The Politics and Economics of Earthquake Hazard Mitigation

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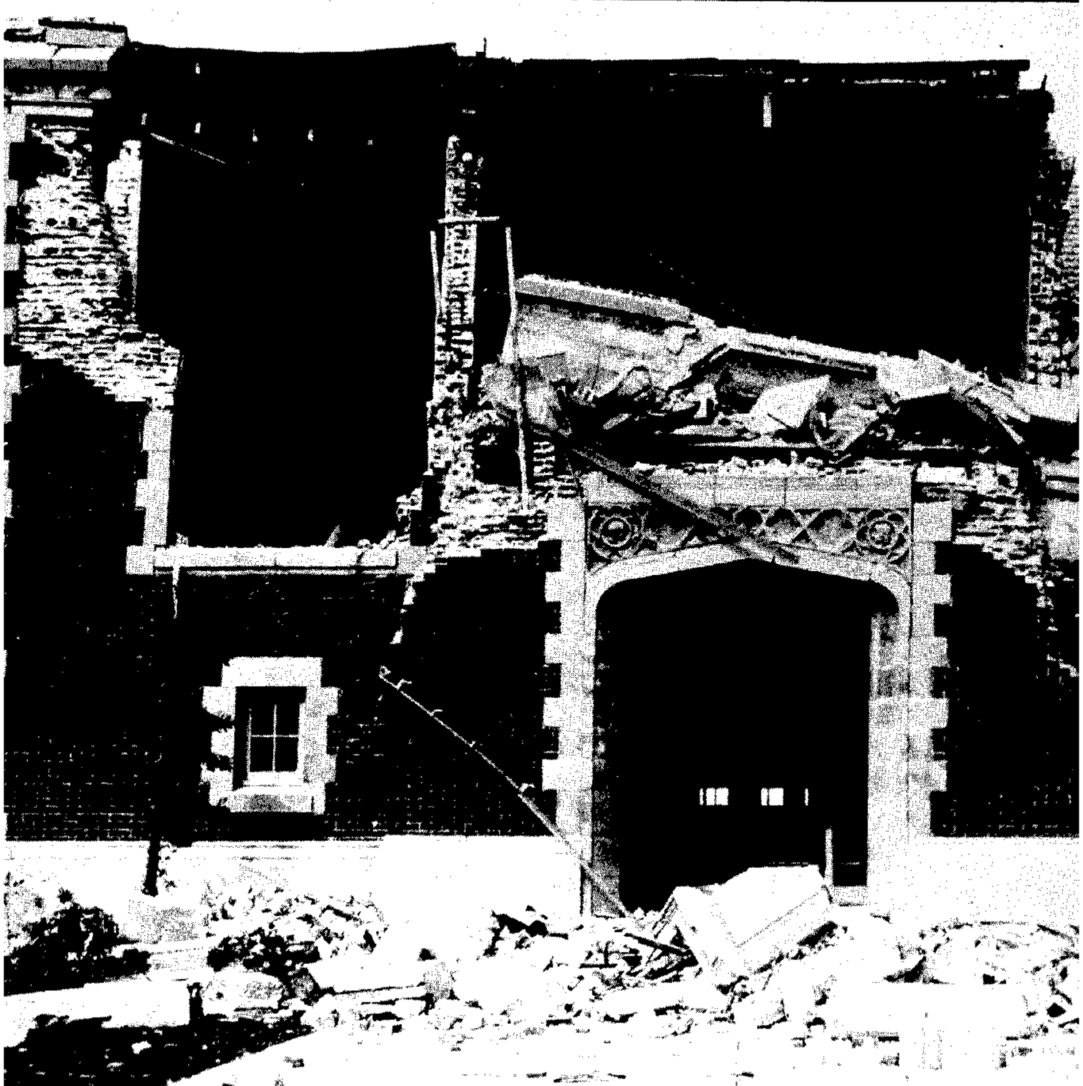

The Politics and Economics of Earthquake Hazard Mitigation
Unreinforced Masonry Buildings in Southern California

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Arthur A. Atkisson
October 5, 1930 - November 6, 1983

This is dedicated to the memory of Arthur A. Atkisson who conceived the project and was its Principal Investigator until his very sudden death one Sunday morning.

Art distinguished himself and the institutions he served in the field he called human ecology and public policy. He was born in Omaha, Nebraska, was graduated from Lewis and Clark College in 1951 with numerous distinctions, and received a Doctor of Public Administration from the University of Southern California in 1973. He served in the U. S. Army, with the Bonneville Power Administration, and in Los Angeles County, where he was deeply involved in air pollution control. He joined the University of Southern California where he created the Institute for Urban Ecology and, later, was a founding professor of the School of Public Health at the University of Texas. Art joined the University of Wisconsin-Green Bay in 1975 because he found its innovative interdisciplinary, problem focussed approach to education and its emphasis on man and the environment appealling. At Green Bay, Art founded the Public and Environmental Administration program. He was instrumental in creating the graduate program in Environmental Administration and the Center for Public Administration and Policy Sciences.

While Art will be remembered for his research for and service to the National Science Foundation, the Federal Emergency Management Agency, the General Accounting Office, and other agencies, his dozens of articles and research reports, and his books, he will be remembered most as teacher, scholar, mentor, husband and father, and friend. He was dedicated to helping deal with problems of public choice in public health and safety, the natural environment, and natural hazards. He was an empiricist, emphasizing risk assessment, systems analysis, and contemporary decision theory. But mostly, he was the great synthesizer, with an uncanny ability to see things as others had not yet seen them. He was a dominant, forceful, and imposing man. He was also iconoclastic and often irreverent and bombastic, but he was always creative, compelling, and contributive. He is sorely missed.

Art, we wrote this on the wall for you.

PREFACE

Throughout history, individuals and governments have sought means for limiting the adverse impacts of earthquakes on people and property. Although any comprehensive, long-term effort to deal with the problems posed by exposure to earthquake hazards requires sophisticated approaches to construction of new buildings, any such effort must also deal with the problems posed by existing buildings, particularly those constructed before the advent of contemporary seismic safety standards. Accordingly, the question of what to do about the earthquake resistance of existing structures has been, and is today, a lively policy issue at national, state, and local levels of government.

When the United States Congress adopted the Earthquake Hazard Reduction Act of 1977, it required that a national implementation plan be developed which should give consideration to "development and promulgation of specifications, building standards, design criteria, and construction practices for achieving appropriate earthquake resistance for new and existing structures." More than with any other earthquake hazard mitigation strategy, a program designed to reduce the risks from existing hazardous buildings has the greatest potential of saving lives and reducing injuries. However, the problem of reducing these risks has, proven to be a pervasive, complex, and controversial issue.

At local levels, the policy issues related to this question have provoked intense debate. Illustratively, the Los Angeles City Council, after serious consideration, adopted an ordinance requiring all unreinforced masonry buildings in the city to be strengthened within a ten year period to meet current safety standards. The Council's position was supported strongly by the Los Angeles Times and the professional community of engineers and seismologists. However, the ordinance generated intense opposition from the owners and occupants of the unreinforced masonry buildings. For example, in an advertisement in the Los Angeles Times, the Apartment Owners Association of Los Angeles County implied that numerous tenants would be evicted if the proposal were enacted and stated that the City would be required to spend four billion dollars to carry out the evictions. Because of this type of resistance, it took the Los Angeles City Council approximately ten years from the date of the San Fernando earthquake and 48 years from the date of the Long Beach earthquake to adopt an earthquake ordinance for old buildings.

The task of reducing the seismic risk associated with existing unreinforced masonry buildings is many-faceted and, of necessity, requires cooperation of various segments of the local community. The professional engineering and geotechnical community has primary responsibility for developing and validating methods for identifying hazardous buildings, as well as developing procedures for structural strengthening of the buildings. Owners and occupants of seismically hazardous buildings are the most directly affected by any requirement to strengthen or condemn an unreinforced masonry building.

Local government building officials are faced with what many believe to be the most difficult role in mitigating the risks from unreinforced masonry buildings. They have the responsibility for drafting and adopting building codes that set minimum design and construction requirements. Thus, local government assumes the overall responsibility for insuring public safety with a minimum negative economic and social impact on both building owners and occupants. The current legal environment and interpretation of tort laws provide additional concern to local officials who attempt to promote public safety through implementation of an earthquake hazard mitigation program. Thus, the design and implementation of ordinances that reduce the earthquake risk associated with unreinforced masonry buildings must give consideration to the social, technical, administrative, political, legal, and economic factors which both constrain and support successful program implementation.

The specific objective of this project has been to perform a review, assessment, and evaluation of the earthquake hazard reduction ordinances adopted by the cities of Long Beach (1971), Santa Ana (1980), and Los Angeles (1981). These ordinances mandated that both building owners and various city agencies take specific actions with regard to hazardous structures. These risk reduction approaches, designed specifically for unreinforced masonry structures, have been considered unique and significant mitigation tools that can assist other communities with similar seismically vulnerable structural problems. Accordingly, we attempted to examine the characteristics, costs, and impacts of the individual ordinances with emphasis on program effectiveness, types and numbers of hazards abated, and consequences of ordinance implementation.

In our research we used several different methods. A case study approach was used to develop important insights into the development, enactment, and implementation of the ordinances. The case histories were subjected to qualitative analysis, utilizing various models of organizational, political, and rational decisionmaking. Survey data were collected and analyzed to assess the preferences of residents of unreinforced masonry buildings. Value and preferences of building owners were assessed utilizing value true analysis and nominal group techniques.

In order to relate what we have learned in our research, this book is organizaed into background information; case studies; administrative, political, social, and economic analyses; and conclusions.

Part One consists of the introductory chapter and technical information in the unreinforced masonry building hazard, the means of mitigation, the extent of risk faced by building owners and occupants, and the likely effectiveness of alternative mitigations against the forces of earthquakes.

Part Two provides an introduction to the case studies and identifies key issues in the research. A comparative analysis of the Long Beach and Los Angeles ordinances, including a comparison of the two policy interventions with special emphasis on the incentives each provides for participants in the process, is provided. Administrative processes, costs, and problems associated with implementing the ordinances are included.

Part Three focuses on the politics of hazard mitigation. It includes an analysis of the political processes involved in enacting the ordinances and an analysis of how stakeholders perceived the issues and valued alternative outcomes. Part Three concludes with an examination of the cases from the perspective of contemporary behavioral decision theory.

Part Four provides a description of the current status of the ordinances in Long Beach and Los Angeles and an examination of the extent to which those ordinances have reduced the risk from unreinforced masonry hazards in those cities. The book ends with conclusions about hazard mitigation policymaking and with recommendations to those concerned with hazard mitigation for low probability-high consequence events.

ACKNOWLEDGMENTS

Although we accept full responsibility for the conclusions and approaches that appear in this book, we must acknowledge the formidable debt we owe to the individual members ofthe research team who participated in the total effort. Specifically, we wish to acknowledge the efforts of Drs. Bruce Clary and Michael Kraft of the University of Wisconsin-Green Bay; Drs. Harlan Hahn, Richard John, Gilbert Siegel, and Detlof von Winterfeldt of the University of Southern California; and Melvyn Green of Los Angeles. Their individual contributions are identified within the manuscript. Special thanks are due Ramona Cayuela-Petak whose efforts resulted in the assembly of the research files from source documents, such as city council records, administrative memoranda, newspaper records, and personal interviews with individual actors in the system. These records and files were critical to our developing an understanding of the processes in each of the cities in drafting, modifying, and adopting the earthquake rehabilitation ordinances.

Special thanks are due to Eugene Zeller and Marvin Hopewell of the City of Long Beach, Earl Schwartz and Al Asakura of the City of Los Angeles, and Joseph Mazzeo of the City of Santa Ana. Without their support, we would not have been able to collect the data that were critical to completion of our study. Mr. Stephen Melnyk of the Los Angeles Apartment Owners Association provided valuable assistance in setting up meetings with owners of pre-1934 unreinforced masonry buildings in Los Angeles.

When this study was conceived and funded, Dr. Fred Krimgold was the National Science Foundation Program Officer. He was followed by Dr. C. Albright. The current Program Officer is Dr. William Anderson. To each we offer our sincere thanks and appreciation for their support and patience.

We are particularly grateful to Sarah K. Nathe of the Natural Hazards Research and Applications Information Center, who edited this book with great skill and attention, and to the other members of the Center who provide such valuable service to those of us who care about hazards and hazards policy.

Finally, a special acknowledgement is due Dr. Arthur Atkisson, the original Principal Investigator for this study, whose untimely death prevented him from seeing the fruits of his labor in this book.

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PART ONE

EARTHQUAKES AND UNREINFORCED MASONRY BUILDINGS

CHAPTER I
INTRODUCTION

The Problem

The terrible consequences of the Mexico City earthquake in September, 1985, are a dramatic and painful reminder of the enormous power and the inevitability of severe, and still largely unpredictable, earthquakes in seismically active areas around the world and here in the United States.

The news from Mexico City came without warning, although seismologists had long expected such an event. The news reports were similar to those we will hear again and again from other cities in other places. One can paraphrase them easily: the city has just been struck by a severe earthquake; no estimates of loss of life or property have yet been made; rescue workers are working non-stop to dig survivors and the dead from under piles of rubble--rubble from buildings that were dropped moments ago by an earthquake; fragmentary communiques relate that thousands may be dead, that hundreds of buildings may have collapsed, that ships are missing off the coast, and that gas and water lines have ruptured throughout the older parts of the metropolitan area; television reports show large buildings that have collapsed upon themselves, fires are burning throughout the damaged areas, and terrorized citizens are seeking family and friends.

Despite the incredible force unleashed by moderate and severe earthquakes, steps can be taken to reduce the loss of life and property when earthquakes do occur. This book is about earthquake hazard mitigation, more specifically, the social, technical, administrative, political, legal, and economic aspects of mitigation policy making. The focus is on one particular earthquake hazard--old, unreinforced masonry buildings in southern California--but the lessons learned there apply to seismically active areas throughout the United States.

The story that we have to tell began more than fifty years ago, when at 5:54 p.m., on the afternoon of March 10, 1933, a moderate earthquake (Richter magnitude 6.8) struck Long Beach, California, and neighboring communities. It caused severe damage and at least 120 persons died as a direct result of the tremor. The epicenter of the shock was located several miles off shore from Newport Beach on the Newport-Inglewood fault, some 15 miles southeast of Long Beach. There was serious shaking from Newport Beach to Inglewood, a distance of almost 40 miles, and from the shore communities to Santa Ana and Huntington Park, along a band more than ten miles wide. There was destruction in areas more than ten miles from the fault in a zone several miles in width. Total damages in the shaken area amounted to some $41 million ($300 million 1980 dollars). Santa Ana, located more than 20 miles from the epicenter, suffered an estimated $1 million in losses ($7.3 million 1980 dollars).

The 1933 Long Beach earthquake was one of a class of phenomena that can best be described as low-probability/high-consequence events. In seismically active areas, moderate and severe earthquakes have a low probability of occurring in any given year, but when they do, it is probable that they will generate considerable loss of life and property.

For many kinds of low-probability/high-consequence events, it is possible to take steps prior to the event that will reduce substantially the impact on people and property when the disaster does strike. People need not live in flood channels and on flood plains. They do not have to build on cliffs with unstable soil conditions. Nor do they need to build on or near major earthquake fault lines. However, given the opportunity, they frequently do, and, just as frequently, those same people are surprised when the flood waters reach their door, when their cliffside home becomes beachfront rubble, and when an earthquake rips the foundation from under their home.

It is typically difficult to create and implement public policies intended to reduce the potential for loss of life and property caused by this class of hazard before development takes place. It is doubly difficult to enact and implement such mitigation policies after development has taken place in a hazard-prone area, or when the mitigation is likely to impose significant and immediate costs on individuals.

The purpose of this book is to help provide insight into the issues and problems associated with mitigating the hazards that result from high-consequence/low-probability events, especially where there is the potential for significant impacts on stakeholders concerned with outcomes of policy making. The research on which this book is based focuses primarily on the development, enactment, and implementation of earthquake damage mitigation policies in the cities of Long Beach, Los Angeles, and Santa Ana, California. The policies of specific interest in those cities are ones intended to reduce the risks to life and property posed by old buildings built of unreinforced masonry--a construction method used in the early decades of this century which made buildings that are extremely susceptible to damage from even moderate earthquakes.

The research traces 50 years of policy development in the three cities through case studies. The research is intended to illuminate and contribute to the understanding of critical technical, political, and economic issues in the development of policies to reduce the hazard posed by the existence of tens of thousands of these existing unsafe brick buildings. One should not think of this as a book that is relevant only to California; it has nationwide relevance. First, it is about how to develop, enact, and implement hazard mitigation policies for low-probability/high-consequence events, and that is broadly applicable information. Second, while one tends to think of earthquakes as a West Coast phenomenon, large portions of the contiguous United States hold the potential for devastating tremors. Some areas of the United States are at far greater risk than others, but only North Dakota has escaped an earthquake since colonial times.

From 1971 to 1978, earthquakes were reported in every state except Iowa, Kansas, Louisiana, Michigan, Mississippi, New Hampshire, North and South Dakota, Ohio, and Wisconsin (Steinbrugge, 1982, p. 14). Figure I-1 indicates the potential for earthquakes throughout the contiguous United States, and the expected peak acceleration within each area. Maximum probable earthquakes for selected areas of the United States are: Utah and Washington R 8.3; Southern and Central Alaska R 8.7; New Madrid, Missouri and neighboring areas of Arkansas, Tennessee, Kentucky, Illinois, and Mississippi R 8.7; other states west of the Rocky Mountains R 7-8 (Steinbrugge, 1982, p. 31).

Several model building codes provide the basis for municipal building codes in the United States. The Uniform Building Code serves as the model for most western cities. It has incorporated aseismic design requirements since 1935, primarily because of the 1933 Long Beach earthquake. As a consequence, by far the largest proportion of buildings in the West have aseismic design features; however, other model building codes widely used in the United States have not incorporated aseismic design requirements. This means that in most of the United States, including those eastern and southern areas with considerable potential for damaging earthquakes, there are hundreds of thousands of buildings subject to failure under earthquake stresses.

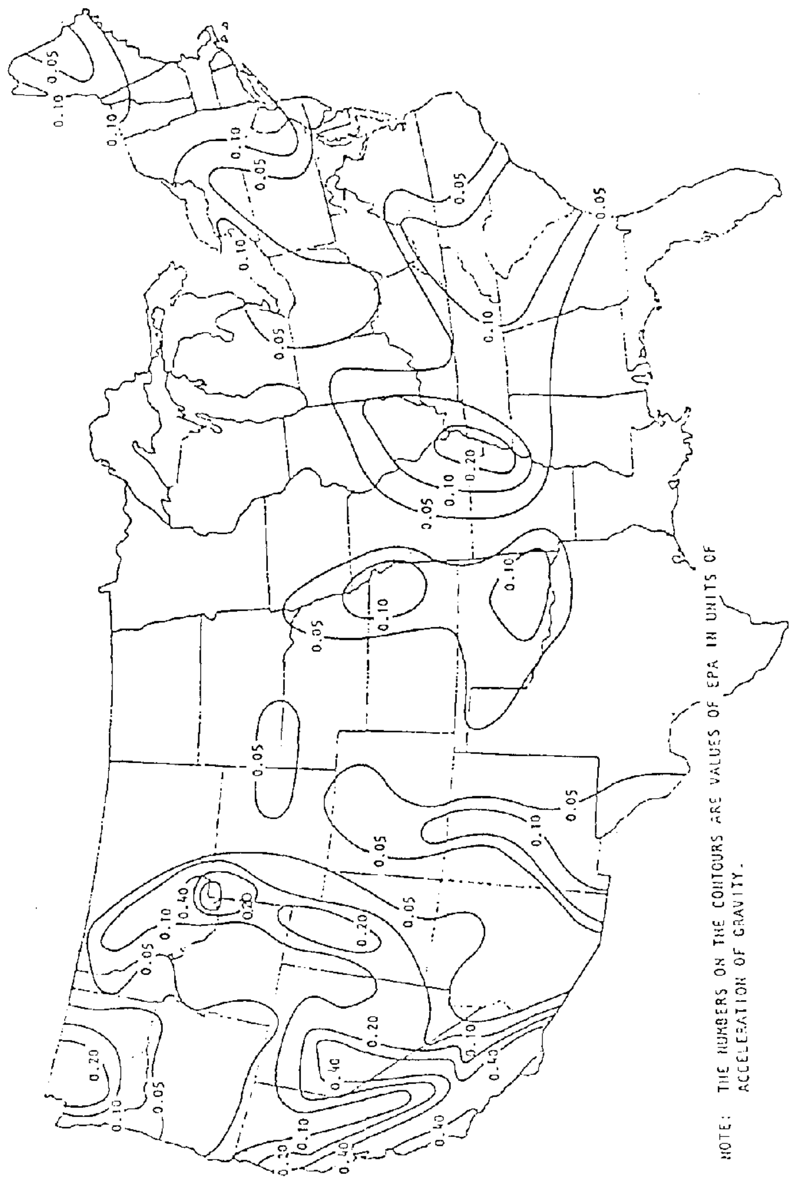
The History

In the immediate aftermath of the 1933 Long Beach earthquake, architects, engineers, and other professionals formed teams to investiate the effects of the earthquake and to determine the reasons for the extensive loss of life and property. Their purpose was to develop steps to be taken to minimize the effects of future earthquakes. Among the findings, it was noted that more than half of the 3,417 damaged buildings in the City of Long Beach had been constructed with unreinforced masonry exterior walls. Eighty-six percent of the unreinforced masonry buildings affected by the quake failed in some way.

Building brick buildings with very little vertical or lateral reinforcement in the walls was a widespread practice in California prior to 1933. It had been a popular construction method in eastern cities in the United States and, when eastern masons moved west to California, they brought that building technology with them. Masons who employed the construction technique in southern California often made the mortar for the brick walls from beach sand; however, beach sand proved to be a poor choice because it was well worn from ages of pounding under the California surf and did not create a firm bond with the brick courses. The masons also tended to substitute large proportions of lime for cement when mixing the mortar. Lime mortar deterior-

FIGURE I-1 SEISMIC RISK FOR THE CONTIGUOUS 48 STATES IN TERMS OF EFFECTIVE PEAK ACCELERATION.

(Applied Technology Council, 1978)



ates because it leaches out when water or dampness is absorbed by the masonry wall.

The unstable nature of the mortar used by the masons, while not fully understood at the time, had been of concern to Long Beach officials prior to the earthquake, as evidenced by increasingly strict revisions to the city's building codes in 1913, 1923, and 1930. The 1913 code permitted a straight line mortar for all walls, except that isolated piers, foundation walls, parapets, and chimneys above the roof line were required to be laid up in cement lime mortar with one part cement to every three parts lime. In 1923, the standards were revised upward to require additional proportions of cement. In 1930, mortar requirements were amended again to require a minimum of one part cement, one part lime, and six parts of "clean, sharp sand." The code called for workmanship employing "full joints, shoved work using wet bricks."

The 1930 Long Beach code was essentially the same as the 1930 edition of the Uniform Building Code, a model building code developed and periodically updated by the International Conference of Building Officials (ICBO). Despite the increasingly strict requirements for improved mortar and workmanship in building codes, however, it was made devastatingly clear in the 1933 earthquake that unreinforced masonry construction was an inappropriate building technique in seismically active areas.

During the 1933 earthquake, unreinforced masonry structures proved to be highly susceptible to the stresses imposed by lateral ground acceleration. They crumbled and collapsed. In reporting on its inquest concerning the victims of the 1933 earthquake, the Coroner's Jury in Long Beach concluded:

> Masonry buildings were the principal sufferers and their failure occasioned the principal loss of life. Damage was mostly confined to those buildings built with poor quality lime mortar, inadequate bonding and anchoring, or of inferior workmanship, and built to designs which took no account of horizontal forces (City of Long Beach, 1933).

By 1933, Japan, Italy, and New Zealand had adopted standards of building design to minimize the effects of earthquakes on buildings, but little consideration had been given the problem in the United

States. In the wake of the 1933 Long Beach earthquake, however, architects and engineers urged policy makers to revise building laws and regulations to ensure that structures would be designed and built to withstand seismic, insofar as that was economically feasible. There was also concern for strengthening existing buildings. In a report on the damage in Long Beach, the California Joint Technical Committee on Earthquake Protection noted that:

> Compared to the large number of buildings which now exist in this metropolitan center and in other communities through the Pacific Southwest, relatively few new buildings will be constructed during the next ten years; consequently the necessity for strengthening existing buildings is more important even than a change in standards for new buildings. Insofar as the police power of the state will permit, it should be required that all privately owned existing buildings be made earthquake resistant. Strengthening of public buildings, however, is subject to the will of the people, and there should be no delay in making these buildings--particularly school buildings--safe (1933).

The concern generated by the Long Beach earthquake and the recommendations of the various organizations that studied its effects resulted in the adoption of legislation by the State of California that came to be known as the Field and Riley Acts. On April 10, 1933, the Field Act vested the Division of Architecture, California Department of Public Works, with the authority and responsibility to approve or reject plans and specifications for all public school buildings, except those specifically exempted, and to supervise their construction. The Riley Act, enacted a month later on May 23, 1933, required all buildings built after that date to be constructed under far more rigorous standards than had been previously considered necessary. On October 6, 1933, the City of Los Angeles adopted earthquake-resistant measures in its building code for new construction. Long Beach followed suit in January, 1934.

Although the inclusion of aseismic construction standards in the Uniform Building Code, and their subsequent incorporation into municipal codes, did much to reduce the vulnerability of new buildings to the forces imposed on them by earthquakes, the Long Beach earthquake resulted in few policies and little action to mitigate the hazard posed by many thousands of pre-1934 unreinforced masonry buildings that remained throughout California. At 6:01 a.m., on February 9, 1971, millions of Southern Californians were jolted awake by an earthquake with a Richter magnitude of 6.6 (a moderate earthquake). Within ten seconds, 2,400 people were injured and some 60 persons were dead. Extensive structural damage was inflicted by the earthquake; in the wake of the high-intensity ground shaking and surface ground rupture was $500 million in property damage ($1 billion 1980 dollars). The area affected most immediately was the San Fernando Valley, located about 25 miles from downtown Los Angeles.

This seismic event produced unreinforced building failures similar to the 1933 Long Beach quake in terms of the failure of unreinforced masonry buildings. Almost one-half of the pre-1934 buildings that were affected by the quake suffered moderate to major damage. Some unreinforced masonry buildings in downtown Los Angeles (as far as 25 miles from the earthquake epicenter) were damaged. The majority of the persons killed occupied one of the Veterans' Hospital buildings which had been constructed prior to the 1934 seismic structural code revisions. This event once again focussed attention on the hazardous nature of the old unreinforced masonry structures.

More seismically related legislation was passed in California during the two years following the San Fernando Valley earthquake than was adopted either before the quake or since then. Among the legislation enacted was a City of Long Beach ordinance entitled "Earthquake Hazard Regulations for Rehabilitation of Existing Structures Within the City," passed on June 29, 1971. Despite the fact that it became known by engineers, architects, and public officials after 1933 that existing unreinforced masonry buildings posed a significant hazard to occupants during seismic events, it took until 1971 for Long Beach to pass an ordinance to mitigate those hazards, and Los Angeles did not enact a similar ordinance until 1981, ten years after the San Fernando Valley earthquake and 48 years after the Long Beach quake.

Research Objectives

Fundamentally, this book is about why it took so long for southern California cities to develop and enact municipal policies to reduce the obvious hazards posed by the existence of thousands of unreinforced masonry buildings. After all, the dangers were well-known, as was the likelihood of earthquakes that would destroy those buildings. This book is also about the design of effective policies for mitigating earthquake hazards, and about how those concerned with hazard mitigation for earthquakes, and for other hazards, might work more effectively to develop policies and to ensure that they are enacted.

The research on which this book is based was conceived in 1981 as an analysis and evaluation of the Long Beach seismic hazard mitigation ordinance on the tenth anniversary of its passage. The Long Beach ordinance had been, after all, a pioneering step in hazard mitigation; it seemed particularly appropriate to determine how the policy had fared over the ten-year period. It became apparent during our preliminary inquiry that, although the ordinance had been passed ten years before, its administration had proceeded slowly and that the ordinance itself had been amended significantly in 1976. Any rigorous evaluation of the effects of the ordinance would be futile, since there had been few effects on the hazardous buildings themselves. Most of the effects had been along other dimensions, as one might expect in the case of a major institutional innovation.

Moreover, there were other significant events to shed light on issues we were concerned about. Los Angeles was in the process of passing its seismic hazard mitigation ordinance, as were Santa Ana and several other southern California cities. A preliminary examination of the experience in these cities indicated that the difficulties encountered in Long Beach were not unique, and that much was to be learned by examining Los Angeles as well. It was clear that the focus of the research ought to be an analysis of those key issues brought to light in Long Beach and Los Angeles in connection with the design, enactment, and implementation of the ordinances.

First, the research was aimed at identifying and illuminating the social, technical, administrative, political, legal, and economic issues associated with the development, enactment, and implementation of municipal earthquake hazard reduction policies. Specifically, the focus was to be on the policies intended to reduce the hazards posed by unreinforced masonry buildings constructed prior to 1934, and on the development of aseismic construction standards, with particular emphasis on Long Beach and Los Angeles.

The research was designed to identify commonalities and differences among the cases, and provide an opportunity to link the findings with contemporary theory concerning policy development and implementation. This, in turn, gives broader insight into the generic problems associated with instituting mitigation policies for low-probability/high-consequence events. It is hoped that the findings will provide useful guidance to others concerning appropriate ways to more easily institute mitigation policies in similar circumstances.

Second, the research was intended to evaluate the Long Beach and Los Angeles ordinances, to the extent possible, in terms of their effects on the several key stakeholder groups and on the hazard itself. The ordinances employ somewhat different approaches to mitigating the unreinforced masonry building hazard, and thus present two alternative models for would-be hazard mitigators. The analysis was designed to go beyond an analysis of the extent to which hazardous URM buildings were strengthened, rehabilitated, or demolished in the two cities, to include an analysis of real and imagined impacts on the various stakeholders in the policy making process.

The analysis included an evaluation of the processes by which the policies were developed, adopted, and revised, where revision took place. It also included an evaluation of the interventions themselves, of the design of the intervention policies imbedded in the ordinances. The project included an identification and evaluation of the administrative procedures and implementation costs associated with the mitigation policies. Finally, there was an evaluation of whether the mitigation policies that were adopted were worth developing, given the nature of the risk, the extent to which the hazard was being diminished by other market forces, and the costs of mitigation.

Third, it was decided that an effort would be made to develop added understanding about the policy making process useful to other municipalities located in seismically active areas with buildings that are particularly subject to failure during earthquakes, that have not yet implemented effective mitigation policies. The guidelines were to include information about the implications of alternative approaches to mitigation, and also about conditions under which mitigation policy is likely to be adopted or rejected.

Research Methods

Most of the data were collected through three case studies. As indicated above, case histories were created about the development, enactment, and implementation of ordinances to mitigate the unreinforced masonry building hazard in Long Beach and Los Angeles, California. The case studies were developed from a search of source documents in municipal records and files, including council minutes, correspondence, consulting reports, ordinances, and statutes. The source document search was augmented by newspaper accounts reporting events as they occurred, and by interviews with participants in the policy making process. The interviews were conducted from 1982 into 1986. The case histories were reviewed by participants in the policy making process to help ensure their historical accuracy.

The case histories were subjected to qualitative analysis, utilizing various models of organizational, political, and rational decision making models. These qualitative analyses were assessed in terms of recent research findings of others reported in the scholarly literature.

To supplement the case studies, survey research methods were employed to obtain data concerning values and preferences of residents of unreinforced masonry buildings. The survey data were subjected to traditional methods of multivariate analysis. The values and preferences of unreinforced masonry building owners were analyzed utilizing value tree analysis and nominal group techniques.

The research method is intentionally eclectic, representing the authors' belief that research methods from a variety of disciplines are a means for getting at the answers to troublesome issues of public policy and policy making. Specific information about the methods for the various aspects of the analysis are included, in a summary fashion, in the chapters themselves. More detailed methodological statements are found in working papers on which the chapters are based, which are referenced in the chapters.

Plan for the Book

The book is organized into four corresponding parts. Part One consists of this introductory chapter and Chapter II. Chapter II provides technical information on the unreinforced masonry building hazard, the means of mitigation, the extent of the risk faced by building owners and occupants, and the likely effectiveness of alternative mitigations against the forces of earthquakes. This information is drawn primarily from research performed by others, and is as simple and straightforward as possible.

Part Two consists of an introduction to the case studies that identifies key issues in the research. Chapters IV through VI are the Long Beach, Los Angeles, and Santa Ana case histories. Chapter VII is a comparative analysis of the Long Beach and Los Angeles ordinances, including a comparison of the two policy interventions that emphasizes the incentives each creates for participants in the process. The chapter also addresses the administrative processes, costs, and problems associated with implementing the ordinances.

Chapters VIII through XII comprise Part Three of the report. It centers on the politics of hazard mitigation viewed from several perspectives. There are analyses of the political processes involved in enacting the ordinances and of how stakeholders perceived the issues and valued alternative outcomes. Part Three concludes with an examination of the cases from the perspective of contemporary behavioral decision theory.

Part Four consists of descriptions of the current status of the ordinances in Long Beach and Los Angeles and of the extent to which those ordinances have diminished the unreinforced masonry hazards in those cities. The book ends with our conclusions and recommendations about the hazard mitigation policy making.

CHAPTER II
RISKS, MITIGATION TECHNIQUES, AND COSTS

It is important to remember, as one reads the case studies that follow in Part Two, that much of the information provided in this chapter was not available to decision makers during the course of the debates that led, ultimately, to the adoption of earthquake hazard reduction policies for unreinforced masonry buildings in Long Beach and Los Angeles. The information is provided here so that the reader will be able to make better use of the case histories in understanding what is required for adoption and implementation of hazard mitigation policies.

Risks

Earthquake Dynamics

The extent of the damage to a building from an earthquake depends on characteristics of the earthquake, the ground around the epicenter and under the building, and the building. Energy unleashed by slippage or rupture along a fault is transmitted through the earth or, depending upon the location of the earthquake's epicenter, through water as well. The earth shakes in response to those energy waves. A number of measures are employed to characterize an earthquake's effects in a specific locale: ground acceleration, velocity, ground displacement, wave period, wave frequency, wave length, and duration of shaking (Bolt, 1978, pp. 109 ff.).

In the simplest terms, ground acceleration refers to the rate at which the earth is moved laterally by the force of the earthquake. Ground displacement refers to the vertical movement of the earth caused by the quake. A useful analogy is to think of an earthquake in terms of a rock dropped into a puddle of water. The size of the ripples depends on the size of the puddle, the size of the rock, and the nature of the bottom and edges of the puddle. All these variables affect the speed of the ripples, their vertical displacement, and their overall size. How wet the bystander becomes depends on his or her proximity to the dropped rock and a number of other variables. Such is the case with earthquakes and buildings.

In terms of damage to unreinforced masonry buildings, the principal seismic variables that cause damage are ground acceleration and the duration of ground motion (ABK, 1981a). Ground acceleration is measured in terms of gravitational force. Since gravity is defined in terms of acceleration (980 cm/sec^2), lateral ground movement is also defined in terms of acceleration. When attempting to measure the potential seismic forces that a building may be subjected to, one is concerned with a measurement concept known as effective peak acceleration (EPA). Lateral ground acceleration above .1 g (10% of the force of gravity) is sufficient, under the right circumstances, to result in structural damage. Measuring lateral ground acceleration is a relatively recent development. The highest horizontal acceleration recorded thus far was on the abutment of the Pacoima Dam in the 1971 San Fernando Valley earthquake; it reached 1.15 g (Bolt, 1978, p. 110).

When earthquake energy waves strike a building site, the earth is literally moved from under the building. Vertical forces from the earthquake can lift a building from its foundations and, if the building comes down while the ground is still horizontally displaced, the building, or what's left of it, will come to rest off the foundation. If the building sits on soils subject to liquefaction (soils that, when shaken, tend to compress in volume and to flow like a viscous liquid), then the earth may slide downhill or subside dramatically.

Unreinforced Masonry Buildings in Earthquakes

Many of the brick buildings built in California, and elsewhere in the United States, were built to withstand the vertical forces imposed by gravity, but with insufficient horizontal and vertical reinforcement to withstand the lateral forces imposed on those buildings by even moderate earthquakes. When the ground is laterally accelerated by an earthquake, the first wall struck by the force of the earthquake is accelerated. The foundation moves with the accelerated ground, and, if the base of that wall is tied to the foundation, it also moves with the energy wave. However, the top of the building, dutifully obeying Newton, remains at rest until the energy is transmitted up the wall of the building. If a building is properly designed, the walls will tend to withstand the shearing stresses induced by the earthquake (depending, of course, on the force of the quake), but the force tends to cause the walls of unreinforced masonry buildings to fail.

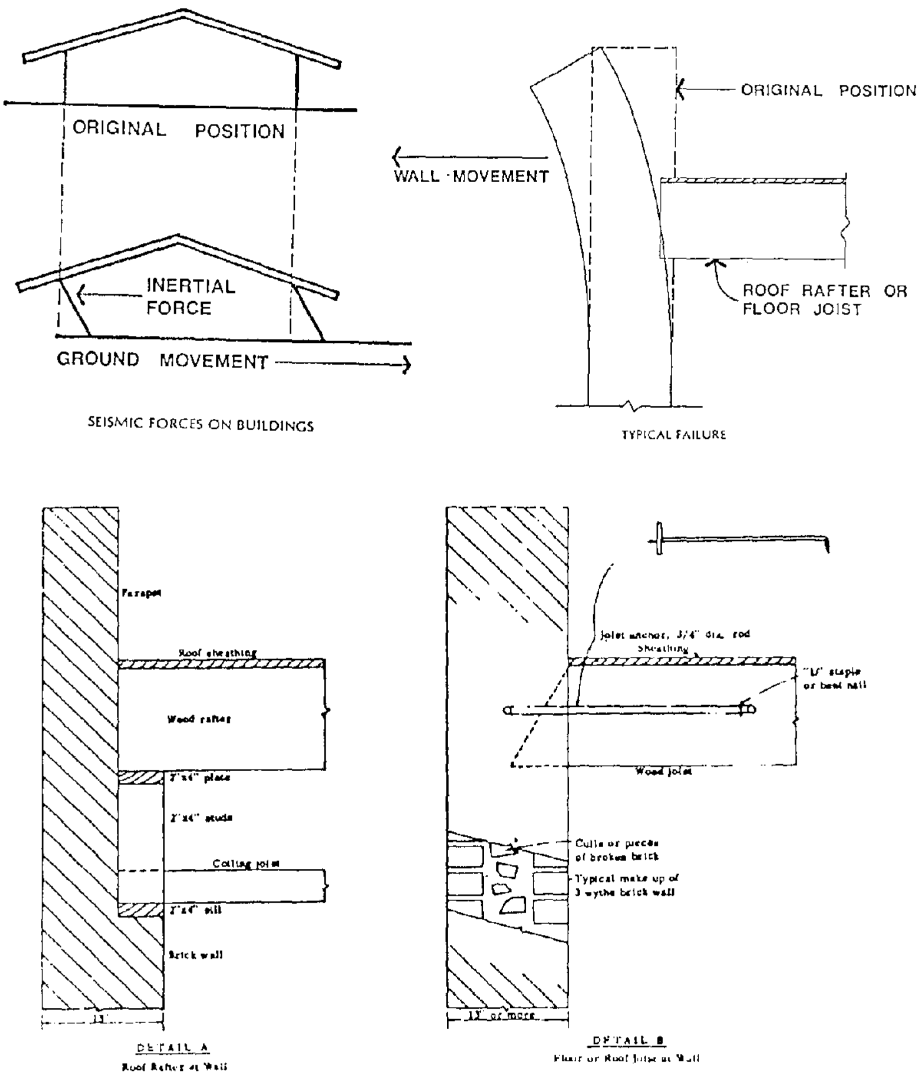
To further complicate matters, the far walls of buildings are not accelerated by the earthquake until a split second after acceleration of the near wall or walls. The result is that the building walls are frequently under opposing stresses. If the building's walls are fastened firmly to the foundation, and if the floors are bonded tightly to the walls, and if the building walls are rigid, the structure is better equipped to handle the stress. If, however, the walls are not tied to the foundation, the floors are not tied tightly to the walls, and the walls are not sufficiently stiffened, then one wall sways to and the other sways fro, and they spread apart so that the floors are free to fall between the walls, crashing down toward the ground, one upon the other, like a house of cards.

