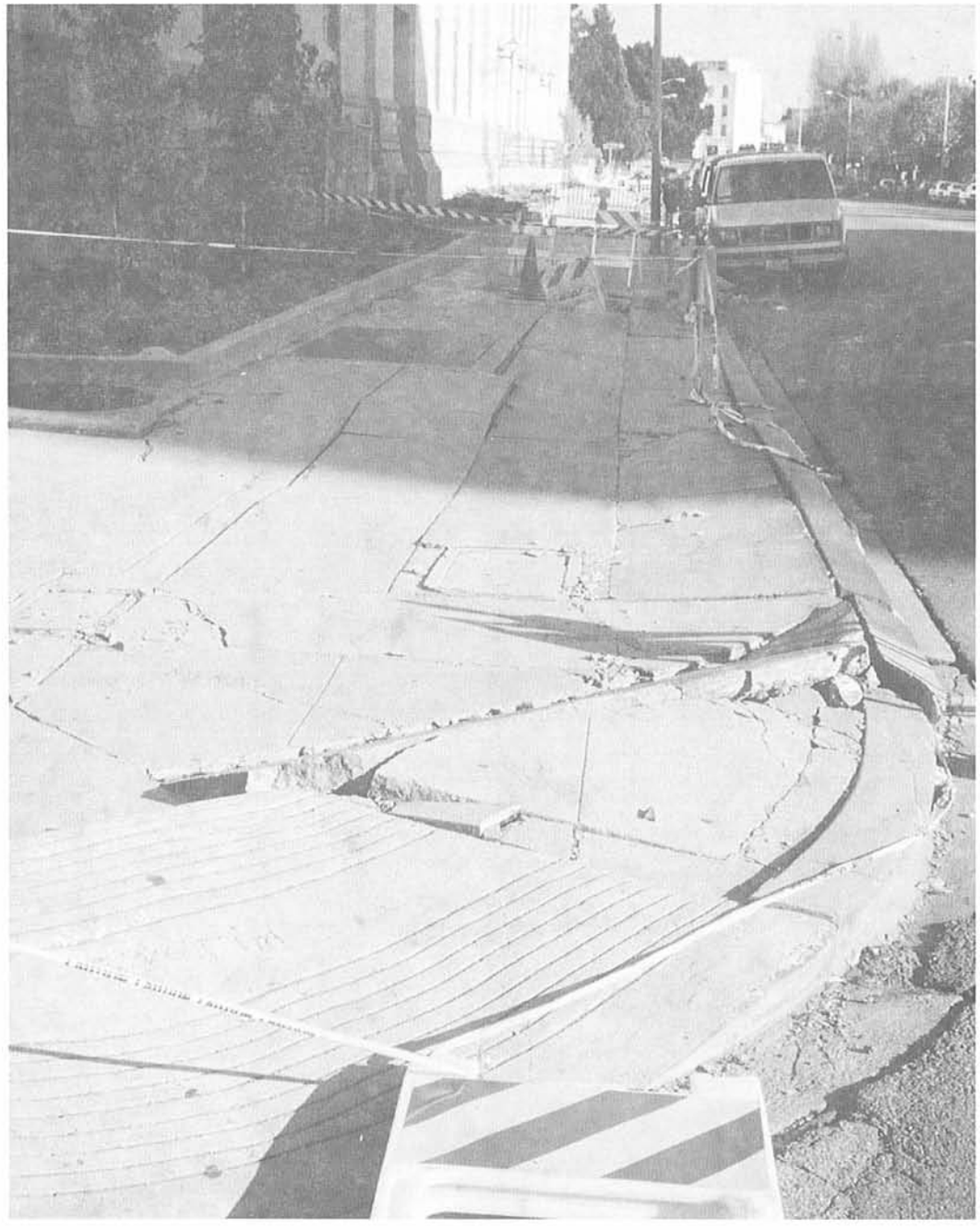
Some sand and gravel streambanks cave in

Chimneys crack to great extent; walls crack somewhat

Plaster and stucco fall in large amounts

Loosened bricks and tiles fall

Sidewalks crack



MMI – VIII Effects

Alarm approaches panic

People driving vehicles notice the disturbance

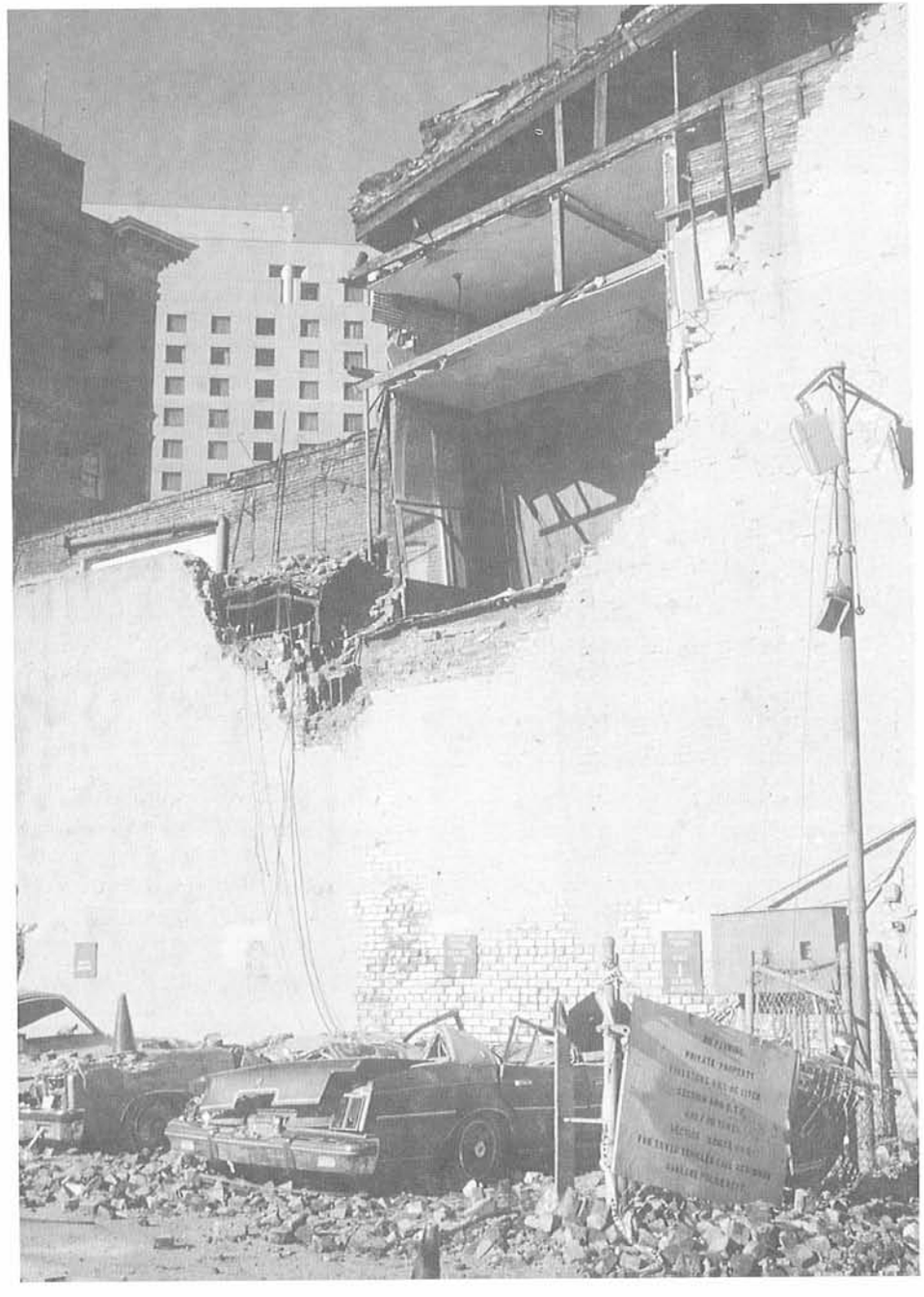
Trees shake strongly, and branches break off

Sand and mud are ejected from the ground in small amounts

Temporary and permanent changes occur in springs and wells

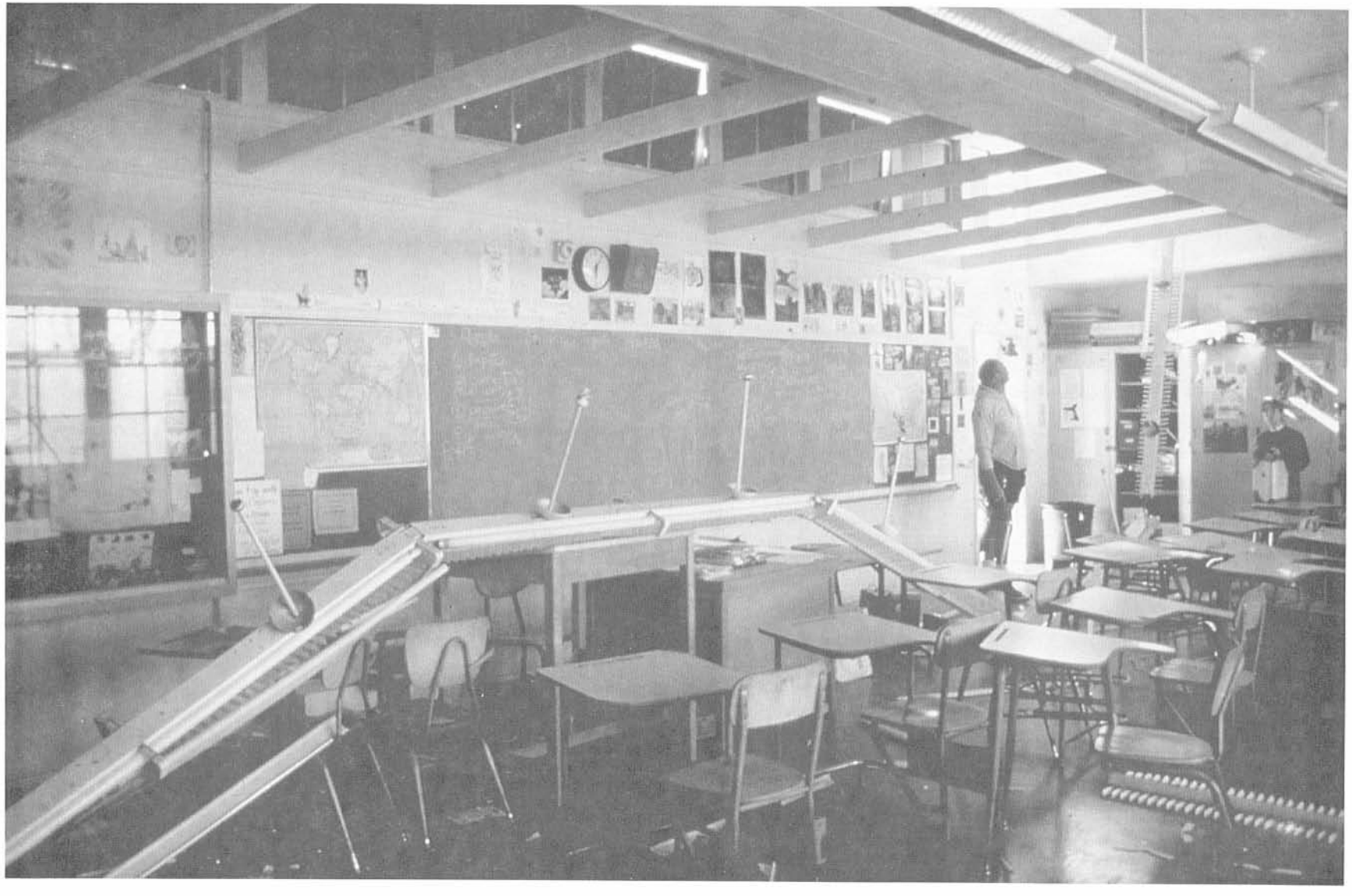
Chimneys, columns, monuments fall

Major structural damage can occur



MMI – VIII Damage

MMI – VIII Damage



MMI – VIII Damage

MMI – IX Effects

People generally panic

Ground cracks conspicuously

Masonry structures knocked out of plumb

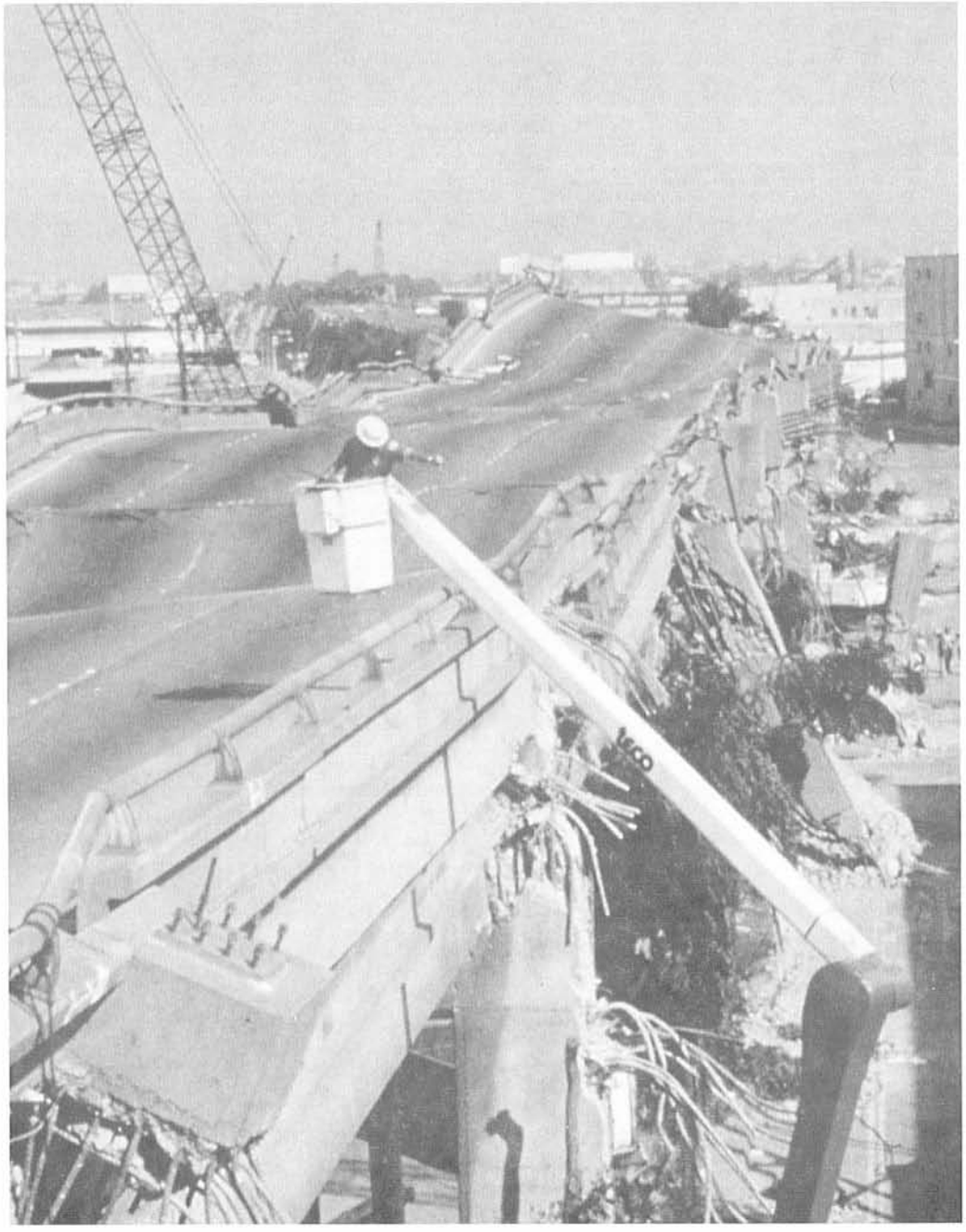
Large parts of masonry buildings collapse