Research on why unreinforced masonry (URM) buildings fail in the face of seismic forces is still under way, but it is known that failure is due partly to the lack of vertical and horizontal reinforcement between the masonry courses and partly to the mortar holding the courses of brick together in pre-1934 URM buildings. Poor cement mixtures, incorporating large proportions of lime, did not form a strong bond with the bricks. The energy unleashed by an earthquake tends to separate the walls along the weak mortar bonds, causing the building walls to fail and fall.

Recent research has identified seven URM building elements that are hazardous under stresses induced by even relatively small earthquakes (ABK, 1981a, p. 6.1):

- URM cornices, parapets, and appendages extending above the uppermost anchorage level.
- URM walls adjacent to roof elements not continuous with the major plane of the roof sheathing. Mansard roofs, roof edges pitched for roof drainage, and end walls of northlighted roof framing are examples of these hazardous building elements.
- URM walls adjacent to skylights or other openings through the roof and/or floors.
- URM walls with unbonded veneer courses.
- URM walls without anchors to roofs and floors above ground.

FIGURE II-1 UNREINFORCED MASONRY BUILDINGS: TYPICAL WALL CONSTRUCTION AND SOURCES OF FAILURE (Green, 1981)



- Gable walls of URM walls.
- Masonry ornamentation cantilevering from the URM wall face.

The Extent of the Risk in the Los Angeles Region

The risk to unreinforced masonry buildings is a function of the number of such buildings and the number of people and businesses that occupy them, the probability of occurrence of earthquakes generating sufficient lateral ground acceleration in sufficient proximity to those buildings to cause damage to them, and the vulnerability of the buildings to seismic damage.

Number of buildings and occupancy. Approximately 15,000 unreinforced masonry buildings occupied by households, commercial and industrial establishments, and government stand in Los Angeles County alone, with many thousands more throughout southern California. Of these, there were approximately 8,000 in Los Angeles and 800 in Long Beach at the time this research was begun. The 8,000 buildings in Los Angeles included, as of 1980, 28,000 apartment units, 17,000 hotel rooms, and "15,000 businesses and industrial concerns employing approximately 70,000 workers" (Hamilton, 1980).

The unreinforced masonry building hazard has diminished considerably through time through attrition: many URM buildings in California have been demolished and replaced to make way for new structures. If one knew with any confidence the number of URM buildings that remain and the rate at which they are being demolished to make room for new buildings with greater seismic resistance, then one could estimate at least one parameter of the risk equation. These data are not available, however. Indeed, it was not until well into the policy debates that data about the number of existing URM buildings became available even for Long Beach and Los Angeles.

Probability and magnitude. The second part of the risk equation concerns the probability of earthquakes generating significant lateral ground acceleration in proximity to URM buildings. Because of widespread underlying faults, most of California holds the potential for considerable earthquake damage. There are at least 42 major earthquake faults in the Los Angeles area, including the San Andreas fault, which holds the potential to cause an earthquake with 100 times the power of the 1971 San Fernando Valley quake and which, according to seismologists, has a high probability of generating such an event before the turn of the century. Indeed, the Federal Emergency Management Agency (FEMA) states that:

> (E)arth scientists unanimously agree on the inevitability of major earthquakes in California ...(G)eologists estimate that the probability for the recurrence of a (major) earthquake is currently as large as 2 to 5 percent per year and greater than 50 percent in the next 30 years...The aggregate probability for a catastrophic earthquake in the whole of California in the next three decades is well in excess of 50 percent (1980, p. 3).

The *maximum credible earthquake* is the term for the maximum earthquake that appears possible for an area, given the geological environment, based on the judgment of capable geologists, seismologists, and other technically qualified persons. The maximum credible earthquake for California is 8.5 on the Richter scale. The 1906 San Francisco earthquake was about R 8.3 and the 1964 Alaskan quake measured R 8.4. These are thought to be the largest earthquakes in North America since 1900. An earthquake measuring R 8.5 is ten times more powerful than one measuring R 8.4. The *maximum probable earthquake* is the maximum earthquake that, on a statistical basis, will most likely occur during a certain interval of time. The maximum probable earthquake for California is R 8.3 (Steinbrugge, 1982, pp. 27-31). Table II-1 describes the most probable locations and faults of major California earthquakes in the next 20 to 30 years.

Loss of life and property. In 1972 and 1973, estimates were made under the auspices of FEMA and its predecessor agencies concerning property losses and casualties for various California earthquakes. These data were updated in 1980. The estimates include private and public buildings, but exclude replacement costs of transportation and communication facilities, dams, utility installations, and special purpose structures such as convention centers and sports arenas. The maximum probable earthquakes for the Southern San Andreas fault could

TABLE II-1 MAJOR CALIFORNIA EARTHQUAKES: TWENTY TO THIRTY YEAR ESTIMATES

Region	Fault System	Richter Magnitude	Current Annual Probability	Likelihood of Occurrence, Next 20-30 Years
Los Angeles San Bernardino	Southern San Andreas	8.3	.02-.05	High
San Francisco Bay Area	Northern San Andreas	8.3	.01	Moderate
San Francisco Bay Area	Hayward	7.4	.01	Moderate
Los Angeles	Newport-Inglewood	7.5	.001	Moderate-Low
San Diego	Rose Canyon	7.0	.0001	Low
Riverside-San Bernardino	Cucamonga	6.8	.001	Moderate-Low
Los Angeles	Santa Monica	6.7	.0001	Low

(Federal Emergency Management Agency, 1980)

result in $11 billion in building losses and $6 billion in content losses, for a total of $17 billion. Such an earthquake on the Newport-Inglewood fault would be likely to result in much greater losses: $45 billion in building losses and $24 billion in contents for a total loss of $69 billion. These estimates are said to be uncertain by a possible factor of two to three (FEMA, 1980). Either of these earthquakes would have a major impact on unreinforced masonry buildings, although, because of its close proximity to the places where the older buildings exist, the Newport-Inglewood earthquake would probably have the greater impact on the unreinforced masonry buildings.

Casualty estimates for these earthquakes are contained in Table II-2, below. The number of dead from a major earthquake on the southern San Andreas fault could be up to 14,000, while the number could go as

TABLE II-2 ESTIMATES OF CASUALTIES FROM REPRESENTATIVE CALIFORNIA EARTHQUAKES*

Fault	Time	Dead	Hospitalized
Southern San Andreas	2:30 a.m.	3,000	12000
	2:00 p.m.	12,000	50,000
	4:30 p.m.	14,000	55,000
Newport-Inglewood	2:30 a.m.	4,000	18,000
	2:00 p.m.	21,000	83,000
	4:30 p.m.	23,000	91,000

*Uncertain by a possible factor of two to three.

(Federal Emergency Management Agency, 1980)

high as 23,000 for a comparable earthquake on the Newport-Inglewood fault. One would, of course, expect large numbers of the dead to have been killed in and near unreinforced masonry buildings.

Mitigation Techniques

The Technology

Unreinforced masonry buildings can be strengthened to become more resistant to earthquakes. As indicated above, there are several kinds of hazards associated with URM buildings and, as a consequence, there is a variety of mitigations applicable for reducing the various hazards. From the time of the 1933 Long Beach earthquake, when serious study of the URM building hazard really first began, a great deal of progress has been made in both understanding appropriate strengthening techniques and developing means to apply them to buildings. As demonstrated in the case studies that follow, the relative shortage of technical and practical information about how to strengthen the old URM buildings was one of the reasons it took so long to enact effective mitigation policies in the cities studied.

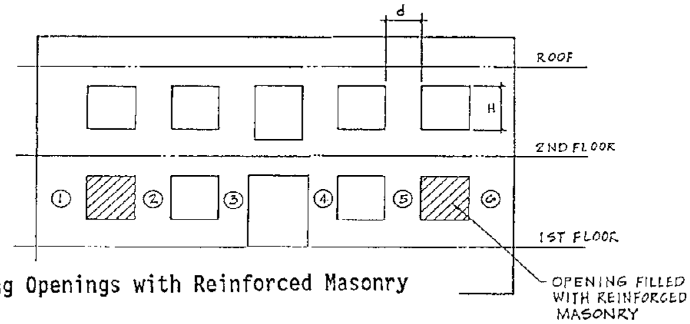
In a report prepared under sponsorship of the National Science Foundation, the ABK joint venture group described the basic methods for mitigating the hazards posed by an existing URM building (ABK, 1981b). The effort should begin with an analysis of the existing structure because not all URM buildings are equally vulnerable to seismic forces. Analysis of the structure includes determining the seismic resistance implied by its design, the construction methods employed, and the nature of materials used in construction. The purpose of the initial evaluation is to determine overall seismic resistance, as it stands, and the features of the building that make it most susceptible to earthquake damage.

Once the primary sources of the hazard are identified, appropriate mitigations can be specified. One should not assume that such an evaluation is simple. Older buildings tend to have been remodeled from time to time, making it difficult to tell precisely what structural members are tied to what. Moreover, it is seldom a simple task to determine, for example, whether floors are fastened effectively to walls without cutting into the structure. One should anticipate that previously unknown information will be obtained during the course of strengthening, even as construction workers are working on the building.

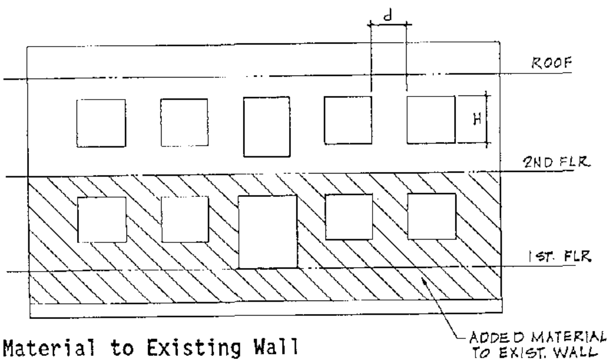
At the simplest level, seismic strengthening of URM buildings begins with ensuring that the building's foundation is structurally sound and that the building is bolted or otherwise fastened to it firmly. This may require repair or replacement of a portion of the foundation itself. From there, one ensures that walls are anchored firmly to the floors of the building through the use of wall anchors. This can be accomplished with anchor bolts and, depending on the construction, can sometimes be accomplished relatively easily and inexpensively.

Overhanging parapets, cornices and ornamentation should be either removed or strengthened and fastened firmly to the building.

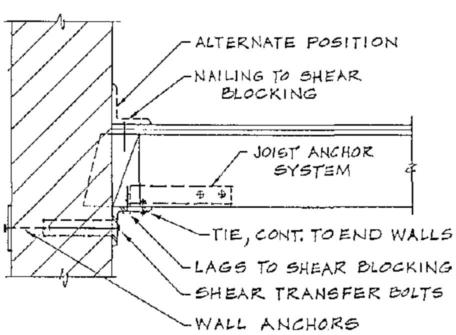
Horizontal diaphragms (such as upper floors) should be such that they have the capacity to act as a single, continuous element during seismc stress. When they have structural discontinuities, such as



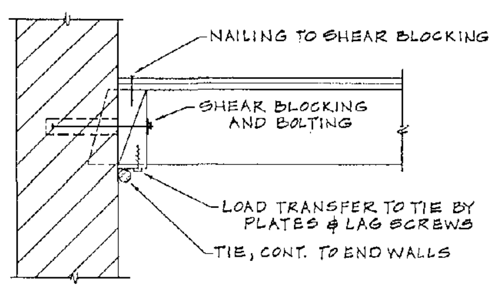
Filling Openings with Reinforced Masonry



Adding Material to Existing Wall



Tie Rods



Shear Transfer Bolts

FIGURE II-2 ILLUSTRATIVE METHODS FOR STRENGTHENING UNREINFORCED MASONRY BUILDINGS (Kariotis, 1983a, 1983b).

openings for stairs, the diaphrams should be tied together to act as a continuous element. The component parts of the building (walls, floors, and roof) should be interconnected to permit transfer of the shearing forces of the quake through the building. Floors and interior walls can be stiffened with sheets of plywood firmly fastened across joists and studs so that the stresses generated by earthquakes, or other forces such as wind, are distributed more evenly throughout the building. In this way, more of the strength of the total structure can be employed to cope with the lateral stresses.

It is sometimes necessary to build walls inside the URM buildings to provide adequate stiffness and to transfer shear forces appropriately. Weight-bearing walls should incorporate similar structural characteristics. Discontinuities in vertical weight-bearing walls should be fully reinforced. In some cases, it may be necessary to cover exterior walls with reinforced gunite to provide adequate stiffness and bonding of veneer masonry walls (For additional information, see a looseleaf document prepared by the Structural Engineers Association of Southern California, 1981).

<u>The Effectiveness of Techniques</u>

The effectiveness of the mitigation depends on one's objectives and the extent of the forces imposed by the earthquake on the building. The initial objective in hazard mitigation ought to be life safety. In the case of URM buildings:

> the principal threat to life is posed by the exterior walls and parapets. Separation of parts of the URM walls threaten persons adjacent to the building. The building occupant is at much less risk. This statement is valid in seismeic hazard zones of the highest probable ground shaking. Observed damage in URM buildings shaken by intensities of EPA of 0.2 to 0.3 g indicates that separation of the exterior URM walls from the building constitutes the total life-safety threat and the majority of the probable property damage (Kariotis, 1985).

Beyond the primary concern with life safety, one might be concerned with protecting building contents, such as commercial inventory, furniture, or personal items. Beyond that, one might even be concerned with attempting to ensure the structural integrity of the building so that it might continue to be used after the earthquake, thus extending its economic life.

The effectiveness of the building strengthening also depends, however, on the earthquake-generated forces imposed on the building. As reported earlier, the forces imposed on the building depend on where the earthquake is centered, its magnitude, and other geological conditions. For our purposes, we can focus on peak ground acceleration as a primary measure of the earthquake forces imposed on a building. Scientists have mapped expected peak ground acceleration for the United States, based on what is currently known about faults and earth movement.

One cannot say with certainty that any hazard mitigation techniques provides the desired level of safety against earthquake hazards. One must make a decision under conditions of uncertainty; that is, one must make estimates of the maximum credible forces likely to be imposed on the building within a reasonable time frame, and gamble that the forces exerted by earthquakes within that time frame are within the limits for which the mitigations were made to achieve a predetermined level of safety. It is unlikely that one could strengthen an unreinforced masonry building to withstand a massive earthquake in its immediate proximity at any reasonable cost.

In the ABK joint research effort, the effectiveness issue is stated clearly:

> Life safety in the event of ground shaking is the paramount consideration of this methodology. Mitigation of life-safety threats in existing URM buildings is provided by minimizing the probability of the separation of the URM wall and parapets from the roof and floors and collapse of the gravity load-carrying system.
>
> The first goal can be attained by retrofitting anchorage systems; the second goal is attained by analysis of the existing structural systems to determine the need for retrofit systems.
>
> Mitigation of life-safety threats caused by seismic ground motions is generally related to the limitation of property damage. Use of this methodology provides that benefits, but it is not a primary consideration...(B)ecause of the random and unpredictable nature of earthquake motions, the uncertainties of response of URM buildings to earthquake

> motions, and the determination of undesigned material resistance capacities, even a relatively complete methodology (of strengthening) cannot ensure that there will be no loss of life (ABK, 1981b, pp. 1.3-2.4).

The report goes on to indicate the appropriateness of designing mitigations in response to effective peak acceleration, indicating that "(i)n areas of design ground motion of EPA equal to 0.1 or 0.2 g, ... wall anchorage ... will comprise the major part of the seismic hazard mitigation program. The probabilities of the occurrence of significant damage to other elements of URM buildings is very small in these hazard zones." In zones where EPA is substantially greater than 0.2 g, one would expect that more elaborate mitigation techniques would be applied, or that the building would be demolished.

It seems fair to conclude that techniques have been developed and can be applied to such buildings to provide a high probability of life safety within the range of earthquake forces expected to be imposed on those structures. However, it is necessary to speak in probabilistic terms. There is no guarantee that an earthquake of sufficient magnitude won't cause the building to collapse, resulting in loss of life.

The Costs

Ascertaining the probable costs of strengthening old, unreinforced masonry buildings was a problem throughout the years during which the mitigation policies were being developed. Now that there have been several years of experience in URM building damage mitigation, the cost picture is clearer, but it is still difficult to provide the reader with a definitive statement of what it will cost to mitigate URM hazards, except at the most general level.

It will become clear in the case histories that follow that confusion, claims and counterclaims, and just plain ignorance about the costs of mitigating URM hazards was a principal reason that it took so many years to enact and implement municipal mitigation policies. Costs estimates became a major issue, particularly in Los Angeles. The Long Beach and Los Angeles ordinances have been in effect for some time, so there is much more accurate information about costs than has ever before existed. Had this information been available earlier, it would, most certainly, have accelerated the enactment process.

In the heat of the Los Angeles policy debates concerning the mitigation ordinance, for example, Howard Jarvis, well known for his role in the so-called taxpayer revolt that led to the passage in California of Proposition 13, claimed that the costs of mitigating the URM hazard in buildings "would be an amount equal to 80% of the entire structure" (1976).

Subsequent tests conducted on three URM buildings in Los Angeles, scheduled for demolition to make room for a freeway, indicated that the costs would probably be in the range of \$15 to \$20 per square foot for strengthening. Later estimates put the cost for wall anchoring alone at about \$2 to \$4 per square foot.

Actual construction experience since the ordinances in Long Beach and Los Angeles were enacted provides considerably more accurate data about costs. City of Los Angeles engineers have provided unit price guidelines: \$100 to \$150 per wall anchor, \$3.10 per square foot for removing an existing roof and adding new plywood and reinforcing, and \$250 per parapet anchor. They estimate the costs for full compliance with the Los Angeles ordinance at \$3.50 to \$10.00 per square foot, with an average of \$6.50.

Some of the best cost data available were prepared by Raymond Steinberg, a Los Angeles structural engineer, who compiled information on four buildings for which his firm designed mitigations to comply fully with the Los Angeles ordinance. Two of these were commercial buildings. The first was a two story building with 12,000 square feet. Existing walls had to be anchored, shear bolts were added, the existing roof had to be removed and replaced with new plywood and roofing, concrete block construction was required around wall openings, and bracing had to be added at the ceiling. Total cost for construction was approximately \$5.20 per square foot (1983).

The second commercial building was four stories and irregularly shaped. It, too, required wall anchors and shear bolts, bracing was added to interior partitions to reduce the shear loads on the roof, and shear walls were added in the basement and first and second floors. Total costs were approximately \$7.00 per square foot (1983).

A three-story apartment building was the third building. It, and the fourth building, were to be strengthened under the provisions of the Davis Bacon Act. In compliance with the Act, day laborers were to be paid $20 per hour and skilled tradesmen considerably more. Full compliance with the Los Angeles ordinance required shear bolts, wall anchors, roof bracing, and a new foundation wall in the first building. The second building, an apartment/hotel, required anchors and bolts, roof bracing, and additional shear walls. Both projects were estimated to cost $7 per square foot. (1983)

Steinberg also presented data on 15 buildings in central Los Angeles for which preliminary cost estimates were developed for the Los Angeles Community Redevelopment Authority. Costs ranged from a low of $3.47 per square foot to a high of $25.50, with a median cost of $7.26 per square foot. Steinberg's experience with URM buildings reinforces what one might expect about costs:

> It is noted that as the building area decreases, the cost per square foot increases, however, (sic) all costs vary from apprximatley $6-$9 per square foot...(I)t should be noted that these figures are rough, "best guesses." The only accurate method of determining building construction costs is to prepare plans and have the plans let out to bid...
>
> It should also be noted that there are going to be extras. It is quite difficult to prepare plans which perceive all of the conceivable problems which may occur. For example, unexpected improperly enclosed stair shafts, parapet correction anchors which were never installed, etc. The project on West Sixth Street even had existing bearing walls which were to be used (as) shear walls which sat on existing steel beams with no positive attachments between the bottom plate of the existing walls and steel beams. Only gravity loads and friction kept the walls from sliding off the beams (1983).

After a year or two of experience with the Los Angeles ordinance, it became increasingly the case that building contractors were able to apply appropriate mitigations to relatively small, simple buildings without detailed plans developed by architects or structural engineers. This has, of course, driven down costs. As one might expect, costs have continued to decline as builders and engineers have increased experience and have developed improved approaches to strengthening. It seems fair to say that, as this book is being completed, one can complete hazard mitigations in unreinforced masonry buildings sufficient to comply with the Los Angeles ordinance for costs ranging from $3.50 to $20 per square foot, depending on the size and complexity of the building and the extent of strengthening required, with an average of about $8.00 per square foot.

PART TWO

THREE CASE HISTORIES

CHAPTER III
THE DEVELOPMENT, ENACTMENT, AND IMPLEMENTATION OF EARTHQUAKE HAZARD MITIGATION POLICIES AS SEEN IN THE CASE STUDIES

The Histories

Detailed case histories were developed for the Cities of Long Beach, Los Angeles, and Santa Ana, California. Each case history represents a different stage in the development of hazard mitigation policies and a different set of problems that communities face in developing effective hazard mitigation policies.

The City of Long Beach history was included because the 1933 Long Beach earthquake really marked the beginning point for most of the work done in the United States on developing aseismic design require-ments and incorporating them in building codes, to the extent that they have been incorporated, and because the City pioneered efforts to reduce the hazard to buildings built before those provisions were in place. Long Beach represents, in our study, the efforts of the innovator, including all the difficulties associated with that role.

Los Angeles is a very large city with complex social and economic interrelationships. It has had an extensive inventory of unreinforced masonry buildings, and its approach to hazard mitigation is sufficiently different from that of Long Beach to provide an alternative model for other municipalities. The much greater size and complexity of Los Angeles provides a contrast to Long Beach and offers an opportunity to ascertain whether the policy making process was substantially different in the two municipalities. The Los Angeles history is that of the early follower, the organization that is close on the heels of the innovator, learning from the innovator's experience and modifying the innovation to meet its own needs.

Santa Ana is included in the case histories for two primary reasons. First, although the city could be classed as an early innovator, it represents the bulk of communities, incorporating innovations as they are drawn into the mainstream of public policy. Santa Ana thus is representative of what most California cities are likely to go through as they enact policies to mitigate the unreinforced masonry building earthquake hazard. Second, the case provides lessons about of how local officials learned about hazard reduction potentials and decided to pursue a hazard reduction ordinance, the methods they used to enact the ordinance, and the circumstances that led to a reconsideration and revision of the ordinance.

The case histories begin with the 1933 Long Beach earthquake and track developments through mid-1985. Wherever possible, primary documents were utilized to develop the cases, including transcripts of public meetings, copies of ordinances and legal opinions, and original reports generated by public and private organizations at the time of those events. On occasion, it was necessary to use newspaper accounts of events. For more recent events, it was possible to employ semi-structured interviews with participants in the policy making process. Dozens of such interviews were conducted by project personnel.

The comparative analyses that follow the case studies focus primarily on Long Beach and Los Angeles because the ordinances are somewhat different, providing two models for communities. The Santa Ana ordinance is very much like that of Los Angeles, so it has been excluded from the comparisons.

Questions Raised by the Histories

Not only did it take a long time for Long Beach, Los Angeles, and other California cities to adopt measures to mitigate the earthquake hazards posed by unreinforced masonry buildings, but the policy making process was highly politicized. The Long Beach ordinance, and others, underwent substantial revision once adopted. Program implementation has proven to be difficult.

The difficulties encountered in Long Beach and Los Angeles in enacting measures to mitigate the potential disaster posed by a known hazard--in cities that had felt the dramatic consequences of those hazards--raises important questions and issues for those persons concerned with public policy making generally and with hazard mitigation specifically. As the case histories were being developing, the research team developed a list of some of those important questions.

They served as a guide for the analysis of the cases, but the questions serve also as a useful guide for the reader.

Why Did it Take So Long to Pass the Ordinances?

This is perhaps the fundamental question this book is intended to address. The answer to this question answers most of the others in the process. Elected local officials, particularly in larger cities, face critical issues on a daily basis. Most of these issues involve a variety of stakeholders whose perceptions of equity and values are, more likely than not, divergent. Most of those issues are dealt with, one way or another, in much less time than was required to develop and begin implementation of the earthquake hazard mitigation ordinances. Why did these particular ordinances take so long to enact? Were there special circumstances in Long Beach and Los Angeles, or is the process in those cases characteristic of what is required to enact mitigations for low-probability/high-consequence hazards? Will it always require inordinate amounts of time to develop and enact such mitigation policies?

To What Extent Was the Risk Known by Policy Makers?

The public policy making process that resulted in municipal ordinances to mitigate the unreinforced masonry (URM) building hazard was long and arduous, especially in the pioneering cities that adopted them first. While it is clear that professional geologists, architects, engineers, and building officials understood, at least to some extent, the nature of the hazards posed by URM buildings at least since 1933, one is compelled to wonder about the extent to which the risk associated with the hazard was generally understood during the policy making period and the extent to which the general understanding or lack of understanding of the hazard played a role in the policy-making process.

Knowing that a hazard exists is one thing; understanding the level of risk associated with that hazard is quite another. That is, it is not difficult to explain to local officials and residents that an earthquake of a particular intensity would probably cause a particular building to collapse on its inhabitants. It is more difficult to explain that, even though no quake has felled the building in the past 50 years, a risk exists. It is even more difficult to define the level of risk and to convey to the lay person what that risk means in terms that can be understood and internalized. To what extent did policy debates about the hazard and abatement of the hazard include consideration of the level of risk, if at all? Can a meaningful risk assessment be conducted on a communitywide or statewide basis for URM buildings? If not, how can one ascertain whether mitigations are cost-effective or even whether there is a positive benefit-cost relationship associated with the mitigation?

How Did Stakeholders Perceive the Risks?

In each of the cities that enacted mitigation policies, numerous and diverse parties had direct interests in the outcome of policy deliberations on whether the URM building hazards should be mitigated and, if so, the nature of those mitigations. If all parties had perceived the risk associated with the hazard identically, and if they had valued those risks similarly, then it would not have taken long to develop, enact, and implement mitigation policy. However, they didn't. How did the various stakeholders in the policymaking process perceive the risks associated with the URM building hazard? Should one expect various parties to perceive risks differently and to assign different values to them? If so, to what extent do differences in risk perception and valuation play a role in hazard mitigation policy making?

Can Earthquake Mitigation Policies be Implemented At All?

It has been argued by some scholars that controversial public policies often cannot be implemented successfully. Has the Long Beach ordinance, enacted initially in 1971, been implemented successfully? Have the newer Los Angeles and Santa Ana ordinances had different implementation histories? Are the administrative costs and resource requirements reasonable? What are the obstacles to effective administration of mitigation policies? What constitutes effective implementation in mitigating low-probability/high-consequence hazards?

Does the Design of a Hazard Mitigation Policy Make a Difference?

Both the Long Beach and Los Angeles ordinances are intended to mitigate the hazards created by URM buildings. However, the policies are not identical. Each embodies slightly different sanctions and incentives for owners of URM buildings. The incentives and sanctions create "rules of the game" to which individual decision makers apply their own decision rules and choose an appropriate response. To the extent that the ordinances differ from one another, it is useful for policy analysts and public officials to learn whether those differences in the policies result in significantly different behaviors by public officials and property owners. It is equally important to know whether either ordinance has generated dysfunctional side effects. Have these alternative intervention designs resulted in significantly different behaviors by the owners of URM buildings? Has the design made a difference in the effectiveness with which each of the ordinances has been implemented?

Have the Municipal Ordinances Had the Desired Effects?

It is important to ask whether the ordinances enacted by the several cities and examined here have resulted in the desired outcomes. Have the local policies reduced the hazards posed by URM buildings within their jurisdictions? To what extent? Do the ordinances appear to be cost-effective or are there alternative approaches to the mitigation that might make more sense? Under what circumstances is it worth the effort for municipalities to attempt to mitigate this particular hazard?

What General Lessons Can be Learned About Hazard Mitigation?

The more general issues and concerns that flow from this research have to do with designing, enacting, and implementing mitigations for the larger class of low-probability/high-consequence events. Illustratively, there is still insufficient understanding of how people perceive and value different classes of risk, or even of appropriate risk typologies. There is little agreement as to who should bear the costs incurred by knowing risk takers. Finally, there are important questions about the extent to which, and the conditions under which, it is politically feasible to enact effective policies designed to mitigate hazards for high-consequence/low-probability events. We do not purport to provide definitive answers to those questions here. We do, however, address the more specific questions posed above and, to the extent possible, provide some beginning answers to the larger issues and concerns.

It would be convenient for the reader if we were able to simply organize the case studies in terms of these questions. However, because the issues are complex and "inextricably intertwingled", such discourse is almost impossible. We have chosen to take the simpler path: the cases are approached chronologically. Subsequent analysis in later chapters addresses the several issues from a variety of perspectives, organized largely in terms of the issues.

CHAPTER IV
LONG BEACH, CALIFORNIA

The Early Attempts

Within a year of the 1933 earthquake, the City of Long Beach adopted revisions to the it's building code incorporating design requirements intended to reduce the vulnerability of newly constructed buildings to earthquakes. In the years following adoption, Long Beach building officials looked to the ordinance as a way to reduce the hazards associated with the existing unreinforced masonry buildings, but a series of legal interpretations led officials to conclude that the existing regulations provided little authority for enforcing corrections to existing earthquake hazardous buildings, except when there were changes in occupancy.

Although Long Beach building officials continued to try to find ways to mitigate the unreinforced masonry building hazard through the Depression and World War II, it was not until the early 1950's that they were given the legal authority to require repair or removal of hazardous parapets and appendages to buildings. This action resulted in the removal and/or strengthening of a large portion of these unsafe structures within the downtown area of the city. Life-threatening hazards for those outside of buildings had been reduced, but possible risks for occupants or others who might become victims of collapsed walls or buildings had not been affected substantially.

In 1959, Long Beach pioneered the establishment of municipal earthquake safety programs with the adoption of regulations that included the necessary authority for enforcing correction and elimination of earthquake hazards. At that time, the city amended its municipal code to define earthquake hazards associated with buildings as nuisances. This permitted the city to initiate legal proceedings against owners for elimination of earthquake hazardous buildings.

There had been some progress toward seismic hazard reduction in Long Beach, but the city's efforts were hampered by uncertainty about the extent of municipal authority to condemn hazardous buildings. It was not until February of 1966 that this uncertainty was alleviated. The reduction in uncertainty came about because of a decision by the

Supreme Court of the State of California. The case involved a lengthy dispute (the dispute began in 1959) between the City of Bakersfield and the owner of a downtown Bakersfield hotel whose building was condemned as a fire hazard. This decision determined that in appropriate circumstances, a government agency could abate a public nuisance even though doing so could require building demolition. The Court cleared the way for the City of Long Beach to pursue aggressively its program of condemnation of unsafe URM buildings:

> The fact that a building was constructed in accordance with all existing statutes does not immunize it from subsequent abatement as a public nuisance. (Queenside Hills Co. vs. Saxl (1946) 328 U.S. 80, 83; Knapp vs. City of Newport Beach (1960) 186 CA. App. 3d 669,681.) In this action the City does not seek to impose punitive sanctions for the methods of construction used in 1929, but to eliminate a presently existing danger to the public. It would be an unreasonable limitation on the powers of the City to require that this danger be tolerated ad infinitum merely because the hotel did not violate the statute in effect when it was constructed 36 years ago (*The City of Bakersfield vs. Milton Miller*, L.A. 28224)

Development of the 1971 Ordinance

With this legal opinion as reinforcement, the Long Beach Department of Building Safety did, in fact, accelerate its evaluation and condemnation program for existing pre-1933 buildings. As city officials began to implement this more aggressive program to condemn hazardous unreinforced masonry buildings, resistance to the program began to grow. Finally, in 1969, an organization known as the United Property Owners Association of Long Beach was formed. The group requested a hearing before the City Council to express its interest that the city re-evaluate the condemnation proceedings and to request a financial assistance program for affected owners. The owners were concerned that "(t)he city's present course, if not altered an modified, will make the CITY OF LONG BEACH A DISASTER AREA by the CONDEMNING of 1,100 to 3,000 buildings valued at a minimum of ten million dollars; with a loss of income of two million dollars and a loss of property tax dollars as well" (Downtown Long Beach Associates, 1969).

Specifically, the property owners requested that the City 1) direct "the Building and Safety Department to completely investigate and survey all buildings within the City of Long Beach that might be in violation of the 1959 Ordinance under which the Building Department is currently condemning owners' property," 2) to "cease issuing notices of condemnation, as well as cease action on present owners' property under condemnation until the survey of all properties is completed," 3) develop an estimate of the costs required "to make those improvements and corrections to comply with present City Ordinances," 4) establish a means for obtaining financing for affected property owners with which to make the needed repairs," and 5) have the Building and Safety Department inform "every property owner that might be affected, not with a threatening letter of condemnation, but with a letter with a positive approach that the Building and Safety Department wishes to discuss possible improvements and corrections that are necessary and that financing, as well as maximum compensation, is available at the owner's option."

Following lengthy discussion of this matter, the Long Beach City Council referred the matter to its Ordinance Committee for further analysis, requesting a report from the Committee. Several months later, in January 1970, the City Manager of Long Beach wrote to the Ordinance Committee, suggesting that "(S)ince your November meeting, we have continued to review this matter and have come to the conclusion it would be advantageous to have this subject thoroughly reviewed by a qualified consultant with the thought of providing your Committee with the best available outside professional counsel (City of Long Beach, 1970).

The Ordinance Committee agreed with the manager, and it recommended to the full Council that the condemnation issue be reviewed by a qualified, private, independent consultant. The City Council concurred in this and, in January of 1970, the city retained a private consultant to conduct an evaluation of the earthquake hazard in the City of Long Beach.

Eight months later, in August of 1970, the results of this study were presented to the City Council. It was recommended (Wiggins and

Moran, 1970) that Section 2314 of the 1970 Edition of the Uniform Building Code be adopted in its entirety, except that:

- Requirements for lateral force resistance to earthquake forces should vary with "importance factors" assigned to buildings put to different uses.
- Lateral force resistance requirements should vary among buildings depending on the characteristics of the foundation and the susceptibility of the site upon which it is located to earthquakes.
- The existing earthquake resistance of existing buildings should be taken into account (the City would assume a damping factor of 5 per cent. A higher figure should be used if the the characteristics of the building so warrant).

The consultant's report also included the following comments and recommendations:

- Structures over ten stories in height should be designed using approved techniques for assessing site and structural dynamics.
- A specific grading system should be adopted for evaluating the earthquake hazard associated with individual buildings.
- Specific procedures for inspecting and condemning buildings are delineated and recommended for adoption.
- General strengthening procedures are suggested.
- A post-earthquake plan of action should be developed and adopted.
- Relatively simple earthquake instrumentation should be placed on structures to record future earthquakes.
- A map of site dynamics should be prepared for the City.
- A study should be conducted to improve the earthquake insurance and loan situation in the City.
- Soils in the Long Beach harbor should be analyzed to ascertain their susceptibility to liquefaction (the quicksand effect) during an earthquake in view of the investment that is already there and planned future investment.
- Municipal code provisions dealing with requirements for anchoring articles such as light fixtures and internal contents should be developed.

Members of the City Council found the report complex and controversial, and felt that their limited technical knowledge of the subject hampered their ability to decide on appropriate policy. Therefore, the report was turned over to the Ordinance Committee for further analysis. Concurrently, the Downtown Long Beach Associates, a private organization which had voted to participate financially with the city to develop an ordinance, retained an attorney to draft a proposed earthquake safety ordinance (1970). This draft ordinance was submitted to the City Manager in December of 1970 and was subsequently reviewed by a committee comprising representatives of the Offices of the City Attorney and the City Manager, the City Building and Safety Department, the Downtown Long Beach Associates (DLBA), and the consultant. During this period, the Ordinance Committee continued to deliberate the issue, studying particularly the economic and financial implications of the proposed ordinance.

The Committee was still considering the issue when the 1971 San Fernando earthquake struck. This event generated renewed concern about seismic safety and the hazard associated with unreinforced brick buildings. In April 1971, the City Manager presented a Proposed Earthquake Hazard Ordinance to the Council. The ordinance established guidelines for the design of new structures and for the rehabilitation of existing ones. The following month, the City Council approved, in principle, the concept of an Earthquake Hazard Ordinance based upon the 1970 edition of the Uniform Building Code (UBC). The proposed ordinance would apply 1970 UBC standards to new construction. However, based upon study by the consultant and the Ordinance Committee, provisions of the UBC model code would be modified somewhat to give special attention to the problem of existing buildings, including, specifically, unreinforced masonry buildings.

The Council determined that the City Manager and City Attorney should consult further with the DLBA legal council and prepare an ordinance for Council action. This was done and the ordinance, entitled "Earthquake Hazard Regulations for Rehabililtation of Existing Structures within the City," was adopted on June 29, 1971 (City of Long Beach, 1971).

The ordinance required that buildings be graded and that they be ranked into priority groupings for remedial action. Buildings that were more hazardous were assigned higher priorities for repair or demolition. The equation used to rank buildings incorporated several variables: the earthquake susceptibility of the soil on which the building stood, the existing lateral force resistance of the building, and the extent of human exposure in the buildings to earthquake hazards.

In terms of the physical properties of the structures, the priorities established were as follows:

> *First Priority*: Type III buildings which utilize unreinforced masonry bearing walls and exhibit poor quality mortar.
>
> *Second Priority*: Type IV and V buildings with unreinforced masonry veneer, unreinforced non-bearing masonry walls or partitions, poor quality mortar, and poorly anchored bracing systems.
>
> *Third Priority*: Type III buildings with reinforced concrete and reinforced masonry bearing walls and wall openings with an aggregate area exceeding fifty per cent of the area of one or more of such walls.
>
> *Fourth Priority*: Type I and II tall structures with unreinforced masonry curtain and filler walls, and poor quality mortar.

Within each classification, buildings were to be assigned priorities based on their occupancy: buildings likely to have more people in them at any one time would have a higher priority than buildings with few persons in them. The ordinance incorporated an importance factor for average human exposure based on the average number of persons exposed times the average number of hours they were exposed during a specified period of computation.

Another feature of the ordinance was that it recognized that existing buildings do have some capacity to resist lateral forces. The means of calculating the actual lateral force-withstanding capability of individual buildings was detailed in the ordinance. The ordinance recognized that some buildings would not meet its minimum criteria for lateral resistance:

> ...the resultant implication that such structures have no lateral force carrying capacity whatever is inconsistent with the fact that they are still standing, and have experienced wind forces as well as some earthquake-generated lateral forces since their construction. Therefore, all structures which have existed at least ten years and which do not now exhibit evidence of substantial structural damage shall be deemed to have a minimum actual lateral force carrying

capacity... (City of Long Beach, 1971, Sec. 8100.8000, Subdivision 80).

Finally, the ordinance incorporated a Soil Zone Map. The map designated each area of the the city in terms of the relative earthquake hazards associated with those soils. The ordinance presented building owners with five options:

1. Abandon and demolish the building; or
2. Carry out such repairs or strengthening meansures as will raise the level level of the actual lateral resistance to an acceptable level; or
3. Reduce the projected lifetime to demolition of the structure to a level which in turn produces an acceptable level of lateral force carrying capacity; or
4. Reduce the number of persons exposed per year to death or injury in the event the structure suffered major structural failure during an earthquake, thus producing an acceptable level of lateral force carrying capacity; or
5. Accomplishing some combination of 2, 3, and 4 above, which has the aggregate effect of producing an acceptable level of lateral force carrying capacity.

If the owner elected not to upgrade the building, he or she would have 60 days after notice to vacate and demolish from the City's Board of Examiners, Appeals and Condemnation, unless there were appeals, to arrange for demolition. However, if the owner wished to strengthen the building, the owner would provide the city with plans for upgrading. If the plans were acceptable, the owner would have a designated period of time, not to exceed 10% of the expected economic life of the building, to complete the repairs. Allowances were made for extensions up to 50% of the time originally permitted if good reasons could be shown for construction delays.

1976 Modification of the Mitigation Policy

The 1971 ordinance had been considered a big step forward, but it proved difficult to administer. Edward O'Connor, the City's Building Official, reported to the Council that implementation of the new program was cumbersome and that condemnations were slow. Subsequent correspondence between O'Connor and the DLBA emphasized the constant need for continuing assessment of the new ordinance. It was not until November of 1972, 17 months after adoption, that the first notice of

Pending Order of Demolition was issued under the authority of the ordinance.

In September of 1973, The State of California adopted legislation requiring that a seismic safety plan be prepared by all cities and counties. In response, the City of Long Beach retained a consultant engineering and geology firm to do a seismic safety study for the city. In 1974, correspondence between O'Connor and the consultant concluded that the seismic safety study did not contribute a more viable approach to earthquake safety than that contained in the city's existing ordinance. The consultant's findings reinforced the need to proceed with implementation of the existing ordinance by stating:

> The vast majority of deaths during earthquakes are the result of structural failure due to ground shaking. Most such deaths are preventable, even with present knowledge. New construction can and should be designed and built to withstand probable shaking without collapse. The greatest existing hazard in the State is the continued use of tens of thousands of older structures incapable of withstanding earthquake forces. Knowledge of earthquake resisitant design and construction has increased greatly in recent years, though much remains to be learned...The City of Long Beach has a special problem with respect to the presence of old, unreinforced structures. *The rapid implementation of Subdivision 80 of the Long Beach Municipal Code is a rational approach to the reduction of this special seismic hazard* [emphasis added] (Woodward-Mc Neil and Associates, 1974).

By May of 1975, impatient with the slowness of the implementation of C4950, the earthquake hazard mitigation ordinance, Long Beach Building Department officials pressed vigorously for additional personnel. They hoped that added personnel would enable the Building Department to fulfill its obligations in completing the task of rating existing earthquake hazardous buildings--a task assigned four years earlier by passage of the ordinance. A year of intensified effort passed, but there was only minimal measurable impact in the reduction of earthquake hazardous buildings. Finally, in a letter to the City Council, dated October 26, 1976, the City Manager stated that:

> While the program was adopted in 1971, little substantial progress was made in its enforcement until the beginning of fiscal year 1975/1976 at which time the program was pursued with some vigor. At present, 86 buildings have been inspected

and rated, and although this is not too large a percentage of the estimated 850 unreinforced buildings we have in the City, we believe it has given us sufficient experience to identify certain inadequacies in the program.

Two principal difficulties with the ordinance were outlined by the City Manager. First, the ordinance, as written, created increased uncertainty for building owners and tenants. They complained that, under the existing ordinance, they were harmed because they did not know nor were they able to estimate the economic life of their buildings. Since it was not possible for either the Building Department, private engineers, or architects, to predict economic life, leasing the buildings even for short periods of time became difficult, if not impossible. The second major problem with the ordinance was that it did not have procedures that provided for sufficient differentiation between the degree of hazard that existed in the 850 buildings in the city that were affected by the ordinance. Such differentiation was particularly important if the truly hazardous buildings were to be identified and corrected before less hazardous buildings. Priorities established under the ordinance dictated a sequence of inspection and notification that did not permit such selectivity.

Looking back in 1981, the Long Beach Superintendent of Building and Safety, Eugene Zeller, agreed with those earlier observations. He stated that:

> Although the 1971 ordinance had been a major improvement over previous regulations, it had ...certain deficiencies that became evident in subsequent implementation. Of particular concern to owners of affected buildings was the uncertainty as to when the Building Department would evaluate their respective buildings, plus failure of the regulations to establish prescriptive and reasonable time periods for compliance. Without such information, many owners argued that property sales were being affected, long range leases could not be executed, and sound investment decisions could not be made.

Based on the October, 1976 evaluation, the City Manager recommended that the ordinance be reviewed. A series of meetings was held with local engineers to aid in that review. The meetings resulted in a set of recommendations and a proposed amendment to Subdivision 80 of the municipal code--the section that contained the mitigation ordinance.

The amended ordinance, C5276, was adopted in December of 1976, with hopes that it would reduce some of the uncertainty created by the original ordinance, Ordinance C4950, and that it would speed implementation. The revised ordinance provided means for increased differentiation between degrees of hazard and provided time schedules for abatement.

Under the terms of the revised ordinance, the hazard associated with an individual building was based on an index developed from three variables: the importance of the structure, life risk to occupants and/or pedestrians outside, and the structure's ability to resist seismic forces. A "Hazard Index" is computed, consisting of a dimensionless number inversely proportional to the degree of the risk. The formula used is as follows:

$$H.I. = A(1 + (200/O.P.))\ R_s\ cr,$$

where:

A is the building's occupancy classification, designated as follows:

A = 50 for emergency buildings, e.g., Fire, Police, Hospitals, Restrained or Non-Ambulatory Occupancies, Water, Power, Garaging of Emergency Vehicles, Medical Warehouses

A = 80 for Public Assembly, Schools, Colleges, Day Care Centers, Apartments, Hotels, Commercial Retail Buildings, Food Storage, Industrial with Hazardous Contents

A = 100 for Offices, Garages, Industrial Buildings, Work Shops, Warehouses, one and two family residences.

O.P.= Occupancy Potential, in which occupant load is computed based upon the building area used and an occupancy table (Number 33A) in the Long Beach Municipal Code. Buildings in Fire Zone Number 1 and adjacent to a public sidewalk have their occupancy potential increased by twenty percent.

R_s = A comparison of the seismic resistance of the existing building to the seismic resistance required of a new building designed under the provisions of the 1970 Uniform Code.

Five elements are stipulated in the code and are to be evaluated to determine a seismic resistance ratio: 1) vertical wall stability, 2) wall anchorage, 3) horizontal diaphragm capacity, 4) sheer connections parallel to sheer or moment resisting elements, and 5) sheer or moment-resisting elements.

The calculated Hazard Index is then used to classify and rank existing structures in terms of their seismic vulnerability. The regulations require that the 10% of the buildings considered most hazardous, as determined by the computation of the Hazard Index, beclassified as *Grade I-Excessive Hazards*. The next 30% are classified as *Grade II-High Hazards*. The remaining 60% are termed *Grade III-Intermediate Hazards*. Further, any building with dangerous ornamentation or parapets is given a classification of *Immediate Hazard*.

In cases of Immediate and Excessive Hazards, owner actions to repair or demolish a structure must begin at the time of official notice of condemnation. The ordinance required that owners of structures classified as High Hazard were to be notified by the City of Long Beach on or before January 1, 1984. At that time, they would be advised to begin repairs or demolish the building. Owners of structures determined to be intermediate hazards are not to be notified until January 1, 1991.

In order to obtain a Hazard Index rating for buildings with more than three stories, owners are advised to provide data concerning the building from a licensed structural or civil engineer. Failure to provide the city with this information would cause the property to be classified as an excessive hazard. The Department of Building and Safety will notify owners concerning hazard status of existing buildings.

If a building owner makes partial repairs that upgrade a building determined to be Excessive and High Hazard, the city may grant a delay in the date by which complete compliance is required, even to the 1991 compliance year. Plans for full or partial repair must be prepared by licensed civil or structural engineers or architects. Hazard grade certifications for individual buildings are recorded with the City Recorder. This is an attempt on the part of the City to inform prospective property buyers of the earthquake hazard potential for those buildings.

Seismic requirements of the Uniform Building Code of 1970 are the accepted minimum standard for renovation of hazardous buildings. Buildings are taken off the hazardous list as appropriate renovation results in a building that can withstand the minimum seismic forces established for new buildings as stipulated in the 1970 Uniform Building Code.

Figure IV-1 presents the activity sequence required to implement the 1976 ordinance. Table IV-1 provides a brief comparative summary of the differences in standards for the 1971 and 1976 ordinances.

Summary

In a recent interview, an official of the Building and Safety Department stated that the 1976 code was a marked improvement over the 1971 code. First, building hazard assessment under the 1971 code was based upon a visual inspection by the building inspector. This inspection proved to be highly subjective. Moreover, the 1971 code did not require the use of shear values as an evaluation factor, but used only percent of open space in the building as a basis for grading. Generally, too much was dependent upon the inspector.

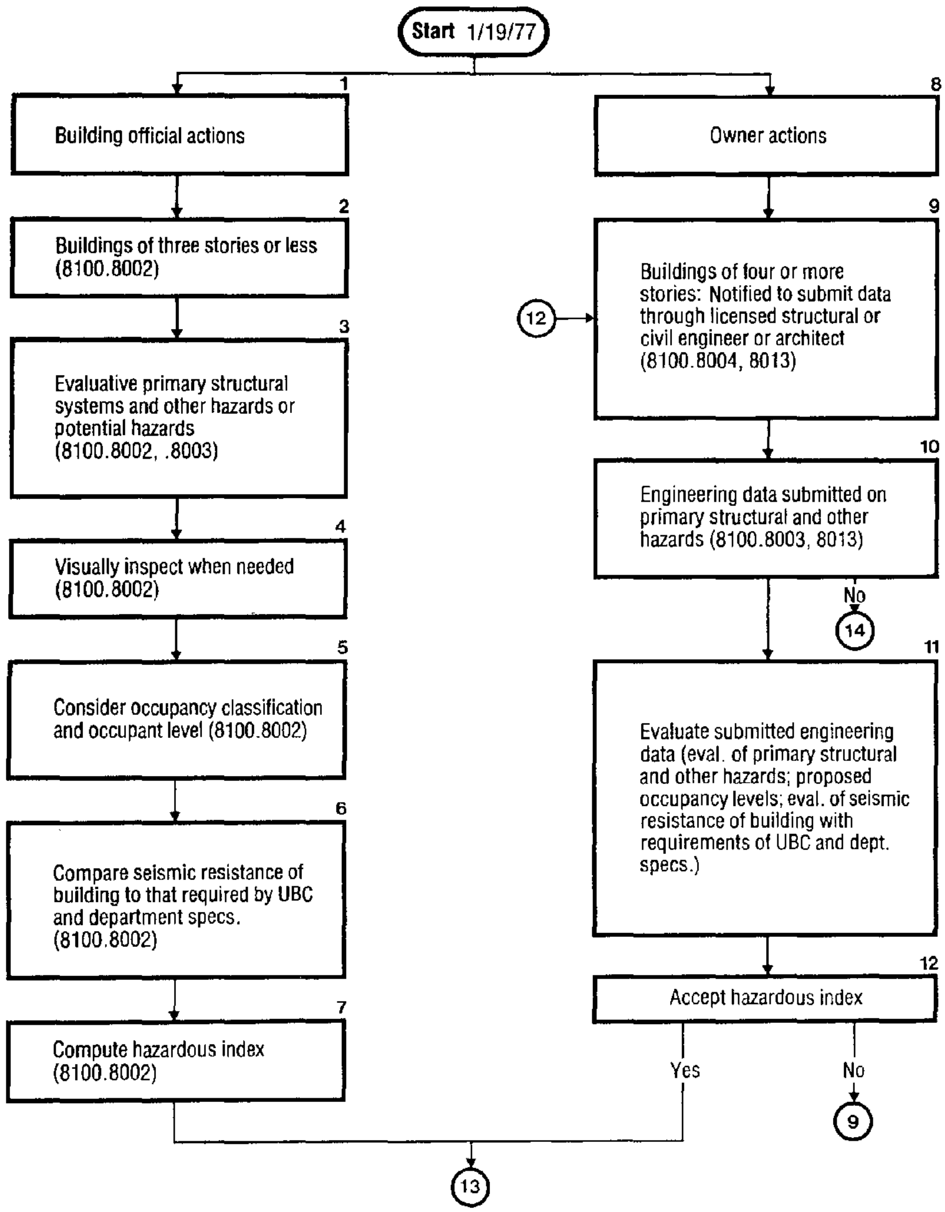
Second, the 1971 ordinance required soil mapping and soil factors analysis to aid in the determination of risk. Officials believed that this requirement did not provide a significant addition to information already available; most buildings involved were small and soil conditions were not, therefore, considered particularly important. Indeed, only 12 of the buildings at risk were over five stories and thus considered high-rise under the terms of the old ordinance. In addition, the 1970 UBC, which was the basis on which the code was developed, did not require use of soil considerations in determining seismic resistance.

The 1976 revised ordinance provides for appeals processes. Evaluation and enforcement procedures are set forth in the code. Should an owner fail to comply with regulations, the building official must apply to the Board of Examiners, Appeals and Condemnation for an abatement order to remove the nuisance. This board is composed of seven private citizens having some expertise in real estate, engineering, construction or architecture. The owner is given an opportunity to appear at a public hearing where both sides, owner and city, present pertinent information. The board then decides the issue. If it concurs with the building official, the owner is ordered to repair or demolish the structure. However, the board's decision can be appealed to the City Council. If the owner fails to comply, then the building official initiates steps for revocation of the Certificate of Occupancy for the building. Under some circumstances, the city may proceed to demolish the building at the owner's expense.

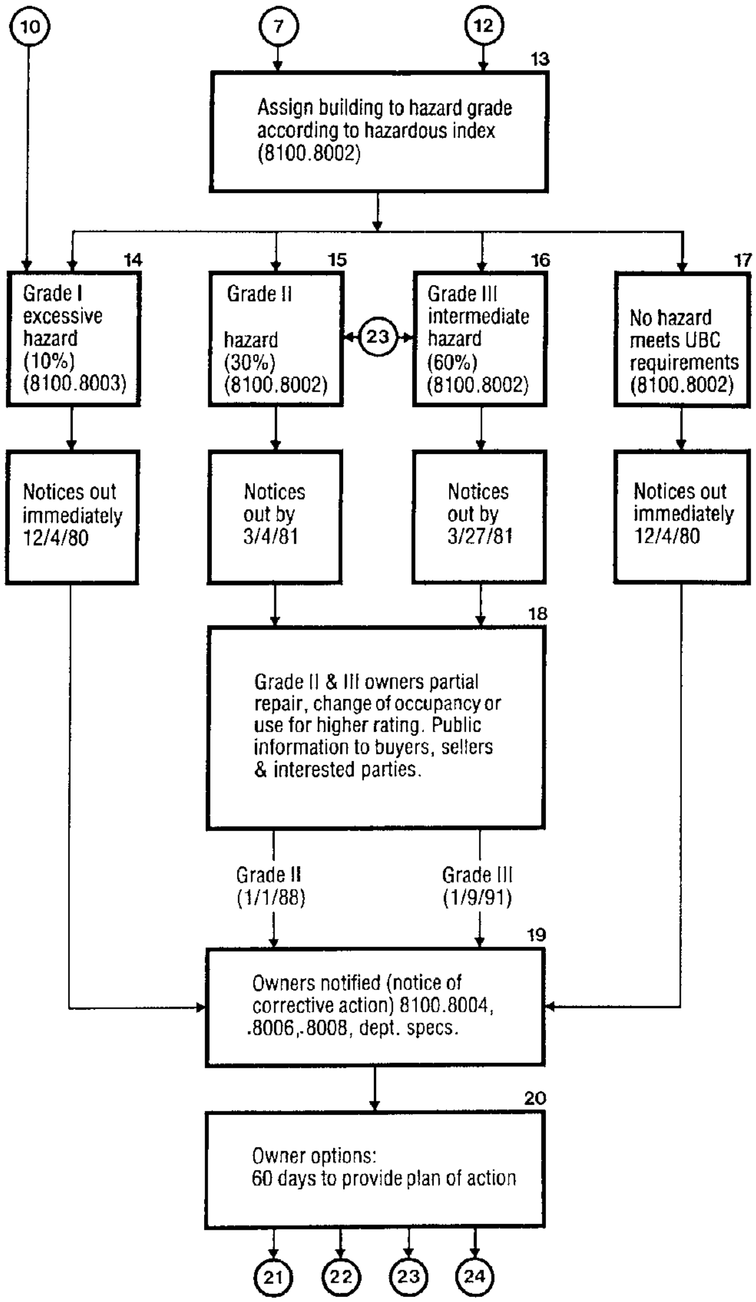
The regulations provide flexibility for the owners of affected buildings in meeting the requirements of the code. For example, intermediate repairs can be made to reduce the degree of hazard,thereby changing the grade to a less restrictive classification, thus delaying the date for full compliance. The hazard index can also be altered, and the associated date for compliance with building strength-ening or demolition deferred by changing the use or occupancy of the building, vacating a portion of the building, or repairing critical structural deficiencies.

A major criticism of the City of Long Beach's early approach was from owners whose buildings had not been evaluated and classified. They complained that they were unable to make investment decisions because of the uncertainty surrounding the future their buildings. Under the 1976 Code, all buildings have been graded and the owners notified. With this knowledge, owners can now examine all possibilities, confident of the time periods within which they will be required to meet the minimum seismic standards for their buildings. The city has greater assurance that building hazards will be abated, thereby improving the seismic safety of the community.

FIGURE IV-1 LONG BEACH EARTHQUAKE REHABILITATION ORDINANCE ADMINISTRATIVE SEQUENCE (ORIGINALLY 6/29/71) AMENDED 12/21/76, BASED ON ANALYSIS OF CODE AND ADMINISTRATIVE REQUIREMENTS



(Continued)



10
7
12
13
Assign building to hazard grade according to hazardous index (8100.8002)
14
Grade I excessive hazard (10%) (8100.8003)
15
Grade II hazard (30%) (8100.8002)
23
16
Grade III intermediate hazard (60%) (8100.8002)
17
No hazard meets UBC requirements (8100.8002)
Notices out immediately 12/4/80
Notices out by 3/4/81
Notices out by 3/27/81
Notices out immediately 12/4/80
18
Grade II & III owners partial repair, change of occupancy or use for higher rating. Public information to buyers, sellers & interested parties.
Grade II (1/1/88)
Grade III (1/9/91)
19
Owners notified (notice of corrective action) 8100.8004, .8006,.8008, dept. specs.
20
Owner options: 60 days to provide plan of action
21
22
23
24

(Continued)

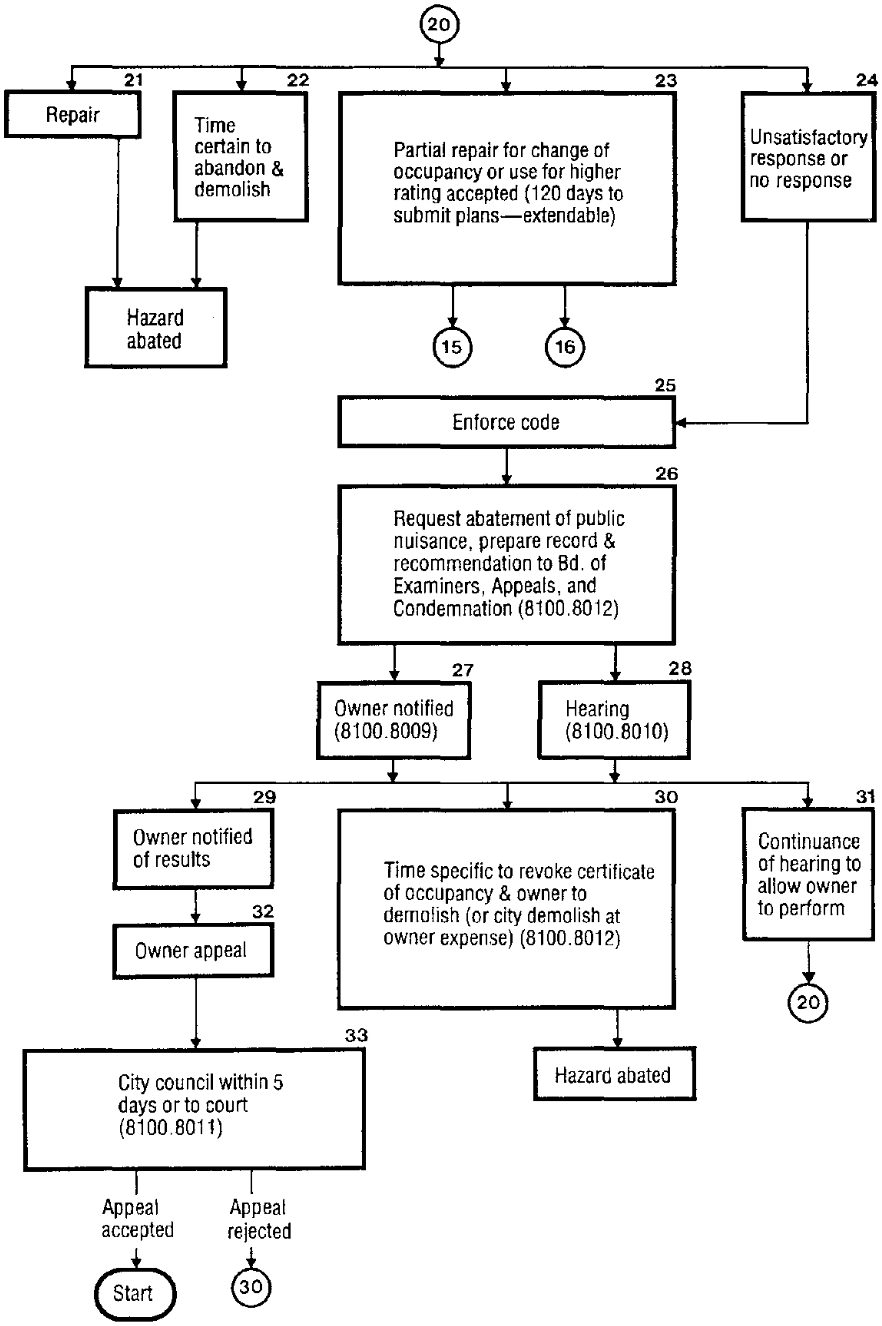

20
21
Repair
22
Time certain to abandon & demolish
23
Partial repair for change of occupancy or use for higher rating accepted (120 days to submit plans—extendable)
24
Unsatisfactory response or no response
Hazard abated
15
16
25
Enforce code
26
Request abatement of public nuisance, prepare record & recommendation to Bd. of Examiners, Appeals, and Condemnation (8100.8012)
27
Owner notified (8100.8009)
28
Hearing (8100.8010)
29
Owner notified of results
30
Time specific to revoke certificate of occupancy & owner to demolish (or city demolish at owner expense) (8100.8012)
31
Continuance of hearing to allow owner to perform
32
Owner appeal
20
33
City council within 5 days or to court (8100.8011)
Hazard abated
Appeal accepted
Appeal rejected
Start
30

TABLE IV-1 COMPARISON OF STANDARDS: 1971 AND 1976 LONG BEACH EARTHQUAKE REHABILITATION ORDINANCE

Standard	1971	1976
1. Requires soil mapping to determine coupling between structure and foundation rock.	Yes	No
2. Priorities for inspection and grading.	Yes	No
3. Lateral resistance or carrying capacity:		
a. Requires repaired buildings to meet 1970 UBC standards. Current carrying capacity is based on estimates made by building inspectors.	Yes	No
b. Actual lateral ability to withstand lateral stresses are based on engineering calculations. Engineer calculates maximum force to which the building can be subjected prior to failure. Buildings that have stood for ten years without substantial damage are assumed to have lateral strength as calculated from a look-up table.	No	Yes
4. Hazard rating:		
a. Rating by type of construction for various building components using a procedure established in the ordinance.	Yes	No
b. Rating is based on a hazard index which is based on building use (present and potential) and relative seismic capacity. Ordinance prescribes approximate percentage distribution of building by each of three hazard grades.	No	Yes
5. Classification of buildings by occupancy.	*	Yes

* 1971 ordinance make reference to high density buildings by incorporating the 1970 edition of the UBC occupancy categories, which are classified by the number of people exposed.

CHAPTER V
LOS ANGELES, CALIFORNIA

In terms of the potential for loss of life and property, the City of Los Angeles was more vulnerable than Long Beach, so the passage of the Long Beach earthquake hazard reduction ordinance in 1971 was viewed with interest by Los Angeles officials, particularly in view of the disastrous San Fernando Valley earthquake earlier that year. In February of 1973, then-Councilman Thomas Bradley formally requested that the Los Angeles City Council direct the City's Department of Building and Safety to analyze the feasibility of the city adopting a building rehabilitation program for seismic safety. The motion was as follows:

> WHEREAS, it is widely agreed among scientists that a major earthquake along the San Andreas Fault is nearly inevitable within the next century; and
>
> WHEREAS, the partial or total collapse of many unreinforced masonry buildings in Los Angeles could be expected in such a quake with great damage to human lives; and,
>
> WHEREAS, the City of Los Angeles must take steps to adopt a systematic long-term program to reduce the risk to lives by repairing such buildings, phasing them out, or converting them to low density uses;
>
> I, THEREFORE MOVE that the City Council instruct the Department of Building and Safety to report on the feasibility of adopting such a program to reduce the risk to the safety of the people of Los Angeles and that the Department be requested to seek qualified independent consultants to evaluate such a program, including studying the City of Long Beach's building safety codes to determine if they are feasible in Los Angeles (City of Los Angeles, 1973).

Nearly eight years would pass before Los Angeles would enact a seismic hazard reduction ordinance. The following is an account of its development.

The First Four Years: 1973 - 1977

Raising the Issues

The City of Los Angeles, a sprawling metropolis, is the second largest city in the United States. In the early 1970's, many thousands of old, unreinforced masonry buildings were still in use. Following the literal and figurative shock of the San Fernando Valley earthquake, a primary concern of cty officials was to minimize, as rapidly as possible, the potential for loss of life from an earthquake. They were, therefore, concerned with mitigating the risks associated with old, hazardous buildings, many of which held very high concentrations of people within their walls.

One such category of old, structurally outmoded buildings was aged motion picture theaters. Early in the discussion concerning the potential ordinance, these high-density, public-assembly buildings were targeted for action. It was argued that an earthquake could result in a seismic tragedy with injury and death to hundreds, perhaps thousands of people, including a high proportion of children. It is alleged that other reasons for early focus on these structures for hazard mitigation was that many of the oldest theaters would probably be demolished rather than strengthened, and that many of the theaters in older, poorer sections of the City regularly featured sexually explicit motion pictures.

It was perhaps a mix of motives that led to a motion on October 8, 1974, more than a year after the original Bradley motion, that:

> ...the City Attorney be instructed to draft an ordinance to require all existing motion picture theatres in the City of Los Angeles to be brought up to today's structural, wiring, and fire hazard codes at the earliest possible date (Snyder, 1974).

The City Council continued the motion. Debate and discussion followed for months. The Association of Motion Picture and Television Producers, Inc., was strongly opposed to the proposed regulation, citing the inability of theater owners to handle the financial burden of rehabilitation. The Association argued that:

> Inasmuch as it is the motion picture theater which is the primary outlet for our product, and since many of our most prestigious theaters such as the Chinese, Pantages, Paramount, etc., would be among those affected...we would oppose any further ordinances which would make the operation of theaters more costly or which would result in the closing of theaters...(Hunt, 1975).

Joining in strong protest to the proposed regulation was the California Society of Theatre Historians. This group felt that many of the buildings in question were part of the Los Angeles cultural heritage and that they should be exempt from any danger of demolition.

After review, the General Manager of the City's Building and Safety Department concurred with the need for the motion picture theater ordinance and suggested at the April 23, 1975, City Council meeting (now two years after the original Bradley motion and four years after the San Fernando Valley earthquake) that a similar ordinance be developed for all other structures with large assembly areas. The City Council decided that the matter was sufficiently sensitive to warrant a public meeting and tabled further discussion until one could be held.

The public meeting was held ten months later, in January of 1976. Arguments were heard from the public at large and from interested professionals. Following the meeting, the Conservation Bureau of the Building and Safety Department was directed to draft an ordinance "encompassing pre-1934 assembly buildings with unreinforced masonry bearing walls amd containing over 100 occupants in the assembly areas."

It was decided subsequently to hold a second public hearing in April, the subject of which would be "Earthquake Safety for Existing Buildings Housing Assembly Occupancies." During the second public hearing, strong concern was expressed by members of the public concerning methods of financing rehabilitations to assembly buildings should they become required. In April 1976, the President of the Board of Building and Safety Commission wrote to the City Council voicing these concerns. The letter, in part, read:

> Almost all of these buildings are in the older and lower-income areas of the City and repairs to these buildings are exceptionally expensive. *It has been estimated that the cost of structurally upgrading an unreinforced masonry building approximates the cost of a new building [emphasis supplied]*. Due to the fact that many of the neighborhoods are redlined, private loans for repairs are not available, and most owners are not able to carry such large expenses on their own. . . Socio-economic affect of legislation requiring massive removal or repair without accompanying funding would be severe. . .in the long run it is much cheaper in terms of dollars and lives saved to spend money for prevention of a disaster, rather than to wait for the disaster to occur and then spend enormous sums for clean up, replacement, hospitalization, and other earthquake abatement.

Consequently, the Commission President requested that the council investigate and lobby for federal and state grants, low-interest loans, or tax incentives so that unreinforced buildings could be repaired or removed without causing undue financial hardships for owners.

Developing a Draft Ordinance

From January through April of 1976, several versions of a proposed ordinance were submitted for council approval, but each time the proposals were returned to the Building and Safety Commission for clarification or change.

A continuing concern of the City Council was with deadlines established in the draft ordinances for bringing unreinforced masonry buildings up to acceptable standards. Upon consideration, the Conservation Bureau stated that although it was estimated that some 14,000 buildings were at seismic risk, only about 300 of these needed to be dealt with on a "first priority basis" due to their "potential for complete collapse." The bureau was opposed to any time extension for repair of these 300, but believed that the owners of the remaining buildings could have a time extension ranging from one year to two years to apply for a permit and that the time for actually mitigating the hazards associated with the individual buildings could be extended from two to four years. It was the bureau's view that cultural and historical monuments could be repaired under state guidelines for rehabilitating historical buildings.

Another matter of concern to the City Council was related to the use of a variety of structural mitigation methods to buildings beyond those methods specified in early drafts of the ordinance. The Conservation Bureau suggested that provisions could be incorporated in the ordinance to provide for the use of alternative methods of design and construction materials, but that the alternative approaches that might be permitted should meet standards equivalent to code requirements (City of Los Angeles, 1976).

In May of 1976, the city's Legislative Analyst presented the City Council with a draft of the ordinance that incorporated the above and combined motion picture theaters with other buildings where the assembly occupancy load was 100 or more persons. It was estimated that enforcement costs of approximately $150,000 per annum would be offset by fees, except for about $35,000. The Conservation Bureau urged that the proposed ordinance addressing the 300 most hazardous structures be adopted immediately, and that abatement regulations should be adopted in the near future for all pre-1934 unreinforced buildings. Bureau staff stated they considered this a matter of high priority, and that their view was shared by the Structural Engineers' Association of Southern California (SEASC), the State of California Seismic Safety Commission, and members of local state educational institutions.

In a letter to the Building and Safety Committee, SEASC urged rapid passage of the ordinance, suggesting that it was "the logical first step toward implementing" the Seismic Safety Plan adopted by the Los Angeles City Council the year before, in September of 1975. The association of engineers cited the following paragraph from the plan:

> A major seismically-related problem faced by the City is the strengthening or abatement of existing earthquake hazardous buildings. Recognizing the potential for massive economic dislocations that would result if a full-scale program were instituted at one time, the Plan recommends that priorities for abatement be set based upon method of construction, hazard to life, occupancy, physical condition and location. A systematic time-phased program that begins now could result in hazard abatement within the life of this Plan. Ongoing City programs that result in the removal of hazardous buildings from the scene, although at a much slower rate, are also recommended for continuance (City of Los Angeles, 1975, p.3).

<u>Dealing With Multiple Interests</u>

The safety of city residents was a primary concern of the members of the Building and Safety Committee, but the financial burden for rehabilitation that would be imposed on the owners of these old buildings could not be ignored. The committee questioned the City Attorney as to whether it would be constitutional for the city or other levels of government to provide loans to churches and private businesses to finance the rehabilitation of their buildings to reinforce them against earthquakes, and about the legal implications of developing a program for testing buildings to determine their capacity to withstand earthquakes. The City Attorney reported that loans could be provided to private businesses for the purpose of reinforcing their buildings against earthquakes, but that loans could not be made to churches or other buildings used primarily for sectarian purposes.

Meanwhile, the Legislative Analyst's Office was researching other possible means for providing financial assistance to building owners, and other officials worked on the problems associated with enforcing a regulation for rehabilitating hazardous structures and and with alternatives to costly methods for diminishing seismic risk to citizens, including interim solutions.

On October 1, 1976, an interim solution was proposed. The city's Building and Safety Committee directed the City Attorney to prepare an ordinance requiring that conspicuous warning signs be placed on hazardous structures and directing that they remain there until the seismic hazard associated with the building was eliminated. This action triggered a rash of citizen protests. Apartment house owners, the Hollywood Chamber of Commerce, private attorneys, owners of commercial properties, and Howard Jarvis, representing the Apartment Association of Los Angeles County, Inc., all voiced angry objections, arguing that the ordinance was a threat to the right of property ownership, the right to operate businesses, and the right to a means of livelihood. One property-owning attorney provided 13 arguments against the posting of such signs or the adoption of a rehabilitation ordinance:

> The proposed ordinance is a direct attack on the poor. . . on senior citizens. . . on every tenant in the city. . .makes it impossible for the owners of and investors in the older buildings to comply with it. . . would put tremendous upward pressure on rents in the City. . . create unimaginable voter unrest . . . create great investor unrest. . . attacks buildings which have stood safely for fifty years or more and have demonstrated they are reasonably safe. . . would . . .confiscate private property, and thus be subject to attack as unconstitutional. . . takes no account of the geographical area or strength of individual buildings. . . It is irrelevant that the ordinance will not take effect for ten years. . . The proposed ordinance is unfair and unjust to me, as well as to other building owners. . . The proposed ordinance is unfair and unjust to those in most need.

While many of the arguments were presented emotionally, there was no question that some very real citizen concerns were being expressed. At the time of the proposal, the Hollywood area was in the midst of a major revitalization effort. Three thousand of the unreinforced masonry buildings at issue fell within this community's borders, and the Chamber of Commerce was concerned that demolishing them would result in substantial loss of property taxes, added welfare problems due to lost jobs, increased insurance rates, reduced potential for future sales of the buildings, and financing problems for upgrading or rebuilding the structures. The City had intended that posting the signs would simply warn residents who were at risk prior to the time when rehabilitation work would begin, but the owners believed that the signs themselves would cause tenants to stop paying rent during the same period that the owners would be required to expend large sums for reconstruction.

Not everyone was opposed to the proposed ordinance, however; positive reinforcement came from the Los Angeles Chamber of Commerce, the Chairman of the State Historical Building Code Advisory Board, private citizens, and members of the U.C.L.A. engineering faculty. Those who supported the ordinance did not ignore the economic factors, but believed that the hazards were sufficiently great to warrant the socioeconomic costs. Alfred Ingersoll, a distinguished civil engineer, in voicing his support, said that efforts toward seismic structural safety had been thwarted, time and again, by those who would be burdened by the expense of strengthening or replacing the old buildings.

Intensifying the Political Debate

On November 1, 1976, the City Attorney's Office submitted to the Building and Safety Committee of the City Council a draft of an ordinance amending the Los Angeles Municipal Code to require posting the controversial signs and repair or demolition of earthquake-hazardous buildings. Due to the earlier public outcry, the Council tabled the proposal until a public hearing could be held. In early December, more than 100 invitations were mailed to interested persons advising them of a public hearing scheduled for December 16. In the interim between the mailing and the hearing, Howard Jarvis of the Apartment Association of Los Angeles sent a letter to "All Owners and Operators of Brick Buildings in the City of Los Angeles," indicating that his association "is leading the fight against this ordinance." His letter listed four reasons for opposition:

> 1. Two-thirds of all brick buildings built before the 1933s face demolition.
> 2. *Costs of repair would be an amount equal to 80% of the replacement cost of the entire structure* [emphasis added].
> 3. Ordinance adoption would cause cancellation of most liability insurance policies.
> 4. No one is either going to buy or maintain, or be able to sell or finance, buildings scheduled for demolition (Jarvis, 1976).

The ordinance, as presented to Council in December, stipulated that buildings would be considered earthquake hazardous if the building had been constructed or was under construction prior to October 6, 1933, and if the building had, on the effective date of the ordinance, unreinforced masonry walls which provided vertical support for a floor or roof, and if the total superimposed load was over 100 pounds per lineal foot. Single-family dwellings were not covered by the ordinance.