Some buildings shift off of foundations and frames crack

Reservoirs are seriously damaged

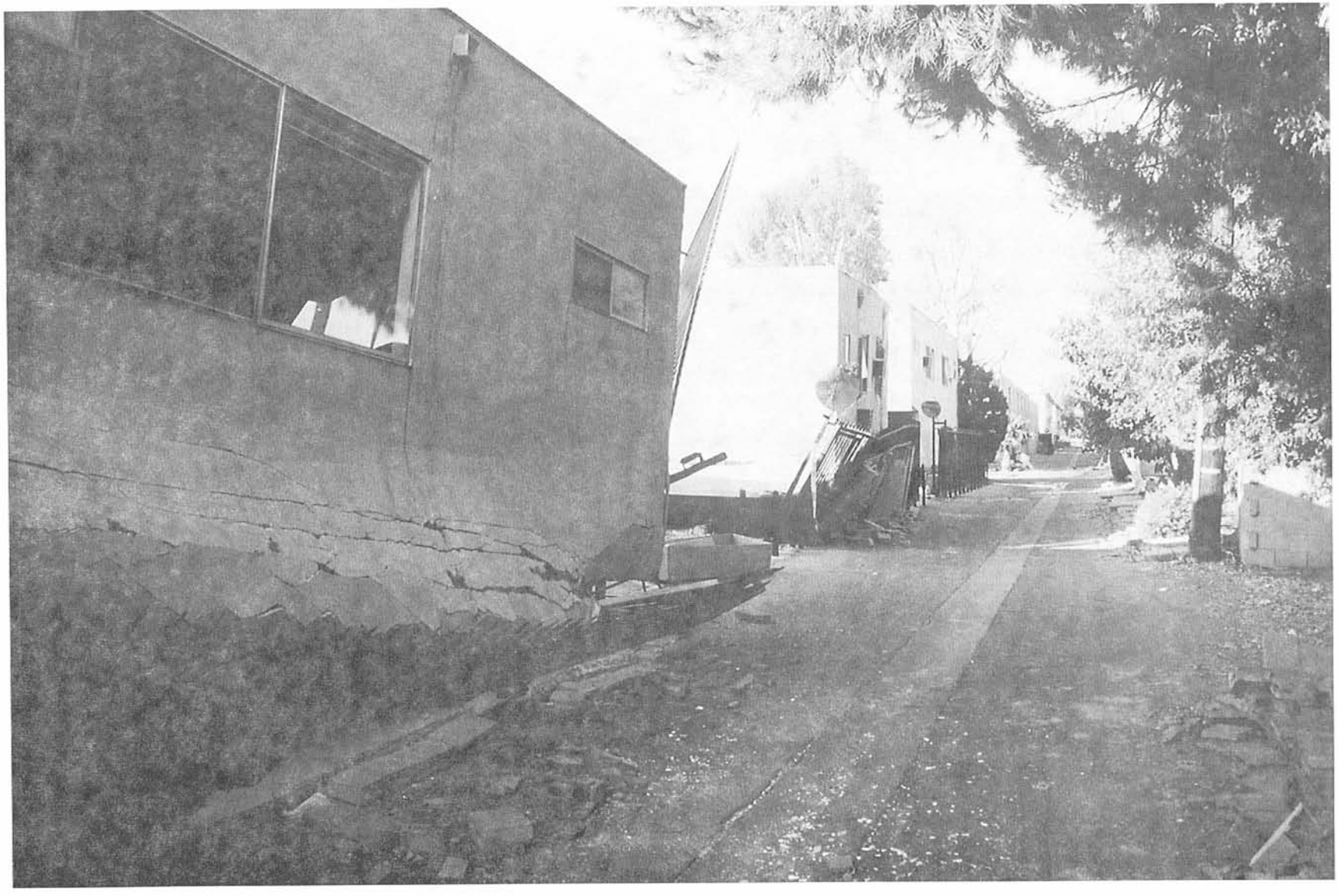
Some underground pipes break

Substantial buildings (and elevated freeways such as this) can collapse



MMI – IX Damage

MMI – IX Damage



Characteristics of Dangerous Buildings

- Brick or stone buildings
- Older buildings (especially large, multistory older buildings)
- Buildings with irregular shapes
- Buildings that appear to be top-heavy or with open first floors (carports, all windows)
- "Tilt-up" low-rise light industrial buildings (one-story warehouse-like buildings common in industrial or office parks since the 1960s).

Identifying Critical Structures

Critical structures are ones that would seriously affect the community if they collapsed or were severely damaged. Structures are deemed critical if they :

- *are needed immediately after an earthquake (fire and police stations)*
- *house needy populations (schools, hospitals, nursing homes)*
- *can have off-site effects (structures with flammable or toxic materials)*

Purpose and History of Building Codes

Building Codes Protect Public Safety

- Regulate building construction and use
- Address structural integrity, fire resistance, safe exits, lighting, and ventilation.
- Regulate construction materials
- Classify structures by use

Building Codes Have a Long History in the U.S.

- Have existed in North America since the seventeenth century
- Comprehensive building regulations were introduced in the mid-1800s
- The three model building codes used today were initiated between 1927 and 1950
- By 1960 more than 60% of American municipalities had adopted building codes
- By 1989 95% of American municipalities had adopted building codes

Model Building Codes

Building Officials and Code Administrators International, Inc. (BOCA)
- *Headquarters in Country Club Hills, Illinois*
- *Formed in 1915*
- *Code is titled the "BOCA National Building Code" (BNBC)*
- *Code is revised every three years*

International Conference of Building Officials (ICBO)
- *Headquarters in Whittier, California*
- *Formed in 1922*
- *Code is titled the "Uniform Building Code" (UBC)*
- *Code is updated every three years*

Southern Building Code Congress International, Inc. (SBCCI)
- *Headquarters in Birmingham, Alabama*
- *Founded in 1940*
- *Publishes the "Standard Building Code" (SBC)*
- *Code is updated every three years*

Council of American Building Officials (CABO)
- *Founded in 1972 by BOCA, ICBO, and SBCCI*
- *Publishes the One- and Two-Family Dwelling Code*

Purpose of Seismic Code Provisions

Structures built according to a seismic code should:

- ***Resist minor earthquakes undamaged***
- ***Resist moderate earthquakes without significant structural damage even though incurring nonstructural damage***
- ***Resist severe earthquakes without collapse, allowing safe evacuation of occupants***

Seismic Building Code Timeline

1905 Model building law published by NBFU

1906 San Francisco earthquake kills 3,000

1927 Uniform Building Code (UBC), with seismic provisions, first published by ICBO

1933 Long Beach earthquake kills 115

1935 Charles Richter devises magnitude scale for earthquakes

1940 Standard Building Code (SBS) published by SBCCI

1949 UBC contains first national seismic hazard map

1950 Basic Building Code (now the *BOCA National Building Code*) published by BOCA

1960 Sixty-percent of American municipalities had adopted one of the model codes

Early '70s Study of earthquake-resistant design provisions funded by NSF

1971 San Fernando earthquake kills 65

1972 CABO formed

1973 UBC revised because of San Fernando quake

1976 UBC includes new seismic provisions

1978 ATC releases ATC3-06 report

1979 BSSC formed

1985 FEMA releases NEHRP provisions for new buildings

1989 Ninety-five percent of American municipalities covered by state-wide codes

1989 Loma Prieta, California, earthquake kills 63

1990 EO 12699 requires that all federal agencies incorporate seismic resistant design in new buildings

1992 All three model codes require seismic designs consistent with NEHRP provisions

1992 Northridge, California, earthquake kills 57

1993 EO12699 provisions took effect

1994 ICC formed

1994 EO 12941 establishes seismic standards for federally owned or leased buildings

2000 ICC codes to be finished

Seismic Codes Are Effective

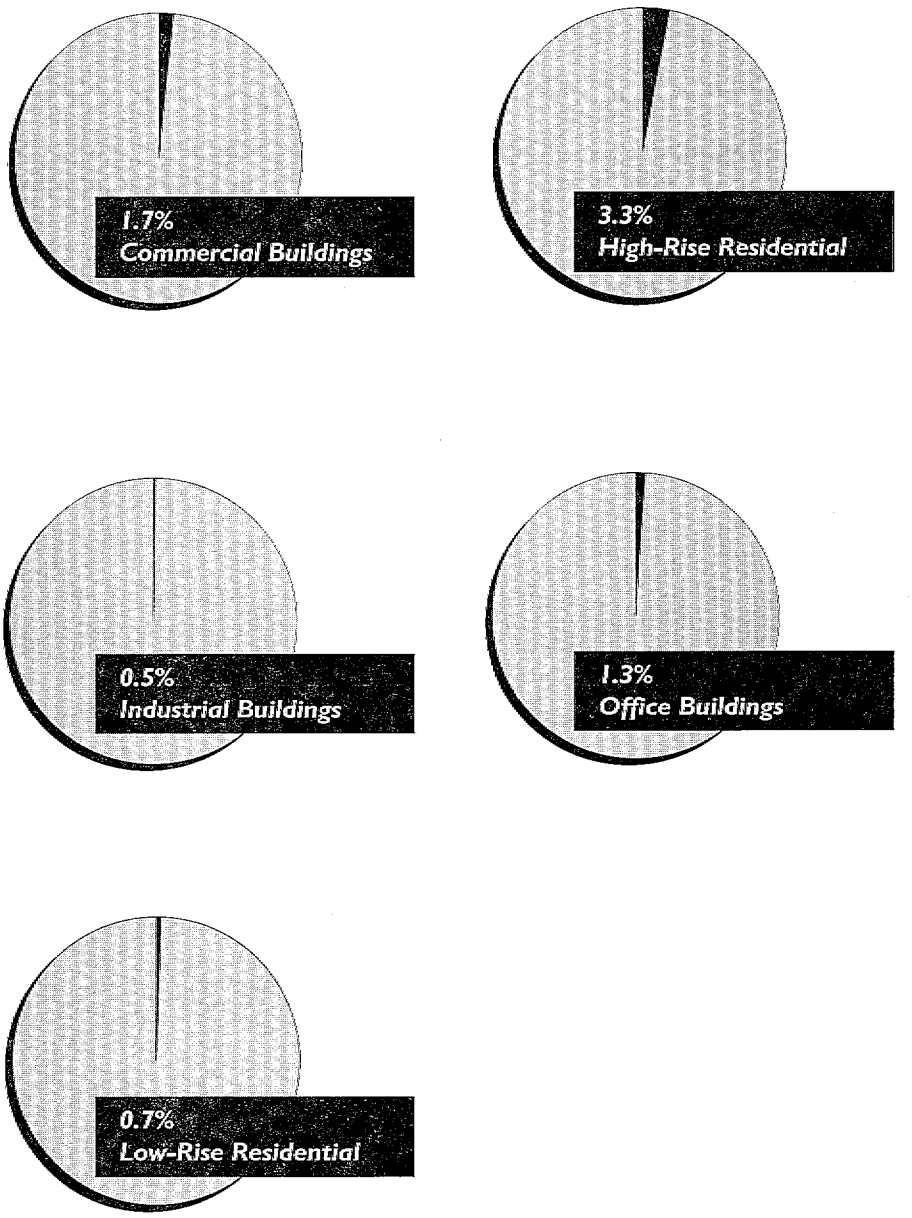
Ohbayashi Corporation's Study of Buildings Damaged in the January 17, 1995, Earthquake in Kobe, Japan*

	Green Tags (little or no damage)	Yellow Tags (some damage)	Red Tags (extensive damage)
Pre-1971 Buildings (old seismic code)	42%	22%	36%
1972-1980 (transitional period)	72%	17%	11%
Post-1981 Buildings (new seismic code)	84%	10%	6%

*In this study, Ohbayashi Corporation reviewed buildings it had constructed to the specifications of various seismic codes and assessed the extent of damage resulting from the 1995 earthquake.

Seismic Codes Are Inexpensive

Increase in cost resulting from seismic design:



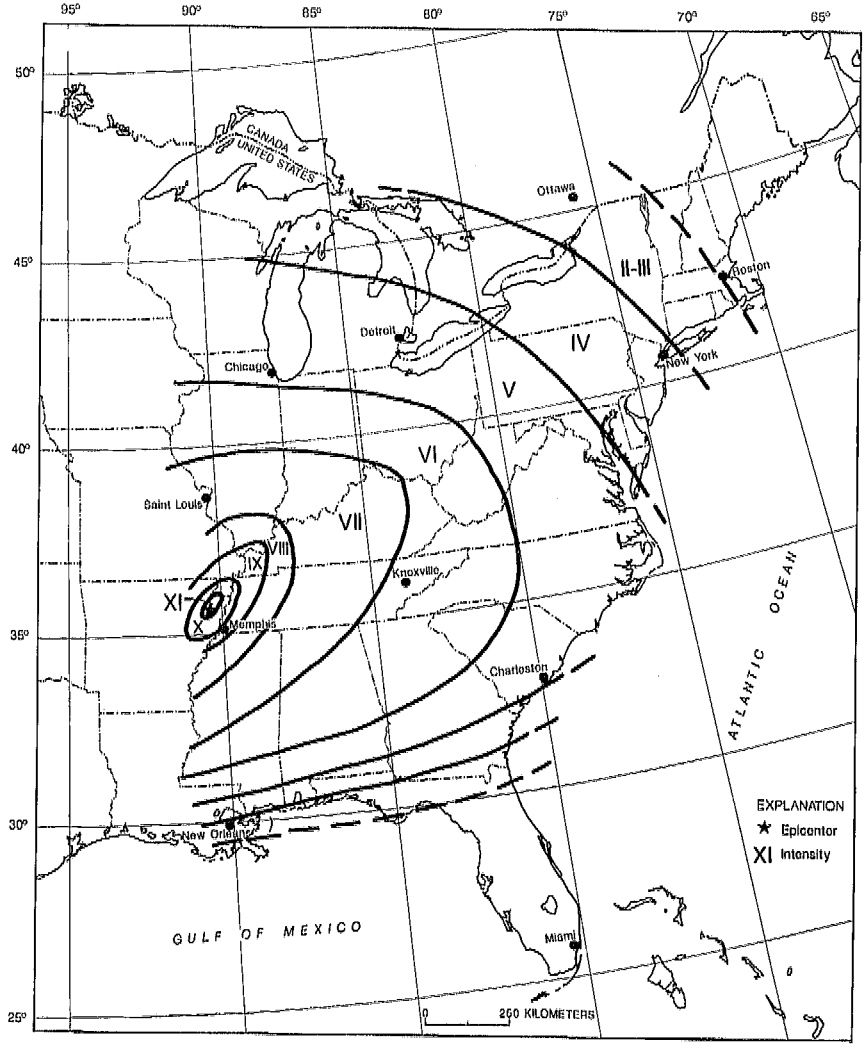
Source: Building Seismic Safety Council, 1985

Studies Indicate That the Benefits of Seismic Codes Outweigh the Costs

Estimated costs and benefits of seismic building codes for Memphis, Tennessee, assuming damage from magnitude 6 and 8 earthquakes in the southern New Madrid fault zone: benefits exceed costs by a factor of 1.8 for the magnitude 6 event and 10.3 for the magnitude 8 event.

The expected damage over forty years is more than three times greater than the costs of building to code.

Benefits are underestimated because they do not account for the benefits of reducing fatalities, injuries, fire potential, or economic losses.



New Madrid earthquake, Dec. 16, 1811. This was a magnitude 8 event. (Map: U.S. Geological Survey, Professional Paper 1527, 1993)

Arguments In Favor of Seismic Codes

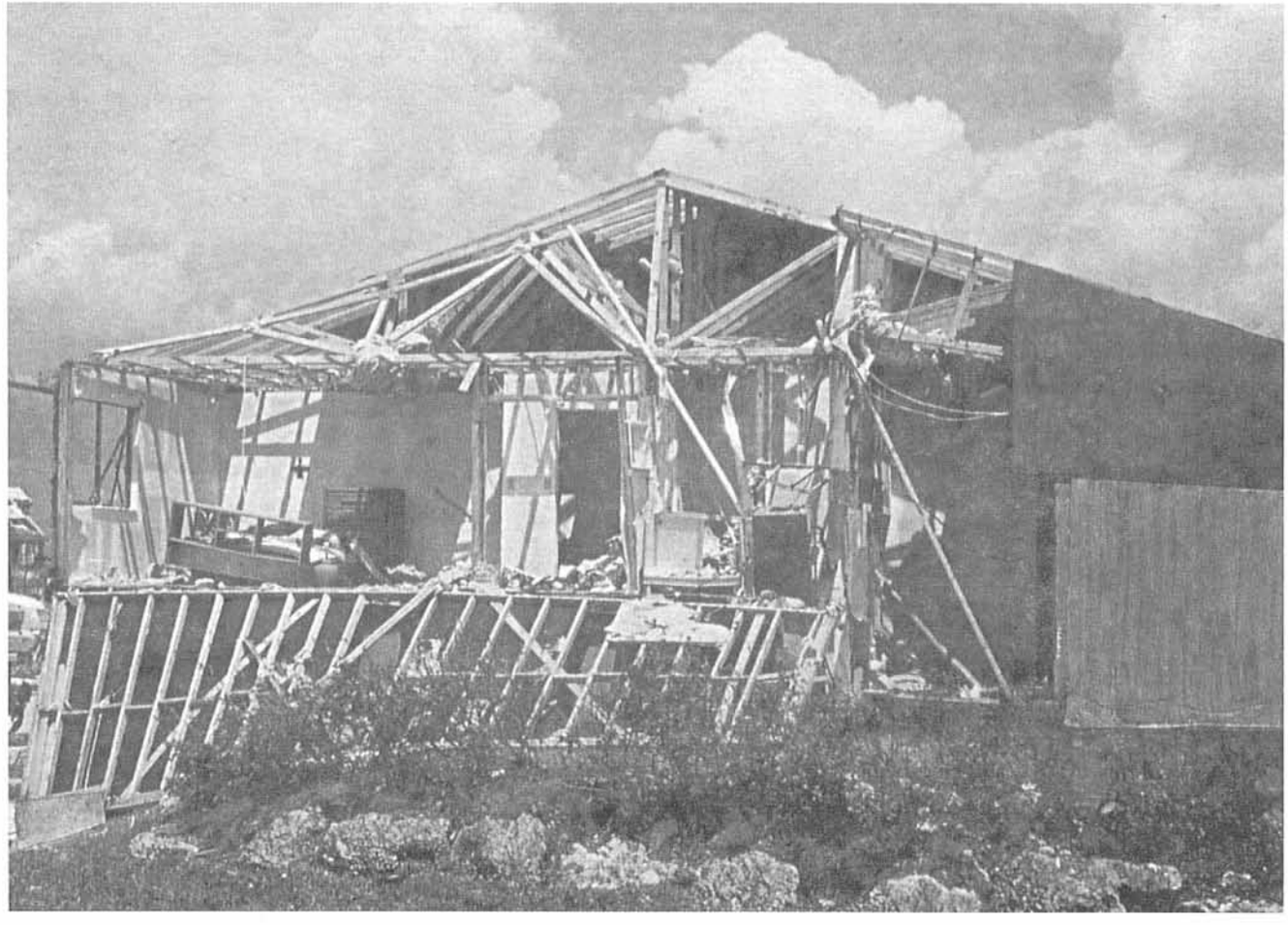
- For elected officials: A damaging earthquake can occur during your term of office.
- For elected officials: Citizens support seismic codes.
- Codes will not hurt business.
- A seismic code will improve successful survival of the next earthquake.
- Everyone else is doing it.
- It's easy.
- It's good for the community.
- All communities need a seismic code regardless of risk.