The proposed ordinance described a sequence of action by city officials once a structure was determined to be hazardous. First, the owner was required to post a sign warning occupants of the earthquake hazard associated with the building. Second, the owner was required to maintain the sign until the building is "repaired to conform to the horizontal force requirements of the Building Code in effect at the time a building permit is issued to make such repairs." Third, if the repairs were not made, the owner would have to demolish the building not later than January 1, 1987.

The draft was available to those present at the December 16 public hearing. At the hearing, the City Attorney discussed the legal ramifications of the proposed ordinance, indicating, in response to questions, that "the proposed ordinance is an exercise of the City's police power" and does "...not constitute a taking of property for public use for which compensation must be paid." While the City Attorney recognized the real economic problems which could result for owners from enforcement of the ordinance, the legality of the ordinance did not appear to be in question.

Seeking Clarification and Facts

Following the hearing, the City Council requested additional research and clarification, the results of which were to be presented at a special meeting on December 22, 1976. The Chief Deputy of the State of California Insurance Department and representatives of private insurance firms were invited to attend in order to provide information related to the possibility that insurance costs would be increased if buildings were designated as seismically hazardous. The Conservation Bureau of the Department of Building and Safety was charged with presenting a report on the economic impact of the ordinance, and the City Attorney was directed to provide information about the city's liability if steps were not taken to require the renovation of privately and publicly owned buildings to make them earthquake-resistant.

At the meeting, the Conservation Bureau presented preliminary findings based upon a random sample of 200 buildings inspected by city staff. Based upon this sample, it was estimated that approximately 14,500 businesses employing 75,000 people were operating in unreinforced masonry structures, and that 9,300 businesses (48,800 employees) would face permanent relocation if these buildings were to be demolished. Approximately 72,000 people were estimated to live in dwelling units which would be affected. Of these, 46,300 people would have to be relocated permanently. The residential vacancy factor in the buildings exceeded 15%.

The report assumed that attrition would account for a reduction of about 4,000 unreinforced masonry buildings over the ten-year period during which the ordinance would be implemented and that 50% of the remaining buildings would be repaired at a cost of some $660 million. Demolition costs for the remaining 5,000 buildings were estimated at $67 million. Two additional points were addressed: the total estimated market value (1976) for the 14,000 structures was about $840 million, and over 20% of the buildings surveyed for a 1961 city ordinance requiring mitigation of hazardous parapets had since been destroyed.

The City Attorney (1976) reported that there was some possibility that the City could be held liable in the event of a seriously damaging earthquake "where it has prior knowledge of unsafe condition...actual liability, however, could only be determined under the specific facts which pertain at the time of injury."

The culmination of the special meeting was the scheduling of yet another public meeting for January 6, 1977. It was decided that the press would be given sufficient advance notice of the public hearing date to provide as many citizens as possible with sufficient prior notification. Additionally, the City Attorney was directed to prepare another report on the liabilities of property owners relative to seismically hazardous buildings.

Continuing Concern by Building Owners

Public commentary at the January, 1977, meetings essentially restated original concerns about the costs of rehabilitation and the social and economic consequences of the proposed ordinance to a part of the city that was already economically disadvantaged. In addition, property and business owners were disturbed about the negative effects of the warning signs that were to be posted conspicuously on the affected properties. Comments included statements such as:

> "To give a 10-year time to comply with a code is one thing, but to jeopardize our business by requiring a sign of this nature is unfair..."

> "...even conceding that the proposed ordinance were meritorious, which we do not, how much safety can we afford?"

> "The income from our building pays for most of my 94 year old Mother's expenses in a convalescent hospital, and so far, we have been able to keep her off of welfare. I am willing to make any necessary and/or reasonable repairs to make our building safer, but I do not agree with the idea of posting signs on the buildings."

Citizens also expressed their concerns about the uncertainty of the earthquake hazard in Los Angeles:

> "Now I've heard everything! Our brilliant City Council is going to tear down 14,000 buildings because there *might* be an earthquake that *might* knock these buildings down and the people *might* get hurt."

"So you're going to knock them down first and leave them (the people) homeless instead. That's like cutting off your arm so then you won't ever have to worry about breaking it!"

"Are you gentlemen playing with all your marbles?"

The Los Angeles City Council was faced with a very difficult choice. Fourteen thousand structures were known to represent a significant seismic hazard to many thousands of city residents. Professionals in the geophysical community were cautioning Southern California of the fact that time was running out before a seismic catastrophe would occur. Almost four years had gone by since the initial motion by Tom Bradley to initiate an abatement program for pre-1934 seismically hazardous buildings. Numerous drafts of proposed ordinances had been submitted by city staff and all had been found wanting. Five public hearings had been held in which property owners raised important and emotionally charged issues. The entire subject was becoming politically volatile.

<u>Postponing the Decision</u>

The City Council requested a summary of the history of the proposed ordinance from the Building and Safety Committee. This was presented at the end of January, 1977. After a comprehensive review, the Council's Committee studying the matter said:

> We believe that a balance should be maintained between our concern for the public's safety, on the one hand, and the economic survival of a segment of the public, on the other.
>
> In view of the above, we recommend as follows:
>
> (1) That the Department of Building and Safety conduct a city-wide survey, over a period of two years, for the purpose of identifying and cataloging all pre-1934 unreinforced masonry bearing wall buildings, except one- and two-family dwellings.
>
> (2) That the Building and Safety Committee be instructed to appoint a special study committee, under the chairmanship of the Department of Building and Safety, to develop a comprehensive earthquake safety ordinance for all pre-1934 unreinforced masonry bearing wall buildings, except one- and two-family dwellings.
>
> (3) That the Planning Department be instructed to review impact upon the environment of such an ordinance . . . and to prepare an appropriate environmental report.

> (4) That the City Council request our Congressional delegation to seek financial assistance to rehabilitate buildings prior to a disaster rather than after the fact.
>
> We further RECOMMEND that the accompanying ordinance [*the current draft*] *not be presented* [*for Council consideration at this time*] [emphasis added].

Following receipt of this Committee report, the City Council held two additional public hearings. Owners of unreinforced masonry apartment, commercial, and industrial buildings reiterated citizen concerns. Others, such as James Slosson of the State Seismic Safety Commission, recommended adoption of the ordinance. A motion was made to approve a two-year study as recommended by the Building and Safety Committee. The council approved the motion. Mayor Bradley concurred in the decision and transferred $81,680 for implementation of the study on February 1, 1977. The motion was later amended (February 17) to limit the study to one year.

The Second Four Years: 1978 - 1982

Fact-Finding and Rethinking

Within ten months of the request for the study, a preliminary draft of an ordinance entitled "Earthquake Hazard Reduction in Existing Buildings" was completed by the Earthquake Safety Study Committee. The draft was presented to the City Council in December of 1978. The proposed ordinance would apply to unreinforced masonry bearing wall buildings constructed prior to aseismic code requirements incorporated into the Los Angeles building code in October of 1933. Detached residential buildings with fewer than five dwelling units would be excluded from the requirements for seismic strengthening.

In addition to establishing structural requirements for strengthening the seismic resistance of URM buildings, the ordinance established a compliance program to extend over a ten year period, allowing for appeals and time extensions for hardship cases. Notification for compliance was to be based on a priority system. Compliance would be required to begin in six months for high-risk buildings (large open buildings with 100 or more occupants used more than 20 hours per week), in 18 months for medium-risk buidlings (any building with 20 or more occupants if not an essential building or a high-risk building), and five years for low-risk buildings (all other buildings if not an essential building). A class of structures was defined as *Essential Buildings*: these were buildings required for emergency use immediately following an earthquake (hospitals, communication centers, fire stations, and police stations). Strengthening of these buildings would have to begin as soon as the owners were notified of structural deficiencies.

Subcommittees of the City's Earthquake Safety Committee concerned with evaluating impacts of the proposed ordinance and with technical considerations had met frequently during the year. The subcommittees recommended several topics for council consideration. *First*, no reasonably accurate information was available concerning the probable costs of rehabilitation and, therefore, no data were available concerning the financial impact of the ordinance. *Second*, although many ideas had been suggested for financing repairs, no solid recommendation had emerged. The subcommittee believed that the Council should defer enactment of the ordinance until a financing plan was available. *Third*, no massive increases in insurance premiums had occurred in Long Beach following enactment of that city's seismic ordinance; however, only 800 buildings were involved. While 800 buildings might not occasion rate increases, the large number of unsafe buildings in the Los Angeles inventory might result in substantial increases in insurance premiums. *Fourth*, the subcommittees were unable to find a definitive way to help finance relocation of residents or commercial building tenants. *Fifth*, it was concluded that there was a high probability that rents would be increased by owners to offset the cost of repairs. Since a significant number of the affected tenants were elderly or poor or both, this posed severe social problems. *Sixth*, because Proposition 13 had been passed, it was unlikely that municipal tax revenues could be used to any great extent to help with relocation or subsidized housing to help deal with the problems generated by passage of the ordinance. Moreover, the possibility existed that businesses located in pre-1933 buildings would move out of the city entirely, rather than face tenancy interruptions or rehabilitation costs.

Finally, the Subcommittees identified several topics deserving further consideration, but which would require legislative action at either the state or federal level. These included the possibility of enacting tax incentives for owners who engage in rehabilitation work, creation of low-interest loans for rehabilitation work, and providing incentives for new building construction following demolition of the old building.

During the eight years since the ordinance had been first proposed, a great deal of information had been developed concerning the possible problems of implementing a seismic ordinance, but the issues had not changed: the threat to life and safety from the URM buildings was serious, disadvantaged persons were at risk, and no financing program was immediately available. The sheer duration of the development of the Los Angeles ordinance was taking a toll. Urging swift adoption, Charles Richter, developer of the seismic Richter Scale, said "I do not overlook problems of relocating present occupants, nor the loss of income to property owners; but these points are secondary to the obvious issue of life and death. Central Los Angeles should be treated as a potential disaster area before it becomes an actual one" (1979).

On November 27, 1979, the Building and Safety Committee sent invitations to yet another public hearing to all those who had shown either positive or negative interest in the passage of the seismic ordinance. The hearing was held on Saturday, December 1, to "further consider the proposed Earthquake Safety Ordinance which would provide for mandatory rehabilitation of about 8,000 unreinforced masonry buildings built prior to 1934."

Developing Data on Costs and Technology

Since the ordinance had been first proposed, the total number of URM structures at risk continued to decline as a result of attrition resulting from redevelopment, street widenings, and normal building replacement. Three old buildings had been scheduled for demolition in

1978 because they stood in the path of a planned street-widening program. However,the city agreed to postpone the planned roadwork in order to allow Ben Schmid and other engineers with a continuing interest in the problems of rehabilitating unreinforced masonry buildings, on behalf of the Structural Engineers Association of Southern California's Hazardous Buildings Committee, to test hypotheses concerning ways to reinforce such structures. The committee also persuaded the City of Los Angeles to donate the three buildings for testing purposes.

Until then, possible methods for rehabilitating such buildings had been mostly theoretical; the absence of very much empirical information had contributed to the uncertainty about the costs of rehabilitation. Grants from several private sources were arranged so that the necessary work could be done by students from California State University, Los Angeles. The results of these efforts eventually smoothed the way for the enactment of both the Los Angeles and the Santa Ana seismic regulations, but in late 1979, the political climate in Los Angeles was too sensitive for the findings to have a major impact on council deliberations.

At the December 1 public hearing, city staff presented attendees with a fact sheet on the proposed ordinance. The fact sheet detailed the four categories of buildings (*Essential*, *High Risk*, *Medium Risk*, and *Low Risk* Buildings), and the proposed compliance schedule for each. The staff announced the creation of a special steering committee on financing and an ad hoc committee which would, early in 1980, complete a study to estimate the costs of compliance. This latter study, of course, was greatly aided by the results of the experimental rehabilitation work on the three old buildings. The city's staff asked participants at the public hearing to consider four issues:

1. Can the city, which has this information, ignore its moral and legal responsibility to protect the lives of its citizens to the best of its ability?

2. Can the city in good conscience mandate a program for landlords, most of whose tenants are in the lower income categories, that involves costly rehabilitation?

3. Can the city in good conscience dislocate people from their affordable housing either temporarily or permanently, realizing both the cost of rental housing and a very low vacancy rate?

4. Should the City of Los Angeles decide not to enact the proposed ordinance due to the lack of solutions for the previous two concerns, does it then become liable in the event of a disaster for being conscious of the problem and still not taking any action?

The issues had not changed appreciably since the inception of the city's deliberations on pre-1934 seismically hazardous buildings. Yet indecision was still the order of the day. No conclusions were reached at the hearing.

The concern over the costs of rehabilitating the unreinforced masonry buildings continued, but the cost study commissioned by the City Council was nearing completion. In May of 1980, the consulting engineering firm of Wheeler and Gray submitted its report, "Cost Study Report for Structural Strengthening Using Proposed Division 68 Standards," to the city (Division 68 is the portion of the Los Angeles City Ordinance dealing with earthquake hazard mitigation in existing buildings). The study, based on evaluations of a number of different types of buildings, suggested fairly reasonable rehabilition costs per square foot: $5.65 for a four-story apartment building; $11.00 for a building with apartments over a light industrial operation; $7.90 for a one-story warehouse; $7.15 for a one-story warehouse with a mezzanine, and so forth (see Table V-1).

In mid-July, the City Council's Building and Safety Committee met to assess the probable costs associated with implementing of the proposed seismic ordinance based upon the Wheeler and Gray findings. The committee determined that the average strengthening cost equalled 21% of the replacement cost of the buildings studied, but would be only about 15% of the replacement of apartment buildings. Using these figures, and assuming a 15-year amortization period, the committee computed monthly costs per unit ranging from $21 to $87, depending on current interest rates and the size of the housing unit (see Table V-2). The Building and Safety Committee concluded:

> ...the use of the proposed...earthquake standards will reduce the strengthening costs from a previously estimated 70% (using 1980 earthquake standards for new construction) to approximately 20% of the replacement costs. These earthquake strengthening costs would be shared jointly by the tenants and owners with possible help from the government in the form of low interest loans. In addition...the value of buildings strengthened to Division 68 standards will increase, however [sic] the amount of increase is difficult to determine at this time.

The lessons learned from the SEASC work on the three old buildings, including newly devised methods for rehabilitating unreinforced masonry structures, and the Wheeler and Gray cost studies had paid dividends to the city. Not only had better methods been developed for reinforcing such buildings, but it could be shown that rehabilitation costs would be significantly lower than the 80% of replacement costs originally suggested by Howard Jarvis several years before and, indeed, below the costs originally feared by the owners.

While the research on techniques and costs analyses was being developed, concern had been voiced concerning the need for special consideration for unreinforced masonry buildings if they were deemed to have significant cultural or historical value. It was proposed that an exception be incorporated in the seismic ordinance to provide that such buildings would be dealt with under the existing State Historical Building Code.

Adjusting the Proposed Ordinance

In August of 1980, a suggestion was offered by the Department of Building and Safety to lessen the financial and social impacts of the proposed regulation. The department suggested a "dual time-phased concept" for compliance. This would provide owners with a choice. They could either strengthen their buildings to conform to the ordinance within three years of notification or, if they anchored unreinforced masonry walls properly within one year of notification, depending on the building classification, an additional four to ten

TABLE V-1 **COST ESTIMATES FOR COMPLYING WITH SEISMIC STANDARDS REQUIREMENTS FOR FIVE UNREINFORCED MASONRY BUILDINGS, 1980 ***

Building Description	No. of Stories	Construction Cost** Total	Construction Cost** Per Sq. Ft.	Project Cost*** Total	Project Cost*** Per Sq. Ft.
Apartment 33,400 sq. ft.	4	$190,000	$ 5.67	$208,000	$ 6.22
Apartment and Industrial Use 17,200 sq. ft.	3	189,000	11.02	207,000	12.08
Warehouse 6,400 sq. ft.	1	50,400	7.90	55,600	8.70
Industrial 10,800 sq. ft.	1 + mez.	78,300	7.15	86,000	7.90
Commercial 14,000 sq. ft.	2	135,000	9.66	148,000	10.60
Average 16,400 sq. ft.		$129,000	$ 7.87	$141,000	$ 8.60

*Based on April 1980 dollars.
**Includes contractor's profit, overhead, and contingencies.
***Includes engineering, testing, and building permit fees.

(Wheeler and Gray, 1980)

years would be permitted for full compliance. All notices, regardless of building classification, would be sent to owners within four years of ordinance adoption and all buildings would be scheduled for compliance or demolition within 15 years (See Table V-3).

The dual compliance scheme was approved by the Building and Safety and the Planning Departments and, during the first week of December, 1980, the City Attorney was directed to draft what was hoped to be the final version of the seismic safety ordinance for the abatement of hazardous structures in the City of Los Angeles.

TABLE V-2 ESTIMATED COST IMPACT PER MONTH ON REHABILITATED DWELLING UNITS BASED ON COMPLIANCE WITH PROPOSED STANDARDS FOR THE LOS ANGELES ORDINANCE REQUIRING STRENGTHENING OF UNREINFORCED MASONRY BUILDINGS *

Assumed Interest Rate	Cost per Unit Per Month**	
	600 Sq. Ft. Unit	1000 Sq. Ft. Unit
0%	$21	$34
3%	26	43
10%	40	67
15%	52	87

*Based on $6.20 total cost per square foot (1980 dollars).
**Rehabilitation costs amortized over 15 years.
(City of Los Angeles, 1980)

On December 10, 1980, the the City's Planning Department submitted its completed Environmental Impact Report along with a "Statement of Overriding Considerations." The statement indicated that there may be significant environmental effects from the implementation of the proposed earthquake hazard reduction ordinance, including a reduction of housing stock, dislocation of tenants, impacts on commercial and industrial facilities, and loss of irreplaceable cultural resources. However, said the Planning Department, the social, economic, and other benefits of the proposed ordinance outweighed the prospective costs. The report indicated that the following benefits would derive from enacting the ordinance:

1. The hazard to life in the event of a major earthquake would be substantially alleviated, with perhaps a five-fold reduction in anticipated casualties.

2. Buildings that might otherwise collapse or be damaged beyond repair under moderate ground shaking could be expected to sustain only moderate damage and remain serviceable.

3. Essential facilities that are within the scope of this proposal and needed to cope with the immediate effects of an earthquake would be more likely to survive the earthquake in a functional condition.

4. Buildings not worth repairing would eventually be demolished, conceivably making the land available for more productive use.

5. Rehabilitation of the older buildings could make them and their neighborhoods more attractive, improving their competitive position relative to newer areas.

6. The needed repair or demolition of 8,000 buildings would provide work for the construction industry.

<u>Bringing it All Together</u>

In the eight years since Councilman (and subsequently Mayor) Bradley had first introduced a resolution to begin serious action on an unreinforced masonry building earthquake hazard mitigation ordinance, the process had become intensely politicized. Seismic specialists, engineers, and other scientists pressed for an ordinance; landlords and owners lobbied hard against one, enlisting when possible the help of tenants concerned more about rent increases than about seismic safety. Just as in Long Beach--where the city's chief building official, Edward O'Conner, and his successors, including Eugene Zeller, worked unceasingly as inside advocates to help ensure passage of an effective municipal policy--Los Angeles had its inside advocates. Although many inside the city government, including Earl Schwartz and others, worked hard for passage of an ordinance. Councilman Hal Bernson should be noted for his role as an inside advocate. Bernson, who headed the Council's Building and Safety Committee during the critical periods of policy development and whose own district had been hardest hit by the 1971 San Fernando earthquake, worked diligently as an advocate of seismic safety and should be credited for an instrumental role in passage of the ordinance.

TABLE V-3 PROPOSED DUAL TIME-PHASED CONCEPT FOR REHABILITATING UNREINFORCED MASONRY BUILDINGS IN LOS ANGELES, 1980

Building Classification	Years to Notification	Years for Full Compliance*	<u>or</u> Years to Install Anchors*	Years for Full Compliance*
I Essential (100)	0 -1/4	3	1	4
II High Risk (1800)	1/4 - 1	3	1	6
III Med. Risk: over 100 occupants (1600)	1 - 1 3/4	3	1	8
III Med. Risk: 50 to 100 occupants (1700)	1 3/4 - 2 1/2	3	1	9
III Med. Risk: under 50 occupants (1600)	2 1/2 - 3 1/4	3	1	9
IV Low Risk (1000)	3 1/4 - 4	3	1	10

Numbers in parentheses indicate estimated number of URM buildings it that category.
*Computed from date of official notification.
(City of Los Angeles, 1980)

The City of Los Angeles was coming close to adopting a municipal policy to require seismic strengthening of URM buildings. On December 16, 1980, another public hearing was held, during which the City Council heard from those opposed and those in favor of the new draft of the ordinance as submitted by the City Attorney. The Wilshire Chamber of Commerce requested a deferment to allow additional time for study of the Environmental Impact Report. A motion for a 30-day extension was made, but failed to carry, so the council voted on the First Reading of the ordinance. The vote was 11-3 in favor; however, since a unanimous vote had not been obtained, council by-laws necessitated that a Second Reading take place one week later on December 23.

For the December 23 council meeting, the Building and Safety Committee once again prepared a summary of the history of the deliberations on the ordinance in which they told council members that "the Special Earthquake Safety Study Committee spent two years of study involving several hundred hours of work and many meetings with engineers, architects, geologists, seismologists, property owners and tenants." The summation reminded the council that the United States Geological Survey had predicted "catastrophic results if a major earthquake hits the Los Angeles area" and that such an event could result in 12,000 fatalities and 48,000 injuries, most of which would occur in "unsound, unreinforced masonry buildings such as...covered by the ordinance." The council was reminded of the cost findings of the Wheeler and Gray report, and of the fact that "a representative of (a major local bank) stated that financing of these buildings would be made available by lending institutions."

Many interested citizens attended the meeting and wished to speak on the subject. There was not enough time for all those who wished to speak, so the meeting was continued to the next day, December 24. There was still not enough time for all those who wished to speak, so the meeting was continued to January 7.

On January 7, 1981, the Second Reading of the ordinance took place. Councilman Snyder of the 13th District requested a number of revisions and moved that a new draft of the ordinance be prepared to reflect these. The motion failed by a tie vote of 6-6. A brief public hearing was then held, during which those opposed to the ordinance voiced objections related to excessive rehabilitation costs, rent increases caused by rehabilitation, tenant displacement, and possible reduction in the number of living accommodations in the city as a result of demolition. Persons speaking in support of the ordinance noted the inevitability of an earthquake in Los Angeles, the reasonableness of the proposed ordinance in terms of compliance times, and the fact that the costs incurred might not be as great as had been anticipated.

Following this last opportunity for public comment, the council voted on the Second Reading of the ordinance, passing it by a vote of 11 for and 3 against. The ordinance was transmitted to the mayor. The

City of Los Angeles finally got an ordinance for mitigating the earthquake hazards posed by unreinforced masonry buildings.

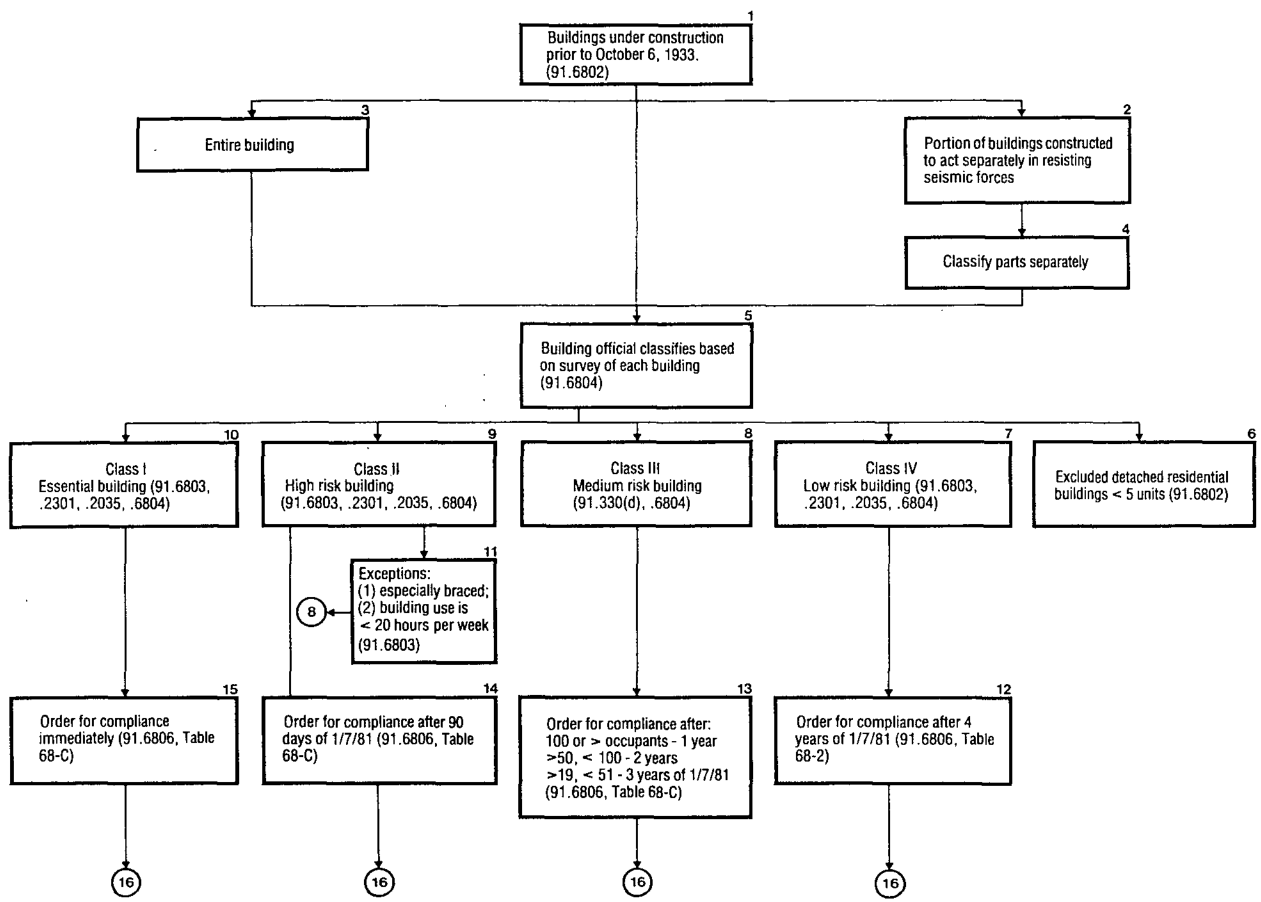
The ordinance, as finally passed, had as its purposes to establish minimum earthquake standards for existing buildings and to reduce risk of death and injury in the event of an earthquake. The ordinance applied to all pre-1934 unreinforced masonry buildings except for detached residential buildings having fewer than five dwelling units. Four rating classifications were established to determine priorities for enforcement. Building owners were required to hire a licensed engineer or architect to determine the building's earthquake deficiencies and to structurally alter the deficiencies to meet established standards. Generally, the standards imposed by the ordinance reflected the standards in effect in the city from 1940 to 1960 and were approximately 50% to 70% of the 1980 Los Angeles Building Code requirements for new construction.

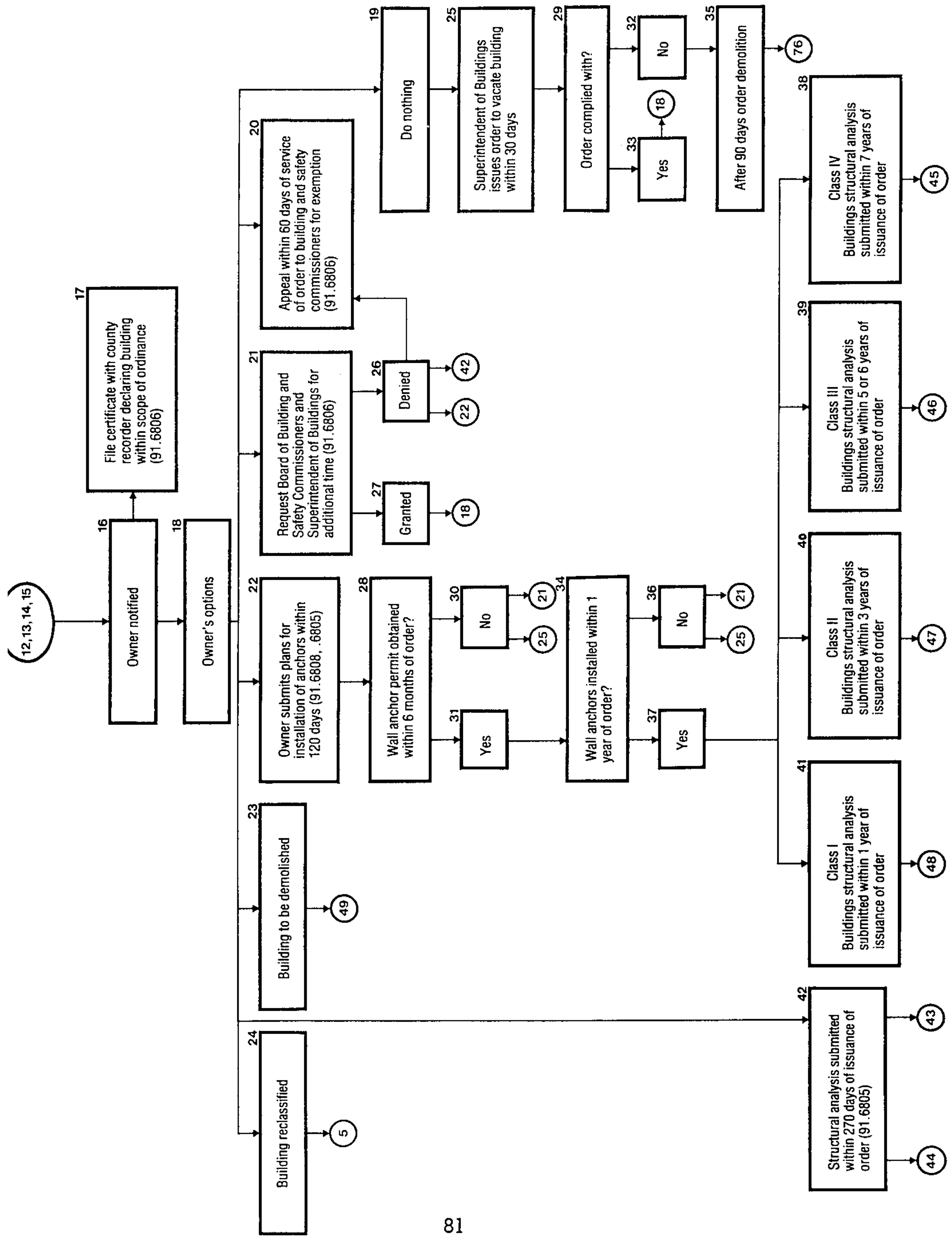
The dual time approach was incorporated into the ordinance, but no provisions for financial assistance were included. Owners who installed wall anchors, which would reduce substantially risks to life safety, would have additional time to comply with all structural requirements. Owners were to comply based on priority classifications assigned buildings: *essential* and *high-occupancy* buildings were scheduled for earliest compliance. *Low-occupant* buildings were to be last. An appeals process was established.

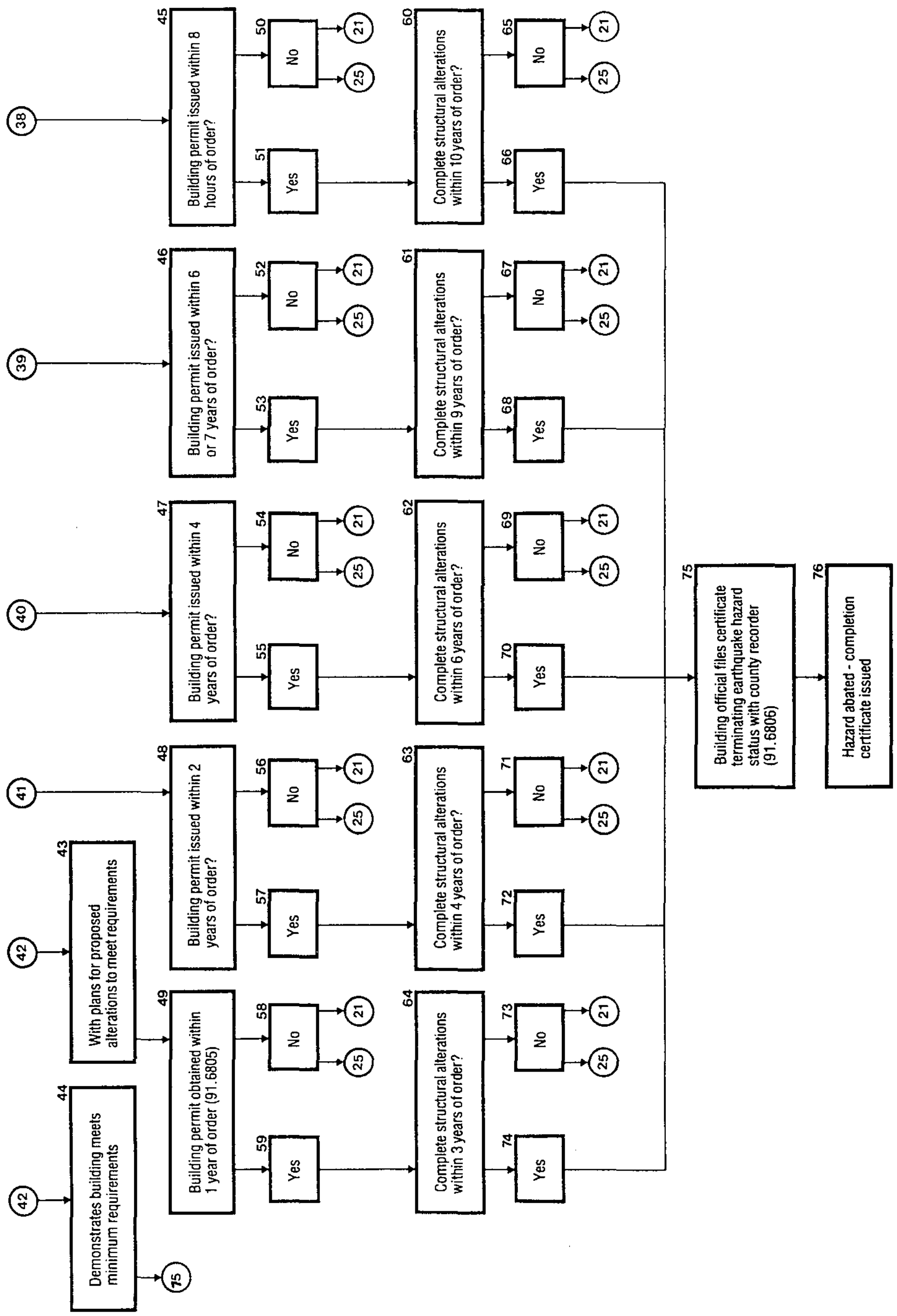
Finally, the ordinance recognized the lateral resistance of the existing structure by including allowable design values for materials and by providing testing procedures for evaluating the strength of masonry walls.

The administrative process for implementing the 1981 Los Angeles ordinance is included as Figure V-1.

FIGURE V-1 LOS ANGELES EARTHQUAKE MITIGATION ORDINANCE ADMINISTRATIVE SEQUENCE




12, 13, 14, 15
16 Owner notified
17 File certificate with county recorder declaring building within scope of ordinance (91.6806)
18 Owner's options
19 Do nothing
20 Appeal within 60 days of service of order to building and safety commissioners for exemption (91.6806)
21 Request Board of Building and Safety Commissioners and Superintendent of Buildings for additional time (91.6806)
22 Owner submits plans for installation of anchors within 120 days (91.6808, .6805)
23 Building to be demolished
24 Building reclassified
25 Superintendent of Buildings issues order to vacate building within 30 days
26 Denied
27 Granted
28 Wall anchor permit obtained within 6 months of order?
29 Order complied with?
30 No
31 Yes
32 No
33 Yes
34 Wall anchors installed within 1 year of order?
35 After 90 days order demolition
36 No
37 Yes
38 Class IV Buildings structural analysis submitted within 7 years of issuance of order
39 Class III Buildings structural analysis submitted within 5 or 6 years of issuance of order
40 Class II Buildings structural analysis submitted within 3 years of issuance of order
41 Class I Buildings structural analysis submitted within 1 year of issuance of order
42 Structural analysis submitted within 270 days of issuance of order (91.6805)
5
18
21
22
25
42
43
44
45
46
47
48
49
76



38
39
40
41
42
42
45 Building permit issued within 8 hours of order?
46 Building permit issued within 6 or 7 years of order?
47 Building permit issued within 4 years of order?
48 Building permit issued within 2 years of order?
43 With plans for proposed alterations to meet requirements
44 Demonstrates building meets minimum requirements
75
49 Building permit obtained within 1 year of order (91.6805)
50 No
51 Yes
52 No
53 Yes
54 No
55 Yes
56 No
57 Yes
58 No
59 Yes
21
25
60 Complete structural alterations within 10 years of order?
61 Complete structural alterations within 9 years of order?
62 Complete structural alterations within 6 years of order?
63 Complete structural alterations within 4 years of order?
64 Complete structural alterations within 3 years of order?
65 No
66 Yes
67 No
68 Yes
69 No
70 Yes
71 No
72 Yes
73 No
74 Yes
75 Building official files certificate terminating earthquake hazard status with county recorder (91.6806)
76 Hazard abated - completion certificate issued

CHAPTER VI
SANTA ANA, CALIFORNIA

Seismic risk from unreinforced masonry structures is much lower in the City of Santa Ana than in Los Angeles or Long Beach because fewer than 200 such buildings existed in the city in 1980 and only 50 of those were considered to be high-risk buildings. Nonetheless, on February 19, 1980, the City Council of Santa Ana adopted, by unanimous vote, an ordinance intended for "Earthquake Hazard Reduction in Existing Buildings" to the Municipal Code (Ordinance No. N.S. 1518, Article XI).

The stated objective of the article was to: "...promote public health, safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry buildings." The ordinance established minimum seismic structural requirements, and outlined procedures and standards for identifying and classifying unreinforced masonry buildings based upon building use and occupancy.

During the development of the seismic strengthening ordinance, the City of Santa Ana was involved in, and strongly committed to, a plan for community redevelopment. The redevelopment project was pivotal in the emergence of the seismic ordinance. Seventy-six percent of the high-risk structures identified in preliminary seismic studies were located in the redevelopment area.

This chapter traces the development of the Santa Ana seismic ordinance, reviews the relationship between the policy and the downtown rehabilitation program, and examines the circumstances which led to a substantial revision to the ordinance. The Santa Ana experience is demonstrative of a community that learns quickly from the experience of the pioneers and early innovators, adopting and adapting those innovations to meet its specific needs.