Poor Code Enforcement Results in Deficient Buildings

A substantial portion of the damage from Hurricane Andrew in 1992 was from lack of enforcement of the South Florida Building Code.

(Source: FEMA 1993)

In a 1993 study, USC researchers found that key items to resist seismic load are frequently (13 to 72 percent of surveyed units) missing or flawed.



Five Elements of Effective Code Enforcement:

1. *Code provisions must be up to date*

2. *Builders must apply for permits*

3. *A qualified reviewer must review building plans*

4. *Construction should proceed according to approved plans*

5. *A qualified inspector must inspect the construction*

Adopting Seismic Code Provisions

Step 1: Determine the current building code requirement (if any) and develop a strategy for incorporating or initiating current seismic provisions.

Step 2: Gather support for the proposed changes.

Step 3: Lobby the decision-making body with information explaining why the changes are needed and describing the kind of support you have gathered.

Step 4: Continue your involvement through the administrative implementation and enforcement stages once the seismic provisions are approved.

Establishing an Effective Building Code Enforcement Program

Step 1: ***Adopt a model code.***

Step 2: ***Establish fee structures for permits and plan review.***

Step 3: ***Institute a systematic plan review system.***

Step 4: ***Adopt an inspection schedule.***

Step 5: ***Maintain a trained, qualified staff.***

Step 6: ***Be persistent but patient.***

Some Selected Notable Earthquakes from 36 States

This table lists selected notable historical earthquakes from across the United States. Only states with at least one event of Modified Mercalli Intensity VII or greater are listed, and at least one such event is described for each state. Only a few illustrative events are listed for highly seismic states, such as California and Alaska. Note that this list is based on the location of the earthquake epicenter; many additional states have been affected by strong earthquakes in neighboring states.

This information is summarized from U.S. Geological Survey Professional Paper 1527, *Seismicity of the United States, 1568-1989* (rev.), 1993. This publication is a particularly good source of information for historic seismicity in all the states. It contains numerous maps of Modified Mercalli Intensities for historic earthquakes, including ones in your state. This publication can be purchased from the USGS at (800) 435-7627, or it can be obtained from most university or state geological survey libraries.

State	Date	Maximum MMI	Magnitude	Effects
AL	Oct. 18, 1916	VII	?	Destroyed numerous chimneys near Birmingham.
AK	July 10, 1958	XI	8.3	5 deaths, massive rockslide and ensuing wave, extensive damage to port facilities at Yakutat.
	March 28, 1964	X	9.2	125 deaths (110 from tsunami), $311 million in property loss. Heavy damage from building collapses and landslides in Anchorage; tsunami devastated many coastal areas.
AZ	May 3, 1887	XII	7.4	Centered in Northern Sonora, caused 51 deaths in Mexico, and widespread damage in southeast Arizona from intensities of VII, VIII, and IX.
AR	Dec. 16, 1811	XI	7.7	Part of New Madrid earthquake sequence, centered in northeast Arkansas. Extensive ground deformation and landsliding throughout sparsely-populated region. Chimneys toppled as far away as Cincinnati. Sequence includes the largest earthquakes known in 48 states.
	Jan. 1, 1969	VI	4.3	Walls and floors cracked and dishes broken in Little Rock.
CA	April 18, 1906	XI	7.7	Earthquake and fires killed 3,000 people and caused $524 million in property damage in and near San Francisco. Buildings and chimneys collapsed, pipelines broke, soft ground severely deformed. Fires destroyed a large part of San Francisco.
	March 11, 1933	VIII	6.2	115 people killed, $40 million in property damage. Severe property damage in Long Beach and Compton, particularly to masonry structures, especially those on soft ground.
	Feb. 9, 1971	XI	6.6	65 deaths, 2,000 injuries, and property damage of $505 million, mostly in San Fernando Valley. Damage to hospitals, freeways, utilities, dams. Older buildings and thousands of chimneys damaged. Fault rupture, ground fracturing, and landsliding caused extensive damage.
	May 2, 1983	VIII	6.2	Coalinga earthquake caused $10 million in property damage and injured 94 people. 8-block downtown area almost completely destroyed, primarily unreinforced brick buildings. Newer buildings sustained only superficial damage. Also destroyed hundreds of single-family homes and apartments.
	Oct. 17, 1989	IX	7.1	63 deaths, 3,757 injuries, and $6 billion in property damage. Damage to freeways and to older buildings on soft soils in San Francisco and Oakland. Severe damage in and near Santa Cruz, primarily to unreinforced brick buildings. Engineered buildings, including those near the epicenter, performed well.

Some Selected Notable Earthquakes from 36 States Continued

CO	Aug. 9, 1967	VII	5.3	Foundations, floors, and walls cracked, windows broke in northern suburbs of Denver.
	Nov. 8, 1882	VII	6.2	Minor damage in Colorado and southern Wyoming. Electricity cut off in Denver; plaster fell from the ceiling of a building at the University of Colorado in Boulder.
CT	May 16, 1791	VII	?	Stone walls shaken down, tops of chimneys fallen in Middlesex County, northeast of New Haven. Felt in Boston and New York.
DE	Oct. 9, 1871	VII	?	Chimneys toppled and windows broken in Wilmington area.
HI	Nov. 29, 1975	VIII	7.4	Two deaths, property damage of $4.1 million on island of Hawaii. Slight to moderate structural damage to 100 buildings from ground-shaking. Widespread ground deformation, subsidence, and faulting. Tsunami caused considerable damage to coastal areas.
ID	March 28, 1975	VIII	6.1	Shifted houses from foundations and toppled chimneys in sparsely-populated Pocatello Valley. Caused $1 million in damage.
	Oct. 28, 1983	IX	7.0	Two deaths and $12.5 million in damage in Challis-MacKay area. Numerous commercial buildings damaged, primarily those built of masonry. 90 percent of chimneys in Mackay were damaged. Extensive damage to high school in Challis.
IL	Nov. 9, 1968	VII	5.3	Cracked foundations, downed chimneys, broken windows in southern Illinois. Most buildings with chimney damage were 30 to 50 years old. Felt in parts of 23 states.
IN	Sept. 27, 1909	VII	5.1	Downed chimneys and cracked plaster in Terre Haute, Covington, and Princeton.
KS	Jan. 8, 1906	VII	4.9	Fallen chimneys and cracked plaster in and near Manhattan.
KY	July 27, 1980	VII	5.0	Caused $1 million damage in Maysville to 37 commercial and 269 residential structures. Old multistory brick structures in the downtown were affected the most. Fallen chimneys and cracked ground occurred. Felt in parts of 15 states.
ME	March 21, 1904	VII	5.1	Overthrew chimneys in Washington County. Felt throughout New England.
MA	Nov. 18, 1755	VIII	?	Up to 1,500 chimneys damaged in Boston, stone fences thrown down, ground cracking. Much of the damage in Boston was on filled land near wharfs. Generated a tsunami that affected the West Indies. Earthquake was centered off Cape Ann.
MI	July 27, 1905	VII	4.5	Downed many chimneys and broke plate glass windows at Calumet, Houghton County.
MO	Feb. 7, 1812	XII	7.9	Part of New Madrid earthquake sequence. Destroyed town of New Madrid. Many houses damaged in St. Louis. Ground warping, fissuring, landslides. Sequence includes the largest earthquakes known in 48 states.
	Oct. 31, 1895	VIII	6.7	Extensive damage to schools, churches, private houses, and almost all the buildings in the commercial section of Charleston. Extensive damage also to public buildings and brick walls in Cairo, Illinois. Felt in parts of 23 states.
MT	June 28, 1925	VIII	6.6	Severe damage to chimneys and schools in Gallatin County. Almost all masonry buildings showed damage.
	Oct. 18, 1935	VIII	6.2	This was the main shock in a series of at least three large earthquakes during October. These caused an estimated total of $4 million in property damage in Helena. Two people were killed and 300 buildings damaged. Damage was most severe to old brick houses. Downed chimneys and cracked plaster common. Severe damage to Helena High School (completed 2 months earlier) and other public buildings.

Some Selected Notable Earthquakes from 36 States Continued

	Aug. 18, 1959	X	7.3	28 deaths, and $11 million in damage to highways and timber. Most disastrous effect was from a huge landslide in the Madison River Canyon.
NE	Nov. 15, 1877	VII	5.1	Damaged courthouse and school at Columbus, cracked walls. Felt in seven states.
NV	Dec. 21, 1932	X	7.2	Major earthquake in an uninhabited region, as is true of most of Nevada's major historical earthquakes. Chimneys and walls fell in Mineral County. Large landslides occurred and boulders were shaken from cliffs.
NH	Dec. 20-24, 1940	VII	5.5	Two similarly-sized earthquakes damaged old houses and chimneys in Carroll County. Also cracked walls, broken pipes, and broken furniture. Minor damage in Maine, Massachusetts, New York, Vermont.
NJ	June 1, 1927	VII	?	Damage to chimneys and fallen plaster in Monmouth County.
NM	Jan. 23, 1966	VII	5.0	Damage to chimneys, brick walls, and plaster, especially at schools in Dulce. Rock falls at Dulce Point.
NY	Aug. 10, 1884	VII	5.5	Severe property damage at Jamaica and Amityville. Fallen chimneys and cracked walls throughout area.
	Sept. 5, 1944	VIII	5.5	Caused $2 million in property damage at Massena, NY, and Cornwall, Ontario. At Massena, 90% of chimneys were damaged, as were many house foundations, plumbing, and masonry. Chimneys were downed in several NY towns.
NC	Feb. 21, 1916	VII	5.2	Tops of chimneys and windows broken in Waynesville. Minor damage in wider area of NC and TN.
OH	March 9, 1937	VIII	5.4	Damaged almost every chimney in Anna (Shelby County), severely cracked the schoolhouse, and damaged two churches. Felt in tall buildings in Chicago, Milwaukee, and Toronto.
OK	April 9, 1952	VII	5.5	Toppled chimneys and smokestacks, loosened bricks, and broken windows at El Reno, Oklahoma City, and Ponca City. Caused 15-meter-long crack in State Capitol building.
OR	March 25, 1993	VII	5.6	Caused significant structural damage to many unreinforced brick buildings at Scotts Mills and Mollala. Estimated $2 million in uninsured losses, and $12 million damage to public facilities. Cracked State Capitol rotunda. (Source: EERI Newsletter, vol. 27, no. 5, 1993)
	July 16, 1936	VII	5.8	Chimneys broken, houses shifted from foundations in Umatilla County. Several houses severely damaged, school damaged. Caused $100,000 damage. Many ground cracks formed.
SC	Aug. 31, 1886	X	7.0,	60 deaths, $5-6 million in damage. Most structures in Charleston were seriously damaged. Every brick and stone building was cracked. Large public buildings required extensive repair. 65% of brick buildings were damaged, compared to 7% of wooden buildings. Structural damage also in AL, OH, KY, VA, and WV. Extensive cratering and fissuring, severely damaged railroad tracks. (Source: O.W. Nuttli, G.A. Bollinger, R.B. Herrmann, *The 1886 Charleston, South Carolina, Earthquake—A 1986 Perspective*, U.S. Geological Survey Circular 985, 1986)
	Jan. 1, 1913	VII	4.8	Overthrew chimneys, damaged plaster and stone walls in Union County. Cracked walls of jail and courthouse in Union.
TN	Aug. 17, 1865	VII	5.0	Chimneys thrown down at Memphis, and chimneys damaged at New Madrid, MO. Felt from St. Louis to Jackson, MS.
TX	Aug. 16, 1931	VIII	5.8	All buildings except wood-frame houses were damaged in Valentine, and all chimneys were toppled or damaged. Schoolhouse had to be rebuilt. Landslides occurred in a widespread area.

Some Selected Notable Earthquakes from 36 States Continued

UT	March 12, 1934	VIII	6.5	In a sparsely-settled area in Box Elder County, but two people were killed. Downed chimneys and cracked walls in brick buildings. Large rockslides and fissures.
	Aug. 30, 1962	VII	5.8	Severely damaged many unreinforced brick buildings in Cache Valley. 75% of chimneys collapsed in Richmond, walls of many houses were badly damaged, and several houses were unsafe for occupancy. Property damage of $1 million. Landslides also occurred.
VA	May 31, 1897	VIII	5.6	Damaged chimneys and brick houses in Giles County, especially at Pearisburg. Large area felt Intensity VII, including Lynchburg, VA, Bluefield, WV, and Bristol, TN. Felt from Georgia to Pennsylvania.
WA	April 13, 1949	VIII	6.7	8 people killed, $25 million in property damage in Puget Sound area. Almost all large buildings were damaged in Olympia, including eight on the Capitol grounds. Several structures condemned, including three schools, a church, and a library. At Seattle, houses on filled ground were demolished, many old brick buildings were damaged and chimneys toppled.
	April 29, 1965	VIII	6.7	7 people killed, $12.5 million in property damage. In West Seattle, two schools were severely damaged and chimneys were damaged extensively. Unreinforced brick buildings were damaged most severely, and wood-frame buildings performed very well.
WY	June 30, 1975	VII	6.4	Caused rockfalls, landslides, and cracks in a parking lot at Yellowstone Park. Many park roads were closed. Two new geysers formed.
Guam	August 8, 1993	?	8.1	This very powerful earthquake was centered about 40 miles south of Agana. Generated no tsunamis, no deaths, and comparatively little damage to Guam's code-designed structures. The most significant damage occurred to some of the tall hotels, possibly due to construction quality problems. Significant ground failure problems occurred in waterfront areas. (Source: EERI Newsletter, vol. 27, No. 10, October 1993)

Effects of the most common damaging MMI intensity values

MMI Level	Effects
V	Felt by most people, indoors and out
	Buildings tremble
	Dishes and glassware break
	Small or unstable objects overturn and may fall
	Doors and shutters open or close abruptly
	Small objects and furnishings move slightly
	Liquids in open containers may spill slightly
VI	Felt by all people, indoors and out
	People move about unsteadily
	Some plaster cracks; fine cracks appear in chimneys
	Dishes, glassware, and windows break
	Books and picture fall
	Some furniture overturns
VII	Most people are frightened
	Many people find it difficult to stand
	Water is disturbed and muddied
	Some sand and gravel streambanks cave in
	Chimneys crack to great extent; walls crack somewhat
	Plaster and stucco fall in large amounts
	Loosened bricks and tiles fall
	Damage negligible in buildings of seismic design and construction
	Damage considerable in poorly built buildings
VIII	People are alarmed
	People driving vehicles notice the disturbance
	Trees shake strongly, and branches break off
	Sand and mud are ejected from the ground in small amounts
	Temporary and permanent changes occur in springs and wells

MMI Level	Effects
VIII	Ground becomes wet to some extent, even on steep slopes
	Chimneys, columns, monuments fall
	Damage slight in structures built to withstand earthquakes
	Damage considerable in ordinary substantial buildings
IX	People generally panic Ground cracks conspicuously
	Masonry structures knocked out of plumb
	Large parts of masonry buildings collapse
	Some buildings shift off of foundations
	Reservoirs are seriously damaged
	Some underground pipes break
	Damage considerable in structures built to withstand earthquakes
	Damage great in substantial buildings
X	Ground cracks as large as several inches
	Numerous landslides on riverbanks and steep slopes
	Most masonry and frame structures are destroyed
	Buried pipelines are torn apart or crushed
	Wavy folds open in concrete pavements and asphalt surfaces

Group Exercise #1: Community Risk at MMI ____

SAFETY RATING SCALE					
Don't Know	Unsafe			Very Safe	
?	1	2	3	4	5

	Safety Rating	Built to Current Building Code Specs? y/n/?	Built to Current Seismic Code Specs? y/n/?
City Hall Building:	____	____	____
Fire Station(s):			
_____	____	____	____
_____	____	____	____
School(s):			
_____	____	____	____
_____	____	____	____
_____	____	____	____
Hospital(s):			
_____	____	____	____
_____	____	____	____
Recent large building(s):			
_____	____	____	____
_____	____	____	____
Other major community building(s):			
_____	____	____	____
_____	____	____	____

Where would you like most to be during an earthquake?

_____

_____

_____

Where would you like least to be during an earthquake?

_____

_____

_____

Purpose and History of Building Codes

Building codes regulate building construction and use in order to protect the safety of occupants. Codes address structural integrity, fire resistance, safe exits, lighting, and ventilation. Codes also regulate construction materials.

Building codes classify structures by use and apply different standards to each classification. For example, office buildings and residential multi-unit buildings are in separate categories with different performance (such as strength and stability) requirements.

The validity of building codes is based on state police powers, which allow regulation of activities and property to preserve or promote the public health, safety, and general welfare. Zoning ordinances and environmental protection regulations are also founded in police powers.

Building Codes Have a Long History in the U.S.

Building codes to reduce the loss of life, limb, and property have existed in North America since the seventeenth century. The earliest building regulations addressed problems resulting from dense urban construction, such as rapid spread of fire. New York City, then called New Amsterdam, first regulated chimneys and roofing material in 1648. These regulations were aimed at controlling the destructive force of fire in urban areas, as evidenced by London's 1666 fire, New York's 1835 and 1845 fires, and the great Chicago fire of 1871.

Comprehensive building regulations were introduced in the mid-1800s. Building regulations were of two types: housing codes and building codes. Housing codes were intended to reduce the ill effects of residential overcrowding, and their introduction paralleled Europe's housing and sanitation reform. New York City in the late 1850s adopted a citywide housing code in order to provide air and light into dwellings and reduce the risk of fatal hazards. Chicago followed by passing its initial tenement housing ordinance in 1874. Building codes were later enacted to comprehensively specify construction methods and materials.

In 1905 the National Board of Fire Underwriters published a model building law aimed at reducing fire risks. The three model building codes used today were initiated between 1927 and 1940. The use of codes spread with the growth of new building across the country, particularly after World War II. By 1960 more than 60 percent of American municipalities had adopted building codes.

Model Building Codes

A model building code is a document containing standardized building requirements applicable throughout the United States. Model building codes are performance standards specifying the required performance of all structures. They are published by private organizations, whose voting members are government jurisdictions. The United States has three prominent model building code organizations: the International Conference of Building Officials (ICBO), which publishes the *Uniform Building Code* (UBC); the Building Officials and Code Administrators International, Inc. (BOCA), which publishes the *BOCA National Building Code* (BNBC); and the Southern Building Code Congress International, Inc. (SBCCI), which publishes the *Standard Building Code* (SBC). Each organization also publishes companion documents covering mechanical work, plumbing, fire protection, electrical work, energy, accessibility, and life safety codes.

In addition to writing and updating the codes, the organizations offer a variety of support services, including such technical services as training seminars, code interpretation, technical and administrative publications, customized consulting, videos, and software. Each organization offers certification programs to allow skilled inspectors and plan reviewers to be recognized for their levels of knowledge and experience. For example, BOCA offers certification by examination in twenty-two categories and ICBO in nineteen categories. SBCCI offers four levels of certification in various categories to encourage professional growth through progressive levels of certification.

The model building codes are revised periodically by a democratic process. Each organization allows the public to propose code amendments and hear testimony in meetings organized by the organization, so members and nonmembers are equal participants. Active members of each organization vote on revisions after final testimony is heard during their annual meeting. The content of the codes has become more similar over time, although they still address regional conditions and practices. The newest versions reflect a common code format so that similar topics can be found in consistently numbered chapters among the codes.

Although the code organizations have widespread membership, each organization's model building code is predominantly adopted in one portion of the United States. The BNBC is predominantly adopted in the northeast and north central states, the SBC predominates in the southern states east of the Mississippi, and the UBC is predominant in the western states, including Guam.

In addition, BOCA, ICBO, and SBCCI have moved forward on the development of a single model code, the International Building Code. On December 9, 1994, the International Code Council (ICC) was formed to develop a single set of comprehensive and coordinated national codes. The advantages of a single code are numerous. Code enforcement officials, architects, engineers, designers, and contractors can have consistent requirements that can be used across the country and around the world. Manufacturers can put their efforts into innovative products, instead of designing for all three regional codes. To date, the ICC has produced codes that address plumbing and private sewage disposal. The goal is for the complete family of international codes to be developed by the year 2000.

The ABCs of Model Building Codes

Building Officials and Code Administrators International, Inc. (BOCA). BOCA, headquartered in Country Club Hills, Illinois, was formed in 1915. Its first code, the Basic Building Code now titled the *BOCA National Building Code* (BNBC), was published in 1950 in an attempt to standardize existing codes. The BNBC is revised every three years, most recently in 1996, with a new edition due out in 1999.

International Conference of Building Officials (ICBO). ICBO was formed in 1922 to integrate various design requirements into one code. ICBO published its first model code, the *Uniform Building Code* (UBC), in 1927 from its headquarters in Whittier, California. ICBO updates the UBC every three years. The latest edition was published in 1994.

Southern Building Code Congress International, Inc. (SBCCI). The third model building code organization, the SBCCI was founded in 1940. Located in Birmingham, Alabama, it publishes the *Standard Building Code* (SBC). The SBC is updated every three years, most recently in 1994.

Council of American Building Officials (CABO). CABO was founded in 1972 by BOCA, ICBO, and SBCCI. The *One- and Two-Family Dwelling Code* applies to the construction, prefabrication, alteration, repair, use, occupancy, and maintenance of detached one- or two-family dwellings and one-family town houses not more than three stories in height.

Purpose of Seismic Code Provisions

Seismic Codes Are Designed to Help Buildings Resist Earthquake Shaking

It is important to understand that seismic codes result in earthquake-*resistant* buildings rather than earthquake-*proof* buildings. Their purpose is to protect life safety by preventing building collapse and allowing for safe evacuation. The contents and interiors of buildings, even those of well-designed buildings, may receive extensive damage, and entire functions of a building may cease. And structural damage may occur from major earthquake ground-shaking. According to the Structural Engineers Association of California, structures built according to a seismic code should:

- resist minor earthquakes undamaged,
- resist moderate earthquakes without significant structural damage even though incurring nonstructural damage, and
- resist severe earthquakes without collapse.

Occasionally even a code-designed building may collapse due to unique site conditions or other factors. A report completed by the Earthquake Engineering Research Institute (EERI) just prior to the Northridge, California, earthquake summarized expected earthquake damage to buildings designed according to the 1991 UBC. It stated, for example, that shaking of Intensity VIII could cause moderate damage (easily repairable) to 10 to 30 percent of code-designed buildings, and extensive damage (long-term closure, difficult to repair) to 0 to 5 percent of code-designed buildings. This was the intensity level experienced by much of the San Fernando Valley in January 1994, and buildings performed generally as expected.

Seismic Codes Reflect Social Judgments Regarding Acceptable Risk and Cost

Seismic design standards reflect society's balancing of the risks versus the costs of designing to withstand that risk. They do this in two ways: by designing for (a) an appropriate-sized event and (b) an appropriate performance goal. Society cannot justify the expense of designing for large but highly improbable events. So we select a ground motion event—called the *design event*—that although large and rare has a reasonable chance (10 percent) of being exceeded during a building's lifetime (50 years). The probability selected reflects society's attitude toward risk. This is similar to the philosophy long used for flood protection: Society is willing to absorb the cost of designing for a 100-year flood, but with the exception of critical facilities it would not make economic sense to design for the 500-year or 1,000-year flood.

The goal of seismic codes is to ensure that buildings will not collapse, thereby killing those inside, if shaken by the design event. Seismic codes are for "life safety" and are not aimed at completely preventing damage to existing buildings. Additionally, it is important to realize that there is a 10 percent chance of an earthquake occurring that exceeds the design event.

Seismic Codes Are Effective

Seismic Codes Are Effective

Experience with recent earthquakes in the United States and throughout the world shows that seismic codes work. Cities with seismic codes suffer much less damage than those without such codes.

The Loma Prieta earthquake clearly illustrates the effectiveness of seismic codes. Occurring on October 17, 1989, this earthquake measured 7.1 on the Richter scale and was the strongest in the United States since the 1964 Alaskan earthquake. It shook the San Francisco Bay Area and killed sixty-three people. Although the ground-shaking was intense within the metropolitan area, few buildings collapsed. Most of the damage occurred to unreinforced masonry buildings built before the adoption of seismic codes. Nearly all major reinforced concrete structures built after World War II survived without collapse. Even at the quake's epicenter new buildings and buildings located on firm ground suffered little damage. Informed observers attribute the success to the required UBC seismic codes. This example illustrates that code requirements reduced the damage and loss of life during this moderate earthquake.

A Kyoto University study of the 1995 earthquake in Kobe, Japan, Richter magnitude 6.9, found that damage to reinforced concrete buildings closely paralleled improvements to seismic provisions in the Japanese building code. More than 55 percent of pre-1970 buildings (old version of code) were severely damaged, compared with no post-1980 buildings (newest version of code). Results for steel buildings were comparable.

Even smaller earthquakes can cause extensive damage where buildings are not designed for seismic shaking. A Magnitude 5.6 earthquake in 1993 at Scotts Mills, Oregon, caused significant structural damage to a number of unreinforced masonry (brick) buildings in the area. A high school building was significantly damaged and vacated, 16 residences and 54 businesses sustained major damage, and the Oregon State Capitol, in Salem, suffered cracking in the rotunda. The estimated damage cost to public facilities alone was nearly $13 million. This earthquake confirmed the susceptibility of unreinforced buildings to severe damage, even in a minor earthquake.

Seismic Codes Are Inexpensive

Seismic codes add relatively little to the costs of a structure. To assess the costs of the *National Earthquake Hazard Reduction Program (NEHRP) Seismic Provisions*, the BSSC in 1985 contracted seventeen design firms from nine U.S. cities to perform two designs for each of several typical building types, first using the existing local code and then using the seismic provisions. They found the average increase in total costs to be 0.7 percent for low-rise residential buildings, 3.3 percent for high-rise residential buildings, 1.3 percent for office buildings, 0.5 percent for industrial buildings, and 1.7 percent for commercial buildings. Cities with previous seismic design provisions in their codes averaged much smaller cost increases (0.9 percent) than did cities with no seismic codes at all.

A 1992 study by the National Association of Home Builders (NAHB) for the Insurance Research Council examined the incremental costs of building single-family residences to 1991 *NEHRP Provisions*. They found that "builders can construct houses providing for life safety in earthquakes at a very reasonable added cost-less than 1 percent of the purchase price of a new home in most instances."

All Three Model Codes Contain Seismic Requirements Appropriate to the Community's Level of Risk

Each model code contains a seismic hazard map, based on current scientific knowledge. Its risk philosophy is accepted by a broad consensus of scientists and design and construction professionals. Its use in seismic design was determined by a nationwide consensus process conducted by the Building Seismic Safety Council (BSSC), an organization of more than fifty construction, professional, and trade organizations.

Portions of thirty-nine states are considered to have some degree of earthquake hazard. Some counties need to design for high levels of earthquake ground-shaking, whereas others should design for relatively less. Conversely, some areas, even those with seismic codes, do not need seismic design at all because the risks are so low.

Since 1992 all three model codes require seismic design standards consistent with the *NEHRP Provisions*. ICBO has long been a leader in seismic code development; BOCA incorporated the 1988 *NEHRP Provisions* into the 1992 BOCA *Supplement*; and SBCCI for the first time incorporated seismic design provisions in the 1992 amendments to the SBC. Thus, all communities that adopt the most recent editions of these codes have the most advanced seismic codes available.

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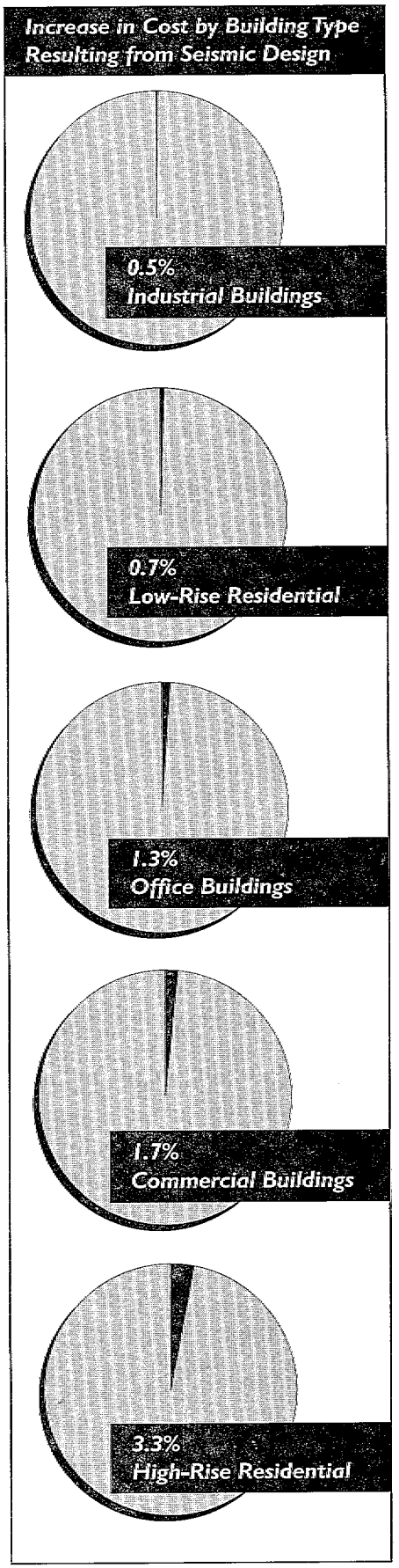
Costs of seismic design can vary. It is easier to provide seismic design for simple-shaped structures, with basic geometric shapes such as a square, and cheaper to do it if seismic considerations are integrated into the earliest stages of building design. In certain situations, the costs for the structure are relatively small in proportion to the total project costs. This occurs if the project has expensive contents or high land values. If this is the case, the cost of seismic-resistant design

Studies Indicate That the Benefits Outweigh the Costs

A few studies have attempted to look at the costs and benefits of seismic design provisions. The studies generally indicate that the costs of seismic-resistant construction are justified.

A 1992 study, *Physical Damage and Human Loss: The Economic Impact of Earthquake Mitigation Measures*, funded by the National Committee on Property Insurance (now IBHS), analyzed the estimated costs and benefits of seismic building codes for Memphis, Tennessee, assuming damage from magnitude 6 and 8 earthquakes in the southern New Madrid fault zone. It found that benefits exceed costs by a factor of 1.8 for the magnitude 6 event and 10.3 for the magnitude 8 event. Moreover, the benefit-cost ratio averaged over a forty-year time horizon, accounting for the expected probability of earthquakes in that time period, was estimated at 3.3. Thus, the expected damage over forty years is more than three times greater than the costs of building to code. Furthermore, the benefits are underestimated because they do not account for the benefits of reducing fatalities, injuries, fire potential, or economic losses. This recent study provides valuable analytic support to the claim that seismic building codes are cost-effective, even in the central United States.



Group Exercise #2: Responding to Arguments Against Seismic Codes

1. List the local arguments against seismic codes:

2. How might you respond?

3. Who is likely to oppose having seismic codes?

4. Who is likely to support having seismic codes?

Arguments in Favor of Seismic Codes

For elected officials: A damaging earthquake can occur during your term of office. The levels of ground-shaking represented on the code's seismic hazard map have a 0.8 percent chance of occurring in any four-year period at each point on the map (such as the community in question), and about a 2 percent chance of occurring in any eight-year period. But these are the *design events*. What about a lesser earthquake? An earthquake half as big as the design event could cause severe damage to many structures not meeting the code and little damage to structures built according to seismic code. Such an event has about a 4 percent chance of occurring in any four-year period and about an 8 percent chance in an eight-year period.

For elected officials: Citizens support seismic codes. Studies in California and the central United States have shown that most citizens support seismic building codes, and that elected officials underestimate this support. For example, in 1984 Arizona State University surveyed residents and officials in the high seismic risk area surrounding the New Madrid fault zone. The survey found that 62 percent of residents believed that seismic building codes for new structures are "very important," and most supported codes even if substantial costs would be involved. In contrast, support by community leaders was much lower at 37 percent. Furthermore, other studies have shown that community leaders greatly underestimate the public's concerns about earthquakes, mistakenly believing public concern to be less than their own.

In a 1994 telephone survey of residents in six hurricane-prone areas, 91 percent of respondents indicated that builders should be required to follow new, stricter building codes even though it might add 5 percent to the cost of a home.

Codes will not hurt business. Building codes have not hurt the economies of the forty-one states that have them, nor have they hurt the 95 percent of all U.S. cities and towns that have codes. Seismic design adds only approximately 1 to 1.5 percent to the cost of a building, according to a 1985 Building Seismic Safety Council (BSSC) study.

Is there a chance that local buildings will be shaken by an earthquake at some point? An earthquake can devastate the small businesses in a community. Following the 1994 Northridge, California earthquake, thousands of small businesses had to relocate or temporarily shut down. Such interruptions can be fatal to small businesses. Simply the loss of business activity can affect neighboring businesses that are fortunate to survive the earthquake ground-shaking.

A seismic code will improve successful survival of the next earthquake. People will live and work in these buildings. Codes work. Look at the evidence of relatively low loss of life in the earthquakes in California in 1989 and 1994. Either a community is designed to survive the next earthquake, or it is not.

Everyone else is doing it. The federal government has set an example with Executive Order 12699. Seismic codes are becoming more prevalent at all levels of government, which means two things: (a) a community will not be at an economic disadvantage for attracting new business and (b) if other communities adopt seismic provisions, those that do not have this safeguard in place invite liability.

It's easy. It doesn't take much to start. Call up a code organization, buy the code, develop a fee structure (to pay for administration), and contract with the county or another nearby agency for initial staffing.