Redevelopment and Seismic Concerns

The City of Santa Ana remained relatively sparsely populated from its incorporation in 1869 until the 1960's. However, from 1960 to

1980, the city's population increased more than 85% from 100,350 to 186,800. Santa Ana, the seat of Orange County government, did not grow as fast as the balance of the county, which tripled in population between 1960 and 1980 from 634,000 to 1,854,000. This dramatic growth created problems for city and county leaders, not the least of which was the question of how and where to house burgeoning city and county administrative offices that had outgrown their facilities. Moreover, the major portion of those offices was in the oldest buildings in the city civic center, and many were in unreinforced masonry buildings.

A number of similar buildings in the civic center had failed in the 1933 earthquake, although they were located some 25 miles from the epicenter of the Long Beach earthquake. Three persons died in Santa Ana and, according to newspaper accounts at the time, "practically every business block in the downtown area" was damaged. Losses were estimated to be $1 million (in 1933 dollars).

Although seismic data for Santa Ana had not been fully developed in 1975, an advisory committee of structural engineers had been engaged by the Santa Ana Redevelopment Agency to develop a revitalization program for the downtown civic center area. The Santa Ana Redevelopment Commission had been charged with rehabilitating as many of the original buildings in central Santa Ana as possible. A number of buildings in the redevelopment area were still owned and operated by families considered to be city founders. These buildings were viewed with pride by their owners, and city leaders encouraged their preservation.

According to Robert Lawson, a member of the commission, "Commission engineers were cognizant of the behavior of unreinforced masonry structures, in part as a result of the San Fernando quake, and of the fact that sophisticated lenders would not provide moneys to rehabilitate them since no reasonable standards of the industry existed."

Downtown Blight and Unsafe Buildings: 1975-1978

On February 3, 1975, the Santa Ana City Council adopted a resolution (No. 75-8) to "preserve and improve the housing conditions in the City, to make the environment better, and to arrest blight and slums."

The Santa Ana central city had "the highest percentage of families below the poverty level, of the unemployed, of families receiving public assistance, of overcrowding, high school dropouts, and density per residential acre," and was referred to as "Orange County's social disaster area." By passing the resolution, the Council approved a three-year housing and community development plan intended to upgrade the area.

Two months later, in April, the Council adopted another resolution (No. 75-39) amending the original one to include a statement of the general objectives for the development plan. These objectives included revitalizing the central city and the North Main shopping area by: implementing a program of beautification and improvements; restoring the economic, social, and physical health of the Santa Ana Redevelopment area; making the area a source of pride to persons residing and working in Santa Ana or visiting the city; guiding development toward an urban environment preserving the aesthetic and cultural qualities of the city; assisting in the re-establishment of businesses within the project area, and; stimulating and attracting private investment, thereby improving the City's economic health, employment opportunities, and the tax base. In addition, the resolution included a general statement of the scope of redevelopment plan, including "demolition and clearance of buildings, structures and other improvements from real property in the Project Area" and "establishment of standards for the rehabilitation, alteration, modernization, general improvement, or any combination thereof by the Redevelopment Agency or the owners of existing structures."

On May 15 of 1975, a public hearing was held to discuss a proposed redevelopment ordinance to provide for implementing the plans embraced in concept by the prior resolutions. At that meeting, the Director of Building Safety reported that a survey had been conducted of the condition of buildings and premises in the proposed project area to determine the extent of blight. The building condition survey indicated the existence of "substantial violations of the Codes and Standards of the City, including such problems as over-crowding of buildings...obsolete building types, as well as defective structural and mechanical elements" (City of Santa Ana, 1975a). He said that 106 of the 472 properties surveyed were sub-standard.

In the public discussion that followed, many of the same arguments against renewal projects that one hears in other cities around the country were voiced. Illustratively, the chairman of a private organization, the Property Rights Association of Santa Ana, objected to the plan, arguing that it provided for "acquisition of private property through eminent domain for private gain." The City's Special Counsel responded that the deterioration in the downtown area had caused a gradual decrease in property and sales tax revenue and that the plan could restore the city to a healthy economic base.

The preliminary community plan was presented to the City Council shortly before the end of 1975. One component of the plan was an analysis of a proposed building rehabilitation program. Analysis indicated that, within the 11 areas of the city targeted for rehabilitation, "65 per cent [of the buildings] were more than 30 years old, and 16 per cent had a life expectancy of less than 19 years." The analysis indicated further that the city's existing Building Conservation Program had resulted in "...the rehabilitation or demolition of 160 deteriorating residential, accessory or business buildings within the past year." Moreover, intensified building rehabilitation would "conserve the existing inventory of low-moderate cost buildings, reduce unsafe and unsanitary conditions, improve the appearance of existing buildings and structures, and diminish the infectious blight of deleterious buildings leading to neighborhood blight" (City of Santa Ana, 1975b).

The completed 2,000 page plan was not presented for council approval for almost a year, but on November 23, 1976, it was offered to a Joint Study Session of the Planning Commission and the Santa Ana City Council for review. It was reported to the joint session that dilapidated housing and loose buildings were among the six problems identified most frequently by residents in planning surveys in the city. Studies showed about 5,000 units in the city in need of repair or renovation.

More than another year passed before Community Development Program Commercial Property Improvement Guidelines were approved by the City Council. However, in December of 1977, $30,000 was appropriated to encourage approximately 30 businesses to rehabilitate their properties.

From 1975 through 1977, the central issue revolved around community blight, but in May of 1978, Councilman Gordon Bricken questioned the number of buildings in the downtown area that might be unsafe for occupancy and asked for a report on the subject from city staff. That same month, the Assistant City Manager told the council that meetings had been held with the Police, Fire, and Building Safety Departments, and that the staff recommended creation of a task force to survey the downtown buildings, to develop a plan for acquisition and demolition of undesirable buildings, and to proceed with long-range development plans for the downtown area. The suggestion for a "Downtown Building and Safety Cleanup" was put into effect rapidly. In July of 1978, a Public Safety Task Force was authorized by the council and was commissioned to assess the building, fire, police, health and life safety hazards in existing downtown buildings.

By the middle of 1978, then, plans for revitalizing downtown Santa Ana were adopted and work was proceeding. While possible retail exodus and blight were perhaps the foremost concerns of city fathers, concern about hazardous buildings had become an important consideration and steps were being taken to see what might be done, in the context of the plan, to deal with concerns for public safety in hazardous old buildings.

Emergence of Seismic Concern

Later that summer, in September of 1978, the annual conference of the Southern California Association of Structural Engineers (SEASC) was held in San Diego. One of the members of the Santa Ana Redevelopment Commission, Robert Lawson, himself a structural engineer, was present when Ben Schmid, John Kariotis, and Earl Schwartz delivered a paper entitled "Tentative Los Angeles Ordinance and Testing Program for Unreinforced Masonry Buildings." The paper reported preliminary findings from seismic strengthening and costs tests conducted on three unreinforced masonry buildings scheduled for demolition in the City of Los Angeles (See Chapter V). The presentation at the engineering conference would be pivotal to the emergence of the Santa Ana City seismic ordinance.

Following the San Diego conference, Lawson initiated a series of meetings with Schmid, during which they discussed the findings of the Los Angeles experiments and the potential for applying the findings to meet Santa Ana's needs. Lawson shared the information he had obtained with other members of the Santa Ana Redevelopment Commission. Members agreed that the results of the Los Angeles tests had merit and, perhaps, applicability to Santa Ana.

Lawson also discussed the matter with the city's building rehabilitation specialist, who indicated that it would be important to find a way to finance seismic rehabilitation. The discussion led the specialist to begin a search for a variety of ways to encourage owner participation in a program of seismic rehabilitation. Some federal funds were available for creation of a rehabilitation loan fund, under which money could be loaned to building owners at favorable rates for seismic reahbilitation. These funds were insufficient to finance all the needed improvements, but it was thought that they might act as "seed" money to interest commercial bankers to make additional loans.

Essentially, Santa Ana staff was working to create a win-win situation in which the city could be beautified and restored, its citizens would be at far less risk from seismic hazard, and private property owners could extend the economic life of their buildings.

Development of the Seismic Ordinance: November of 1978 to January of 1980

At the November 6, 1978, Santa Ana City Council meeting, the city's rehabilitation specialist suggested that the City of Los Angeles seismic ordinance could serve as a model for drafting an ordinance for Santa Ana to establish minimum standards for structural seismic resistance for unreinforced masonry buildings, and that the Los Angeles materials and the advice of a consultant could help a committee develop a draft ordinance.

Council members were quick to note that "building rehabilitation could be considered on a scale broader than specifically seismic safety," suggesting that it could be "tied into the overall objective of improving the economic feasibility of building rehabilitation." The

City Council was also quick to note the difficulty of developing a volunteer committee of civil and structural engineers sufficiently qualified to handle such a technical problem. In the end, the council voted to establish a Citizens' Committee and to give it authority to evaluate the "validity of test criteria and results incorporated in an ordinance proposed to reduce earthquake hazards in existing unreinforced masonry buildings and to further consider the whole question of rehabilitation of buildings in Santa Ana, subject to the approval of the Community Redevelopment Commission," thus creating the volunteer Citizen's Seismic Ordinance Committee.

That Santa Ana City Council meeting in November of 1978 resulted in two significant actions: a seismic ordinance committee was created and charged with "significantly reducing earthquake hazards at minimum cost," and city staff was instructed to develop a rehabilitation code.

Two weeks later at the council's next meeting, Community Development Coordinator, Alice McCullough, reported on one possible way to provide financial assistance to owners of buildings needing rehabilitation. McCullough indicated that California's Marks-Foran Rehabilitation Act of 1973:

> "authorizes California cities and counties, through local redevelopment agencies, housing authorities, or city agencies, to provide residential rehabilitation loans at below-market interest rates to owners of residential and certain commercial properties, and to sell tax-exempt revenue bonds to finance the loans, using the resulting mortgage loans as security for the bonds. The Program would enable the City to provide rehabilitation services for up to twenty times the number of residents with the same Community Development funds currently available, and can be developed over a period of approximately eightmonths for final Council approval." The program seemed to offer a relatively simple way to overcome the barrier of providing assistance to owners of affected buildings. The City Council directed city staff to initate steps necessary to establish the program. However, as we will see later, the program was never implemented.

Meanwhile, work continued on developing a seismic rehabilitation ordinance. A consulting firm was commissioned to study the seismic risks to the city, and, in April of 1979, the report, "Seismic Evaluation for City of Santa Ana," was completed. The study included analysis of available geologic and seismic data relating to Santa Ana and development of a report of findings and conclusions, including a map showing significant faults and earthquake epicenters. The study summarized the probabalistic hazards to existing unreinforced masonry buildings from seismic activity. The report provided potential parameters of earthquake recurrence, maximum credible earth-quake magnitudes, potential rock and ground accelerations, strong shaking to be expected, and building design parameters.

The report demonstrated that the City of Santa Ana is vulnerable to seismic activity on the Newport-Inglewood and Whittier-Elsinore faults. An earthquake with a Richter magnitude of 4.7 can be expected on the order of once per year, while an event of about R 6.7 can be expected every 100 years.

Table VI-1 ESTIMATED EARTHQUAKE RECURRENCE INTERVALS AND MAGNITUDES, SANTA ANA, CALIFORNIA

Earthquake Richter Magnitude	Recurrence Interval (Years)
5.0	2
5.5	7
6.0	21
6.5	64
7.0	200

Maximum credible earthquakes of magnitudes 7.0, 7.5, and 8.25 were determined for the area.

(Geotechnical Consultants, Inc., 1979)

At the same meeting, council members were presented with the Downtown Public Safety Task Force inspection report. Acting Fire Chief B.J. DuBose stated that the task force had examined several examples of substandard and hazardous buildings in the downtown area, and that, although abatement provisions for hazardous conditions are addressed in the city's existing codes, no suggestions for abatement were made in this initial study.

The City Manager, in further discussion of dangerous and sub-standard buildings, suggested that the city had a legal obligation to correct these conditions. In response to a question from the Mayor, the Assistant City Attorney indicated that "the City liability in permitting hazardous conditions to exist is very complex; that when there is a mandatory duty there is liability." He stated that some of the city's code could be interpreted as mandatory and, "the question of whether liability would accrue is being researched by the City Attorney's office for report to Council."

At the first June meeting of the City Council in 1979, John Coil, Chairman of the Seismic Ordinance Committee, delivered a report on the proposed Earthquake Hazard Reduction Ordinance for Existing Buildings. The committee's preliminary study indicated that, without the ordinance, a major earthquake in the Los Angeles area could result in approximately 160 deaths and 650 casualties in Santa Ana, while, with the enforcement of a seismic ordinance, the death figure could be reduced to 30 and the number of injured to 150. Additionally, it was estimated that "more than $18 million worth of building inventory could be saved from destruction." The cost of implementing such a program was admitted to be uncertain, but it was anticipated that it would be in the range of $6 to $7 per square foot of floor space.

Coil reminded council members that extensive damage caused by the 1933 Long Beach quake had demonstrated the fact that unreinforced masonry buildings constitute a hazard during seismic activity. He said that over one-half of the unreinforced buildings in the Cities of Long Beach and Compton were seriously damaged or demolished by that earthquake and subsequent aftershocks. He recalled the moderate to major damage to more than half of such structures in the City of San Fernando in 1971, and the damage in Los Angeles at that time. Coil also recalled the structural rehabilitation provisions in the California Administrative Code underlying current seismic resistance measures in public school buildings, and referred to their proven efficacy during the 1971 earthquake.

The draft ordinance proposed to the council was very much like the ordinance that was under consideration in Los Angeles at that time. It applied to unreinforced masonry buildings constructed prior to incorporation of aseismic provisions in the city's building code in 1934. Detached residential buildings with fewer than five dwelling units were exempted. The draft ordinance incorporated acknowledgement of lateral resistance in existing buildings if the building was otherwise structurally sound. The draft provided for a time-phased compliance program extending over a ten year-period, with possible time extensions in hardship cases. Like the Los Angeles ordinance, notification to comply would be on a priority basis, with compliance scheduled to begin in six months for *high-risk* buildings, 18 months for *medium-risk* buildings, and five years for *low-risk* buildings. Essential buildings required for emergency use immediately following an earthquake (hospitals, communication centers, fire stations, and police stations) would have to begin compliance as soon as notified. The proposed ordinance was almost a clone of the Los Angeles ordinance.

To underscore the report, Coil stated that the City of Long Beach already had a retroactive code which had been in force for several years. It required that buildings be brought into conformance with the 1970 Uniform Building Code provisions, and that "San Diego, Sacramento, Santa Rosa, and the City of Huntington Beach most recently have incorporated earthquake strengthening requirements into their Codes." He further explained that:

> ...the proposed ordinance and its parent Los Angeles City Ordinance is different from the previous retroactive ordinances in that it recognizes various risk exposures, depending on the use and occupancy of the building, and allows the use of the existing materials for resisting lateral forces in some cases. It also allows the use of lower lateral forces than those required for new construction. This proposed code represents the state-of-the-art for analysis and rehabilitation of existing unreinforced buildings.

Finally, the council was reminded of recent studies at the University of California, Berkeley Seismographic Station, indicating a 50% chance of a major (Richter scale 8+) earthquake by 1989.

Following the the Seismic Ordinance Committee's report, the Acting Director of Building Safety and Housing offered recommendations for a comprehensive rehabilitation code and the Mayor authorized a study committee to work with city staff to develop a rehabilitation code for the city.

There was some concern that the framework for the proposed ordinance advocated standards lower than the current Uniform Building Code in certain cases and could therefore generate problems for the city because the state required compliance with the UBC. This concern was alleviated when, in September 1979, the California State Legislature amended its Health and Safety Code to enable local jurisdictions to adopt lower-than-UBC standards for reconstruction of existing hazardous buildings. The state reasoned that this would "reduce the risk of death and injury in the event of an earthquake," and "establish economically feasible earthquake standards for rehabilitating seismically hazardous buildings which may differ from building standards which govern new building construction." The path was now clear for Santa Ana to refine, adopt and implement the seismic ordinance.

On November 19, 1979, the Santa Ana City Council approved three separate ordinances and two resolutions that provided the necessary machinery for adopting the proposed seismic ordinance and for rehabilitating downtown buildings. The first ordinance dealt with technical matters concerning building classification, and definition and abatement of nuisances. The second ordinance established a special revolving fund for repair and demolition of buildings declared to be public nuisances. The third ordinance authorized city staff to issue citations for building violations. The first resolution created city positions to enforce the new codes. The second resolution approved issuing bonds for helping to finance rehabilitation work.

The framework was fully in place for the enactment of the Santa Ana City seismic ordinance so, in January of 1980, the draft ordinance to reduce the earthquake hazard in existing buildings was presented to the City Council. The ordinance was enacted on February 19, 1980. Like the Los Angeles draft ordinance after which the Santa Ana ordinance was modeled, the new ordinance established a standard for rehabilitation of seismically hazardous buildings comparable to code levels in effect during the 1940's. These levels were approximately 55% to 70% of the 1980 UBC requirements.

The ordinance described administrative procedures for establishing priorities for building owner notifications, the content of the notification itself, and methods of appeal and legally recording actions taken on various properties. In general, buildings with the highest classifications would be notified first. The Director of

Building Safety would notify the property owner that a structural analysis must be made of the building in question by a licensed civil or structural engineer or architect. If these findings indicated that the building was deficient according to the standards established by the ordinance, "the owner shall cause said building to be structurally altered so as to conform to those standards or cause it to be demolished." The notice also informed the owner that the analysis, together with the necessary plans and calculations, should be submitted to the department for review within 270 days after the notice was served. Permits to accomplish necessary structural alterations were to be obtained not later than one year after notice, and the building was to be corrected to meet minimum requirements (or be demolished) within three years of notice being service. Alterations were required to begin within 180 days of issuing the permit.

The ordinance provided procedures for appeal by owners. Owners would be able to appeal the director's initial order and determination within 180 days of the time they were served notice. Appeals would be decided by a hearing officer within 60 days of the date the appeal was filed. The order for demolition could be upheld only if, based upon the evidence, the hearing officer found that the building constituted a nuisance and that there was no other reasonable way to correct the nuisance. City officials were authorized to order demolition of the building if compliance was not accomplished within 90 days of an order to vacate.

Design, Enforcement, and Appeal: 1980-1982

Although the Santa Ana seismic ordinance had been enacted, it was still necessary to develop and refine processes to ensure effective administration. Buildings at seismic risk had to be identified and categorized. Administrative procedures had to be devised and implemented.

In July of 1980, the city added a half-time administrative aide whose duties were to include administering portions of the seismic ordin-ance. In August, an engineering consultant was engaged to identify the unreinforced masonry buildings in the city. Of the 206

URM buildings identified, none was classified as an *essential building*, but 73 were identified as *high-risk*.

On September 23, 1980, letters of notification went out to *high-risk* building owners advising them of the need to "bring the building into conformance" with ordinance standards. Owners were advised to provide a structural analysis for staff review within 270 days from the receipt of the written notice.

In November, approximately 120 first notices were mailed to owners whose buildings fell into the *medium-risk* category. These were advisory in nature, informing the parties of the eventual requirements of the ordinance.

Reminder letters were sent to the owners of *high-risk* buildings in February of 1981. Attention was called to the fact that provisions of the ordinance allowed for appeals within 180 days of the first notice. For the owners, this meant that if an appeal were to be requested, it must have been filed by April 1, 1981.

Only one owner had appealed. He requested reclassification of his building to a lower risk level, claiming that city staff had determined that his building had a possible occupancy load of 130 persons. He believed that this determination was erroneous since he had owned the building for 30 years and "at no time did the property exceed 20 occupants." He submitted sketches and insisted that 90% of the occupants did their business on the telephone. The city denied his informal request, so in March the owner formally requested an appeals hearing. The first appeal hearing under the ordinance was held on April 21, with the newly hired appeals officer. The appeals officer advised the owner that he should engage a licensed structural engineer to provide new plans for the building in question and granted a time extension.

Meanwhile, city staff members had been preparing for a public hearing on the seismic ordinance. Affected merchants and other interested persons were encouraged to attend. On April 22, 1981, 110 people participated in the hearing. The Assistant City Manager provided information on the Community Development Department's Major Commercial Rehabilitation Loan Program, and demonstrated "how our loan program could reduce the rehabilitation costs for a typical 30,000 square foot building by approximately 50 per cent." He pointed out that "an applicant could do both substantial cosmetic and structural improvements, and save enough money to have the structural work done at the equivalent of no cost."

An owner of several pieces of property in the downtown area noted that the City of Los Angeles seismic ordinance provided for a much longer compliance time. The Community Development Director responded that:

> ...the City of Los Angeles Ordinance still required owners of buildings in high risk categories to spend substantial sums to anchor their walls and foundations during the first year, and the City had no program to assist in financing this work. In addition, within one to seven years the owners would still have to complete the remainder of the work which would cause major disruptions in business for a second time.

Another merchant, then engaged in the structural rehabilitation process, expressed concern that he was faced with considerable extra cost in his rehabilitation because the property owners to the north and south, with whom he shared a common wall, had not proceeded with their rehab work. He strongly urged amendment of the ordinance to mandate that property owners who shared common walls would proceed with rehabilitation simultaneously.

At the May 4 Council meeting following the hearing, Councilman Luxembourger moved that citizen inputs from the April hearing be referred to the Seismic Safety Study Committee for review and that the committee should consider revising the ordinance. He moved that the various time frames for compliance be delayed until recommendations for changes could be reviewed by council. The City Council approved the motion unanimously.

During May and June, the Seismic Safety Committee, which had consisted of structural engineeers and city staff, was enlarged to include two downtown property owners and merchants. The committee met six times to consider problems associated with adjacent buildings in different risk categories, party wall situations, compliance schedules, and the possible need for revisions to the ordinance in connection with these issues.

The committee's deliberations resulted in a number of recommendations, some of which dealt with purely technical matters and others of which addressed policy concerns. First, the committee recommended a 60-day extension for all owners of *high-risk* buildings. Second, the committee recommended that the ordinance be revised to deal with specific issues raised in the public hearing. For example, where two or more buildings under separate ownership were to be rehabilitated simultaneously, the committee recommended a compliance extension of at least six months if there were a binding agreement between the owners involved with an actual date of compliance determined by the director.

The committee also recommended creation of a formal appeals process, including a Hazardous Building Board, and an advance notification of Category III and IV buildings to eliminate the problem of a person buying a building and finding out at a later date that it is subject to the ordinance.

On August 11, the City Attorney's review of these suggestions was delivered to the Mayor and members of the City Council. The City Attorney prefaced the formal presentation of the proposed amendments to the ordinance by stating that "it is important to note that the proposed ordinance *does not* change two very important provisions of the existing seismic ordinance: the classification of buildings into one of four classes, and the time limits within which each building must be made to conform to the Seismic Ordinance or be demolished." At the September 8, 1981 meeting of the Santa Ana City Council, the amendments were adopted unanimously.

One of the consequences of the Seismic Safety Committee review and of the initial appeal was establishment of a formal appeals board, created in October. The seven-member board was charged with handling all building code appeals, whether they derived from the seismic ordinance or from other building code requirements.

By December of 1981, some attrition of the originally notified 73 high-risk buildings had taken place. Eight buildings had been reclassified. No structure was demolished as a direct result of the seismic ordinance, but six were earmarked for demolition and one had been razed because it was located in the redevelopment area. Forty-two structures were involved in the seismic rehabilitation process; permits had been issued for 14. Of these, four had received final approval for use and occupancy, and 27 were in various stages of plan approval. In addition, ten owners had received final notification of noncompliance. Five of the ten buildings involved had been determined to fall under the dangerous building abatement code, and the city could take action against the owners under provisions of the ordinance. The remaining five owners had filed appeals.

The appeals board had been created in October, but no hearings were held until April of 1982. In January, the City of Long Beach provided scenario materials to the Santa Ana Board for "practice." At the January 21 meeting, the Uniform Code Appeals Board adopted guidelines for appeal and, on February 2, official rules and regulations for the board were established. During April and May, the board met every two weeks to hear appeals. Five of the eight appeals addressed were because of the seismic ordinance. Each of the five requested building reclassification from *high-* to *medium-risk* because the owners believed the occupancy load was significantly lower than that assigned by City Staff.

The appeal process unearthed some additional concerns regarding the ordinance so, in April of 1982, the Director of Planning and Development Services submitted a second set of proposed amendments to the Santa Ana Seismic Ordinance based on these concerns and on technical lessons learned during actual rehabilitation. The lessons had advanced the state-of-the-art in rehabilitation. The amendments would allow more time to complete rehabilitation for *medium-* and *low-risk* buildings and provide more flexibility in designing the methods for rehabilitation.

The Seismic Safety Committee met in June of 1982 to review the newly proposed revisions and recommended additional review of the recommended amendments prior to adoption. The committee wanted to examine the experience of other cities, principally Los Angeles, to determine if partial repairs and risk management should be allowed for *medium-* and *low-risk* structures, and to decide whether Santa Ana should specific-ally address problems associated with parapets and other ornamentation in its ordinance.

In a little over three years--from the first official mention of a seismic ordinance for the City of Santa Ana in April of 1979, through June of 1982--an ordinance had been developed and enacted, and 42 structures had been rehabilitated or were in the process of rehabilitation. The City of Santa Ana had benefited greatly from the prior efforts of Long Beach and Los Angeles. Those cities had suffered through the difficult problems of fact-finding and policy development, providing Santa Ana with a model for an ordinance and with surrogate administrative experience. Santa Ana used that to great advantage in combination with the opportunity afforded by the redevelopment project.

[redacted]

CHAPTER VII
DESIGN, ADMINISTRATIVE COSTS, AND LEGAL ASPECTS*

The preceding case histories include information on both the administrative and policy making processes that led to adoption of unreinforced masonry building earthquake hazard mitigation ordinances. This chapter focuses more closely on the ordinances themselves. It begins with a comparative analysis of the ordinances, including an examination of both the design of the policy intervention and of the administrative costs of ordinance implementation. It continues with an examination of the legal basis for such ordinances, with an emphasis on recent California legal cases. The chapter concludes with an examination of a model ordinance for mitigating the unreinforced masonry building hazard, an ordinance that emerged recently from California.

Comparing the Long Beach and Los Angeles Ordinances

Ordinance Designs

Despite the general similarities of the Long Beach and Los Angeles hazard mitigation ordinances, there are important differences between them. Some have described the Long Beach ordinance as a "demolition" ordinance and the Los Angeles ordinance as a "rehabilitation" ordinance. Subtle differences in the designs of the policy interventions contribute to this impression, and may lead to significant differences in the effects of the respective ordinances vis a vis the extent to which unreinforced masonry buildings have been strengthened to withstand lateral forces imposed by earthquakes.

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* Background materials incorporated in this chapter were developed by Gilbert Siegel, School of Public Administration, University of Southern California (Siegel, 1986), and by Melvyn Green, Melvyn Green and Associates, Structural Engineers (Green, 1986). Their efforts were supported by the National Science Foundation through Grant No. CEE-80274728.

Hazard evaluation. The Long Beach ordinance bases hazard evaluation on three elements: the importance of the structure, life risk to occupants and/or pedestrians outside the building, and the structure's existing ability to resist seismic forces. These factors are combined in a "Hazard Index." The City Building and Safety Department computers apply the index in the case of buildings of three stories or fewer, while buildings of four or more stories must be evaluated by an engineer or architect, licensed by the State of California, at the owner's expense.

The Los Angeles ordinance calls for hazards evaluations to be developed by the City's Earthquake Safety Division, based on a method that considers the importance of the structure, its occupant load, some structural features, and the structure's existing ability to resist seismic forces.

Both municipal ordinances distinguish among building importance. The more important buildings are those critical to emergencies (fire and police stations, and hospitals) and large assembly areas (hotels and motion picture theaters). Buildings that are likely to contain fewer persons or that are less critical have lower rankings in terms of the urgency of rehabilitation or demolition. Los Angeles ranks buildings in terms of potential number of occupants, based on the application of a formula to historical information. Long Beach uses a slightly different approach, considering the number of potential occupants in relation to the proportion of the building area used.

In Los Angeles, the importance classification for the building is the basis for establishing the time frame within which rehabilitation is to be accomplished. In Long Beach, however, both the importance classification and the building's existing seismic resistance are employed to establish to time frame for compliance.

In its original 1971 ordinance, Long Beach also included in its hazard calculation an evaluation of the soils upon which the building stood. This provision of the hazard calculation was eliminated in the 1976 revision because its marginal effect was fairly insignificant, given that subsoil structures were thought to be of consequence primarily to high rise buildings and only half a dozen buildings were affected by the incorporation of the soils mapping.

Permitted time for compliance. In both Long Beach and Los Angeles, the owner of an unreinforced masonry (URM) building has different amounts of time to strengthen or demolish the building, depending on the hazard rating assigned the building. The two cities used somewhat different approaches to determine how much time would be available to the building owners.

In Long Beach, the approach selected for determining the time allowed for compliance is based on the date upon which the owner is notified of the classification applied to his or her building. The Long Beach Hazard Index, which was applied to all URM buildings covered by the ordinance, resulted in an index number for each building. The buildings were sorted, with the highest-numbered building being classified as the most hazardous, and the lowest-numbered building being placed at the end of the list. The top 10% of the buildings, the most hazardous decile, was classified as *excessive-hazard.* In addition, any building with dangerous ornamentation or parapets was assigned a companion classification as an *immediate-hazard.* Owners of these buildings were notified on January 30, 1981, of the need to comply with the ordinance. Compliance activities were to proceed directly. The next 30% of the buildings were classified as *high-hazard*, and owners were notified on January 1, 1984 that they were to initiate activities to bring their building into compliance. The final 60% of the buildings, classed as *intermediate-hazards*, have until January 1, 1991, at which time their owenrs will be notified to bring the buildings into compliance.

In essence, then, the owners of *excessive-hazard* buildings had from 1976 to 1981, five years, as a grace period for compliance. On the other hand, once notice was given to the owners that their buildings were classified as *excessive hazards*, action had to begin immediately. Owners of *high-hazard* buildings had from 1976 to 1984, eight years, before notification to comply with the ordinance. Finally, owners of the remaining 60% of the buildings, classed as *intermediate-hazards*, had 15 years, from 1976 to 1991, to comply.

URM building owners in Long Beach can make partial repairs to their buildings that will result in a reclassification of the building and, consequently, in a revised compliance date to either 1984 or 1991. All plans for full or partial repair must be prepared by a licensed architect or structural engineer. Buildings are taken off the hazardous list as appropriate rennovations result in the ability of the building to withstand the minimum seismic forces on which the ordinance is based.

Los Angeles had the advantage of learning from Long Beach's pioneering efforts to mitigate the URM hazard and used that experience, coupled with its own needs to meet political objections to the ordinance, to create a somewhat different and, perhaps, an easier approach to providing time for compliance. Long Beach assigned priorities for compliance based on percentage distribution of a continuous index. Los Angeles employed discrete categories for assigning buildings to each of four classifications.

The Los Angeles ordinance provides dual time frames for compliance, giving building owners two choices. The owner may elect to comply with the strengthening requirements directly, thus becoming subject to one time schedule, or he or she may elect to install wall anchors within one year, thus delaying the need for full compliance. Should the owner of an essential-building elect not to install wall anchors, he or she would have one year to obtain a building permit, 180 days to begin construction, and a total of three years in which to comply fully with the ordinance. If the owner applies for a permit within 180 days and installs wall anchors within another 270 days, he or she has a total of four years in which to comply fully with the ordinance.

The same logic applies to buildings in the other three classifications. Owners of buildings in the second highest priority classification would have three years in which to comply fully with the ordinance but, if they install wall anchors within one year, they have six years to comply fully. Owners of buildings in the third priority classification have five or six years to comply (depending on their occupant load); if they install wall anchors within the first year, they have a total of either eight or nine years to comply fully (depending, again on occupancy load). Owners of the lowest priority buildings have seven years to comply. If they install anchors, they have a total of ten years to comply fully (see Table V-3).

In both ordinances, the time permitted the building owner for compliance depends entirely on the relative hazard posed by the building. The Long Beach ordinance typically provides for a shorter period of time for compliance for each level of hazardous building. Although the Long Beach ordinance allows owners to make partial renovations, and thus defer full compliance, the Los Angeles ordinance provides a rather substantial incentive to building owners to install wall anchors within the first year. Since it is thought that installing wall anchors reduces dramatically the threat to life safety from unreinforced masonry buildings, then it would appear that the Los Angeles ordinance, despite its generally longer periods for required compliance, actually provides for a more rapid reduction in the threat from unreinforced masonry buildings than does the Long Beach ordinance.

<u>Retroactive seismic provisions and costs of compliance.</u> From the public's perspective, and possibly from the perspective of the City Councils in the two cities, the Long Beach and Los Angeles ordinances (commonly referred to as Subdivision 80 of the Long Beach Building Code and Division 68 of the Los Angeles Building Code) have a similar overall purpose: to reduce the loss potential of older, pre-earthquake code buildings. Further comparison, however, reveals considerable differences in the policy interventions. The differences flow primarily from specific technical provisions of the two ordinances.

The stated objectives of the two ordinances are subtly different. The earlier Long Beach ordinance has as its purpose to "reduce (the) earthquake-generated hazard to tolerable levels." The Los Angeles ordinance states its goal as "reducing the risk of death or injury" from earthquake damage to unreinforced masonry buildings. To some, this difference in stated objectives indicates that the Los Angeles ordinance is an attempt to control personal risk to building occupants and passers-by, whereas the Long Beach ordinance is an attempt to control economic risk to building owners as well as to impose tougher standards for building strengthening.

In general, both ordinances attempt to accomplish their stated goals using similar technical means. Both limit allowable loads in the building elements (i.e., walls, floors, and roofs), and both address wall anchorage and attachment of building elements and components. Both recognize the need for a continuous stress path to resolve the forces imposed on the building as a result of earthquakes. There are, however, some significant differences between the ordinances.

Diaphragms are floor and roof elements, typically wood, which may be placed at 90^0 45^0 degree angles to the wall. Diaphragms brace the walls and stiffen the building, distributing structural forces to the cross walls. The Long Beach ordinance is significantly more stringent than the Los Angeles ordinance in terms of the allowable loadings in pounds per foot permitted for diaphragms (see Table VII-1).

TABLE VII-1 COMPARATIVE ALLOWABLE DIAPHRAGM LOADINGS, LONG BEACH AND LOS ANGELES UNREINFORCED MASONRY BUILDING EARTHQUAKE REHABILITATION ORDINANCES

	Long Beach	Los Angeles
Roofs with straight sheathing and roofing	50 lb./ft.	100 lb./ft.
Floors with diagonal sheathing and finished wood flooring	300 lb/ft.	450 lb./ft.

(City of Long Beach Building Code Subdivision 80 and City of Los Angeles Building Code Division 68)

In terms of in-plane shear, the maximum resistance to forces parallel to a wall, the Long Beach ordinance is once again more restrictive than the Los Angeles ordinance. The Los Angeles ordinance permits up to ten pounds per square inch lateral resistance based on tests, whereas the Long Beach ordinance restricts the resistance forces of the walls to the weight of the wall itself.

The stability of walls--their resistance to bending, buckling, and collapsing under horizontal loadings--has been a cause of building failure and life loss in unreinforced masonry buildings. Modern brick walls are reinforced with steel to carry the bending loads. The traditional assumption is that the unreinforced masonry walls cannot resist bending and are a principal hazard in URM buildings. The Los Angeles ordinance considers walls with certain height to thickness (h/t) ratios to be acceptable and not in need of reinforcement. The Long Beach ordinance does not permit h/t ratios to be used in calculating existing resistance of the building. Long Beach requires gunniting (spraying of concrete) over steel reinforcements anchored to the existing brick wall.

Green (1981) maintains that the Long Beach ordinance requires substantially greater rehabilitation to URM buildings than does the Los Angeles ordinance, and that the costs to owners to comply with the Long Beach ordinance is therefore substantially greater than for owners in Los Angeles. His point is based on research he conducted on four representative buildings in the Los Angeles area. For each building, Green developed mitigation plans and cost estimates for compliance for the two ordinances. The cost differences are shown in Table VII-2. The results suggest that compliance with the Long Beach ordinance costs between 2 and 2.5 times more than compliance with the Los Angeles ordinance. Green's analysis does not provide for partial strengthening--anchor installation

TABLE VII-2 COST COMPARISONS FOR COMPLIANCE WITH THE LONG BEACH AND LOS ANGELES SEISMIC SAFETY ORDINANCES FOR FOUR REPRESENTATIVE UNREINFORCED MASONRY BUILDINGS, 1981

Building	Description	Area	Cost Per Square Foot Long Beach	Cost Per Square Foot Los Angeles	Cost Ratio L.B:L.A.
1	1-Story Restaurant	5,000	$23	$12	2:1
2	3-Story Commercial	42,750	$10	$5	2:1
3	1-Story Movie Theater	4,500	$49	$20	2.5:1
4	4-Story Apartment	37,180	$7	$3	2.3:1

(Green, 1981)

in Los Angeles, and partial rehabilitation in Long Beach. The comparisons are based on complete compliance with each ordinance as the first action taken by the building owner.

Conclusions about designs. From Green's analysis, it is apparent that one of the effects of the higher standards in Long Beach is to raise the costs of compliance for building owners. This increase in costs of compliance is logically likely to increase the proportion of buildings that are demolished rather than rehabilitated, other things being equal. This is why some have referred to the Long Beach ordinance as a "demolition" ordinance and to the Los Angeles ordinance as a "rehabilitation" ordinance.

One must also consider, however, the level of public safety that derives from the intrinsic design of the two ordinances. The Los Angeles ordinance is clearly aimed at mitigating immediate threats to life safety that are posed by the existence of unreinforced masonry buildings in a seismically active locale. The incentives provided in the Los Angeles ordinance for early installation of wall anchors help to assure this level of safety. The Long Beach ordinance, by imposing more stringent measures, appears to aim at a higher level of public safety--a level that goes beyond the immediate objective of life safety to help assure the continued structural stability of the strengthened building. If, indeed, the ordinance requires the demolition of a greater proportion of unreinforced masonry buildings, then one might well argue that the public safety is well served. Whereas the Los Angeles ordinance would permit marginally safer URM buildings to remain in use, the Long Beach ordinance is more likely to have them demolished and replaced with new buildings meeting contemporary standards for seismic safety.

One might logically inquire as to whether Long Beach should revise its ordinance to incorporate some of the technical features of the Los Angeles ordinance, such as allowances for height to thickness ratios. It should be noted that the Long Beach ordinance was passed initially a decade before the Los Angeles ordinance; the Los Angeles ordinance had the advantage of a decade of research on unreinforced masonry buildings and means of mitigation. It would be surprising if the Los Angeles ordinance did *not* incorporate somewhat more sophisticated measures of measuring lateral resistance to earthquakes. Despite the incorporation of different standards in the two ordinances, one cannot say that either ordinance is "better" than the other in terms of public safety, however, without making some heroic value judgements about how safe is safe enough.