It's good for the community. With a seismic code, residents will know that the community is on its way to seismic safety. The code will reduce long-term liability costs. A good code may ultimately improve the community's insurance rating. A seismic code is not an admission of community weakness, but rather a sign of community strength. It says that the community values safety, takes itself seriously, and wants to survive natural disaster. All communities need a seismic code regardless of hazard. Seismic codes supplied by the building code organizations account for the unique level of hazard in each community. If a community's hazard is low, the code will reflect that. The seismic hazard zone map is based on the latest national scientific evaluation of earthquake risk, representing the consensus of a number of scientific and professional organizations. The code requirements for each community reflect that estimate of hazard.

Enforcing the Seismic Code: A Critical Link

Poor Code Enforcement Results in Deficient Buildings

Recent studies following Hurricanes Hugo and Andrew have shown weaknesses in code enforcement. In 1991 State Farm Insurance Company contracted with SBCCI to evaluate code compliance in twelve randomly selected coastal communities. They found that inspectors and reviewers had little or no training in wind-resistant construction and that there was a general lack of enforcement of adequate connections of windows, doors, and mechanical equipment to the building frame. About half of the communities were not enforcing their own code standards for wind resistance.

Following Hurricane Andrew, reports by a Dade County grand jury and by the Federal Insurance Administration concluded that a substantial portion of the storm's damage was attributable to lack of enforcement of the South Florida Building Code. According to the Insurance Services Office, Inc., at least one-fourth of the record $15.5 billion in insured losses caused by Andrew were because of construction that failed to meet Dade County's code. Thus, even in communities with adequate codes, significant damage can be attributed to poor compliance and enforcement.

In a 1993 study, G.G. Schierle of the University of Southern California found significant problems in quality control of seismic-resistant construction in California. By means of a survey of design professionals and site inspection of 143 projects, the researchers found that key items to resist seismic load are frequently (13 to 72 percent of surveyed units) missing or flawed. Reasons include "inadequate communication, little or no construction observation by design professionals, ignorance, greed, shortsighted false economy, and lack of scrutiny by building inspectors."

Clearly, much effort needs to be spent on improving code enforcement. The weaknesses become apparent only at the moment when resistance is most needed—when the disaster strikes.

Benefits to Communities That Enforce Building Codes

Insurers and lenders have begun to realize that adoption and enforcement of building codes in general, and seismic codes in particular, are in their long-term interest. Accordingly, in 1995 the Insurance Services Office, Commercial Risk Services (ISO/CRS) began to phase in a new Building Code-Effectiveness Grading Schedule. By the end of the decade, this schedule will rate the code-enforcement capabilities of every municipality in the United States.

The insurance industry is developing this new grading schedule to reward communities for promoting property and life safety protection through the use and enforcement of modern codes. The system will be used by property insurers to set differential rates among communities based on code-enforcement practices. Property owners in communities with good code enforcement will pay lower insurance premiums—and owners in communities with poor enforcement will pay more.

The grading schedule measures resources and support available to building code enforcement efforts. It assesses each municipality's support for code enforcement, plan review, and field inspection. The grading process includes interviews with municipal officials, examination of documents, review of training requirements and work schedules, staffing levels, and certification of staff members.

The new system is comparable to the fire protection grading system and the community rating system for flood insurance already used by ISO/CRS. These two systems use a rating scale of one to ten, with one representing the best protection and ten indicating no protection.

For more information, contact the coordinating body, the Insurance Institute for Property Loss Reduction.

Five Elements of Effective Code Enforcement

Code enforcement and administration consist of five sequential elements.

Element 1: Keep the Code Provisions Up To Date

Simply adopting a code is not enough. A code is an active document, evolving to reflect new knowledge and new standards of practice. Once a jurisdiction makes a commitment to use a building code, it must be prepared to update its local code on a regular basis.

Element 2: Ensure That Builders Apply for Permits

Obviously, if builders try to avoid the code-application process, then the code cannot do its job. A jurisdiction must have inspectors out in the field who know the community. The inspector needs to be alert to new construction in his or her jurisdiction and must be aware of current active permits.

In addition, the building department must cultivate and maintain cordial relations with the building and design community. This can be done by arranging informal meetings, sending written materials to local organizations, speaking to community groups, and maintaining memberships in appropriate trade and professional organizations.

Element 3: Have a Qualified Reviewer Review Plans

Plan review is one of the two points at which the local government can affect the details of building construction. At a minimum, plan review verifies that the design complies with the building code. This is the most cost-effective moment to catch mistakes, before any money is spent on construction. Some jurisdictions may also review structural calculations.

Plan reviewers must be fully knowledgeable about code requirements. Some jurisdictions use licensed architects and engineers who can go beyond code compliance review and verify calculations and overall building safety. The building department can approve, require revisions, or reject the plans. Construction cannot begin until the building department confirms that the plans conform to the building code.

Construction of buildings larger than one- or two-family dwellings usually requires architectural and engineering designs. State statutes require that the licensed professional engineer and/or architect place his or her seal and signature on the designs. The seal and signature signify that the design is at the accepted professional standard, which is typically the most recent version of a model building code or technical document.

Element 4: Ensure That Construction Proceeds According to Approved Plans

An owner receives a building permit to construct according to the approved plans, and it is the legal responsibility of the owner to do so. The owner may hire inspectors or the engineers and architects to oversee key aspects of the construction in order to help verify compliance with the plans. To some extent, all government inspection systems depend on this obligation by the owner, which is inherent in the issuance of a permit.

Element 5: Have a Qualified Inspector Inspect the Construction

Inspection is the second point at which the local government can affect the details of building construction. Inspection verifies whether construction is proceeding according to the approved plans and the conditions of the permit. Inspection is typically required at several key stages in the construction process. The inspector has a powerful enforcement tool called a stop work order. A stop work order is issued to the construction firm if the inspector finds a code violation that must be corrected before any further construction is performed. At final inspection, the building can be approved for occupancy.

Depending on the jurisdiction, inspectors may be municipal employees or contracted tradespeople. In either case, building inspectors must be well qualified. They must know how to read building plans and must be familiar with the code. More importantly, they must be familiar with building practices so they can recognize potential problems. Model code organizations offer certification programs to recognize the capabilities of inspectors.

Group Exercise #3a: Action Plan to Adopt a Building Code

Develop a ten-point action plan that will result in a building code (with current seismic provisions!) for this community:

1.

2.

3.

4.

5.

6.

7.

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9.

10.

Group Exercise #3b: Action Plan to Improve Code Enforcement

Develop a ten-point action plan that will result in improved code enforcement for this community:

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10.

Steps Toward Adopting Seismic Code Provisions

Step 1: Determine Code Practices and Options

- To whatever extent the state regulates construction, satisfy yourself that enforcement is adequate.
- If the state mandates local adoption of a specified code, ensure that the community has complied.
- If the state does not currently regulate, or if it allows for stricter local regulations, gather information on local code practices and explore options at the local level.
- Options may include developing an original code, modifying an existing code, or adopting a model building code.
- If a jurisdiction lacks an adequate code, work to initiate a building code.
- Model codes are usually the best option, because of the technical support provided by the code organization.

Step 2: Gather Support

- Work with state officials
- Work with the professional associations of engineers and architects
- Contact civic groups and service clubs, relevant businesses and construction organizations, chambers of commerce, economic development associations, and so forth
- Cultivate the media to help educate the general public

Step 3: Lobby the Decision-Making Body

- Explain why the changes are needed and describe the kind of support you have gathered.
- Gain the support of the governor's office.
- Consider educational programs or incentive programs that will appeal to governmental officials
- Consider ways of subsidizing the cost of joining a model building code organization
- Monitor the process from beginning to end

Step 4: Assist Throughout the Adoption, Implementation, and Enforcement Stages

- Provide information about seismic hazards in the area, the function and effectiveness of seismic codes, elements of code enforcement, and services provided by the model code organizations
- Keep informed of implementation milestones
- Meet periodically with the building official(s)
- Verify that adequate procedures have been introduced for plan review, inspection, and staff training
- Inform the building officials of any problems

Steps for Enforcement of Seismic Codes

This section outlines the six steps toward establishing an effective building code program.

Step 1: Adopt a Model Code

The first step in establishing a program is to review and adopt a model building code and join the appropriate code organization. Numerous publications and telephone-assistance services will then be available to help the new program get started. The information provided includes organization charts, descriptions of staff duties, fee structures, suggested procedures, and so on. New members may want to take seminars in plan review and inspection before officially initiating the code.

New members can request the model code staff to visit and assist in establishing their program. If extensive help is required, the code organization may be hired to provide the needed assistance. It is easy to get started, because the code organizations are set up to effectively and efficiently provide all the support you need.

Step 2: Establish Fee Structures for Permits and Plan Review

Building departments collect fees to pay for the costs of review, inspection, and associated administrative services. The community sets the fee structure based on its needs. Some communities require the building department to be completely self-supporting; others use the fees to offset only a portion of their true costs. Communities with significant experience in code administration can set fees based on previous budgets. Communities just starting out may prefer to use the fee structures suggested by the code organizations.

Plan review fees typically are based on estimated construction value, which depends on building floor area, type of construction, and proposed use. For example, under the BOCA NBC, the suggested building plan review fee for $1 million construction value is $1,250. Review for mechanical work, plumbing, energy conservation, or electrical work is an additional 25 percent each (i.e., each of these additional reviews, if required, costs $312).

Step 3: Institute a Systematic Plan Review System

Plans usually must be circulated to several additional departments for review, such as the planning, public works, and fire departments. It is best to have one department designated as the lead and to require multiple plan copies from the applicant so as to facilitate multi-department reviews.

Applicants should be kept well informed right from the start. Handouts and checklists are very important so that they know what materials to submit and how the plan will be judged.

Step 4: Adopt an Inspection Schedule

Each code has a recommended inspection schedule based on construction milestones. For example, the BOCA NBC suggests the following inspections for residential buildings: footing forms and trenches, basement and foundation wall forms, footing drains and damp proofing, framing, wallboard, and final. Similar schedules exist for electrical and mechanical work and plumbing.

Typically, the builder or owner will call for inspection when each specified milestone is reached. In addition, inspectors occasionally make unannounced inspections based on their judgment of the work progress and the quality of the contractor.

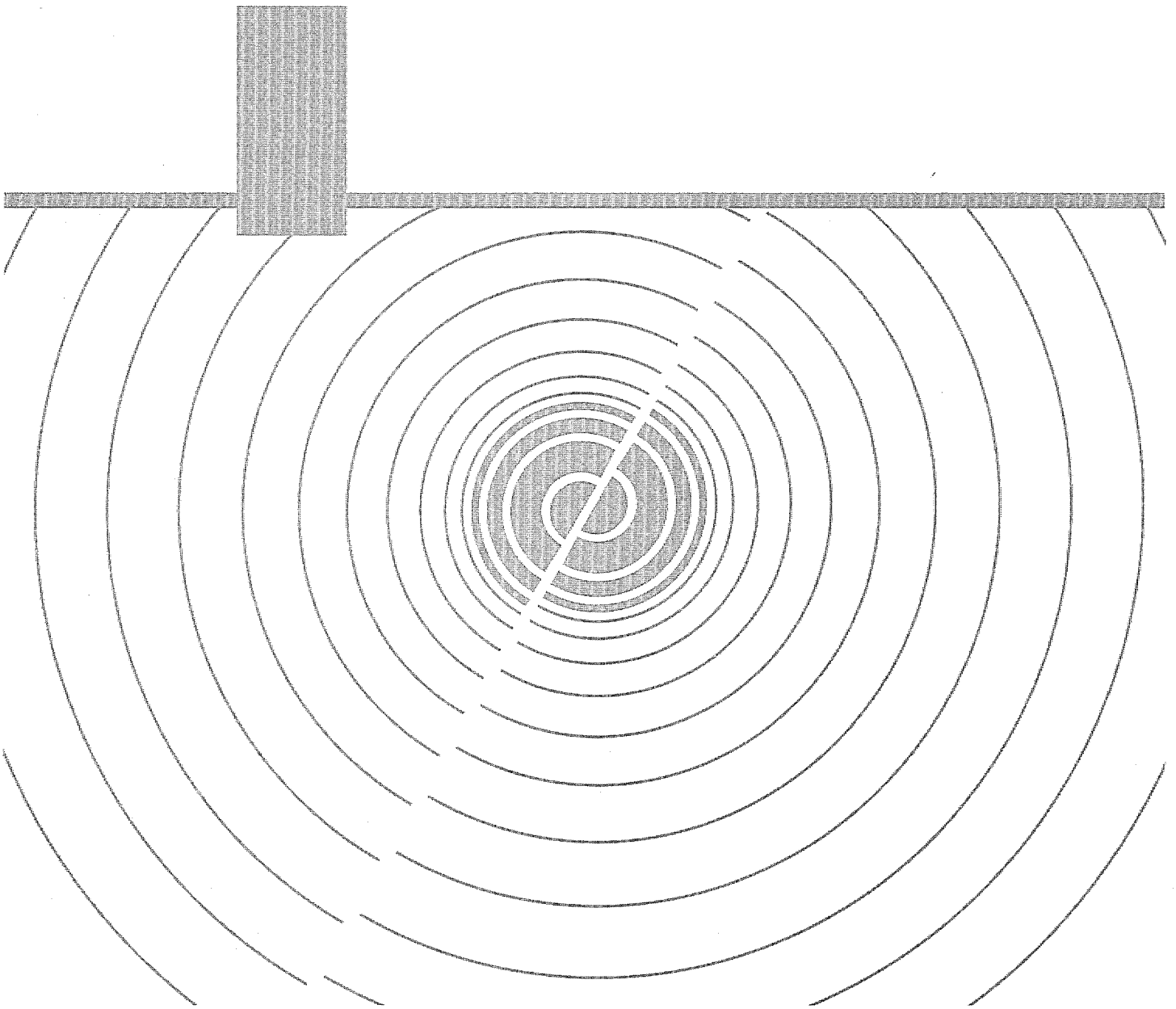
Step 5: Maintain a Trained, Qualified Staff

Ideally some staff members would be licensed engineers and architects, but most departments are too small to justify this cost. At a minimum, reviewers and inspectors must have experience in construction, be able to read plans, and be familiar with the code. Each of the model building code organizations offers certification in a number of categories for inspectors and plan reviewers. More and more building departments are requiring or rewarding certification in order to recognize staff quality levels.

Step 6: Be Persistent But Patient

You need to realize that a new code will not be implemented in one day. Adequate enforcement takes many years of experience and learning from mistakes. Procedures evolve over time. Building officials, plan reviewers, and inspectors must receive technical training and continuing education, which cannot be done overnight. Yet the effort is worth it, as seismic codes afford communities a high degree of improved building safety.

Appendix H:
Sample Press Releases



Appendix H
Sample Press Releases

The Role of News Coverage and How To Get It

Material in this appendix is intended to aid in efforts to promote awareness of earthquake risk and the adoption of the latest building codes. In the effort to educate the public and public officials, the news media can play an important part - maybe even a leading part. To use the media effectively, however, you must be ready to seek out the media, then be prepared if and when they begin to pay attention.

Do not expect reporters, editors, and news directors to find the story for themselves. Expect that you will have to "sell" them on why it is important to the community and their readers. At the same time, be careful not to hype something far beyond its importance; reporters and editors often will see through that. Be ready to back up your claims with facts and expertise.

Many times people dealing with the news media for the first time do not take into account how easily information can be miscommunicated or misunderstood. In your news releases or interviews, take extra care to be sure your major points are clear. Try to get the essential message and facts on paper, either in a news release or in a fact sheet you give to the reporter when meeting for an interview.

In interviews, don't be afraid to repeat your major points and to check and double-check that the reporter has understood the facts. This is especially important in talking about earthquakes, where information about fault zones, degree of risk (be careful using percentages), and the severity of quakes can be easily misconstrued.

Many times with news coverage, the timing is everything. In dealing with earthquake risk, probably the single best time to get the news media's attention is immediately after a major earthquake. The more serious the quake or the closer to your area, the better your opportunity for getting attention. A minor quake, actually felt by the residents in your area, also can be an opportunity.

Editors and news directors often are looking for the "local angle" on current news. If you can tell them why, after a major quake somewhere in the world, it is important to be concerned about earthquakes locally, you are almost assured of coverage. Since this opportunity is so important, and since an earthquake gives no warning, it is important to always be ready. You should have most of a news release already written, containing all the relevant local information, with only the first few sentences left to write when the major event occurs. Those first sentences will be the "hook," used to relate how your information is relevant to the current news and to area residents.

Among other opportunities for getting attention, some of which are anticipated in the attached materials:

- The launching of a statewide or regional effort to promote awareness of earthquake risk and adoption of the latest building codes.
- The anniversary of the Northridge (Los Angeles) and Kobe, Japan, earthquakes. They occurred on the same day, Jan. 17, in 1994 and 1995, respectively.

- When building codes or building code enforcement becomes a topic of serious discussion in city council or other public meetings.
- When emergency preparedness becomes an issue, even if resulting from other kinds of events, such as tornadoes or hurricanes.

Sample Press Releases

This appendix contains: (a) a sample release based on a fictional earthquake, (b) two versions of a "universal" release, designed to raise community awareness and/or announce plans for a campaign to adopt seismic codes; and (c) a sample letter to the editor. Various sections of the releases can be assembled according to your specific situation and local circumstances. This kit has been prepared with the following assumptions:

- Users of the kit may or may not have experience in putting together press releases or dealing with the media generally. The kit was assembled assuming the user would be starting from scratch.
- Users may need maximum flexibility and guidance in assembling a news release for various situations. Thus, we have supplied several versions and made frequent use of brackets, signifying where information must be supplied to fit the specific location or situation.
- It is impossible to anticipate every possible event or situation which might bring with it the opportunity to publicize local or regional earthquake risks. The user ultimately will use this kit as a guide.

In contacting the local media, through a press release or other means, the following advice should be kept in mind:

- Make the information relevant to the newspaper's readers or the station's audience. Answer the question: "Why should they care?" The more relevant the concern, the more editors and news directors will pay attention and cover it.
- Make your case at the top of the release, and in the first sentence if possible. Give the editor or news director a reason to pay attention before going into details.
- Be prepared to move quickly. Everyone is paying more attention immediately after an event - such as a small earthquake locally or a large one somewhere else. But this opportunity to educate will fade very quickly. Be ready with a plan for what you can do when an earthquake occurs, and then be ready to move quickly. Do you have your local facts and risk assessment in hand? Have you identified someone who can speak knowledgeably to the media? The opportunity will fade within a couple of days, if not within hours.
- Keep your points simple, and stick to them.

A final note: To be effective with the news media, it is important to view your communication with reporters, editors, and news directors as an opportunity and not as a distraction or something to just get through. It can be easy to fall into the latter, thereby wasting a valuable opportunity to reach the public that may not come again.

Guide to Press Materials

Sample Press Release:

- Raise community awareness in the wake of a seismic event elsewhere
- Describe the local community's own risks and safety deficits
- Provide background on similar quake events and damage

Universal Press Release 1:

- Raise community awareness in the wake of a seismic event elsewhere
- Describe the local community's own risks and safety deficits
- Present solution in terms of seismic codes
- Detail actions planned to adopt seismic codes

Universal Press Release 2:

- Raise community awareness of seismic risks and safety deficits
- Present solution in terms of seismic codes

Letter to Local Editor or News Director:

- Raise community awareness of seismic risks and safety deficits
- Present solution in terms of seismic codes
- Key points and background information on related costs and importance of seismic codes

Sample Press Release

Emergency Service Disaster Agency
555 E. Main St.
Richter, IL
987-654-3210
Mailed x/x/x

FOR IMMEDIATE RELEASE

RICHTER - They're still assessing the cost in Salt Lake City resulting from last Friday's devastating earthquake. The latest death toll stands at 250, and the current estimate of damage to buildings and infrastructure is between $1 billion and $2 billion.

It could have been much worse, however, and the city's experience holds a lesson for Richter, says Bill Bright, executive director of the local Emergency Services Disaster Agency.

Salt Lake City at least was anticipating a quake, and so had changed its building codes and taken other preparedness measures in recent years. Friday's magnitude 7.1 quake could have killed thousands if those actions had not been taken, he said.

Richter is not even aware of the earthquake risk it faces, and is not prepared, said Bright, who will hold an informational meeting about local earthquake risk and preparedness at 7 p.m. next Thursday, April 27, in the Richter Public Library, 514 E. Main.

Richter lies near an active fault zone and so can expect an earthquake, possibly as severe as the one that struck Salt Lake City, Bright said. Seismologists estimate there is a 25 percent chance that a severe quake - magnitude 6.5 or greater - will affect the southern Illinois region within the next 50 years.

The death toll from that quake will largely be determined by the quality of the buildings in the quake zone - and therefore by the quality of the building codes and enforcement that dictated how those buildings were constructed, Bright said.

A magnitude 7.2 quake in 1995 struck the center of Kobe, Japan, with severe shaking that caused even some well-designed buildings to collapse. But the greatest damage was to older buildings, built before the modern Japanese seismic building code. More than 5,000 people were killed, most of them in older homes built shortly after World War II, with little or no attention to seismic resistance.

Two California quakes of similar strength of recent years, Loma Prieta (San Francisco) and Northridge (Los Angeles), by contrast produced 62 and 57 deaths respectively. Those California communities were prepared for an earthquake, Bright said, having been building for more than 30 years according to building codes that can prevent or minimize seismic damage.

Since 1992, the three model building codes used in the United States have included practical and low-cost construction guidelines that can prevent or minimize seismic damage in new construction, Bright said. The cost of using them is minimal, they vary with the level of risk in each community, and already are being used for all federal government projects and for state-owned buildings in 37 states.

Richter, however, has yet to adopt one of these codes. It also lacks a fully-staffed building safety department that could enforce them. Unless actions are taken to change the situation, Richter may suffer the consequences, Bright said.

-###-

"Universal" Press Release 1

[agency or gov't office]
[address]
[city, state, zip]
[phone]
Mailed x/x/x

FOR IMMEDIATE RELEASE

[CITY, State from which you're sending the release] - The earthquake [two, three, four, etc.] days ago was in [Japan, California, Armenia, etc.], but it could have been here. [County/community] also sits near an active fault zone - a fault zone that could produce a quake at any time.

When a quake occurs, property and lives could be lost needlessly - because buildings were constructed without the benefit of the latest building code, says [local government or agency official].

To prepare for that eventuality, and reduce the potential for damage and loss of life, [state government office or agency] today launched a statewide campaign to raise awareness of the risk and educate local communities on what they can do to deal with it. The chief aim of the campaign, said [name], will be to inform local governments and residents of the benefits of adopting and enforcing the latest version of one of the three model building codes used in the United States.

Since 1992, each of the model codes has included practical and low-cost construction guidelines that can prevent or minimize seismic damage, he/she said. By adopting and enforcing the latest code for new construction, communities can begin to protect themselves against potential quake damage. Too few are doing that, he/she said.

[Might want to say something here about specific campaign plans.]

Among the issues to be addressed in the campaign: [Agenda for meeting]

-###-

"Universal" Press Release 2

[agency or gov't office]
[address]
[city, state, zip]
[phone]
Mailed x/x/x

FOR IMMEDIATE RELEASE

[CITY, State from which you're sending the release] - Buildings may collapse and lives may be lost when an earthquake rumbles through [county/community] sometime in the future. The damage doesn't have to happen.

[County/community] is in an earthquake zone, but it doesn't have the latest building code. That lays the groundwork for potential and unnecessary tragedy, says [local government or agency official].

When a quake occurs, property and lives could be lost needlessly - because buildings were constructed without the benefit of the latest building code, says [local government or agency official].

Since 1992, the three model building codes used in the United States have included practical and low-cost construction guidelines that can prevent or minimize seismic damage in new construction, [official] said. The cost of using them is minimal, they vary with the level of risk in each community, and already are being used for all federal government projects and for state-owned buildings in 37 states.

[City], however, has yet to adopt one of these codes. It also lacks a fully-staffed building safety department that could enforce them. Unless actions are taken to change the situation, [City] may suffer the consequences, [official] said.

-###-

Sample Letter To The Editor

Dear Editor/News Director

[County/community] is in an earthquake zone, with a [number] percent chance of experiencing a damaging earthquake within the next [number] years. But are its buildings being constructed with that in mind? Has the local government adopted the latest building code, which includes practical and low-cost construction guidelines that can prevent or minimize seismic damage? And are local residents aware of the potential damage and loss of life that could be prevented if buildings are constructed using the latest code?

A magnitude 6.7 quake in Armenia in 1988 killed approximately 25,000. In part this was caused by poor building construction and an insufficient seismic building code. The same thing could happen here.

Two California quakes of similar strength of recent years, Loma Prieta (San Francisco) and Northridge (Los Angeles), by contrast produced 62 and 57 deaths respectively. Those California communities were prepared for an earthquake, having been building for more than 30 years according to building codes that can prevent or minimize seismic damage.

I'm writing to ask that you consider asking these questions in your community as the basis for a possible story. Since 1992, all three of the model building codes used in the United States have included seismic design provisions, but your local government [has not updated its code], [has never implemented a building code], or [is neglecting enforcement].

Since the threat of an earthquake often is thought of as something only in the distant future, local officials may underestimate voter support for taking actions that might reduce the potential for quake damage, or may be resisting it out of an unwarranted fear of the costs to developers or business. Voters may not be voicing support for taking action because they haven't been made aware of the importance of acting now.

Below are some key points related to earthquake mitigation and building codes. For further information, contact [the state office of....., at .....]

- **Why the building code is important.** In the 1995 earthquake in Kobe, Japan, older (pre-1971) buildings were *more than six times more likely* to be severely damaged than buildings constructed according to the latest seismic code. A 1988 earthquake in Armenia killed 25,000 people. But severe quakes near San Francisco in 1989 and near Los Angeles in 1994 killed only 62 and 57 respectively. The difference in the death toll resulted largely from the quality of buildings and codes in each area.
- **Cost.** The cost of using the seismic guidelines in the latest codes is minimal. They add an average of 2.1 percent to total building costs across all types of construction, and only 0.7 percent for low-rise residential, according to the Building Seismic Safety Council, a nonprofit organization of engineering and construction groups.
- **Level of need.** Seismic codes take into account the level of risk in each community. If a community's risk is low, the code reflects that. Having a seismic code doesn't mean you build to San Francisco standards.
- **Who is using seismic building codes.** They already are required for federal government construction projects, for state-owned buildings in 37 states, and are being more widely used by all levels of government. The three model codes, on which most local building codes are based, now include seismic codes. More communities are using them, making those communities safer.
- **Insurance cost.** The insurance industry is implementing a system of building-code enforcement ratings, which include the new seismic requirements, much like those used to rate local fire protection. Communities that do not incorporate seismic codes for new construction may be rated as having a higher risk, thus bringing higher insurance costs to residents.

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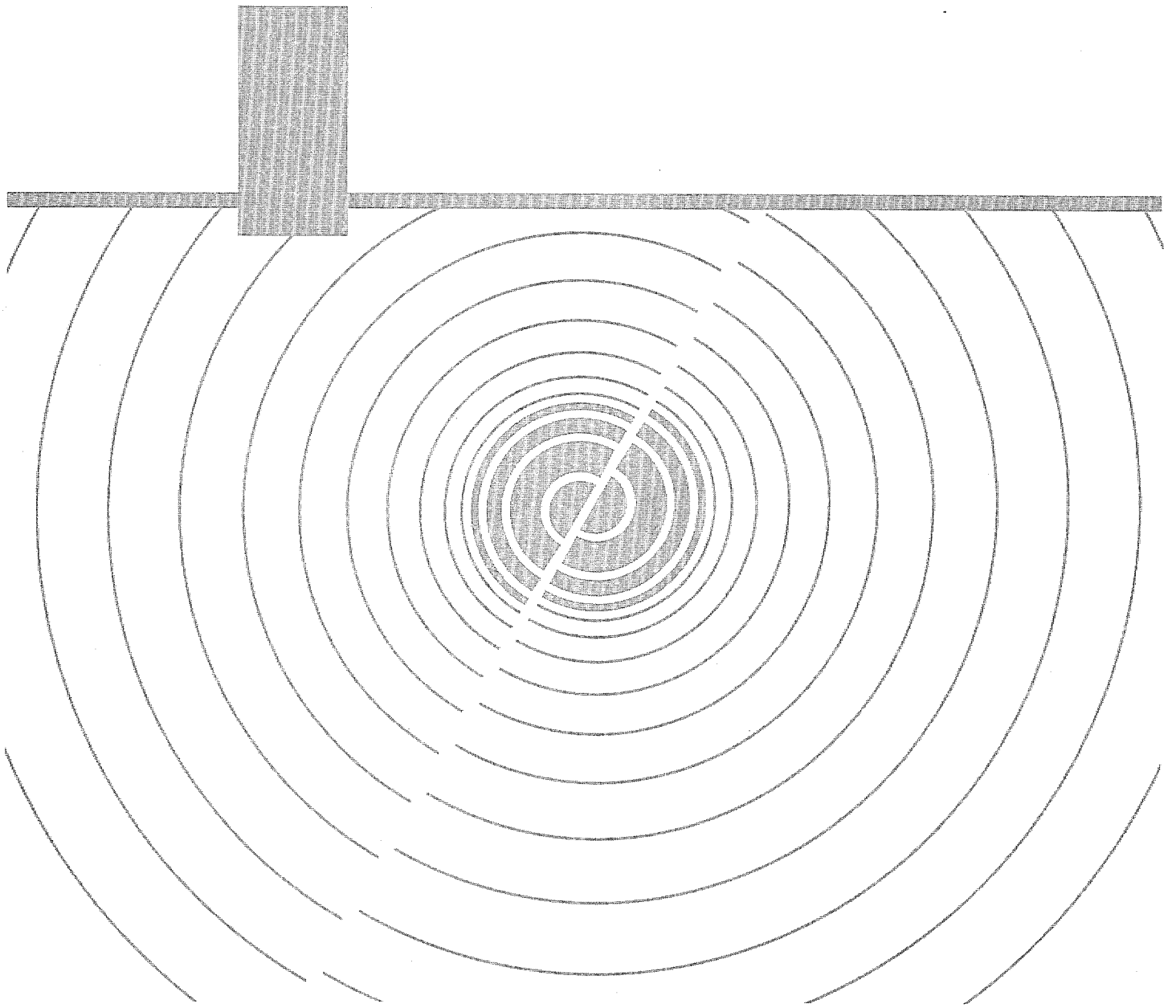
Appendix I: Sample Brochures



Appendix I: Sample Brochures

Brochures are an inexpensive way to deliver your message to a large number of people. Materials in this appendix are set up so that you can photocopy the pages (front and back) and fold them for ready-made brochures.

The brochures are intended for (a) architects and engineers, and others involved in the construction industry and (b) local officials and decision-makers. Four areas are covered:

- Design & Build for Earthquake Safety: A Guide for Architects & Engineers
- Design & Build for Earthquake Safety: A Guide for Local Officials
- Enforce Seismic Code Provisions for Earthquake Safety: A Guide for Architects & Engineers
- Enforce Seismic Code Provisions for Earthquake Safety: A Guide for Local Officials

Use the brochures to generate interest in improving local seismic code provisions. They can also serve as handouts for workshop presentations.

Seismic Protection: Considerations for Local Officials

- **Seismic codes will not hurt business.** Seismic building codes do not drive business from communities. In the words of one building official, "I've never heard of an industry not coming to town because of seismic requirements." Also, without the code protection, even minor seismic events can force businesses to relocate or temporarily shut down.
- **Seismic codes are becoming the national norm.** The federal government has set an example with Executive Order 12699, January 1990, which mandates a wide variety of seismic design standards. Seismic codes are becoming more prevalent at all levels of government, which means two things: (a) you will not be at an economic disadvantage for attracting new business and (b) if everyone else does it and you do not, you invite liability. Furthermore, to be eligible for most forms of federal financial assistance for new buildings, your community should adopt one of the model codes with seismic provisions.
- **Adopting seismic provisions is easy.** Call up a model code organization, buy the code, develop a fee structure (to pay for administration), and contract with the county or another nearby agency for initial staffing.
- **Seismic provisions are good for the community.** With a seismic code you will know that the community is on its way to seismic safety. The code will reduce long-term liability costs. A good code may ultimately improve the community's insurance rating.
- **All communities need a seismic code regardless of risk.** Seismic codes supplied by the building code organizations account for your community's level of seismic risk. If your risk is low, the code will reflect that.
- **Citizens support seismic codes.** Studies in California and the central United States have shown that most citizens support seismic building codes, and that elected officials underestimate this support.

Seismic Building Codes Are Affordable

Seismic codes add relatively little to the cost of a new building; and as experience with seismic design and construction grows, this increment will shrink. A 1985 federal study found that seismic codes increase total building costs by 2.1 percent on average. A 1992 study by the National Association of Home Builders found that builders can construct houses providing for life safety in earthquakes for an additional 1 percent or less of the purchase price. This is a small price to pay for the proven level of protection provided.

How To Learn More About Seismic Building Design

As seismic design practice rapidly spreads throughout the country, it is becoming easier and easier to access educational programs and materials. The model building code organizations now offer materials and seminars on their seismic design requirements. These seminars are sponsored periodically in most states, often by the state emergency management agency. Contact the three model code organizations for more information.