Administrative Costs

After the activities required to implement the Long Beach and Los Angeles ordinances were corroborated with local government officials (see Figures IV-1 and V-1), each step was analyzed to provide a basis for cost estimates. Because the Long Beach ordinance has been implemented since 1977 under the direction of the same Senior Civil Engineer, it was possible to estimate a labor distribution by flow chart steps, based on experiences with personnel and types of expenditures. Under the Long Beach ordinance, implementation costs are different for one to three story buildings, buildings with four or more stories, and either of the two if the owners have changed the type of occupancy to reduce the need for rehabilitation (e.g., from a movie theater to an automobile garage) or physically altered the buildings to strengthen them. Time estimates for the various tasks were multiplied by 1982-83 hourly rates to arrive at costs. Materials, supplies, and municipal overheads were estimated as a percent of labor costs based on data from the 1982-83 municipal budget.

At the time this cost analysis was conducted, the City of Los Angeles had been implementing its mitigation ordinance for a relatively brief period. Therefore, cost estimates were based on departmental standards (rather than analysis of historical records) for the three program options: full compliance, wall anchors and full compliance, and wall anchors only. The departmental standards allow for materials and supplies normally allocated to comparable tasks. Standard overhead rates for the city and for the unit charged with administration of the ordinance were applied to the cost estimates. Estimates for human resource costs for each flow chart step were based on 1981-82 salary rates.

Table VII-3 includes the unit costs of implementing both the Long Beach and the Los Angeles ordinances. Unit costs are summarized by task for each of the three Los Angeles and four Long Beach alternatives. The

Los Angeles ordinance costs more to administer than that of Long Beach for all alternatives, including the least-cost alternative.

There appear to be three primary reasons for Los Angeles having higher unit costs for program administration. First, the Los Angeles ordinance requires more inspections than does the Long Beach ordinance. Moreover, field inspections in Long Beach are less time-consuming because the city is smaller and the buildings are closer to city hall. Second, Long Beach externalizes the costs of building classification to the owners in the case of buildings with four or more stories. Owners are required to employ the services of a licensed California engineer or architect. Los Angeles internalizes the costs of administration.

Finally, the City of Los Angeles has higher overhead rates than does the City of Long Beach (this information is not shown in Table VII-3). It may be that some of the variance in overhead costs can be attributed to differences in accounting and cost classification. In any case, Long Beach overheads and fringe rates, at the time of the analysis, were about 108% of salaries; Los Angeles' rate was 180%, about 67% higher. As suggested, Los Angeles included some system processing under departmental overhead (e.g., board appeals and public information) which are counted as direct costs in Long Beach.

Administrative costs are an important consideration, particularly in times of fiscal stringency. Administrative costs should not be viewed as the total cost of the program; they must be considered, in this case, in connection with the owners' costs of rehabilitation and with administrative costs that might be externalized to the owners. Because programs can be designed to externalize administrative costs by having others parties--such as the owners of larger buildings in the case of Long Beach--bear some of the administrative costs, the total administrative costs are not the same as the amount allocated in the municipal budget for program administration. Moreover, as seen in the two cases examined here, muncipalities do not follow identical accounting practices. This means that program administration costs frequently show up in a variety of places within the municipal budget: in other administrative agencies or as a part of overhead. Each of these analytical problems arises in this analysis of Long Beach and Los Angeles administrative costs for the hazard mitigation ordinances.

TABLE VII-3 ESTIMATED BUDGETARY COSTS PER BUILDING TO ADMINISTER THE LONG BEACH AND LOS ANGELES EARTHQUAKE HAZARD REDUCTION ORDINANCES FOR URM BUILDINGS, 1983

City of Los Angeles* Task	Alternative: Full Compliance	Wall Anchors, and Full Compliance	Wall Anchors Only
Field Survey Building	$ 113	$ 113	$ 113
Draft Compliance Order	42	42	42
Est. File, type order, type, notarize, record, and file certificate	28	28	28
Certified mail or hand deliver order	35	35	35
Log and file plans, make computer entry	42	28	28
Check plans, issue permits	692	173	173
Inspect completed wall anchor installation		469	469
Type completion letter or reminder notices		8	
Check plan, issue permits		2,289	
Inspect completed construction		911	
Prepare termination of earthquake hazard report	85	85	85
TOTAL BUDGETARY COSTS	$1,942	$4,181	$ 945

City of Long Beach**	Building Type: 1-3 Story Building	4 or more Story Building	1-3 Story Building with Occupancy Change or Upgrade	4 or more Story Bldg with Occupancy Change or Upgrade
Determine procedures, develop forms	$	$	$	$
Rate 1-3 story buildings	210		210	
Notices to owners of four story or more buildings, inc. reminders, etc.		42-71		42-71
Evaluate engineering data submitted for four story or more buildings		377		377
Assign Hazard Grade to buildings	54-192	54-192	54-192	54-192
Review status change: repair or occupancy			19	19
Review owner's engineering reports for options			23	23
Prepare cases for abatement as nuisances	39	39	39	39
TOTAL BUDGETARY COSTS	$303-441	$512-679	$345-483	$554-721

*Based on 1981-82 Salaries. **Based on 1982-83 Salaries.

Table VII-3 indicates that the ordinance affects Los Angeles' budget more than it does in Long Beach's. It is difficult to determine, however, whether the total administrative costs of the Los Angeles ordinance are substantially in excess of those in Long Beach. Long Beach has the benefit of being smaller and more compact than Los Angeles and has externalized some of its costs to the building owners. Los Angeles has a greater array of types of unreinforced masonry buildings and many more large buildings in need of evaluation. A completely accurate cost analysis would require normalizing not only municipal accounting, but also the mix and geographical distribution of buildings and the allocation of administrative costs between municipality and owner. In general, however, the Long Beach ordinance appears to be significantly less costly to administer than the Los Angeles ordinance.

Legal Considerations

The Legal Basis

Shortly after the 1933 Long Beach earthquake led to the passage of new building codes with seismic design provisions, Long Beach city officials first began their attempts to mitigate the hazards posed by thousands of existing unreinforced masonry buildings. Their efforts were hampered for years because the city was uncertain of the legal basis for its right to condemn buildings that were not safe because of their vulnerability to earthquakes.

As reported in the Long Beach case history, the legal basis for Long Beach's 1971 enactment and subsequent implementation of its pioneering ordinance requiring seismic strengthening or demolition of pre-1934 unreinforced masonry buildings was established in the case of *The City of Bakersfield v. Milton Miller* (1966). The case resulted from a lengthy dispute between Miller and the City of Bakersfield that was settled, ultimately, by the California Supreme Court. The city was concerned that Miller's hotel did not meet the city's current building code, particularly as it related to provisions for fire prevention, and declared the building a public nuisance, ordering that the violations be corrected or that the upper floors of the building be vacated. Miller argued that the city exceeded its legislative powers in declaring ,as a matter of law, that the violations in his building constituted a public nuisance. His counsel maintained, in the appeal from the trial court, that the trial court erred in failing to make an independent finding as to whether the building was, in fact, a nuisance under state law.

The Supreme Court found for the city. It stated that it is a proper function of the legislature to define what is to be considered a public nuisance. Further, noted the court, considerable judicial discretion has been allowed in determining whether an alleged danger is sufficiently serious to justify abatement, and it would be a usurpation of the legislative power for a court to deny enforcement arbitrarily merely because, in its independent judgment, the danger caused by a violation was not significant. The court noted that city legislative bodies were empowered by the California legislature to declare what constitutes a nusiance.

The court also, and very importantly, stated that "the fact that a building was constructed in accordance with all existing statutes does not immunize it from subsequent abatement as a public nuisance," citing *Queenside Hills Co. v. Saxl* ((1946) 328 U.S. 80, 83). It went on to say that "it would be an unreasonable limitation on the powers of the city to require that this danger be tolerated *ad infinitum* merely because the hotel did not violate the statutes in effect when it was constructed 36 years ago." Further, the court added that "in appropriate circumstances, a governmental agency may abate a public nuisance even thought to do so requires that a building be demolished."

The Bakersfield decision in 1966 paved the way for the 1971 Long Beach ordinance and provided a sufficient basis for passage, in Los Angeles, of its ordinance in 1981. However, within a year of the passage of the Los Angeles ordinance, it was challenged in court. Six individual plaintiffs filed lawsuits challenging the constitutionality of the ordinance (Siedorf and Henry, 1985). The six suits were consolidated under the title *Barenfeld v. the City of Los Angeles* ((1984) 162 Cal. App. 3d. 1043)).

Each of the plaintiffs owned one or more unreinforced masonry buildings classified by the City of Los Angeles as *high-risk* buildings. The plaintiffs argued that the Los Angeles mitigation ordinance, Division

68, was arbitrary and unreasonable and that it was an unreasonable exercise of the police power because it effectively took private property without compensation. The court issued a brief opinion, determining that the city's URM hazard mitigation ordinance was, indeed, a valid exercise of the city's police power. The court, in addressing the police power issue, stated that, "The Plaintiffs are confusing the police power with eminent domain. Under the police power, property is not taken for use by the public; its use by private persons is regulated or prohibited where necessary for the public welfare" (cited in Siedorf and Henry, 1985).

Although the court did not consider the issues, Siedorf and Henry conclude that the city's approach of exempting single family housing and apartments with fewer than five units, while focusing on buildings with high occupancy loads, would not pose a problem in the courts: the "courts will not second-guess a municipality's otherwise valid distinctions designed to address the more serious problem first, providing there is any 'reasonable justification for the classification'." Finally, Siedorf and Henry argue that:

> The import of the Barenfeld decision is clear. In the area of the public health and safety the Courts are not going to disturb the judgment of the legislature in determining what measures are necessary for the protection of the public interest. The courts will neither nullify laws enacted under the police power providing the laws have a substantial relation to the public interest to be served nor will they equate inverse condemnation with the reasonable exercise of the police power. Further, the fact that experts may disagree regarding the necessity for the regulation or its benefits will not invalidate the measure.

Is There a Legal Obligation?

The California courts have apparently decided, in that state, that municipalities do have the power to require the buildings be retrofitted to meet current standards for health and safety despite the fact that they may have met all applicable standards when they were built. The California courts based their decisions on precedent-setting cases centering on appropriate uses of the police power. It seems, therefore, that the outcomes of the several cases in California dealing with hazard mitigation are likely to duplicated in other states should similar court cases arise.

Given that California municipalities do have the legal basis for requiring retrofitting to accomplish hazard mitigation, one is compelled to ask whether municipalities have the *obligation* to require retrofitting now that the nature of the hazard is clear. In other words, if a city fails to enact and enforce unreinforced masonry building retrofitting standards, would the municipality be liable in the event of an earthquake that results in deaths from URM buildings that fail? A California City Attorney recently summed up the problem from the municipality's perspective:

> It is inevitable that every natural disaster will be followed by multiple lawsuits against every public agency that can be identified as having any casual relationship with the damages. We are not worried about lawsuits -- we are worried about winning them (Marsh, 1985).

The attorney goes on to say that "there is no legal requirement that a city do anything to make non-conforming structures conform" to current aseismic design standards but, on the basis of court decisions, they are empowered to do so. "The best defense," argues the attorney, "is a record of action that says 'We did everything we reasonably could to prevent the loss'."

Petak (1985) suggests that recent court decisions appear to be imposing significant liability on local government units. This, he argues, has caused mounting concern among code officials and other governmental leaders. Relying on materials developed in part by H. Crane Miller, Petak argues that:

> Local government immunity from liability has deep roots in the common law. The general rule is that all states are immune from tort liability unless they consent by constitution, statute, or judicial decision to such liability. However, local governments have been consistently treated differently ...The general rule is that there can be no recovery against a local government for injuries caused by its negligence or failure to act in the exercise of functions essentially governmental in character. However, many states have enacted legislation which subjects both the state and their local governments to some degree of tort liability.

Kusler (1985) states that "local governments are not, of course, responsible for all private hazard losses. Traditionally, local governments have not been held liable for 'no action' with regard to hazards, including failing to remedy natural hazards." Courts have also held, according to Kusler, that "local governments are not liable for failing to adopt regulations unless they are under some statutory duty to do so." Kusler argues that the advice of some municipal attornies to do nothing in order to avoid liability is not likely to be practical. There is a tendency for municipalities to adopt a variety of ordinances, including flood plain regulations, to mitigate natural hazards; however, passage of such ordinances "creates duties and are often considered by the courts to establish a standard of care for municipalities."

Finally, Kusler makes a point of significant importance to municipalities:

> In a typical liability suit, the standard applied by the court is usually one of 'reasonable care', not strict liability. Reasonable care depneds upon what a reasonable prudent individual would do in the circumstances. In other words, a municipality is not liable automatically if someone is damaged. The damaged individual must show that the municipality failed to act reasonably in light of the foreseeability of the harm, its seriousness, the cost of action, and other factors. In general, the more serious the anticipated hazard, the greater the care required" (1985: pp. 120-21).

There is a substantial body of knowledge on the fact that unreinforced masonry buildings pose a significant threat to life safety of both occupants and those immediately adjacent to those buildings in the event of even a moderate earthquake. There is also substantial evidence of a high probability that California will be subjected to one or more major earthquakes within the next two decades, with the possibility that such an earthquake could hit later today. Given the existence of such information, it would seem particularly prudent for municipalities concerned with potential liability suits, not to mention concern for the safety of residents, to develop, enact, and implement appropriate policies for seismic strengthening or demolition of unreinforced masonry buildings.

PART THREE
POLITICS, PERCEPTIONS, AND PROCESS

CHAPTER VIII
UNDERSTANDING POLITICS, PERCEPTIONS, AND PROCESSES

Devising engineering methods to reduce the vulnerability of unreinforced masonry buildings to earthquakes was not particularly difficult. The simplest technical approach is to raze the unsafe brick buildings, but structural engineers came up with ways to strengthen the buildings, thus extending their economic life and preserving them for architectural or historical purposes. It was slightly more difficult to find relatively *inexpensive* ways to strengthen the buildings, but, the engineers proved equal to that task as well. From an engineering standpoint, then, designing a earthquake hazard mitigation policy for unreinforced masonry buildings was not a real obstacle.

The problem, of course, has been political. It centers on how our collective policy-making process balances the uncertain risks of the low-consequence/high-probability event against what various stakeholders think are certain consequences of policy alternatives--consequences that those stakeholders believe to be contrary to their interests. Examining the policy process provides insights about the adoption of URM building ordinances. How did the issue get raised in appropriate forums? How were the interests of various stakeholders articulated and represented? How did municipality policy makers achieve a sufficient level of agreement on objectives with respect to the hazard and on specific mitigation policies in order to enact an ordinance and implement it? Was there something peculiar about URM building hazard mitigation that made it take almost half a century to enact mitigations after the risks became known? Who, if anyone, was to blame for the delays? Does the experience in southern California teach us any lessons for mitigation efforts elsewhere for other hazards?

Part Three focuses on policy making from a behavioral perspective. We do not believe that the process is particularly rational; it may have rational components, but generally policy making involves a substantial element of chance. The process incorporates several basic components. One of these is that problems must be articulated, and, when they are, issues arise because actors have different stakes in the outcome. Their positions depend on their values, perceptions, and priorities. A second component is solutions to the problems, about which two observations can be made here: 1) solutions sometimes exist independent of problems (some people spend their entire working lives carrying around a favored solution for which they seek problems that can be bent or shaped to fit that solution); and 2) solutions come and go--pass in and out of favor. A third basic component is the set of participants involved in policy development. When someone once said that decisions are made by those who have nothing better to do, it reflected the fact that policy outcomes are shaped by people who value those outcomes highly and who put extraordinary effort into ensuring that the outcomes match their preferences. A final component involves making a place on the agenda in which the issue can be addressed.

Chapter IX describes the political processes involved in hazard mitigation. The chapter examines the case histories in those Long Beach and Los Angeles in terms of policy-making models. The chapter emphasizes the difficulties associated with attempting to enact policy in an issue area that most people view as having relatively little immediate impact on them, the critical importance of specific actors in the process and how they perceived their roles, and the community context within which the hazard mitigation policies were being considered.

Chapters X and XI discuss two important groups of people with very specific interests in the outcomes of the policy discussions. Chapter X focuses on the occupants of unreinforced masonry buildings, including renters and owner-occupants--their perceptions of the risks associated with earthquakes and unreinforced masonry buildings like those in which they live, how they perceive those risks compared with other risks to which they are exposed, their attitudes about the risks, and the tradeoffs they make between reductions in earthquake-related risks and potential increases in housing costs. In the final stages of the policy debates in Los Angeles, almost 400 renters were mobilized in opposition to the proposed ordinance. In view of the fact that the ordinance was intended, in large part, to improve their safety, it is important to examine their values and perceptions.

Chapter XI turns attention to unreinforced masonry building owners. The chapter presents the results of a value tree exercise, conducted shortly after the Los Angeles ordinace was passed, in which URM building owners identified aspects of the Los Angeles ordinance that were particiularly important to them. Owners considered alternatives to the new ordinance and defined preferences concerning policy alternatives. Sensitivity analyses revealed how strongly owners valued various elements of mitigation policy.

Chapter XI also includes the results of a nominal group exercise with a separate group of owners that clarified owners' perceptions of the problems associated with the ordinance and the alternative hazard mitigation approaches they might have preferred to see enacted as policy. Overall, the chapter is an analysis of owners' views of the problems associated with mitigating the URM building hazard and the tradeoffs they would have been willing to make between increased safety and costs of rehabilitation.

Risk perception, risk valuation, and tradeoffs that stakeholders are willing to make are all particularly germane to hazard mitigation. These three variables help to determine whether a hazard will ever get on the serious policy agenda--the short list of issues that policy makers will attempt to deal with. After all, a problem is not a problem unless there is a disparity between the perceived state of affairs and some desired state of affairs--unless a gap exists between what is and what ought to be. Moreover, whether a complex issue, such as the one being examined here, appears on the agenda of policy makers depends on how the potential outcomes associated with action or inaction are valued by the various actors (stakeholders) in the policy process, and the tradeoffs they are willing to make.

The final chapter in this section, Chapter XII, is an analysis and interpretation of the earthquake hazard policy-making process from the perspective of a contemporary model of organizational decision-making. It emphasizes the problem of making decisions under conditions of ambiguity and uncertainty. The primary purpose is to help develop an understanding of the Long Beach, Los Angeles, and Santa Ana experiences so that hazard mitigation policies might be developed and implemented more smoothly elsewhere.

CHAPTER IX

A POLITICAL ANALYSIS OF THE LONG BEACH AND LOS ANGELES CASES*

Policies directed at reinforcement of unreinforced masonry buildings are regulatory in character and, contrasted with older distributive policies such as disaster relief, are increasingly seen as preferable for the mitigation of hazards Lowi, 1981). However, they typically involve a much greater degree of political conflict, because they impose costs on affected parties (e.g., building owners) that invite opposition. Thus, both policy adoption and policy implementation are more difficult processes than those characteristic of the older distributive policies (Mushkatel and Kilijanek, 1981; Wyner, 1981; Lambright, 1982).

Political and administrative constraints on policy development and implementation may be described as a significant set of variables that merit close examination. While scientific capabilitites (e.g., capacity to estimate seismic risk) obviously limit policy development, political factors have received relatively little attention to date. Study of the policy processes associated with innovative approaches to seismic safety in Long Beach and Los Angeles not only explains how some of these constraints were overcome, but also helps to illuminate the necessary conditions for development of effective seismic safety policies.

Theoretical Framework

Methods

This political analysis draws from the case histories presented in Chapters III and IV, supplemented by semi-structured interviews with participants in the policy process: city council members, attorneys,

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*This chapter was written by Michael Kraft, Professor of Public and Environmental Administration, University of Wisconsin-Green Bay. It is a highly condensed version of a monograph prepared for the research project and published by the University of Wisconsin-Green Bay, Institute for Public Administration and Policy Science (Kraft, 1984).

planners, building and safety officials, apartment house owners, and officials of business associations active in ordinance decisions. The interviews were conducted in January of 1982; most were recorded, so excerpts from the transcripts are used here. The case histories are based upon a variety of materials: newspaper and other media documents; formal records of local government decision making, including city council minutes, transcripts of public hearings before the planning commissions, and records of proceedings involving the city attorney's office; and informal accounts maintained in the departments of building and safety, such as internal memorandums, clipping files, and policy histories written by city officials (Petak, 1986).

Relevant Models

The two cases are examined with reference to models of the policy process (Jones, 1984; Anderson, 1984), and with special attention to innovation as one form of policy development. Long Beach's ordinance, in particular, may be considered to be innovative because it was unusual at the time of adoption and has often considered to be a model of earthquake mitigation policy in local government. The analysis focuses on the first three stages of the policy process: problem identification, proposal formulation, and policy legitimization.

The first stage, also referred to as agenda setting, is particularly relevant for understanding why problems like seismic safety may be ignored in some cities but become prominent on the policy agenda in others. Agenda setting also refers to the selection of some policy alternatives for serious consideration and the neglect of others (Kingdon, 1984; Cobb and Elder, 1972).

The relevance of agenda setting to earthquakes as public problems is obvious. Earthquakes are infrequent and thus not very visible, and therefore not often an object of public (or governmental) concern. Action is not a high priority in part because there is likely to be no significant organized constituency pressing for governmental action, and because few policy makers see earthquake mitigation as attractive enough to warrant spending their limited time, resources, and political capital.

Policy action typically occurs just after a major earthquake when public concern is high. Such concern is likely to dissipate fairly quickly once conditions return to normal. Specialists in agenda-setting emphasize the special importance of 1) policy entrepreneurs (advocates willing to allocate their time, energy, money, and reputation to promotion of a particular proposal); 2) the availability of "open windows" or opportunities for advocates to push their proposals, a concept similar to the notion of a catalyst that precipitates policy action; 3) a supportive climate of opinion or organized constituencies pressing for change; and 4) the media's role in shaping the way issues are perceived and alternatives are constructed.

The second stage--policy or proposal formulation--refers to the process of designing a particular solution to the problem at hand. In a highly technical area like seismic safety, policy formulation is usually an activity dominated by knowledgeable specialists in building safety or engineering, and it may involve outside experts or consultants, as was the case with Long Beach. Other actors involved in formulation may include elected and appointed officials, civil servants, members of interest groups, active citizens, and members of professional societies (e.g., structural engineers).

The last stage in policy making, policy adoption (or legitimation), refers to the formal process of approving a public policy (e.g., a city council vote) and, more significantly, to the political task of building a majority supportive of the policy. The latter may be a complicated and time-consuming process of identification of interests, communication, negotiation, persuasion, compromise, and (finally) approval. The term legitimation is intended to indicate that the process involves legitimate (e.g., elected or accountable) policy actors engaged in open and deliberate examination of the problem and proposed solutions. Under normal conditions, there is an expectation of technical rationality (or skilled professionalism) as well as political accountability.

Policy innovation is a special case of policy making, for which Polsby (1984) proposes three characteristics: innovations are relatively "large-scale phenomena, highly visible to political actors and observers"; they embody a "break with preceding governmental responses"; and they have "institutional or societal effects that are in a sense 'lasting'." Local seismic safety policies that involve new approaches to earthquake mitigation (e.g., regulatory rather than distributive policy), incorporate new concepts or methods (e.g., balanced risk), or significantly expand the scope of governmental authority may be considered to be innovative.

Findings of Related Studies

Although the literature on seismic safety policy development is quite limited, the findings and suggestions in some recent studies are relevant to the cases of Long Beach and Los Angeles. Atkisson and Petak (1981), for example, argued that the capacity of a community to design and implement one of the four major types of seismic risk reduction strategies noted above depends upon financial resources, the availability of highly skilled personnel, and knowldge of the type of hazard faced. A number of conditions influence this capacity: 1) the size of the community (which determines the tax base for funding mitigation activities; 2) governmental structure and authority (especially the ability in multi-jurisdictional metropolitan areas to enforce zoning and building codes in contiguous areas); 3) local nongovernmental resources (e.g., universities and research institutions where skilled personnel may be found); and 4) such other characteristics of local government as political culture or ethos, budgetary resources, staff size, and technical expertise of public officials. The three cities studied varied significantly in their capacity to plan and implement earthquake mitigation strategies and policies; Los Angeles demonstrated most of the requisite qualities, while Boston did not.

Similarly, Rossi et al. (1982) found that the seriousness attributed to natural hazards in general was "uniformly low" in the same three cities and, as a consequence, natural hazard issues were low on the political agenda. The seriousness attributed to earthquakes in particular was also consistently low. Rossi et al. also found that elite opinion in each city was most supportive of structural mitigations such as building protection and disaster assistance. There was little support for the various "new wave" policies, such as nonstructural mitigations, that employ land use management, and hazard-sensitive building codes, and compulsory insurance. However, there was find more support for such policies at the community level than at the state level.

Lambright (1982) examined policy innovation in earthquake preparedness in three states. He found the key elements of innovation (effective policy development and implementation, as he defines it) to be "an objective threat and leadership (i.e., entrepreneurship) within the state." A combination of influences account for innovation, but chief among them are a major earthquake (and thus heightened awareness of risk) and policy entrepreneurs who are supported politically. Much turns on the cooperation of public officials and the existence of incentives for them to lend their support to policy development.

In a similar vein, Wyner (1981) examined earthquake policy development in California, with special attention to the disposition of "strategically placed local officials." He found few non-governmental interest groups pressing for policy change; rather, change was brought about through the efforts of zealous officials, "true believers" in the importance of seismic safety. Like Lambright, he noted that local officials generally do not think seismic safety issues provide political benefits to them. Public knowledge is very limited, the saliency of the issues is low, there is little public communication with officials on the matter, and the issues rarely are prominent in political campaigns. Thus there are few political incentives and rewards to take a strong stand in favor of rigorous safety standards.

This is hardly an exhaustive review of the prevailing literature, but the findings and arguments in these studies reinforce the conclusions drawn for Long Beach and Los Angeles below.

Case Analyses

The earthquake safety ordinances in both Long Beach and Los Angeles represent innovative and seemingly effective responses to the collapse of older, vulnerable buildings that pre-date modern building codes. The Long Beach ordinance of 1971 (modified in 1976) is particularly interesting because it was based on the concept of balanced risk. The Los Angeles ordinance of 1981 is similar to Long Beach's in that it employs many of the same variables in measuring hazards: the importance and use of the building, exposure of occupants to risk, and the building's capacity to resist seismic forces. Partly because Long Beach acted so early to mitigate its earthquake risks, its ordinance has been widely recognized as a unique approach to the problem and a possible model for other cities. However, as the policy history below reveals, succesful adoption and implementation of such an ordinance depends upon far more than the mere availability of a "model law." In particular, leadership and public support in the community are critical and may limit policy action elsewhere.

Long Beach

The major catalyst for policy change in Long Beach in the 1930's was the 1933 earthquake. A number of local and state policies were adopted fairly rapidly, including city ordinances in both Long Beach and Los Angeles (in 1934 and 1933, respectively) regulating new construction requirements for earthquake resistance. Later policy development in both cities resulted from the failure to apply earthquake-resistant standards to existing buildings. By 1959, a Long Beach ordinance authorized the Building and Safety Department to declare an earthquake hazardous building a nuisance and to require repair or demolition, but implementation proceeded slowly between 1959 and 1966. Unresolved legal issues and political caution dictated initial slowness, but following a key State Supreme Court ruling on the legitimacy of such ordinances (*City of Bakersfield vs. Milton*, 1966), implementation speeded up noticeably.

As suggested by some theories of agenda setting, the push to implement the 1959 ordinance and to deal more effectively with seismic safety issues in Long Beach came from a single policy entrepreneur, the Director of Building and Safety, Edward O'Connor. He explained his role as follows:

> I started this thing all alone mainly because I felt that, by God, something should be done. Why should we go along and wait for a moderate or strong earthquake and get a lot of additional loss of life and property damage?

Once the legal issues were resolved by the 1966 decision, O'Connor moved ahead aggressively: "It was then we started to condemn buildings block by block." He encountered strong opposition from the structural engineering profession and, not surprisingly, from affected property owners, who challenged their legality. However, O'Connor seemed to have the support of city officials, including the City Attorney, Leonard Putnam.

A related and important characteristic of the early implementation process was its low-key nature. O'Connor did not seek the approval of the local business community, in part because he knew they would object to the enforcement, but also because he knew his strategy was likely to create adverse publicity and even greater opposition. What he had going for him, in short, was support from the city government and a good press, or at least one that did not undermine his efforts. His commitment, energy, and leadership skills on this issue also fit the model of implementation. As other studies have noted, one often finds a single individual or a very few policy entrepreneurs or leaders behind governmental action on low-visibility hazards.

The ordinance's 60-day notice period and the objections raised by property owners to the costs of repair imposed on them began to have a political effect. As O'Connor put it, "once we condemned some 116 buildings, that generated a lot of flak." The flak resulted in the formation of the United Property Owners Association (UPOA), which acted in cooperation with the Downtown Long Beach Associates (DLBA) to try to revise the city ordinance. Thus began a new strategy by the property owners to find relief from the code enforcement. They set about to rewrite the code itself.

The revision process was a long and complicated affair, and included a number of hearings before the City Council that provided the opportunity for critics to voice their complaints. There was also a fair amount of publicity in the local press, and several lawsuits were filed against O'Connor and the city by late 1969. While O'Connor continued to receive support from the City Attorney's office, City Manager John Mansell requested that the council's ordinance committee engage in a thorough review of the matter by hiring an outside expert on matters of seismic safety.

The resultant study by the J.H. Wiggins Company (Wiggins and Moran, 1970), financed in part by the DLBA, was presented to the council's Ordinance Committee on August 10, 1970. The distinguishing feature of the Wiggins study was the use of the concept of balanced risk in assessing earthquake hazards and in developing engineering code standards. The Wiggins report recommended that the 1959 provisions of the city code by replaced by Section 2314 of the 1970 edition of the Uniform Building Code (UBC), with some exceptions. The report formed the basis of the new ordinance adopted in June of 1971.

The process of formulating the 1971 ordinance was highly unusual. The DBLA hired an attorney with engineering experience, Philip Fife, to help draft an ordinance that would relieve them of the kinds of problems they faced with O'Connor's implementation of the 1959 code provisions. As Arthur Honda, Deputy City Attorney, described the process, Fife was largely responsible for the ordinance language because the city attorney's office was unable to handle the task:

> Phil Fife, with his engineering background, help us draft an ordinance with all these formulae and so forth, something foreign to me. He laid his foundation on the Wiggins studies.

The effort included others as well. When the informal working group--Honda, Fife, O'Connor, Mansell, and Wiggins--completed its formulation of the ordinance, it was transmitted (in April of 1971) by Mansell to the Ordinance Committee of the city council. The committee referred the proposed ordinance to the full council for a public hearing. On May 25, the council approved the concept embodied in the ordinance and requested that the City Manager and the City Attorney prepare a final ordinance for action. That ordinance was approved by the council in June of 1971. By the time the council considered the proposed ordinance, according to Honda, "everybody was seeking a compromise or some rational approach where we could continue our program abating." No council member was opposed to the ordinance, but the question was one of means: how to go about it, how fast, and what kind of standards. The San Fernando earthquake on February 9, 1971 helped to remove any doubt about the need to act on the ordinance at that time.

The 1976-77 amendment process was an incremental adjustment in an on-going program. The amended ordinance received final approval on December 21, 1976, but it did not receive universal praise. O'Connor believed it represented a weakening of the 1971 ordinance (which, in turn, he saw as a weakening of the 1959 ordinance as he enforced it). Fife characterized the 1976 changes as having "gutted the ordinance." Whatever the merits of the 1976 amendments, they did seem to eliminate most of the objections raised by organized property owners and the DLBA. Although individual owners protested from time to time, there were no legal or political efforts comparable to those of the period from 1967 through 1971. The apparently consensual and quiet process of revision in 1976 reflected the city's strategy of cooperation with the DBLA and property owners. As is often true of effective governmental regulation (Saba-tier, 1977), the city gained the support of "constituency groups," and thus headed off political objections and legal challenges.

The Long Beach ordinance is significant also for its scope. According to a 1981 report by Eugene Zeller, Superintendent of Building and Safety, the program involves a total of 923 buildings containing some 3,000 dwelling units, and over 2,000 hotel guest rooms. Between 1971 and 1981, 161 buildings were demolished and 37 repaired (Zeller, 1981). By 1981, 98% of the pre-1934 masonry buildings and been "rated and graded" into the categories specified in the ordinance.

The events and decisions described in this case illustrate a number of steps in the policy-making process. O'Connor dominated the agenda-setting stage of the process, clearly demonstrating what is usually termed the role of the policy entrepreneur. His self-defined professional role required that he act vigorously to mitigate earthquake hazards, and he did so through a variety of means over the years. His efforts were aided considerably by the generally supportive climate of opinion in Long Beach. While earthquake hazards were not a highly salient issue for the populace, no one seriously denied the risk. The 1933 and 1971 earthquakes created conditions favorable to O'Connor's actions.

Another striking feature that emerges from interviews with policy actors is the remarkable consensus among city officials, who were willing to back O'Connor even as organized protests by property owners increased in the late 1960's. The 1971 innovation, of course, arose out of a temporary breakdown in the apparently typical consensus among what Fife termed the "power elite" of the city. Forced to deal with protests by the DLBA and the UPOA, the City Council turned to outside expert advice and relied upon the informal working group that actually formulated the new ordinance. The ordinance was acceptable because it allowed the council to respond to the demands of property owners and, at the same time, to modify the previous code enforcement procedures in a way that seemed rational and fair to most parties.

In one sense, Long Beach did not so much seek out innovation--innovation was thrust upon the city. It was introduced in a fairly quiet fashion by a small working group that hashed out the details between August of 1970 and April of 1971. Legitimation of the new policy can be said to have taken place chiefly in this working group, with the council ratifying the outcome. Several public hearings provided the concerned public (chiefly organized property owners) with the opportunity to voice their concerns. The willingness of the city to work closely with the DLBA, in particular, cleared the way to approval of the ordinance and to its reasonably smooth, if slow, implementation after 1971.

Los Angeles

On February 9, 1981, after eight years of political conflict and negotiation, Los Angeles adopted an ordinance similar to Long Beach's. The development of the Los Angeles seismic safety policy differs from that of Long Beach in many respects, as might be expected given the differences in city size, governmental structure, and political culture. While less innovative than Long Beach's (in part for coming ten years later) Los Angeles' policy is important because it illustrates clearly the usual political and administrative obstacles to the design of effective safety policies.

Where the 1933 earthquake helped to set the stage for later efforts in Long Beach, the 1971 San Fernando earthquake performed something of the same function in Los Angeles. However, the first major directive to the Director of Building and Safety, Earl Schwartz, did not come until 1973, when the City Council, pursuant to Councilman Thomas Bradley's resolution referring to the Long Beach ordinance, asked the Department of Building and Safety to begin studying the problem with older buildings. One of the differences between the policy development processes in Los Angeles and Long Beach was Earl Schwartz' conception of his professional role--one that played down entrepreneurial leadership and looked to the political system to shape the policy process. Additional factors in Los Angeles combined to shape a process that was decidedly more complicated, contentious, and drawn out.

The initial council mandate of 1973 to study the seismic safety problem did not lead to immediate action, but a second request by Councilman Arthur Snyder in 1974 to look at certain types of unreinforced masonry buildings, including specifically motion picture theaters, finally "started the ball rolling," according to Schwartz. Still the process moved slowly. The Building and Safety Committee of the City Council asked the Building Department to conduct a seismic survey of city-owned buildings, which took some two years to complete. Eventually, the data base it created was used for a report to the city that included a repair priority rating and cost estimates. About a year later, with the support of the Structural Engineering Association of Southern California (SEASC), the City Council approved an Earthquake Safety Plan, incorporating the city's goals for eliminating hazards associated with older structures. However, no specific requirements for changing building construction were included.

Some six months later, controversy erupted over Councilman Snyder's efforts to rehabilitate motion picture theaters. Several public hearings provided the opportunity for opponents to voice their objections (based largely on economic costs and concern for preservation of buildings with historic value). All this controversy greatly lowered the probability of council action on a new ordinance. The council considered several versions of a proposed ordinance dealing with buildings used for public assembly, but referred them back to the Department of Building and Safety. To further complicate matters, the department had to work with a series of council building committees of changing composition. That slowed the process of ordinance writing, although it may have contributed to council understanding of the issues and to its eventual positive action.

On October 25, 1976, the council's Building and Safety Committee proposed to the full council an ordinance that would require repair of all unreinforced masonry buildings in the city within ten years, and they recommended that the city seek federal financial assistance for the effort. The Building and Safety Department had recommended, according to Schwartz, "the highest degree of safety that could be affordable, and so the policy of the Building and Safety Department was to have a standard that was even higher than the Long Beach standard." In sharp contrast to the political process in Long Beach, however, the proposal did not fare well. As Schwartz acknowledged, the Department:

> ...left it really to the political system, the system of public hearings and what have you. (We) left it to that vehicle as a method of compromising a lower standard... through give and take at the public hearings, and getting the citizenry involved.

At a packed public hearing in the council chambers on December 9, 1976, the proposed ordinance was overwhelmingly opposed. Several council members denounced the proposal, including Gilbert Lindsay, whose downtown district included a large percentage of the older buildings that would be affected. Instead of a safety measure, he said, the ordinance was a "hunger measure": "A lot of businesses will be closed and a lot of people will be thrown into the streets" (Los Angeles Times, December 10, 1976). The council heeded the strongly held views of the some 400 persons in the audience, and voted 11 to 0 to send the proposal back to the Building and Safety Committee for "further citzens' input."

Earl Schwartz then saw the consequence of his decision to leave the matter to the political system. As he observed, public opposition in effect meant that the proposed ordinance, "was never seriously considered. The council generally thought it was too premature, even after two or three years of study and what have you."

After four years of studies, numerous drafts of proposed ordinances, five public hearings, and in the face of continued warnings that Southern California faced a potentially catastrophic earthquake, the council found itself still unable to approve an ordinance. The Building and Safety Committee presented a review of the entire problem and the proposed ordinance to the council in late January, 1977. It recommended that the city survey pre-1934 unreinforced masonry buildings, and that a study committee be established to formulate an ordinance, among other activities. The committee recommended *against* presenting the draft ordinance until a variety of studies could be completed.

By December, 1978, the Special Earthquake Study Committee, (chaired by former building superintendent, Robert Williams) produced a draft ordinance and urged that "positive action be taken quickly." The city had planned extensive public hearings on the proposal in early 1979, but there were further delays. Other studies were underway at about the same time, including field tests by a technical subcommittee of the Williams Citizen Committee, and the environmental impact statement being prepared by the city's Planning Department. By the time all this information was presented to the Council's Building and Safety Committee (late 1979), Councilman Hal Bernson had assumed the chairmanship. Bernson developed a strong interest in seismic safety issues, held additional public hearings, and asked for further studies of the costs and impact of the proposed ordinance. A modified ordinance was reformulated, taking into account many of the objections raised.

During this period, Earl Schwartz worked closely with Councilman Bernson, supplying updated fact sheets and briefing members of the council on the proposed ordinance. The lead role in this final period of policy legitimation was played by Bernson. It was an unusual role for a politician, but can be explained in part by the fact that Bernson represented the district most directly affected by the 1971 San

Fernando earthquake. However, Bernson's personal concern for seismic safety was as evident as the political dividends that came with increased media coverage of his work on the ordinance. As Olson notes (1985), there were three interrelated elements in Bernson's strategy: he emphasized means for providing financial assistance for building owners, stressed that implementation would be politically sensitive (i.e., could be slowed if too costly), and tried to convince leaders in the business and financial communities that an ordinance of some kind was inevitable--he sought their participation in its formulation in hopes of also getting their support. Bernson's efforts notwithstanding, consensus in Los Angeles was not to be built as easily as it was in Long Beach.

After receipt of a favorable environmental impact report from the Planning Department in December, 1980, the City Council scheduled additional public hearings. Despite last-minute protests by some 400 renters who were mobilized into action by the apartment owners' association, the council voted 11-3 on January 7, 1981 to accept the ordinance. However, the conflicts that continued until the final vote were indicative of the difficulty of fashioning an acceptable seismic safety ordinance.

Comparative Analysis

As Nelson Polsby has demonstrated for major policy innovations at the national level (1984), there are seven descriptive dimensions that affect adoption of policies: 1) the elapsed time between first proposal and approval of the innovation, 2) specialization (experts versus politicians), 3) consensus in the decision making culture, 4) the saliency of the issues, 5) the degree of political conflict (e.g., public or group opposition), 6) the extent of research and technical design incorporated into the innovation, and 7) the extent of separation and temporal juxtaposition between the two processes of recognizing the need for a solution and proposing the alternatives.

While Polsby's categorization of variables cannot be applied directly to the cases of seismic safety innovation in Long Beach and Los Angeles, the exercise is helpful for suggesting how the two cities might be compared. Without stretching reality too much to fit the theory, Long Beach appears to be closer to the type of innovation that Polsby calls "acute," while Los Angeles seems to better fit the type he labels "incubated." In large part, the distinctions reflect the much longer period required for policy innovation in Los Angeles, the increased opportunities for public participation and organized protest thereby created, and the necessity of a slow, incremental, and accommodative process of policy making to allow suitable political response to the vigorous opposition created by the proposed ordinance. Put otherwise, the process in Los Angeles reflected an extended period of policy legitimation, with a large number of policy actors, whereas in Long Beach the process was shorter and policy legimitation was much more limited and confined to a much smaller number of key policy actors. Table IX-1 attempts to capture some of the characteristics of the policy making in these two cases and to suggest the variables that help to explain the distinctions between Long Beach and Los Angeles.

Although the ordinances adopted in the two cities are similar, they were developed through somewhat different political processes that reflected the different characteristics of each city. While it is difficult to say which of the characteristics is the most consequential (i.e., has the most explanatory power), special attention should be called to the leadership role of the Director of Building and Safety, the support of other policy officials, and the degree of public support and opposition. In the smaller city of Long Beach, the Director of Building and Safety played a strong leadership role. While his personal motivation and drive were important to his success, his efforts were helped by a supportive political environment in Long Beach. That supportive environment is related to the structure of government in that city and the low-key nature of its politics. A strong city manager form of government, a relatively small and homogenous population, and a consensual decision making style all create conditions favorable to the exercise of the role favored by Ed O'Connor.

A generally supportive climate of opinion in a populace that still remembered the devastating 1933 earthquake made his activities more acceptable to city officials than they might have been in a city

TABLE IX-1 CHARACTERISTICS OF THE POLICY-MAKING PROCESS IN LONG BEACH AND LOS ANGELES

Characteristics	Long Beach	Los Angeles
City size and population characteristics	Small, relatively homogeneous	Large, heterogeneous
Governmental structure	City manager	Mayor, city council
Legal resources	Authority for condemnations after 1959	Authority to condemn questionable until 1966 Bakersfield case
Decision-making structure	Elitist, cooperative and consensual	Pluralistic, competitive and conflictual
Decision-making style	Innovative, action-forcing. Primary concern for mitigating hazards.	Disjointed, incremental and reactive. Concern for mitigating hazards and economic impact on owners/occupants
Non-governmental interest groups	Weak to moderate. Stronger after 1969. Chiefly property owners and downtown business association.	Strong in opposition over entire period of 1973-81. Chiefly apartment owners, and other owners.
Availability of seismic safety expertise	High	High
Public perception of seismic risk and saliency of the issue	Moderate, but no organized constituency favoring ordinance	Low to moderate; no organized constituency favoring ordinance
Climate of opinion, including media	Highly favorable	Moderately favorable
Public hearings held, opportunities for citizen	Few hearings, opportunities limited	Large number of hearings; exceptional opportunity for participation
Technical expertise of city administrators	High	High
Leadership by administrators	Strong; policy entrepreneur role by building and safety director, 1950s and 1960s	Moderate; professional role for building director, although active in advisory role in 1979-81
Leadership by elected officials	Weak; deferrence to administrators and technical personnel	Weak to strong; weak in early 1970s, but strong in 1979-81
Support of elected officials, city attorney, city council	Strong over most of the period	Weak, but variable
Major catalytic event setting policy agenda	1933 Long Beach quake	1971 San Fernando quake

without that particular memory. As other studies have found (cf. Lambright, 1982; Wyner, 1981), seismic safety policy development seems to depend critically on leadership by a policy entrepreneur like O'Connor in combination with sufficient local concern about seismic risk to create incentives for political leaders to lend their support. Those conditions were present in Long Beach far more than they were in Los Angeles.

Eventually, Los Angeles adopted its own ordinance, but the delays along the way reflect that the city's more complicated, pluralistic and conflictual decision making structure, and a somewhat less concerned public. Given the political culture of that city, administrators are more confined in their entrepreneurial roles, and must wait for the "windows of opportunity" and the supportive political environment to overcome the usual obstacles facing policy innovation. The 1971 San Fernando earthquake helped to shift public concern, as did forecasts of a major earthquake over the next 30 years. Media coverage thereof made the risk to public safety and property difficult to ignore. Concern over the city's legal liability--should no hazardous-structure abatement programs be in place--was an additional encouragement to ordinance approval in Los Angeles.

That organized interest groups were able to slow the process of innovation in Los Angeles far more than in Long Beach is a consequence of the city's governmental structure and, in particular, the visibilty and responsiveness of the City Council. Put otherwise, policy legitimation on a controversial issue like seismic safety is made more difficult because organized groups are more likely to be heard and listened to. Earl Schwartz indicated as much in noting his deference to the political system and the elaborate set of public hearings needed to produce an acceptable compromise. Without passage of AB 604 in 1981, which authorized local governments in California to issue bonds for long-term, low-interest loans for building rehabilitation, and a substantial reduction in estimated costs for retrofitting buildings, property owners and other opponents might have succeeded in challenging the proposed ordinance.

CHAPTER X

RISK PERCEPTIONS, VALUES, AND VIEWS OF BUILDING OCCUPANTS*

In order to better understand the relationship between perception of earthquake hazards and local government seismic policy formation, a survey of households affected by the Los Angeles ordinance was conducted. The survey addressed three basic questions that form the overall outline for this chapter:

1. How important do people perceive earthquakes to be compared with other risks they face?
2. How is governmental regulation of seismic hazard viewed?
3. What specific attitudes did occupants of affected buildings have about the Los Angeles seismic safety ordinance?

The importance of this type of study was emphasized by White and Haas (1975, p. 95) in their assessment of priorities for natural hazards research, when they hypothesized:

> If there were a thorough understanding of the factors which affect the choice of adjustments to hazards at both the individual and community level, it would be relatively easy to have a significant effect upon future benefits and costs of hazard adjustment, and upon the changes in levels of risk acceptance in the United States.

This survey research is intended to aid in understanding risk perceptions and values, and the consequences of those perceptions for seismic policy makers.

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* This chapter was written by Bruce B. Clary, Associate Professor of Public and Environmental Administration, University of Wisconsin-Green Bay. His analysis is based on a survey developed and administered by William Petak and Harlan Hahn. The chapter is based on a more detailed and longer technical report (with much more extensive statistical notation) published by the University of Wisconsin-Green Bay, Center for Public Administration and Policy Science (Clary, 1986).

Survey Design and Rationale

Individual perceptions of and responses to natural hazards are complex processes involving a multiplicity of variables. The physical properties of hazards are important, but basic personality attributes and social attitudes also play a significant role. Among the characteristics linked to hazard-related behaviors are: sense of personal control (Sims and Baumann, 1972), fatalism (Burton et al., 1978), rationalization (Kates, 1962), recall of past experiences (Slovic et al., 1980), and whether a risk is viewed as voluntary or not (Starr, 1969). People tend to adopt only a few simple adjustments to hazards and act largely in response to a disaster or its aftermath. The best predictor of how people will adjust is past experience--how much an individual has suffered due to hazard exposure. The greater the losses sustained, the greater the probability that adjustments to hazards will be made (Jackson, 1981, pp. 407-408).

Earthquakes, however, differ in one important respect from other natural hazards. Although they have a catastrophic potential, the large-magnitude earthquake is rare. There has been only one major seismic event in the United States since 1971. Although residents of seismically active areas are familiar with earthquakes, most are at the low end of the severity scale. In the most comprehensive analysis of hazard victimization to date, earthquakes had a lower level of human impact than fires, floods, hurricanes and tornados (Rossi et al., 1983). In a national survey of hazard victimization covering the period from 1970 to 1980, the rate for earthquakes was .96 per 1000, compared with 2.2 for floods, 2.5 for hurricanes, 3.7 for fires, and 6.4 for tornados. Consequently, people tend to underestimate the risk associated with the low-probability/high-severity earthquake.

In case studies of decision making in 13 California cities (Wyner and Mann, 1983), seismic safety tended to be a low priority on the policy agenda. Other, more pressing issues occupied the attention of decision makers. When seismic safety does become a major policy issue, it is usually in the wake of a major quake (as demonstrated in the Long Beach case). The policy system has been driven almost entirely by crisis (see Scott, 1979).

It was within the context of the prior research referenced above that the household survey was conducted. The respondents to the survey are all occupants, either renters or co-op owners, of unreinforced masonry buildings in Los Angeles. The rationale for focusing on residents of unreinforced masonry buildings is that, due to the possible impacts of the earthquake hazard mitigation ordinance on them specifically, they would probably be more aware than the average citizen of the ordinance's ramifications.

The sample was developed from the resident population of all buildings from which a resident or owner testified or appeared at public hearings concerning the Los Angeles earthquake hazard ordinance. A sample of 500 residents was selected randomly. A self-administered mail survey was distributed in December of 1982, about a year after the ordinance was passed. A follow-up letter was sent and responses were received through February, 1983.

The response rate was 16%. Return rates for mail surveys tend to be generally lower than for other types of survey methods, rarely exceeding 50%. Whenever the return rate is low, the question always exists as to whether respondents differ in significant ways from nonrespondents (Jones, 1971, p. 71). Given the low response rate to the survey, the findings should be considered preliminary, suggesting hypotheses that can be examined using more representative data. As Blalock (1972) states, surveys can perform a useful exploratory function in social research, even if they are based on nonprobability samples or have low response rates.

A similar survey conducted in San Francisco also had a low response rate (22%). The researchers felt that people who reside in seismically active areas are hesitant to respond to questionnaires that focus directly on earthquakes. There is concern about the hazard, but a strong reluctance to talk about the problem. It was hypothesized that this behavior is a form of cognitive dissonance reduction: an attempt by individuals to reconcile living in a desirable environment and facing, on a day-to-day basis, a potentially catastrophic threat to it (Jackson and Mukerjee, 1974, p. 163).

Perception of Earthquake Risks

What is the relationship between low-probability/potentially destructive hazards and human perceptions? One position is that people tend not to pay attention to their possible consequences (Kunreuther, 1979). A typical attitude is that the odds are small that anything serious will occur tomorrow or the next day, so why worry. Individuals tend to discount highly the future costs of a hazard event like a catastrophic earthquake (Wyner and Mann, 1983, pp. 84-86).

The respondents to this survey do not ignore the fact that a damaging earthquake might happen (72% of the respondents thought that a severe earthquake would hit southern California within the next ten to 20 years), but relatively few were concerned about the risks that it poses compared to the other hazards they face on a daily basis. Survey respondents tended to be much more concerned about everyday risks such as price inflation, violent crime, and auto accidents. Other low-probability, but potentially severe events (health threats from cigarette smoking and nuclear war) were ranked near the bottom of the scale along with earthquakes. Indeed, of the potential hazards included in the survey, earthquakes were ranked last by respondents.

This conclusion is quite similar to one derived from a separate three-city survey of attitudes towards earthquakes. In that survey, only 1.7% of the respondents mentioned earthquakes as community problems, with air pollution, crowding, traffic, climate, noise and crime cited more frequently (Jackson, 1981, p. 397). Overall, the implications from the present survey and others that have been conducted are similar (Jackson and Mukerjee, 1974; Jackson, 1977; Jackson, 1981; Kiecolt and Nigg, 1982). Earthquakes are generally viewed from a short-term perspective and their cataclysmic potential downgraded or ignored.

The political impact of limited public concern with earthquakes is predictable: there is not much of a constituency for seismic safety (Meltsner, 1978, p. 3; Wyner and Mann, 1983, pp. 105-11). Policy ramifications of this attitude were explored in other questions and support this proposition. The respondents to the survey tended to feel that, in comparison to other hazards, earthquakes were a hazard against which government can provide the least protection. Similarly, earthquake hazard mitigation was ranked last as a priority for governmental action.

Influences on Seismic Risk Perceptions

There are two major schools of thought about how people assess risk and make appropriate hazard adjustments. Economists use expected utility theory to argue that individuals make a benefit-cost calculation and choose the alternative that renders the most gain at the least expense. This formulation has been questioned widely, largely on the basis of psychological experiments in decision making (see Arrow, 1982). Psychological studies show that people have limited recall of past events, are overconfident in their estimates of risk, rationalize that hazards will not affect them, and anchor themselves to existing ways of looking at things (Slovic et al., 1980). All of these militate against the rational weighing of costs and benefits in arriving at a decision about a hazard and the risk it poses.

In this research, the primary objective was to learn what influences people's risk perceptions in order to explain, in part, why it has proven so difficult to enact and implement hazard mitigation policy, with particular emphasis on URM building hazards. We hypothesized that people's perceptions of earthquakes as an important risk was a function of some of their personal characteristics. The question was, which characteristics?

Based on a review of the literature, it was decided that one important set of personal characteristics were psychological and would be likely to include one's sense of personal control over one's life. This represents psychological properties that are very close to the concept of internal control, which Sims and Bauman (1972) found to be statistically related to the adoption of adjustments to tornado hazards, and to fatalism about earthquakes, a problem explored by Turner and Kiecolt (1984). A second psychological factor likely to affect one's views of how much of a threat earthquakes posed was one's sense of personal security. Since no single question can really evoke indications of such subtle concepts from respondents, a scale was constructed for each of the factors from several questions. The purpose of using the two scales was to ensure that every step possible would be taken to determine whether general psychological states bear any relationship to earthquake perception.

Another scale was developed from several other questions to measure peoples' fear of personal loss from exposure to hazards. From a rational decision-making perspective, the more a person fears losses from earthquakes, the more he or she should show evidence of concern about their catastrophic potential. The scale reflects some of the elements of expected utility theory in its application to hazard perception.

In addition to the psychological characteristics of individuals, it was concluded that other, more easily measured characteristics might provide insight into how people view and value the earthquake risk. Some research shows that better educated and more affluent persons are more likely to make hazard adjustments than are people with less education and low incomes (Burton et al., 1978, pp. 106-111), although Jackson (1981, p. 43) found no relationship between income and earthquake hazard perception. One reason to expect a correlation between income and risk perception is that more affluent persons have more discretionary income with which to mitigate hazards; poor people, in contrast, face more immediate, pressing demands on their incomes, so investments are more difficult to make, especially to protect themselves from an event that may not occur. Yet another index was constructed to measure socioeconomic status--an index constructed from objective measures of income and educational attainment.

Several other demographic characteristics of the respondents were selected for analysis to determine whether they were related to earthquake hazard risk perception. It was thought that older persons might be more concerned about the hazard than younger persons, so age was included. Retired persons, most of whom live on fixed incomes, were hypothesized to be more concerned about losses due to risks than other people, so that variable was included. Whether the respondent was disabled was included; it was hypothesized that disabled persons are likely to be at greater risk from earthquakes and, thus, may be more concerned about them. Whether the respondent was a member of a minority group was included because it was hypothesized that minority group members might find it more difficult to obtain adequate housing and might, therefore, be more interested in not diminishing the housing stock than in improving seismic safety. Finally, it was decided to investigate the extent to which renters were more or less likely than homeowners to perceive earthquakes as significant hazards.

Having decided which characteristics of the respondents to focus on, it was necessary to develop a way to measure perceptions of earthquakes as risks. This was accomplished by creating an index from four questions in the survey instrument: 1) how important earthquakes were as a source of danger to the respondent, 2) whether the respondent thought government should do something about the earthquake hazards, 3) how much protection the respondent thought government could provide, and 4) the extent to which the respondent was willing to pay for additional protection from earthquakes.

Statistical methods (correlation analysis) were then used to measure the extent to which the the respondents' personal characteristics were related to how important a source of risk earthquakes were to them (as measured by the scale devised above). The results of the analysis are shown in Table X-1. Of the nine personal characteristics measured, only three were significant (correlated at statistically significant levels): sense of personal control, fear of loss from hazard exposure, and status as a tenant.

The relationship between tenant status and perception of seismic risk may reflect a concern among renters about their ability to find another place to live, should their residence be damaged by an earthquake. Since many apartments in Los Angeles are rent-controlled, a tenant who has to move from an apartment with a rent ceiling faces the prospect of much higher rents if a comparable unit cannot be found. Tenants were also more likely than owners to have lower socioeconomic status, be members of a minority group, and be disabled--all of which make a change of residence more difficult. Tenants may, therefore, attribute greater significance to earthquakes because of fears about their housing opportunities should one occur.

Fear of loss from earthquakes is also related to tenant status and sense of personal control. The association of fear of loss with tenant status is consistent with the earlier interpretation that tenants appear more apprehensive about the impact of quakes on them than do owners.

TABLE X-1 RELATIONSHIP OF SELECTED DEMOGRAPHIC AND PERSONALITY FACTORS WITH RISK PERCEPTION OF EARTHQUAKES

Variables	Perception of Earthquakes As an Important Risk	
	Pearson r	Statistical Significance
Personal insecurity	.01	.48
Sense of personal control	.28	.02
Fear of loss from hazard exposure	.39	.001
Socioeconomic status	.03	.43
Age	-.02	.43
Disabled*	.01	.47
Retired*	-.03	.41
Minority*	.18	.07
Tenant*	.38	.001

*Coded as dummy variables: 1 = attribute present; 0 = attribute absent.

The connection between fear of loss and sense of personal control may reflect realism on the part of individuals who feel that they have some level of control over the external events that affect them. Rather than deny or ignore the possibility of being affected by an unexpected hazard, they realize the potential effects it can have on them in terms of bodily injury and other consequences. They do not appear resigned or fatalistic. This interpretation is consistent with the findings of Sims and Baumann (1972) on the connection between a sense of internal control and the adoption of personal hazard mitigation measures.

To measure the joint effect of respondent characteristics on earthquake risk perception, additional statistical analyses (multiple regressions) were conducted.* The results support a number of important conclusions about earthquake perceptions. First, how people assess seismic risk is not random; it reflects basic personality elements, social attitudes, and demographic factors. Specifically, one tends to be more concerned about natural hazards if one feels greater control over one's destiny (Sims and Bauman, 1972). Although prior studies have questioned the extent to which rational judgment plays a role in individual risk assssment (see Kunreuther, 1979; Slovic et al., 1980; Arrow, 1979), the association between fear of loss and risk perception suggests a rational linkage of concern over the possibility of hazard loss with the threat posed by earthquakes. The connection between tenant status and attitudes toward seismic risk also provides evidence for the importance of concern over personal loss as a factor in hazard perception.

Finally, the data support an important observation about natural hazard mitigation policy-making: government must consider the psychology of individuals in the development of hazard management programs (Kunreuther, 1979). Policies, if they are to be effective, cannot be based solely on risk assessments which ignore how people subjectively weigh risk (see Fishhoff et al., 1979). Rational calculation of loss can play a role in individual risk decisions, but basic personality attributes have a fundamental impact on choices made risks.

Attitudes Toward Seismic Safety Regulation

The public questioned in our survey would favor reduction of hazards posed by several other everyday risks before pushing for action on earthquake hazard mitigation. This does not preclude the possibility of a constituency for seismic safety, but it would likely be smaller and

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*The resulting equation was:

$$Y = 4.34 + \underset{(.34)}{.24F} + \underset{(.41)}{.31IV} + \underset{(.41)}{.68PC} + \underset{(.28)}{.78TS},$$

where

Y = earthquake hazard perception scale,
F = fear of loss,
IV = interaction variable (PC x F),
PC = sense of personal control, and
TS = tenant status,
and where $R^2 = .45$, the relationship is significant at the .01 level of confidence, N = 52 (listwise deletion), and variable IV was transformed using x = x-(x mean) because of multicollinearity. Beta weights are shown in parentheses beneath the coefficients.

possibly less strident than for other policy areas where risk abatement is an issue. Questions in the survey were designed to measure attitudes toward specific roles that government might play in earthquake hazard mitigation. No comparisons were made with other risks, so the relative priority of earthquakes as a risk problem was not considered.

Table X-2 lists the percentage of respondents who support each of the earthquake hazard abatement measures mentioned in the survey. A majority of respondents supports governmental action in three of the five policy options included. Residents are most supportive (80%) of the requirement that potentially hazardous buildings have warning signs. One obvious reason this measure is favored is that it requires no investment by the property owner and, presumably, no rent increase for the tenant. However, a warning of this kind could deter potential renters, and vacancy rates might increase or rents might have to be lowered to compensate for the unsafe building designation.

TABLE X-2 PERCENT OF SURVEY RESPONDENTS SUPPORTING EACH OF SEVERAL POSSIBLE GOVERNMENT EARTHQUAKE HAZARD MITIGATION POLICIES

Variable	Percent In Agreement
1. Public notices should be placed on potentially unsafe buildings.	80%
2. It is the responsibility of the federal government to provide earthquake insurance.	74%
3. Property owners should be required to rehabilitate buildings to meet earthquake construction standards.	53%
4. Compliance with earthquake preparedness efforts undertaken by government should not be voluntary.	50%
5. If apartments must be remodeled to become more earthquake resistant, the main effect will *not* be to increase rent for tenants.	30%

Nearly 75% of the respondents would like government to provide some form of earthquake insurance. Similarly, in a separate three-city study of earthquake attitudes, insurance was mentioned more than any other measure as a way to reduce hazards posed by earthquakes (Jackson, 1981, p. 403). Nevertheless, available evidence indicates that residents would be very unlikely to purchase it. Earthquake coverage has been provided by private insurance companies in California since 1916, at reasonable prices: the rate for a $50,000 home is approximately $100 per year. Yet, as of 1979, fewer than 5% of all California homeowners had bought earthquake insurance (Kunreuther, 1979). Any recommendations based on public support for earthquake insurance must take into account the low participation rate to date.

There is much less agreement on the acceptability of other types of earthquake policies. Only 53% of the respondents support mandatory retrofitting of buildings to meet earthquake standards. An even lower proportion (30%) think that retrofitting could be done without raising the rent of tenants substantially. Finally, there is a 50-50 split on whether compliance with earthquake regulations should be voluntary.

There is substantial opposition to governmental policies that make conforming with regulations mandatory and that produce economic costs for the community. These reservations about regulation are not peculiar to earthquake policy, however; there is a growing public trend to be less supportive of governmental regulation in general. For example, support in national samples for high standards and additional improvements in pollution control, regardless of cost, dropped from 55% to 43% between 1977 and 1980. Likewise, the proportion who felt holding down costs ought to be emphasized over stricter controls rose from 20% to 34% (Bullock et al., 1983, pp. 112-113).

The potential economic costs of earthquake hazard mitigation cannot be ignored as producing citizen opposition. Cost was a major issue in deliberations over adoption of the City of Los Angeles' seismic safety ordinance. The economic impact of the ordinance falls heaviest on apartment and commercial property owners and, predictably, these groups were the most vocal source of opposition to the measure. Tenants, however, were often opposed, due largely to a fear that rents would be raised in order to cover the costs of building modifications.

In order to analyze further the influences on attitudes toward seismic safety policy, a number of variables were correlated statistically with a scale designed to measure opposition to earthquake policy. The scale was developed from responses to five questions (see Table X-2) concerning attitudes toward earthquake hazard mitigation policies (results are shown in Table X-3). Five of the variables tested demonstrate statistically significant correlations with opposition to seismic safety regulation. In summary, people who are generally opposed to governmental controls to mitigate earthquake hazards:

1) tend to have lower levels of personal insecurity ($r = -.28$),
2) evidence less concern with personal loss due to hazard exposure ($r = -.51$),
3) are not as concerned about the risk from earthquakes ($r = -.40$), and
4) are more likely to be property owners ($r = -.50$) and older ($r = .29$).

Additional statistical analysis (multiple regression analysis) was conducted to determine what proportion (of the variance) of the opposition to government earthquake hazard mitigation efforts could be explained by the variables listed in Table X-3. When the effects of the variables are considered jointly, only two help to explain opposition to government hazard mitigation policies at a statistically significant level: fear of hazard loss and tenant status*. The more important predictor of the two is fear of loss due to hazard exposure and the correlation is negative: when people fear hazard loss, they are more likely to support governmental action.

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*The regression analysis generated the following results:

Independent Variable	Partial R^2	Beta	B/Std. Err.
Fear of Hazard Loss	.29	-.41	-1.06/.27
Tenant Status	.40	-.36	-3.81/1.11

where:
Constant = 20.5, $R^2 = .40$, N = 65 (listwise deletion), and $p < .01$.

TABLE X-3 CORRELATES WITH OPPOSITION TO GOVERNMENTAL EARTHQUAKE HAZARD MITIGATION POLICIES

Variable	Pearson r	Statistical Significance
Personal Insecurity	-.28	.04
Sense of Personal Control	-.18	.09
Fear of Loss from Hazard Exposure	-.51	.001
Liberalism	-.18	.07
Political Activity	.15	.10
Political Efficacy	-.01	.46
Concern With Earthquake Hazard	-.40	.001
Socioeconomic Status	-.03	.41
Minority*	-.11	.18
Tenant*	-.50	.001
Age	.29	.007
Retired*	.26	.48
Disabled*	.001	.48

* Coded as dummy variables: 1 = attribute present; 0 = attribute absent.

When the latter finding is coupled with the earlier conclusion that earthquakes tend to be seen as relatively minor risks, the need for public education about the problem suggests itself. Since there is a high probability of an earthquake in southern California within this century, the concern of residents about hazard loss is well-founded. If people have difficulty understanding and making choices about low-probability/high-consequence events (see Slovic et al., 1980), an intense educational program could change that perception by making them aware of the actual dangers that earthquakes pose.

Attitudes Toward the Los Angeles Seismic Safety Ordinance

The Los Angeles Seismic Safety Ordinance was hotly debated because it required that buildings had to be rehabilitated if they did not meet certain structural standards and that individual owners were financially reponsible for the modifications. All survey respondents lived in unreinforced masonry buildings, the target of the ordinance. It can be assumed, therefore, that the respondents were more knowledgeable about the ordinance and had more concrete feelings about it than the average citizen. Secondly, it must be recognized that the findings reflect the attitudes of a specific group of residents, not of the population of the city as a whole.

Knowledge of the Ordinance and Political Activity

Almost two-thirds of the survey respondents (63%) knew that the earthquake hazard policy had been enacted. Of the respondents aware of the ordinance, 36% (22% of all respondents) actually went to a meeting where the ordinance was a topic of discussion. This level of citizen involvement in the adoption of the Los Angeles seismic safety ordinance is similar to what generally is found in local politics. In one of the most comprehensive studies of political participation, 30% of the sample had worked with others in trying to solve community problems and 19% had attended at least one political meeting within the last three years (Verba and Nie, 1972, p. 31).

A proposed earthquake ordinance along the lines of Los Angeles' should have the potential to mobilize individuals to take some form of political action. It is likely that public awareness will develop when similar policies are considered in other cities. At a minimum, participation that is consistent with average levels of involvement in community issues can be expected.

Support for the Ordinance

Respondents were asked whether they were initially supportive of the ordinance and what their present attitude was. In both instances, a majority opposed the measure: 63% and 60%, respectively. Few respondents had changed their feelings about the ordinance. Just 7% indicated they had a different attitude.

Almost all (95%) of the owners of co-op apartments opposed the ordinance, compared to just 36% of the tenants. The most likely explanation for this difference is economics: homeowners have a greater fear about paying for renovations than tenants have regarding the possibility of higher rents. Second, there is some evidence that opponents of the measure were more involved politically. Attendance at the earthquake hearings was positively correlated with opposition to the ordinance (r=.39, p=.007).

Table X-4 describes the relationship of selected variables to support for the earthquake ordinance. Opposition to the ordinance increases with age and opposition to seismic regulation generally. Support for the ordinance is related to fear of loss from hazard exposure, concern with the earthquake hazard, and tenant status. Perception of the problem, therefore, is multi-dimensional, involving political and social attitudes as well as the demographic background of respondents.

TABLE X-4 CORRELATES WITH SUPPORT FOR THE LOS ANGELES EARTHQUAKE HAZARD MITIGATION ORDINANCE

Variable	Pearson r	Statistical Significance
Personal Insecurity	.17	.24
Sense of Personal Control	.14	.22
Fear of Loss from Hazard Exposure	.38	.01
Liberalism	.22	.07
Political Activity	.11	.25
Political Efficacy	.08	.31
Concern With Earthquake Hazard	.59	.001
Socio-economic Status	-.14	.25
Minority*	.22	.08
Tenant*	.60	.001
Age	-.31	.02
Retired*	-.23	.06
Disabled*	-.18	.11
Opposition to Seismic Regulation	-.60	.001

*Coded as dummy variables: 1 = attribute present; 2 = attribute absent.

To determine the power of the variables to explain support for the ordinance, a multiple regression model was tested. The model demonstrated that whether a person owns or rents property is crucial in determining support or opposition to the ordinance, while general opposition to seismic safety ordinances is also significant.

Together, the two variables explained 48% of the variance in attitude toward the ordinance.*

Concluding Note

The survey findings should be considered preliminary (primarily because of a low response rate) and in need of further testing with more representative data. The respondents also consisted entirely of residents of affected buildings, making it difficult to draw generalizable inferences about the community as a whole. Nevertheless, some significant findings resulted from the survey. Future evaluations of alternative seismic policies should include consideration of the level of earthquake regulation that people are willing to accept and how this support is likely to vary across different social groups. Political and social attitudes, psychological attributes, and demographic characteristics are important in shaping perceptions of the earthquake problem, and hazard management programs must take them into account.

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*The regression analysis generated the following results:

Independent Variable	R square	Beta	B/Std. Err.
Tenant Status	.39	.43	.42/.13
Opposition to Seismic Regulation	.48	-.36	-3.64/1.36

where:

Constant = .65

R^2 = .48, N = 43 (listwise deletion) and p <.01.

CHAPTER XI

RISK PERCEPTIONS, VALUES AND PREFERENCES OF BUILDING OWNERS*

Most of the vocal opposition to the proposed ordinances requiring strengthening of unreinforced masonry buildings came from owners and from owner associations. Since we've viewed the policy process from the perspective of public officials, engineers and geophysicists, and occupants of unreinforced masonry buildings, we focus now on the views of building owners--specifically, on their perceptions of the earthquake risks associated with the old buildings, their values concerning the hazard mitigation, and their policy preferences.

Two methods were used in our efforts to assess the nature and intensity of building owner opposition to the Los Angeles ordinance: value tree analysis and the nominal group technique. Both techniques were used with a relatively small number of representative owners to cast light on their views so we could better understand how policy making might have been altered to either reduce owner opposition to hazard mitigation or to create mitigation alternatives that were both effective and relatively acceptable to the owners.

The Real Estate Market

It is useful, first, to know a little bit about the unreinforced masonry building real estate market. There is, at least in metropolitan Los Angeles, a submarket for old brick buildings. The owners we talked with called themselves "brickers," and indicated that they have specialized in buying and selling old brick buildings. The economics of old brick buildings contributes to their forming a real estate sub-market. Because the buildings typically do not conform to contemporary

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*The value tree research reported here was conducted in 1983 by Detlof von Winterfeldt and Richard S. John of the University of Southern California, Institute for Safety and Systems Management (see von Winterfeldt and Johns, 1986). The nominal group research was conducted by Arthur Atkisson, University of Wisconsin-Green Bay, and William Petak, also of the USC Institute of Safety and Systems Management.

building standards, it is difficult to obtain conventional mortgage financing for them. Therefore, buyers and sellers frequently employ land contracts to transfer such properties.

Anecdotal evidence suggests that buildings often sell for high prices--at least in terms of what traditional real estate analysis would suggest they might be valued at--but are also sold at low interest rates on land contract. This arrangement allows sellers to realize the benefits of the sale primarily as capital gains. Interest payments, taxed at higher rates as ordinary income, are kept low. The buyer, too, benefits from this arrangement: the high initial price provides the new owners with substantial tax benefits from depreciation allowances, and the fact that the interest rates are relatively low means that the total price for the building is roughly the same as if it were priced at a lower level and the interest rates were more typical of the overall market.

If the anecdotal evidence provides a correct picture of the market for the old buildings, then the ordinances, as passed, could create genuine financial hardships for the owners. There is a ready rental market for old brick buildings, but the renters tend to be poor, old, minority group members, or businesses and industries that are particularly interested in keeping costs at very low levels--renters that are not typically able to pay high rents.

The benefits of owning unreinforced masonry buildings could disappear quickly if the cost structure were to change. The Long Beach and Los Angeles seismic safety programs would create such a change in the costs of ownership and of doing business. Indeed, in some cases, the earthquake rehabilitation ordinance could require that an owner spend so much on strengthening that he would trigger other mechanisms that would necessitate bringing the entire building into total compliance with current building codes, including plumbing, electrical, fire, and other specialty codes. The value of unreinforced masonry buildings (we believe them to be artificially high) would plummet because of the need to spend large sums to bring the building up to standards. This would make the "brickers" subject to potentially very large capital losses because of the change in conditions occurred during their ownership.

Brickers could experience large losses--an unpleasant reversal of the much preferred windfall gain. One would, therefore, expect considerable opposition from building owners to seismic safety ordinances requiring large-scale strengthening.

Value Tree Analysis

Shortly after the Los Angeles seismic safety ordinance was passed, two sessions were held with owners of unreinforced masonry buildings in that city (see von Winterfeldt and John, 1986). The purpose of the sessions was to identify and formally model the building owners' concerns with the required structural changes in the old brick buildings they owned. The sessions were structured around a process called "value tree analysis" which consists of:

1. Identifying a set of alternatives to the ordinance, including straw alternatives of "do nothing" and forced demolition;
2. Structuring the values and concerns of building owners in the form of a value tree;
3. Generating a matrix of alternatives and attributes of those alternatives through a computer program;
4. Eliciting judgments of the relative performance of the alternatives on the attributes in the form of "location measures;" and
5. Eliciting judgments from the participants about the relative importance of the attributes.

The five steps comprise one part of the value tree analysis. The remaining steps require application of a detailed computer model of the participants' responses. The computer model evaluates each of the alternatives using the participants' own measures and weights. The analysis:

1. Maps the logic of the participants argument with their own evaluation model;
2. Compares individual evaluation models to highlight differences and similarities among participants; and
3. Conducts a sensitivity analysis that indicates which model parameters (especially weights) would lead to a change in preferences among the alternatives.

The value tree analysis helps to answer questions such as the following: Why are the building owners so strongly opposed to the ordinance? Is it because they perceive the risk reduction to be minimal, because they think that the costs are too high, or because they have different cost-risk tradeoffs from city officials? What changes could have been made in the ordinance to generate greater acceptance by building owners? Would better financing, binding agreements, or less stringent standards help? What do the owners think will happen as a result of the ordinance to rents and housing availability in Los Angeles?

The First Session

Value tree analysis groups are necessarily small; The first session, which lasted three hours, was held with three participants. After a brief introduction, the three owners identified four main areas of concern to them: economics, impacts on renters, consequences of rehabilitation, and safety. The owners were asked to list some alternatives to the ordinance that would either do very well or very poorly in serving their broadly defined values. They identified five alternatives:

1. No ordinance. This alternative was defined as the preordinance status quo.
2. Wall anchoring only--this alternative would require building owners to install wall anchors only. This alternative had been proposed as a compromise during the drafting of the ordinance.
3. Forced demolition of all URM buildings within 25 to 30 years--this alternative would give the owners the most flexibility in financial planning, but would result in demolition of all URM buildings.
4. Ordinance as is--this alternative was defined as leaving the present ordinance intact.
5. Demolition now--this is the extreme alternative. It would consist of an ordinance so restrictive that it would result in immediate demolition of all URM buildings.

Using these five alternatives as a basis, the owners were asked to structure their values and concerns in much more detail. This process is the perhaps the most creative aspect of value tree analysis for the participants; it involves asking provocative questions: What do you mean by "safety"? How would you measure the economic impact of the alternative? What are all the things that are good about each alternative (even if contrary to your preferences)? By listing, defining, redefining, and pruning the answers to such questions, the participants generated the value tree shown in Figure XI-1.

Since most branches and twigs of the value tree in Figure XI-1 are self-explanatory, we will comment only on the more peculiar branches. The attribute "delay of rehabilitation" under the general area, *Impacts on Tenants*, was mentioned as a value because the participants felt that many building owners would hold back funds set aside for necessary rehabilitation work. The impending large investments that had to be made for structural improvements would not permit owners to spend money on other improvements. The attribute "ease of relocating tenants" was perceived as a possible positive impact of the ordinance since it would provide owners with a convenient way to get rid of unwanted tenants. The attribute of "incidental building improvements" was mentioned because some building owners argued that they would take the opportunity of the major structural work to simultaneously carry out other improvements, such as plumbing and electrical wiring. This attribute was not stressed by the owners; some participants argued that the required rehabilitation work would so strap them financially that they could not afford such extravagances.

Safety was clearly a concern, but the building owners felt that the ordinance would not improve safety greatly over the alternative of simply installing wall anchors. One way the owners liked to think about safety was in terms of the extent to which the reconstruction would bring the URM buildings up to present seismic safety standards. Another way of thinking about safety was in terms of actual deaths averted. Two scenarios were created to estimate fatalities: the first involved a large earthquake (the "33 quake"), and the other a moderate earthquake (the "71 quake"). In both cases, the number of fatalities seemed a reasonable measure of the risks and the reduction in fatalities an indication of improved safety.