Model Code Organizations

Building Officials and Code Administrators International, Inc. (BOCA)
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795
Tel: 708-799-2300; fax: 708-799-4981;
http://www.bocai.org

International Conference of Building Officials (ICBO)
5360 South Workman Mill Road
Whittier, CA 90601-2298
Tel: 562-699-0541; fax: 562-6998031
http://www.icbo.org

Southern Building Code Congress International, Inc. (SBCCI)
900 Montclair Road
Birmingham, AL 35213-1206
Tel: 205-591-1853; fax: 205-592-7001;
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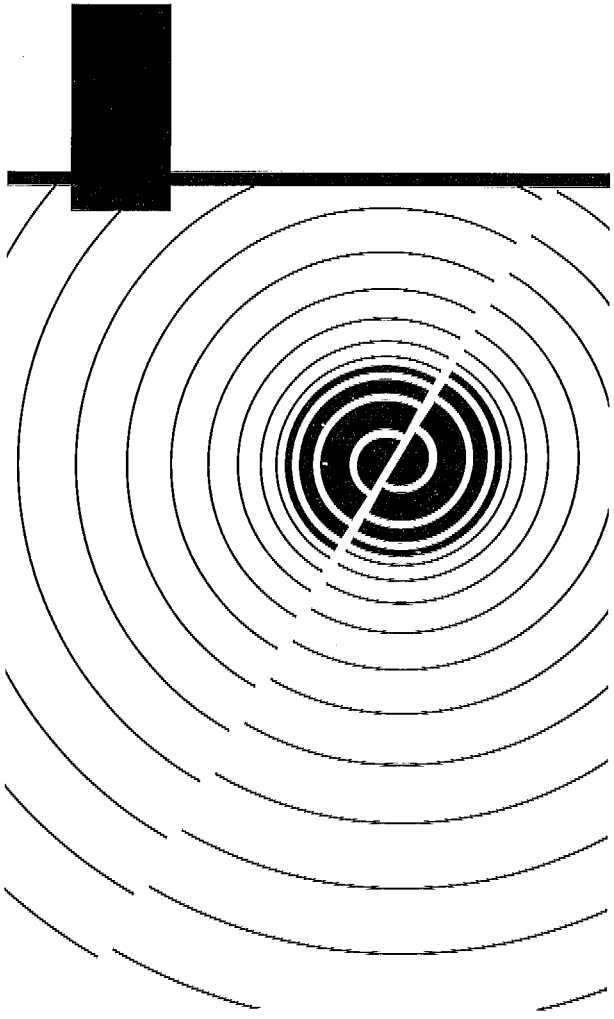
FEDERAL EMERGENCY MANAGEMENT AGENCY FEMA 313 / January 1998

Design and Build for Earthquake Safety

A Guide for Local Officials



Design and Build for Earthquake Safety

A Guide for Local Officials

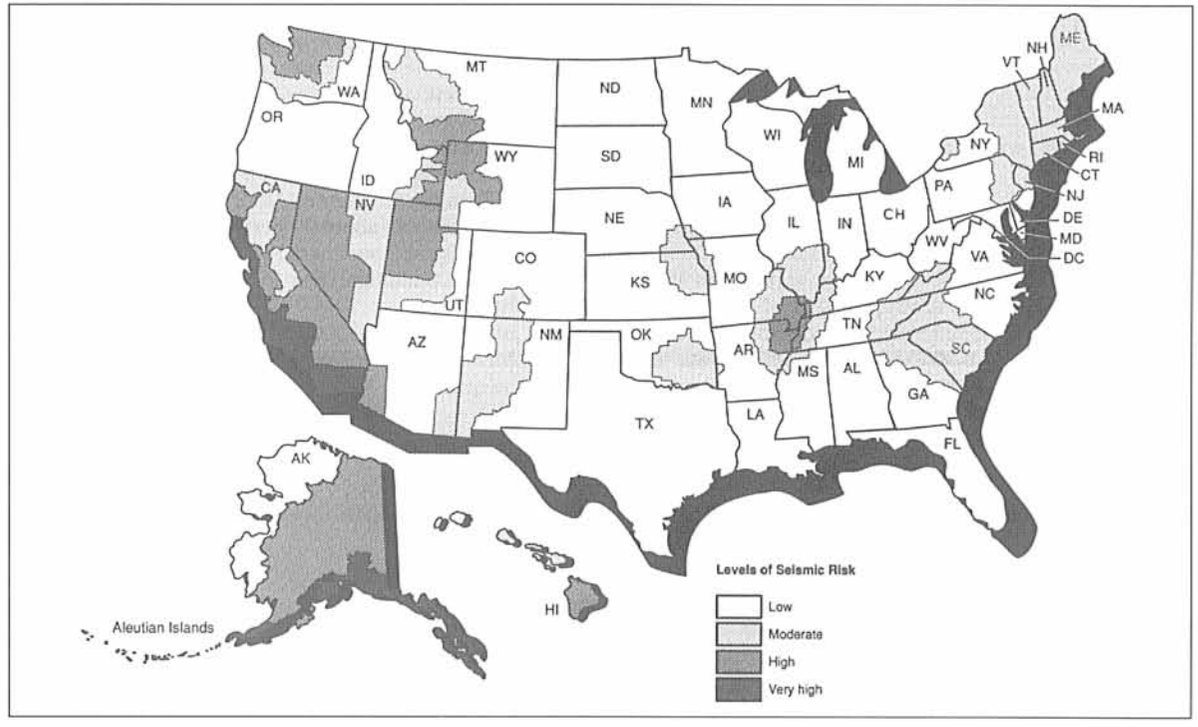
Most parts of the United States have the potential to suffer from earthquake damage. Local officials can help to reduce risk from earthquake damage by adopting a building code that contains current seismic provisions.

Each of the three model building codes specifies seismic code provisions appropriate to a given area's level of hazard. By adopting one of the model codes and incorporating the seismic provisions into new design and building, you can help to ensure that new structures withstand damage and help to protect lives in your community.

Seismic Building Codes Are Specific to Local Conditions

Each model code contains a seismic hazard map, based on current scientific knowledge. Its risk philosophy is accepted by a broad consensus of scientists and design and construction professionals. Its use in seismic design was determined by a nationwide consensus process conducted by the Building Seismic Safety Council (BSSC), an organization of more than fifty construction, professional, and trade organizations.

Portions of thirty-nine states are considered to have some degree of earthquake hazard. Some counties need to design for high levels of earthquake ground-shaking, whereas others should design for relatively less. Conversely, some areas, even those with seismic codes, do not need seismic design at all because the risks are so low. High-risk facilities, of course, demand customized, site-specific analysis.



This seismic hazard map shows that, although the most severe seismic shaking is expected in the western U.S. and Mississippi River areas, much of the U.S. has some level of seismic hazard.

Seismic Building Codes Work

Recent earthquakes in the United States and throughout the world show that seismic codes work. Cities that have built structures to meet seismic codes have suffered much less damage than those without such codes. In the 1995 earthquake in Kobe, Japan, most of the 5,000 fatalities occurred in homes built prior to the advent of modern seismic codes. The 1988 Armenian earthquake destroyed entire communities and killed 25,000 people. The construction standards used in Armenia are similar to those used in much of the United States. The 1989 Loma Prieta and 1994 Northridge, California, earthquakes had relatively low loss of life (63 and 57 deaths, respectively) largely because of the widespread use of seismic building codes.

Smaller seismic events, while receiving less attention from the media, can result in substantial losses to a community. Helena, Montana, experienced an M6.0 event in 1935 (predating seismic codes) and suffered $4 million damage, including severe damage to the high school. A Magnitude 5.6 earthquake in 1993 at Scotts Mills, Oregon, caused significant structural damage to a number of unreinforced masonry (brick) buildings. The estimated damage cost to public facilities alone was nearly $13 million.

Seismic Design Is Becoming the National Norm

Since 1992 all three model codes in the United States have included seismic design provisions. By a 1990 presidential executive order (EO 12699), all federal agencies must require seismic design and construction of all new buildings that they own, lease, regulate, or financially assist, including single-family homes with Federal Housing Authority mortgages. At least thirty-seven states now have seismic design requirements for state-owned buildings. Seismic design is rapidly becoming the standard of practice throughout the United States.

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How To Learn More About Seismic Building Design

As seismic design practice rapidly spreads throughout the country, it is becoming easier and easier to access educational programs and materials. The model building code organizations now offer materials and seminars on their seismic design requirements. These seminars are sponsored periodically in most states, often by the state emergency management agency. Contact the three model code organizations for more information.

Professional Organizations:

American Institute of Architects
1735 New York Avenue, NW, Washington, DC 20006
Tel: 202-626-7300; http://www.aia.org

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191-4400
Tel: 800-548-2723; http://www.asce.org

Model Code Organizations:

Building Officials and Code Administrators International, Inc. (BOCA)
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795
Tel: 708-799-2300; fax: 708-799-4981;
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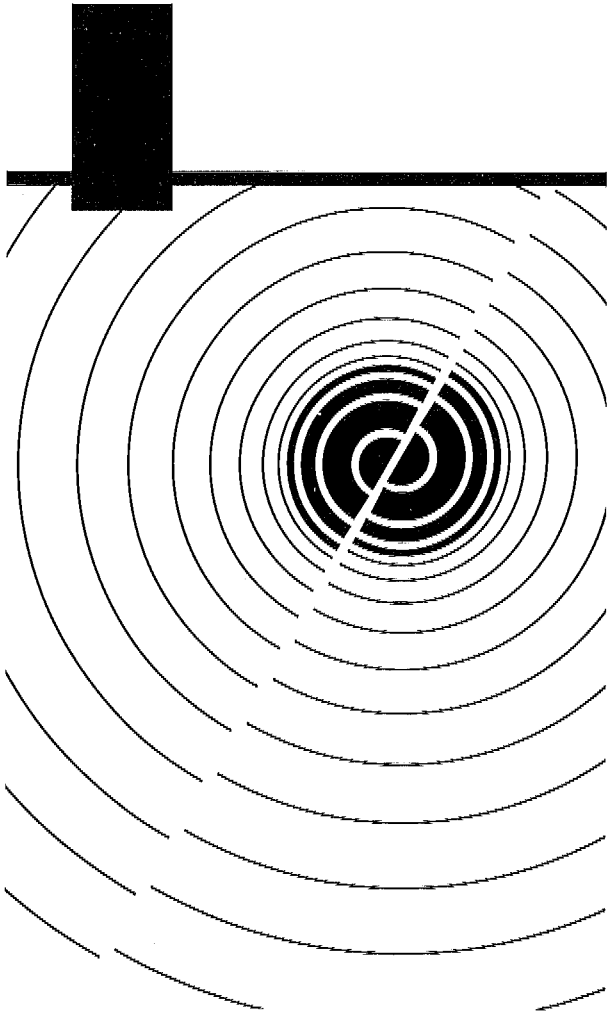
The Earthquake Engineering Research Institute of Oakland, California (tel: 510-451-0905) has sponsored two-day seismic design seminars in various parts of the country. Also, civil engineering and construction technology programs at many public universities now teach courses, mini-courses, and workshops in seismic design.

FEDERAL EMERGENCY MANAGEMENT AGENCY FEMA 313 / January 1998

Design and Build for Earthquake Safety

A Guide for Architects & Engineers



Design and Build for Earthquake Safety

A Guide for Architects & Engineers

Most parts of the United States have the potential to suffer from earthquake damage. Architects and engineers, as key players in the construction industry, can help to reduce risk from earthquake damage by encouraging the adoption of seismic building codes.

Each of the three model building codes specifies seismic code provisions appropriate to a given area's level of hazard. By adopting one of the model codes and incorporating the seismic provisions into new design and building, you can help to ensure that new structures withstand damage and help to protect lives in your community.

Seismic Building Codes Are Specific to Local Conditions

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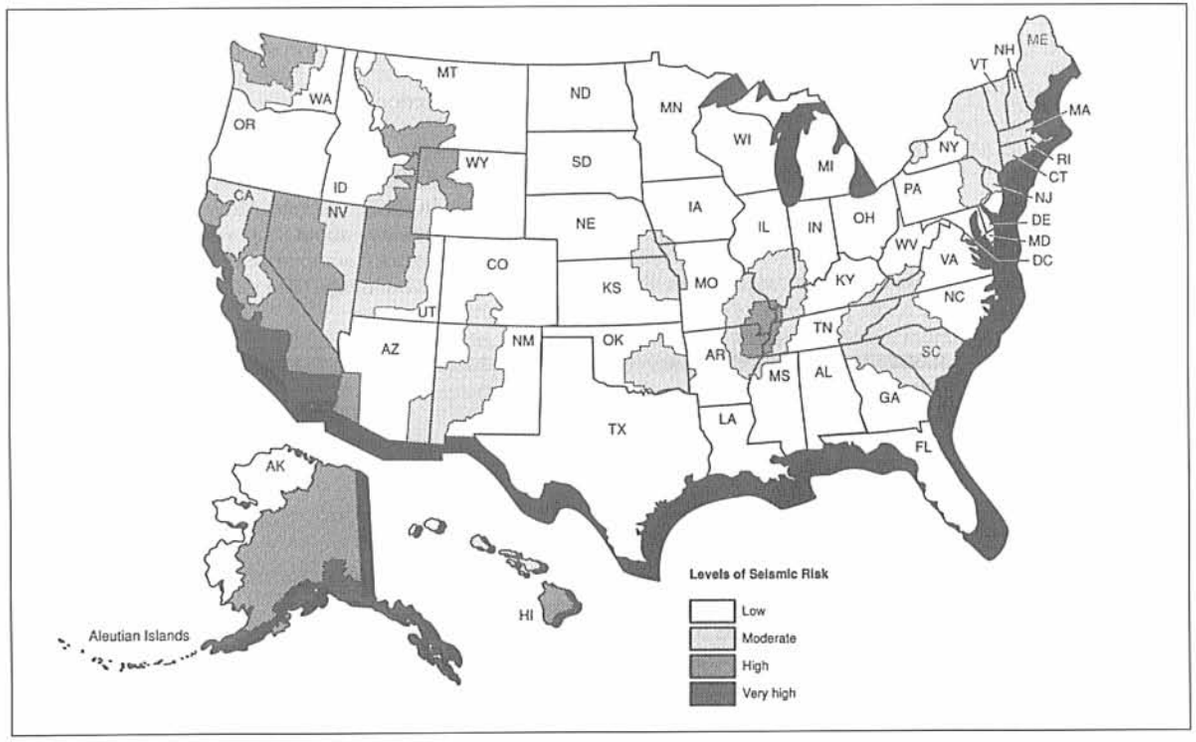

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whether construction is proceeding according to the approved plans and the conditions of the permit. Inspection is typically required at several key stages in the construction process. The inspector has a powerful enforcement tool called a *stop work order*. A stop work order is issued to the construction firm if the inspector finds a code violation that must be corrected before any further construction is performed. At final inspection, the building can be approved for occupancy.

Architects & Engineers Can Help Improve Code Enforcement

Architects and engineers can, and should, help to improve code enforcement. Structures built improperly can damage the architect's profesional reputation and may lead to being named in a lawsuit. Secondly, the reputation of the professional as a whole may suffer if numerous errors and failures occur. Some actions you can take include:

- Verify the enforcement capabilities in every jurisdiction in which you work. If possible, find out the code-effectiveness rating of each building department.
- Work with local building departments to convince them of the need for effective enforcement.
- Inspect your own jobs more carefully in jurisdictions with poor enforcement, and inform your client of the reason.
- Work with your local professional organizations to lobby for more effective enforcement.

Model Code Organizations

Building Officials and Code Administrators International, Inc. (BOCA)
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795
Tel: 708-799-2300; fax: 708-799-4981;
http://www.bocai.org

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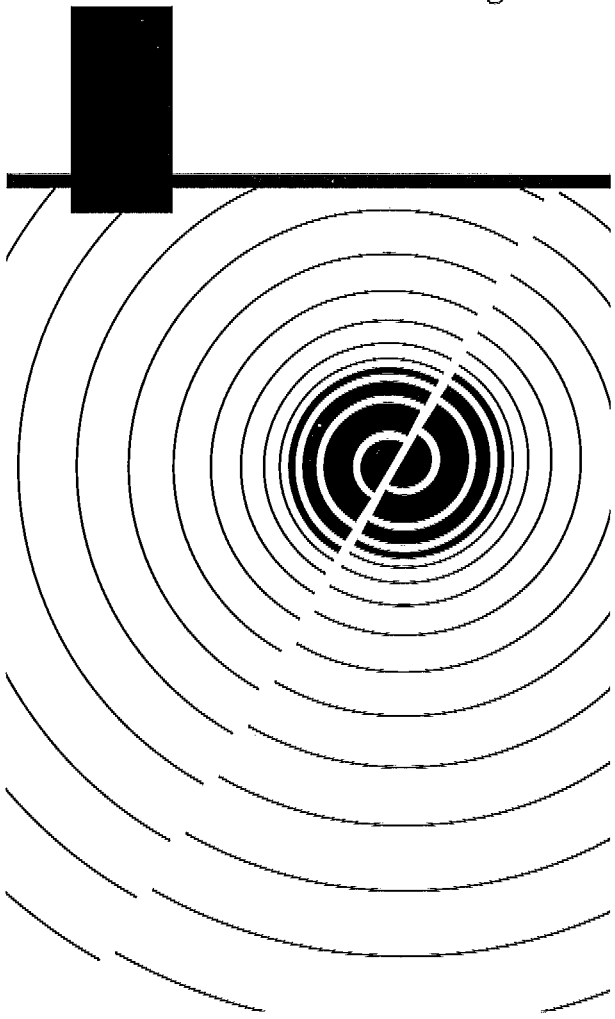
FEDERAL EMERGENCY MANAGEMENT AGENCY FEMA 313 / January 1998

Enforce Seismic Code Provisions for Earthquake Safety

A Guide for Architects & Engineers



Enforce Seismic Code Provisions for Earthquake Safety

A Guide for Architects & Engineers

A building code is just a book. To achieve the community goal of safer buildings, the building code and its seismic provisions must be enforced-a process in which architects and engineers can play an important role. By specifying practices in accordance with the code, and working closely with code-enforcement personnel, architects and engineers can ensure that safer buildings are constructed according to plan and without costly interruptions.

Poor Code Enforcement Results in Deficient Buildings

Recent studies following Hurricanes Hugo and Andrew have shown weaknesses in code enforcement. In 1991 State Farm Insurance Company contracted with SBCCI (Southern Building Code Congress International, a model code organization) to evaluate code compliance in twelve randomly selected coastal communities. They found that inspectors and reviewers had little or no training in wind-resistant construction and that there was a general lack of enforcement of adequate connections of windows, doors, and mechanical equipment to the building frame. About half of the communities were not enforcing their own code standards for wind resistance. Thus, even in communities with adequate codes, significant damage was attributed to poor compliance and enforcement. With respect to seismic design, a 1993 study by the University of Southern California found significant problems in quality control of seismic-resistant construction in California.

Insurers Recognize the Critical Importance of Code Enforcement

The code-enforcement problems discovered in the wake of Hurricane Andrew have prompted the insurance industry to initiate a code-effectiveness grading schedule, in order to identify communities with good enforcement practices. The new system will be phased in over a five-year period beginning in 1995. Property owners in communities with good code-enforcement practices may be rewarded with reduced insurance premiums.

Elements of Code Enforcement

Code enforcement and administration consist of five sequential elements. For architects and engineers, the most important aspects of enforcement are plan review and construction inspection—but effective code administration must consider the entire sequence.

Code provisions must be up to date. A code is an active document, evolving to reflect new knowledge and new standards of practice. Once a jurisdiction makes a commitment to use a building code, it must be prepared to update its local code on a regular basis.

Builders must apply for permits. Obviously, if builders try to avoid the code-application process, then the code cannot do its job. A jurisdiction must have inspectors out in the field who know the community. The inspector needs to be alert to new construction in his or her jurisdiction and must be aware of current active permits. Architects and engineers can help to ensure that clients obtain building permits.

A qualified reviewer must review building plans. Plan review is one of the two points at which the local government can affect the details of building construction. At a minimum, the plan review verifies whether the design complies with the building code. This is the most cost-effective moment to catch mistakes, before any money is spent on construction. Some jurisdictions may also review structural calculations.

Architects and engineers can help by specifying practices in accordance with the code and working closely with reviewers. State statutes require that the licensed professional engineer and/or architect place his or her seal and signature on the designs. The seal and signature signify that the design is at the accepted professional standard, which is typically the most recent version of a model building code or technical document. An added incentive for conformity is the legal liability the engineers and architects assume when the seal and signature are placed on the document. Typically, licensed architects and engineers also inspect the construction of their designs.

Construction should proceed according to approved plans. An owner receives a building permit to construct according to the approved plans, and it is the legal responsibility of the owner to do so. The builder uses the plans to order materials and construct the building. The owner may hire inspectors or the engineers and architects to oversee key aspects of the construction in order to help verify compliance with the plans. To some extent, all government inspection systems depend on this obligation by the owner, which is inherent in the issuance of a permit.

A qualified inspector must inspect the construction. Inspection is the second point at which the local government can affect the details of building construction. Inspection verifies

Improving Substandard Enforcement Practices

The most direct way to improve building code enforcement is to increase the quantity or quality of staff. The new code-enforcement grading system may aid local legislative bodies in encouraging or requiring building department staff to participate in continuing education and certification. All the model building code organizations have extensive education programs, including handbooks, workshops, seminars, and videotapes. These programs aim to improve both technical expertise and administrative effectiveness in order to increase the level of professionalism in code administration. Each code organization also has a certification program for a number of categories of plan review and inspection. Certification-based promotions will help to reward staff members for their achievements.

Model Code Organizations

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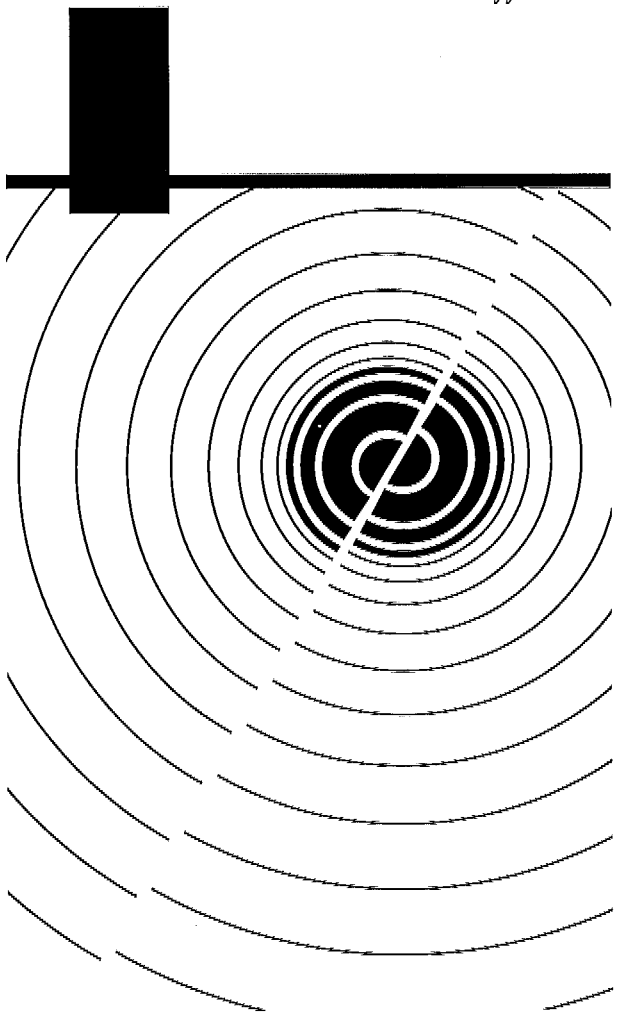
FEDERAL EMERGENCY MANAGEMENT AGENCY FEMA 313 / January 1998

Enforce Seismic Code Provisions for Earthquake Safety

A Guide for Local Officials



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A building code is just a book. To achieve the community goal of safer buildings, the building code and its seismic provisions must be enforced—a process facilitated by the active involvement and oversight of local officials. Through proper staffing and code-enforcement procedures, and coordination with area architects, engineers, and builders, local officials can ensure that safer buildings are constructed according to plan and without costly interruptions.

Poor Code Enforcement Results in Deficient Buildings

Recent studies following Hurricanes Hugo and Andrew have shown weaknesses in code enforcement. In 1991 State Farm Insurance Company contracted with SBCCI (Southern Building Code Congress International, a model code organization) to evaluate code compliance in twelve randomly selected coastal communities. They found that inspectors and reviewers had little or no training in wind-resistant construction and that there was a general lack of enforcement of adequate connections of windows, doors, and mechanical equipment to the building frame. About half of the communities were not enforcing their own code standards for wind resistance. Thus, even in communities with adequate codes, significant damage was attributed to poor compliance and enforcement. With respect to seismic design, a 1993 study by the University of Southern California found significant problems in quality control of seismic-resistant construction in California.

Steps Toward an Effective Building Code-Enforcement Program

Step 1: Adopt a model code.

Step 2: Establish fee structures for permits and plan review.

Step 3: Institute a systematic plan review system.

Step 4: Determine an inspection schedule.

Insurers Recognize the Critical Importance of Code Enforcement

The code-enforcement problems discovered in the wake of Hurricane Andrew have prompted the insurance industry to initiate a code-effectiveness grading schedule, in order to identify communities with good enforcement practices. The new system will be phased in over a five-year period beginning in 1995. *Communities with good code-enforcement practices may be rewarded with reduced insurance premiums.*

Elements of Code Enforcement

Code enforcement and administration consist of five sequential elements. Local officials must ensure that each element functions smoothly and is staffed by trained personnel.

Code provisions must be up to date. A code is an active document, evolving to reflect new knowledge and new standards of practice. Once a jurisdiction makes a commitment to use a building code, it must be prepared to update its local code on a regular basis.

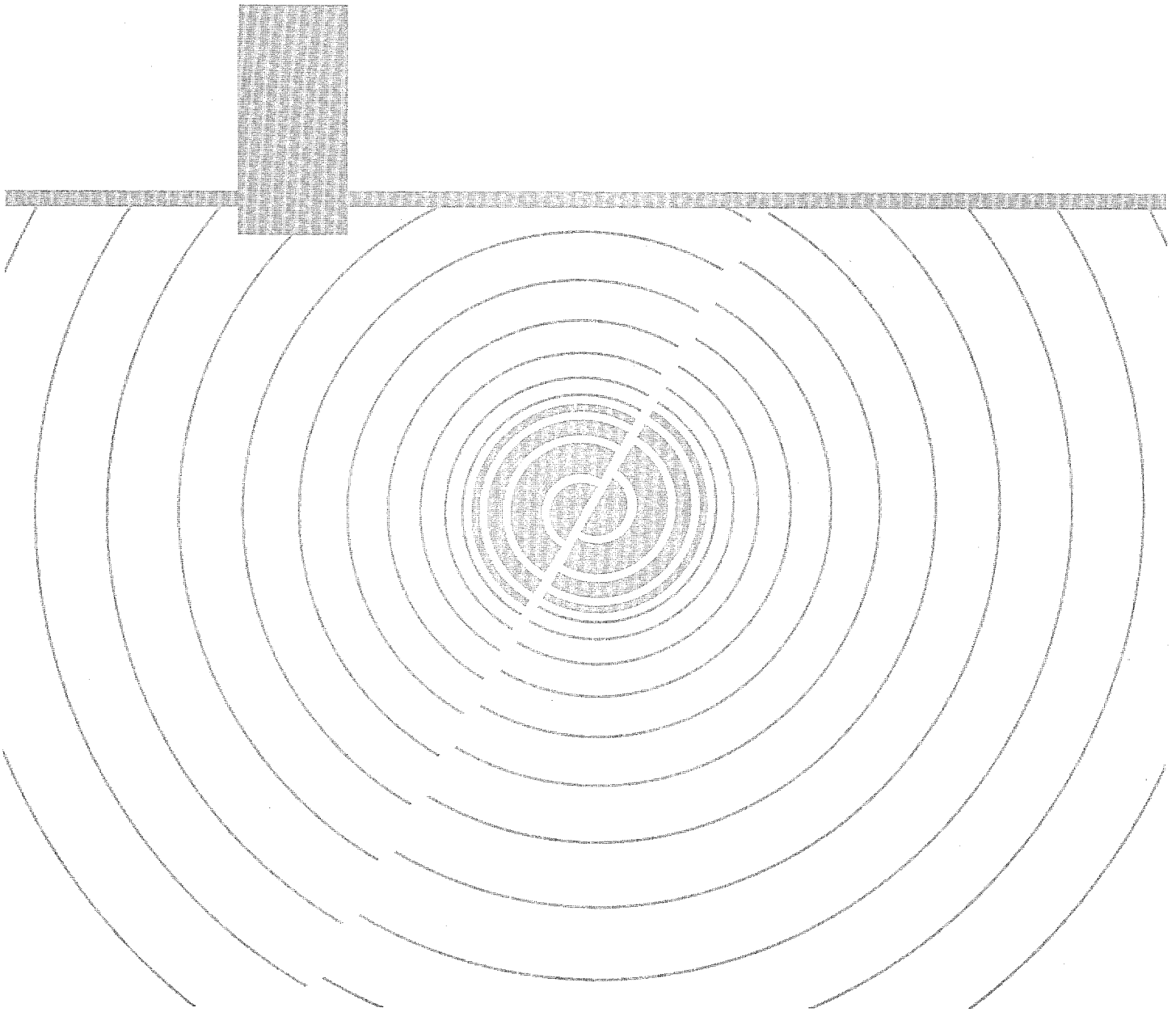
Builders must apply for permits. Obviously, if builders try to avoid the code-application process, then the code cannot do its job. A jurisdiction must have inspectors out in the field who know the community. The inspector needs to be alert to new construction in his or her jurisdiction and must be aware of current active permits.

A qualified reviewer must review building plans. Plan review is one of the two points at which the local government can affect the details of building construction. At a minimum, the plan review verifies whether the design complies with the building code. This is the most cost-effective moment to catch mistakes, before any money is spent on construction. Some jurisdictions may also review structural calculations.

Construction should proceed according to approved plans. An owner receives a building permit to construct according to the approved plans, and it is the legal responsibility of the owner to do so. The builder uses the plans to order materials and construct the building. The owner may hire inspectors or the engineers and architects to oversee key aspects of the construction in order to help verify compliance with the plans. To some extent, all government inspection systems depend on this obligation by the owner, which is inherent in the issuance of a permit.

A qualified inspector must inspect the construction. Inspection is the second point at which the local government can affect the details of building construction. Inspection verifies whether construction is proceeding according to the approved plans and the conditions of the permit. Inspection is typically required at several key stages in the construction process. The inspector has a powerful enforcement tool called a *stop work order*. A stop work order is issued to the construction firm if the inspector finds a code violation that must be corrected before any further construction is performed. At final inspection, the building can be approved for occupancy.

Appendix J: Glossary and Acronyms



Appendix J
Glossary and Acronyms

Glossary of Terms and Definitions Related to Building Codes

Body-wave magnitude
Magnitude of an earthquake as determined from seismic waves that travel through the interior of the Earth.

Brittle failure
Sudden rupture with little warning.

Building code
Officially adopted comprehensive specifications regulating building construction, materials, and performance to protect the public health, safety, and welfare.

Ductile failure
Rupture or collapse preceded by large deformations (bending).

Ductility
Ability of a material to deform without fracturing.

Dynamic structural analysis
Modeling (most often by computer) of the building's behavior during an entire cycle of earthquake forces.

Earthquake zone map
Map that divides the country into zones of relative earthquake hazard and reflects the maximum ground-shaking expected within a specified time period.

Epicenter
Surface projection of the *hypocenter*, the point within the earth where an earthquake originates.

Frame
Support skeleton of the structure that transfers weight to the foundation.

General failure
Total collapse of a structure.

Geophysics
Study of the physics of the Earth, including seismology, geomagnetism, gravity, geodesy, heat flow.

Geotechnical engineering
Civil engineering subdiscipline that applies knowledge of soil and rock mechanics to engineering problems.

Intensity
Measure of ground-shaking based on the degree of damage to man-made structures, changes in the Earth's surface, and felt reports.

Lateral force
Horizontal force generated by an earthquake's side-to-side motion.

Local failure
Partial collapse of a building limited to noncritical sections.

Magnitude
Measure of the physical size of an earthquake.

Model building code
Document published by a private organization containing standardized building requirements available for adoption by political units in the U.S.

Peak ground acceleration
Maximum rate of change in earthquake-generated ground motion at a specified location that produces the maximum force generated by an earthquake.

Peak ground velocity
Maximum speed (distance divided by time) of the earthquake-generated ground motion.

Reinforcement
Steel rods or wire used to strengthen concrete under tension (pulling).

Seismic hazard
Probability that a specified earthquake intensity will occur during a defined period of time.

Seismic hazard map
Map that indicates the likely level of earthquake ground-shaking throughout the country, or local maps that show the relative hazard from earthquakes.

Seismic moment magnitude
Magnitude of an earthquake as determined from the dimensions of the fault, amount of displacement along the fault during the earthquake, and rigidity of rock.

Seismic rehabilitation
Corrections to a building after the initial construction is completed and before damage is caused by an earthquake.

Seismic-resistant design
Building design that evaluates expected horizontal earthquake forces and strengthens the building to withstand these forces.

Seismic retrofit
Repairs to a building damaged by an earthquake.

Seismology
The study of earthquakes.

Structural engineering
Civil engineering subdiscipline responsible for the selection, design calculations, drawing, and specifications of a building frame.

Surface wave magnitude
Magnitude of an earthquake as determined from seismic waves that travel around the surface of the Earth.

Sway
Side-to-side movement of a structure.

Unreinforced masonry construction
Construction using brick, stone, or concrete blocks that are adhered together solely by mortar with no additional reinforcing material.

Significant Acronyms Related to Building Codes

ACI	American Concrete Institute
AASHTO	American Association of State Highway and Transportation Officials
AIA	American Institute of Architects
AISI	American Iron and Steel Institute
ASCE	American Society of Civil Engineers
ATC	Applied Technology Council
BNBC	BOCA National Building Code
BOCA	Building Officials and Code Administrators International, Inc.
BSSC	Building Seismic Safety Council
CABO	Council of American Building Officials
EERI	Earthquake Engineering Research Institute
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
IBHS	Institute for Business and Home Safety (formerly NCPI and IIPLR)
ICBO	International Conference of Building Officials
ICMA	International City/County Management Association
ICSSC	Interagency Committee on Seismic Safety in Construction
IIPLR	Insurance Institute for Property Loss Reduction (formerly NCPI, now IBHS)
ISO/CRS	Insurance Services Office, Commercial Risk Services
NAHB	National Association of Home Builders
NBS	National Bureau of Standards (now NIST)
NCPI	National Committee on Property Insurance (now IBHS)
NCSBCS	National Conference of States on Building Codes and Standards
NEHRP	National Earthquake Hazards Reduction Program
NIBS	National Institute of Building Science
NIST	National Institute of Standards and Technology (formerly NBS)
NSF	National Science Foundation
SBC	Standard Building Code
SBCCI	Southern Building Code Congress International, Inc.
SEAOC	Structural Engineers Association of California
UBC	Uniform Building Code
USGS	United States Geological Survey