Table XI-1 shows the consensus location measures given by the three participants when judging the performance of the five alternatives on the 13 attributes from Figure XI-1. These location measures were con-

FIGURE XI-1 VALUE TREE FOR OWNERS OF UNREINFORCED MASONRY BUILDINGS, SESSION 1 PARTICIPANTS

Area of Concern	Attribute	Operationalization
ECONOMIC IMPACTS	Costs of structural improvement	$ per square foot
	Competitiveness in rental market	% of URM buildings that remain competitive after rent increases
	Loss of property value	% decrease in value
IMPACTS ON TENANTS	Rent increases	% increase
	Delay of rehabilitation	% reduction of moneys assigned for rehabilitation work
	Relocation impacts	% of tenants needing relocation
	Short term housing availability	% reduction in available URM housing because of demolition
	Long term housing availability	% reduction of available URM housing because of demolition
POSITIVE IMPACTS OF REHABILITATION	Ease of relocating tenants	% of tenants that can be moved
	Incidental building improvements	% of money spent on buildings during reconstruction
SAFETY	Safety factor	% of brick building safety relative to current standards
	Casualties in a large earthquake	Number of people dying in URM buildings
	Casualties in a small earthquake	Number of persons dying in URM buildings

structed in brief discussions for each separate attribute. There was generally some disagreement among the three participants about the precise numbers, but consensus was achieved in all cases. Minor disagreements (less than 5%) were averaged out. The consensus data are reported in Table XI-1. The table is a matrix, depicting the owners' expected outcomes for the five alternatives for each of the 13 attributes.

The table demonstrates a number of remarkable features. First, note that the location measures (expected outcomes) in the major areas of concern (*Economics and Tenant Impact*) point uniformly in the direction of "no ordinance" as the best alternative, followed by the alternative requiring demolition in 25 years and wall anchors, with the present ordinance and the demolition ordinance being distant losers. Second, note the judgments about the improved safety as a result of the alternative ordinances. The big improvement is seen by owners as resulting from wall anchoring (55% safety, 900 lives saved); this view is consistent with those of some reputable structural engineers. The present ordinance is perceived as providing only a marginal improvement over anchoring (75% safety, about 900 lives saved).

Thus, even without weighting, one can extract from the value tree analysis the gist of the building owners' argument: on the economic side, the ordinance generates extreme burdens (which would be much less with the anchoring or 25-year demolition alternatives) while providing only marginal safety benefits. The data also suggest that the building owners would be willing to pay $2 per square foot to save avert 900 statistical premature deaths through anchoring, but that they are unwilling to pay the additional $8 per square foot to avert an additional 50 statistical deaths. These statements about cost-effectiveness and risk-cost were not elicited from the respondents; they were inferred from the argument that anchoring would be acceptable and the separate judgments about the costs and risk reduction.

In addition to generating the matrix of alternatives by attributes (in Table XI-1), participants were asked to rank order the attributes in the order of the relative importance. First, importance judgments were made about the relative importance *within* a general area of concern and, subsequently, the four general areas of importance were ranked in order of importance. Using a rank weights transformation process (Stillwell

TABLE XI-1 PERCEPTIONS OF UNREINFORCED MASONRY BUILDING OWNERS

ATTRIBUTES	ALTERNATIVES				
	No Ordinance	Anchors Only	Demolish in 25 yrs	Present Ordinance	Demolition Now
ECONOMICS					
$ per square foot	0	$3.00	0	$10.00	0
Percent competitive with other buildings	100%	85%	100%	50%	0%
Property value loss	0%	0%	15%	50%	100%
TENANT IMPACTS					
Rent Increases	0%	10%	0%	50%	60%
Reduction in rehabilitation $ available	0%	10%	0%	80%	100%
% tenants needing relocation	0%	10%	0%	50%	100%
Reduction in available housing: short term	0%	10%	0%	50%	100%
Reduction in available housing: long term	0%	5%	100%	20%	100%
POSITIVE IMPACTS OF REHABILITATION					
Ease of relocating tenants	0%	10%	0%	100%	100%
Incidental building improvements	20%	5%	10%	40%	0%
SAFETY					
Degree of meeting current safety stds.	0%	55%	0%	75%	100%
Number dead: large earthquake	1000	100	1000	50	0
Number dead: small earthquake	10	0	10	0	0

et al., 1981), the rank weights were normalized. Cumulative weights of twigs were computed by "multiplying down" the first and second level weights (Edwards and Newman, 1982). The data resulting from the calculations are illustrated for two respondents in Table XI-2.

Analysis of the responses from the first session demonstrated a surprising level of agreement. Economics and tenant impacts were the most important concerns, and the benefits of increased rehabilitation expenditure and of improved seismic safety were relatively minor concerns. This does not mean that rehabilitation and safety are not important in general, but that the ordinances and other alternatives were thought to have little impact on these areas. The respondents did not see safety and rehabilitation expenditures as being particularly sensitive to the several policy alternatives.

In order to complete the evaluation model, location measures were restandardized as follows: the "best" score in each attribute was given a value of 100, the worst a value of 0, and intermediate scores were rated by interpolation. This procedure assumes, of course, linear utility functions, which, given the data, seems to be a reasonable assumption. The value scores for each alternative were then computed as a weighted average:

$$\text{Value (ALT)} = \text{Sum}_{i=1}^{n} \ \text{Weight}_i \times \text{Value}_i \ \text{(ALT)}$$

where:

WT_i is the weight of the i^{th} attribute, and $Value_i$ is the restandardized location measure of the alternative ALT in the i^{th} attribute.

Since rank weights were renormalized to add to one, the overall value scores for the five alternatives varies from a lowest possible value of 0 to a highest possible value of 100.

Detailed analysis was conducted for one of the participants. His importance weights were applied to each of the alternatives originally posed by all the participants in the value tree session. The result is shown in Table XI-3, where the weights are applied, first, within each of the four major areas of concern (economics, impacts on tenants, impacts on rehabilitation, and increased safety), and, second, in an aggregated, weighted overall evaluation of the five alternatives.

TABLE XI-2 IMPORTANCE WEIGHTINGS, RENORMALIZED FROM RANK WEIGHTINGS

	Respondent One			Respondent Two		
	First Level	Second Level	First times Second	First Level	Second Level	First times Second
ECONOMICS	40%			40%		
Cost per square foot		50%	20%		50%	20%
Percent competitive with other buildings		17%	7%		33%	13%
Property value loss		33%	13%		17%	7%
TENANT IMPACTS	30%			30%		
Rent Increases		33%	10%		33%	10%
Reduction in rehabilitation $ available		27%	8%		27%	8%
% tenants needing relocation		20%	6%		20%	6%
Reduction in available housing: short term		13%	4%		13%	4%
Reduction in available housing: long term		7%	2%		7%	2%
POSITIVE IMPACTS OF REHABILITATION	10%			20%		
Ease of relocating tenants		33%	3%		33%	7%
Incidental building improvements		67%	7%		67%	13%
SAFETY	20%			10%		
Degree of meeting current safety stds.		33%	7%		33%	3%
Number dead: large earthquake		50%	10%		50%	5%
Number dead: small earthquake		17%	3%		17%	2%

For each of the four major areas of concern, the total scores indicate the alternative that the respondent believes to be the most preferable. In the case of *economic impacts*, the respondent believed that the "no ordinance" alternative is most preferable, followed by "demolition in 25 years" and by "anchoring only." The preference pattern is repeated for concerns about *impacts on tenants*. However, when the respondent looked at *positive impacts on rehabilitation*, the city's ordinance, as passed, was the most preferable alternative. In the last area of concern, *increased safety*, the "demolition now" alternative was thought to have the most desired outcomes, followed by the city's present ordinance and the anchoring alternative.

Finally, when one examines the overall, cumulative scoring of the four major areas of interest, as weighted by this particular respondent, the most preferred alternative is wall anchoring. This is indicated by the fact that the anchoring alternative received the highest number of points of all the five alternatives in the totals row. The anchoring alternative was followed by the "no ordinance" alternative and forced demolition in 25 years. The present ordinance and forced demolition now were distant followers. The closeness of scores of the present ordinance and the forced demolition alternatives suggests that the owner whose weightings and preferences are examined here finds the present ordinance almost as threatening as forced demolition now.

Value tree analysis also permits sensitivity analysis to test the robustness of respondent preferences. The data shown in Table XI-4 demonstrate the sensitivity testing procedure and the preferred alternatives for the single respondent being examined here, depending on the weights assigned each of the four major areas of concern. In the sensitivity analysis, the weights of each of the four main areas of concern were systematically varied from 0 to 100%, while the remainder of the weights were allocated proportionately to the other three areas of concern. For each weighting level tested, the preferred alternative is marked with an asterisk in the table. When testing alternative weights for economics, the anchoring alternative wins consistently over the "no ordinance" alternative unless economics becomes very important (that is, unless it is weighted at more than 50%). The results are similar when one tests alternative weights for concerns about impacts on tenants.

TABLE XI-3 VALUE TREE ANALYSIS FOR A REPRESENTATIVE OWNER OF UNREINFORCED MASONRY BUILDINGS

ATTRIBUTES	ALTERNATIVES No Ordinance	Anchors Only	Demolish in 25 yrs	Present Ordinance	Demolish Now	Overall
ECONOMICS						
$ per square foot	100	70	100	0	100	20.0%
Percent competitive with other buildings	100	85	100	50	0	6.7
Property value loss	100	100	85	50	0	13.3
TOTAL	100	83	95	25	50	40.0
TENANT IMPACTS						
Rent Increases	100	83	100	17	0	10.0%
Reduction in rehabilitation $ available	100	90	100	20	0	8.0
% tenants needing relocation	100	90	100	50	0	6.0
Reduction in available housing: short term	100	90	100	50	0	4.0
Reduction in available housing: long term	100	95	0	80	0	2.0
TOTAL	100	88	93	33	0	30.0
POSITIVE IMPACTS OF REHABILITATION						
Ease of relocating tenants	0	10	0	100	100	3.3%
Incidental building improvements	50	12	25	100	0	6.7
TOTAL	33	11	17	100	33	10.0
SAFETY						
Degree of meeting current safety stds.	0	60	0	75	100	6.7%
Number dead: large earthquake	0	90	0	95	100	10.0
Number dead: small earthquake	0	100	0	100	100	3.3
TOTAL	0	82	0	89	100	20.0
FIRST LEVEL OVERALL SCORING						
Economics	100	83	95	25	50	40.0%
Tenant Impact	100	88	93	33	0	30.0
Positive impacts on Rehabilitation	33	11	17	100	33	10.0
Improved Safety	0	82	0	89	100	20.0
TOTAL	73	77	68	48	43	100.0

The testing of alternative weights for "positive impacts on rehabilitation" leads the value model through some interesting zig-zags. For a low weight on "rehabilitation benefits," the building owner would prefer anchoring, for a weight of 35%, "no ordinance," and financially, for higher weights (40% and up), the current ordinance is preferred.

There are interesting results when one tests the sensitivity of value weighting for concerns about safety. For a very low weight on safety (0 or 10%), the "no ordinance" option is preferred. For most middle level weightings, the anchoring alternative emerges as the winner. For very high weights on safety (80% or higher), the alternative requiring immediate demolition comes out best. In other words, no matter how high a priority one might set on safety, given the location measures of the building owners, the current ordinance would *never* be preferred over forced demolition.

A similar analysis was conducted for a second participant in the morning session. Overall, the results of the second analysis were similar to the first set, except that the second respondent weighted safety concerns lower than rehabilitation benefits, thereby showing a preference for no ordinance over the anchoring alternative. Indeed, because of the lower concern for safety, the second respondent actually prefers, slightly, the forced demolition in 25 years to the anchoring alternative. In the sensitivity analysis, the second participant sticks with the "no ordinance" alternative much longer than the first participant. Under only two conditions does the second participant prefer any of the alternatives to the "no ordinance" policy option: first, if his concern for economics were to become very low (10% or less), in which case he would prefer the city's ordinance, and second, if his weighting for safety were to become predominant (70% or more), he would prefer anchoring.

The Afternoon Session

Four building owners participated in the second session. Because the first session produced a rather clear value tree and structure of alternatives, the entire process was reviewed with participants rather than repeated. The review resulted in several significant changes in the alternatives and the tree. First, the second session participants

TABLE XI-4 SENSITIVITY ANALYSIS FOR ONE PARTICIPANT IN A VALUE TREE ANALYSIS

Weight	ALTERNATIVES No Ordinance	Anchors Only	Demolish in 25 yrs	Present Ordinance	Demolish Now
ECONOMICS (40% Initial weighting)					
0	56	73*	49	63	39
10	60	74*	54	59	40
20	64	75*	59	55	41
30	69	76*	63	52	42
40	73	77*	68	48	43
50	78	78*	72	44	44
60	82*	79	77	40	46
70	87*	80	81	36	47
80	91*	81	86	33	48
90	96*	82	90	29	49
100	100*	83	95	25	50
TENANT IMPACTS (30% Initial weighting)					
0	62	72*	57	54	62
10	66	74*	60	52	56
20	70	75*	64	50	50
30	73	77*	68	48	43
40	77	78*	71	46	37
50	81*	80	75	44	31
60	85*	82	79	41	25
70	89*	83	82	39	19
80	92*	85	86	37	12
90	96*	86	90	35	6
100	100*	88	93	33	0
POSITIVE IMPACTS OF REHABILITATION (10% Initial weighting)					
0	78	84*	73	42	44
10	73	77*	68	48	43
20	69	70*	62	54	42
30	64*	62	56	59	41
40	60	55	51	65*	40
50	56	48	45	71*	39
60	51	40	39	77*	38
70	47	33	34	83*	37
80	42	26	28	88*	36
90	38	19	22	94*	34
100	33	11	17	100*	33
SAFETY (20% Initial Weighting)					
0	92*	76	85	37	29
10	82*	76	76	43	36
20	73	77*	68	48	43
30	64	77*	59	53	50
40	55	78*	51	58	57
50	46	79*	42	63	65
60	37	79*	34	68	72
70	27	80*	25	74	79
80	18	80	17	79	86*
90	9	81	8	84	93*
100	0	82	0	89	100*

* Indicates preferred alternative at that value weighting.

decided to eliminate the "forced demolition now" alternative because it seemed so unreasonable, even as a straw alternative. Second, a new concern was introduced--the unreliability that the present ordinance would be enforced and the non-binding character of municipal ordinances. The participants argued that there is no way of telling whether a new administration might not come up with different ideas about how to improve earthquake safety, thereby rendering the owners' prior, costly efforts useless. This *reliability of regulation* issue was introduced as a policy alternative.

None of the second session owners thought much of the general area of concern labelled *positive impacts of rehabilitation* by the first session participants, so it was eliminated. Short-term and long-term housing availability were combined into one area of concern and a new area, "slum building" was added. Second session participants believed that a "demolish in 25 years" policy would result in creation of slum housing because owners would stop making improvements and repairs to the buildings.

There was less consensus among second session participants than among first session participants. Illustratively, there was considerable disagreement about the cost of various alternatives. Estimates for wall anchoring varied from a low of $1.50 to a high of $5.00. One participant argued that it would cost $15 per square foot to comply with the present ordinance, whereas the others held that it would cost only $10 per square foot. These differences of opinion resulted in different estimates of the effects of the rehabilitation on rent increases; higher cost estimates for the rehabilitation were, of course, associated with higher rent increase estimates.

One participant believed that none of the ordinances would avert and deaths in the event of an earthquake. Another thought that the percent of deaths averted (compared with the total number of fatalities) for both small and large earthquakes was about 5% for anchoring and about 10% with the city's present ordinance. Two others thought that anchoring would avert about ten percent of the expected fatalities and that the present ordiance would avert about 20% of the expected deaths. The judgments of the second session participants are in marked contrast to those of the first session participants, who thought that anchoring would avert about 90% of the deaths and the city's ordinance would avert 95% of the deaths.

Weightings for the four areas of concern voiced by the second session participants (*economics, tenant impacts, safety, and reliability that the ordinance would be implemented*) were different from those of the first session participants, indicating a comparatively wide spread of values for unreinforced masonry building owners. One owner weighted each of the four categories equally. Another weighted economics at 50%, tenant impacts at 25%, safety at 5%, and reliability at 20%. A third weighted economics at 89%, with correspondingly low scores of 3% for tenant impacts, 2% for safety, and 6% for reliability. The final participant weighted economics at 40%, safety at 10%, reliability at 50%, and did not assign any weight to impacts on tenants.

The analysis proceeded as for the first session. The findings are similar to those for the first session. They are summarized in Table XI-5. One of the participants prefers the anchoring alternative, one

TABLE XI-5 PREFERRED ALTERNATIVES FOR DEALING WITH THE EARTHQUAKE HAZARDS

PARTICIPANT	ALTERNATIVE No Ordinance	Anchors Only	Demolition in 25 Years	Certain Implementation of Present Ordinance	Present Ordinance
First	50	66*	45	61*	28
Second	65*	44	65*	29	5
Third	92*	73	92*	15	2
Fourth	40	40	40	62*	10

* indicates prefered alternative

prefers the present ordinance with certainty that it will be implemented, and the other two are indifferent between having no ordinance and forced demolition in 25 years. Just as in the first session, none of the participants preferred the city's ordinance over other alternatives.

Conclusions

While there exists some disagreement among building owners about which of the policy alternatives examined in this analysis would be best, the lines of argument are clear: building owners who are concerned mainly with economics appreciate economic strategies such as forced demolition in 25 years or, at least, relaxed time frames the most. If the concern is distributed over several areas, an intermediate solution, such as requiring wall anchors alone would do well. Finally, if reliability of the regulation--certainty of implementation--is a strong concern, any step that make the regulation "stick" would be appreciated.

For designers of future ordinances, the results suggest a triple strategy: relax the ordinances in the direction of anchoring, provide more time for the building owners to arrange their economic strategies, and formulate the ordinance to "make it stick." Building owners would generate much less opposition to an ordinance that is designed around these principles. Of course, this analysis is from the point of view of the view of the owners and does not examine the value preferences of other participants in the policy making process.

Nominal Group Analysis

At essentially the same time the value tree sessions were being conducted, a separate nominal group exercise was taking place with a different set of unreinforced masonry building owners. The overall objectives were similar: to learn more about owners' values, concerns, and policy perspectives concerning the recently passed Los Angeles seismic safety ordinance. The nominal group technique involves participation of a relatively small group of participants who, assisted by a facilitator and analyst, develop and explicate their views on a given topic. In this case, the participants were asked to focus on the impacts of the city's new seismic safety ordinance on them as URM building owners, how they would change the ordinance, if at all, and what they would have policy makers do concerning seismic safety policy if they had the opportunity to start fresh.

<u>The Nominal Group Technique</u>

There are seven basic steps in the nominal group technique (Delbecq and Van de Ven, 1975). As a first step, the facilitator describes the general topic and the procedures, asking the participants to generate a list of phrases in response to a question posed by the facilitator. Second, the ideas generated by the participants during the silent writing period are elicited by the facilitator and written on a flip pad. Third, the facilitator leads a discussion to clarify the meaning of ideas presented and the reasons for agreement or disagreement, and to permit time for exploring the meaning of each concept listed. Fourth, the facilitator takes a preliminary vote on the importance of each item listed during the discussion. The voting takes place anonymously by use of cards and the results are typically posted on the flip pad used for listing the concepts. In the fifth step, the facilitator leads a discussion of the preliminary vote, helping with clarification and not pressuring the group toward artificial consensus. The sixth step is a second round of anonymous voting in which participants indicate the concepts or answers that best express their position concerning the issue or question. The final step is for the facilitator-analyst to organize and assess the final responses from the participants.

<u>Findings</u>

Three questions were asked of the building owners. The first question was this: *When you think about complying with the (seismic safety) ordinance, what problems does it produce for you?* Initially, owners listed a large number of concerns, most of which focused on economic hardships that they ordinance would impose on them. Several comments were made concerning hardships that would be imposed on tenants because there would be disruption in the housing market and the total stock of low income housing would decline. In addition, URM buildings housing industrial and commercial uses would be removed from use, thus generating additional unemployment among the least skilled and least employable workers. No comments were made about changes in seismic safety, but, in fairness, the question asked of the owners was about effects on them specifically.

Analysis of the final vote indicates that owners were most concerned about the adverse, disruptive effects of the ordinance on their rental business. They believed that the costs required for improvements would force them to raise rents to the level where they would no longer be competitive and that, because tenants would be forced to relocate during reconstruction, that there would be extensive, disruptive tenant turnover. Nearly as important to the owners was their immediate concern about how they would finance the mandated structural changes. Some believed they simply could not raise the money needed to make the changes. There was concern that making the structural changes would necessitate additional repairs bring the building into compliance with the full range of current specialty codes. Together, concerns over disruptions to the rental business and about how to finance the improvements were far and away the greatest.

The next highest level of concern for owners concerning the ordinance centered on the owners' longer-term financial interests. Some were deeply worried that they could not finance the improvements and that the building would be condemned, in which case they would not have sufficient assets to cover the remaining balance of the mortgage, leading to personal bankruptcy. There was additional concern about the impact of the ordinances on personal income, assets, taxes, and whether they would ever be able to sell their buildings.

Owners also expressed the view that city councils are fickle; while the first of the two stages in the ordinance (the stage permitting installation of wall anchors and deferral of more extensive structural changes) was clear and certain, there was considerable uncertainty about when and whether the second stage would be implemented and what it might look like in the future. Finally, one owner continued to mention the low-income, unskilled workers and tenants who he expected would be made homeless and become unemployed as a result of the ordinance.

The second question the owners were asked was: *If you had the power to make changes in the ordinance or write completely new rules, what changes would you make?* The least supported change was elimination of the ordinance or substantial gutting of it. By far the most preferred alternative among the owners was for some form of financial assistance or financial incentive to help them with the costs of rehabilitation. A relatively small number thought that public funds should be provided for the improvements. A larger number believed that the ordinance should not take effect until arrangements were made for financial assistance, such as a rehabilitation loan fund. Still others thought that some tax advantages or other incentives might be created. Illustratively, reasoned some, it would be a good idea to exempt buildings whose owners agreed to make necessary changes from rent controls.

There was high interest among owners in having some provisions of the ordinance relaxed. Some thought that they should only be required to install anchor bolts, while others argued simply for greater time flexibility for compliance. When given the opportunity to cast at least a symbolic vote against the seismic strengthening ordinance, owners chose, instead, to offer alternatives that would ease the burden of compliance, focusing primarily on public help to ensure the availability of financing the strengthening and, secondly, on providing additional time flexibility for complying.

The third and final question was this: *If the city were starting out all over again, what changes in the process for enacting the ordinance would you recommend?* The most preferred approach among owners, by a slim margin, was for the city to conduct a thorough analysis of the problem from all perspectives, including owners, tenants, accountants, engineers, insurance representatives, and others. Some thought a task force should be formed to ensure that the problem is viewed from all the perspectives.

Clustered just below that approach were three other suggestions. The first was that no ordinance would be put into effect until it was clear that monies would be available for building strengthening. This reflects the concern over financing compliance the owners expressed when they voted on the second question. Second, the owners stated that they would work to develop an approach in which the city council would be bound to agreements made with building owners; they want to reduce their uncertainty and to ensure that political agreements they believe have been made will be honored.

The third approach clustered at this level was a departure from what might have been expected. A significant proportion of the owners indicated their desire that the state government preempt hazard mitigation in this area; the state, they said, should take over policy making about URM buildings. It is not unreasonable that owners might take this position; metropolitan Los Angeles is a maze of municipalities. Unreinforced masonry building owners with properties in several cities could easily envisage a dozen or more cities, each with its own set of rules and policies concerning URM building strengthening, posing to them a bewildering set of regulations.

Conclusions

There is consistency between the value tree analysis and the nominal group analysis. Owners were concerned primarily about the economic impact of the ordinance on them: they were worried about how to finance the mandated improvements; they wanted increased flexibility in compliance; and, overall, felt that the ordinance generated costs for them and their tenants that, first, were out of proportion to what would be gained, and, second, would force their rents to noncompetitive levels.

The owners would opt for an ordinance that required wall anchors only because they viewed that policy as resulting in a considerable increase in safety and as being affordable. However, on the basis of the nominal group results, the owners would accept the more stringent ordinance that was passed if arrangements were made to help them finance the improvements, or if they were to be provided with some financial incentives for compliance.

Owners, like renters, tended to downplay the earthquake hazard; safety considerations were ranked low in the value tree analysis and did not emerge as a matter of concern in the nominal group exercise. It would seem that the owners, like the renters, were more interested in matters of immediate concern than in earthquake safety. As we've said before, there had not been a significant earthquake in the region for ten years. Balance sheets and profit and loss statements are much more in evidence and command immediate attention. There was little evidence that owners were cavalier concerning the safety of their tenants--they simply had more immediate priorities. The fact that few of the owners participating in the nominal group took that opportunity to cast a symbolic vote against the city's newly created ordinance when given the opportunity, opting instead to seek some form of reasonable financial assistance, suggests that they are not unmindful of safety, but simply more immediately involved in finance.

It is clear from the cases that property owners, individually and through their associations, exercised considerable political power. They were able, in both Long Beach and Los Angeles, to delay policy enactment for a considerable time. Hazard mitigators might prudently design their proposed interventions to account for the needs of critical actors in the policy process. In this case, without sacrificing the level of effectiveness of the mitigation (they would not have had to reduce standards to wall anchors only), policy makers could presumably have sped enactment of the ordinance by devising some financial incentives or assistance for URM building owners. Given the tight fiscal constraints on California cities during the period in which the policy options were being debated, it is unlikely that a loan fund could have been created from city budgets, but creation of some imaginative alternative might have resulted in an ordinance years earlier.

CHAPTER XII
POLICY MAKING UNDER CONDITIONS OF AMBIGUITY

A principal objective of this book is to learn why it took so long and proved so difficult to enact and implement earthquake hazard reduction policies in southern California. Had the policy-making effort taken only a few years, or even a decade, the matter might not be so important, but 38 years elapsed between the disastrous 1933 earthquake and the passage, in 1971, of Long Beach's pioneering ordinance requiring abatement of the unreinforced masonry building seismic hazard. In neighboring Los Angeles, it took 48 years to pass a very similar ordinance, including the ten years that elapsed after the San Fernando Valley earthquake.

This chapter examines the development and enactment of the seismic policies from the perspective of contemporary, organizational decision theory. Normative, rational decision-making models are not particularly useful for understanding the events that led to this hazard mitigation ordinance.

Useful Theory: The Garbage Can Model

Over the years, in both our research and management roles, the authors have found it most useful to view organizations as open systems and to assess problems of organizational choice within the context of general systems theory. Within that overall context, however, we have found one behavioral model to be particularly illuminating and helpful. That model, developed by Cohen, March, and Olsen (1972), and elaborated by March and Olsen (1976), is called the garbage can model of organizational decision making .

The garbage can model is based on the triple assumptions that 1) there is always imperfect information, 2) there is never adequate time to deal with all items on the organizational agenda, and 3) not everyone values the array of issues and options equally (they may not even value them similarly). The name drives from the recognition that an individual decision maker's desk can be visualized as a garbage can of problems. Some of the problems in the garbage can are bright and shiny; they can be dealt with simply and quickly. Others are dark, mushy, and foreboding; most of us prefer to avoid dealing with them. We hope that they will sink deeper into the garbage can--out of sight.

The garbage can model suggests also that organizational decision making is further complicated by the fact that new garbage (problems and issues) is frequently added to the can and, occasionally, someone comes along and empties the can, or at least removes part of the contents.

The garbage can analogy can be raised from the case of the unitary decision maker to the organizational and inter-organizational level if one simply increases the size of the garbage can and places the decision maker and his or her desk along the edges of the can along with all the other participants. One can begin to see part of the problems associated with enacting hazard mitigation policy in communities where there are large cans and many problems in those cans.

The garbage can model describes four separate streams that must converge in order for decisions or policy to be made: *problems*, *solutions*, *participants*, and *opportunities for choice*. The model's theory postulates that problems and solutions exist independently from one another--that people often have solutions for which they are seeking matching problems. There are also problems for which solutions have yet to be found. However, a problem and a matching solution are of little solace if there is no opportunity for making a choice--that is, no way to get on the agenda. In addition, of course, one must have the right participants in the right place when the issue is on the agenda. A logical extension of the theory is that decision opportunities sometimes occur serendipitously, but that they also might be *managed* by a participant who is skilled at effecting conversion of the four streams.

Finally, the garbage can model posits that decisions may not be intended to solve problems. After all, problem solving is hard work, requiring time, attention, and often more understanding than we have. March and Olsen suggest that there are three types of decisions made in organizations. One decision type is *oversight*. People frequently attach problems to other choices when those other choices are somewhat easier. If the other decision can be made quickly and easily, it will be, without regard to existing problems. We would add a corollary to March and Olsen's formulation--if substantive issues can be transformed into procedural issues, they probably will be because procedural matters typically have more clearly defined decision rules, and can be dealt with more easily than complex substantive issues.

A second type of decision is *flight*. People frequently hold off making a decision, hoping that the problem will either go away or transform itself into a situation they can deal with more easily.

The third type of decision described by March and Olsen is *resolution*. Some choices actually resolve problems, but they require considerable effort. This is the kind of decision most typically dealt with in the literature, but it is not the type of decision that is made most often.

Seismic Safety Policy and the Garbage Can

The garbage can model allows us to examine policy development from the perspective of each of the four dominant streams in the theory. It should help us understand why it took so long and was so difficult to enact the earthquake safety ordinances. Beyond that, the theory should provide us with some predictive capabilities so that we can devise ways to accelerate the hazard mitigation policy process in other instances or, at the very least, to predict those situations in which one would expect the mitigation policy process to be long and arduous.

The Problem Stream

The extent to which a set of phenomena represent a problem depends on the observer's perceptions, values, and sense of efficacy. A dozen people observing the same phenomenon might all disagree about whether it is a problem or, if it is, how important it is and whether anything can be done about it.

A problem can be said to exist when there is a disparity between the perceived and the desired state of affairs. If there is no perceived disparity, then no problem exists for the viewer. If there is a perceived disparity, but the viewer places low value on the disparity, or has higher priorities competing for limited attention and resources, then the viewer classifies the phenomenon either as an insignificant problem at that particular time or as no problem at all. One's definition of what constitutes a problem changes over time as the gaps between perceived and desired reality change or as values change. The garbage can model requires that problems exist prior to enactment of a policy. The question for us, then, is to ascertain the extent to which a problem existed for the roughly half century between the Long Beach earthquake and the enactment of seismic safety policy for unreinforced masonry buildings. We will look at the various classes of actors who have a stake in the outcome of earthquake hazard reduction--government building officials and seismic professionals, occupants, building owners, and elected policy makers--to determine the extent to which a problem existed for them over the period and, if so, the nature of that problem.

Building officials and seismic professionals. The case histories, the survey research on occupants, and the evaluations of owners' attitudes and perceptions provide us with a rich base for examining the problem stream from the garbage can approach. From the case histories, it is clear that the major protagonists for the development of the URM building seismic policies in Long Beach and Los Angeles were the local building officials and the seismic professionals (structural engineers, geologists, and seismologists). They understood, from the initial studies following the 1933 Long Beach earthquake and from the increasingly sophisticated research conducted subsequently, the causes of the earthquake risk--from tectonic plate movement, through ground acceleration, through the generation of shearing forces in buildings, to building failure. They also understood the probabilities of significant earthquakes. Their understanding of causes and outcomes resulted in their having defined the problem and having become the perennial, persistent voices urging policy makers to acknowledge the situation as a significant problem.

Other threads became woven into the problem fabric as the seismic professionals and public officials continued their explorations. One of these was the potential for municipal liability in the event that a major earthquake occurred and the individual municipalities had made no effort to mitigate the known URM building hazard. While it is difficult to ascertain the extent of liability in cases like this prior to any actual adjudication, it was clear to a number of officials that the potential for group or personal liability was looming out there in the future.

From the standpoint of the seismic and building professionals, the problem was one of how to get a policy enacted that would reduce the hazard by strengthening the buildings, removing them from the building inventory, removing people from the buildings, or some combination thereof. In addition, if the policy reduced potential municipal liability, that would also be highly desirable.

<u>Building occupants.</u> The building occupants would seem to have had an even more direct interest in seismic safety in URM buildings than the building officials and seismic professionals. After all, when a major earthquake hits, they are the ones most likely to have the building fall on them. However, some building occupants did not understand the objective causality and the probabilities associated with major seismic events and building failure, and others did not value the outcomes highly. Some occupants subjectively reduced the probabilities of earthquakes and building failure, while others understood the probabilities but did not value the outcomes as highly as they valued other potential events with higher probabilities of occurring.

Occupants of unreinforced masonry buildings who responded to the survey (See Chapter X) were given an opportunity to comment. Some of the respondents' comments indicated that they did not believe living in an unreinforced masonry building--at least in *their* unreinforced masonry building--posed any greater hazard than living in a newer building incorporating aseismic design features:

> I live in this 'old brick building' because I feel safer here than any other place I have ever lived...Tell them to worry about those poor employees who work downtown in those high rise buildings. Only wings could help them if one of those should topple. When the earthquake comes I hope I will be fortunate enough to be in this 'old brick building.'

> The building in which I live...was constructed in the late 20's. It was built by professional men who used materials of superior quality. It is soundproof and sturdy...This building

> has survived all earthquakes with no damage. Frankly, I am convinced it is far more safe than the newer ones.

> This building is one of the safest buildings in Los Angeles. It was built in 1925 and survived the bad earthquake we had. I was visiting in Illinois at the time and found no damage when I returned while other buildings built in later years were totally demolished.

Other comments focused on respondent perceptions about the efficacy of seismic strengthening:

> It's a dilemma. No matter how much we reinforce buildings, the big quake will still get all of us. I'm fatalistic.

> If the epicenter of a serious quake is anywhere within a few miles of us, the 'Mickey Mouse' kind of 'reinforcement' will do about as much good as an umbrella against a nuclear blast.

> I doubt very much that any building, old or new, can be made earthquake-proof.

> It is not my intention to operate a hazardous place and if I thought reinforcing would make it safe I would gladly comply. If we had a severe earthquake nothing is going to keep the bricks from falling.

The comments of these occupants indicate that, in contrast with the views of building and seismic professionals, they did not perceive much of a problem with the old buildings. Moreover, many of the occupants had higher priorities; they were less concerned about the consequences of a severe earthquake than they were about the consequences of other phenomena:

> I think the risks in Los Angeles are not different from other big cities. From the point of view of a senior citizen, the main concern is [that] one does not feel safe anymore wherever you are. One is exposed to crime in broad daylight; going out at night is a thing of the past.

> Over-population [and] crowding, racial overtones, smog, smoking, V.D., T.B., mixed racial anxieties, evevators in high-rise buildings, food contamination, continued illegal migration across our southern border, [then] older, dilapidated buildings.

> I feel that the low probability of an earthquake occurring of a magnitude to cause emergency situations and natural disasters is so remote than any money-spending methods to alleviate the strain would be wasted and should be used on more high-probability...situations such as unemployment and drug abuse.

Other respondents questioned the motives of those who were pushing for increased earthquake safety in the hazardous buildings:

> The *main reason* the [seismic strengthening] ordinance was passed is to force abandonment of properties by poor people unable to afford it. Then *in* rush the vultures--the banks, real estate interests and the 'developers,' gobbling up plenty of *cheap*, *condemned* property. *That* is what the whole thing was about. Their [city council] hypocritical excuse about concern for lives is laughable. Since when did politicians ever give a damn about the poor?

> The least government is the best government. Instead of meddling in...protection against the Acts of God (as in earthquake hazards) our City Fathers should concentrate their efforts in protecting us from the Acts of Men (as in street crime, burglaries, and robberies)...It's just throwing good money after bad.

> It's nothing but a rip-off for City officials for construction contracts and under-the-table pay offs...Let's get these 'fast profit idiots out of office. Who do they think they're kidding?

These reactions by occupants--some of them renters and others owners--do not suggest that the problem as set forth by the professionals was defined similarly among those likely to benefit most directly by a reduction in seismic risk. From the occupants' perspective, the problem was quite different. To paraphrase several of the tenants we talked with:

> Look, I'm 80 years old. I don't have much money and what I do have goes for food, rent, and medicine. Sure, I'm concerned about safety, but I'm more concerned about getting mugged thanI am about earthquakes. I know this: if the building gets strengthened against earthquakes, my rent will go up. That's certain. On the other hand, there is great uncertainty about when the next big earthquake will occur. I'll probably be dead by then. I'll trade the virtual certainty of a rent increase against the uncertainty of being injured or killed in an earthquake--and that's rational.

The composite tenant makes a rational choice, given his or her values, perceptions, and marginal utilities. The important problem for the tenants, if one can generalize for them, is how to avoid a rent increase, because the marginal utility for a dollar among most of the URM tenant occupants is extremely high. However, if a tenant can avoid a rent increase and simultaneously gain some marginal increase in safety from an uncertain and potentially remote source of danger, so much the better. It would be wise to take that set of perspectives into account whenever one designs mitigation policies for low-probability/high-consequence events.

Building owners. For owners of unreinforced masonry buildings, the potential consequences of a low-probability earthquake for their buildings and occupants held far less salience than did the prospect of the almost certain economic consequences of the proposed hazard mitigation. As we have seen (in Chapter XI), the owners appeared to be concerned for the well-being and safety of tenants, but they were much more worried about the immediate economic implications for them if they were required to spend considerable sums of money to strengthen their buildings against the prospect of earthquake damage. Few of the URM building owners held the same set of perceptions as the seismic professionals. Indeed, for many of the owners, the seismic professionals and their proposed policies became the problem. From the owners' perspectives, any workable solution to problems of seismic safety would have to accommodate their concerns about how to finance the improvements and about how to avoid the financial losses that would result from massive disruptions in business and tenancy. As we have seen, were the principal concerns of the URM building owners who participated in the value tree and nominal group analyses.

Elected policy makers. City council members, the elected policy makers we are concerned with in this case, are the actors in the policy process who shape the decision agenda, even though a strong case can be made that they do not determine the overall policy agenda. They are the ones who allocate the time in the legitimate policy-making forum during which issues can be addressed and policy can be enacted. In terms of the garbage can model, one would expect council members not to allot agenda space to issues over which there is little concurrence about whether a problem really exists, there is no solution that seems appropriate to most of the key stakeholders, and there appears to be little immediate need for action. Moreover, council members, like everyone else, have their own agendas--things they hope to accomplish in the relatively short time between elections.

In the garbage can model, council members are a critical component in what Kingdon calls the "policy primeval soup" (1984). Not only do council members allocate time on busy agendas for considering policy options and decide their fate, but they can help to determine whether an idea survives long enough to become a candidate for a public policy. As Kingdon states:

> Many ideas are possible...Ideas become prominent and then fade. There is a long process of 'softening up': ideas are floated, bills introduced, speeches made; proposals are drafted, then amended in response to reaction and floated again. Ideas confront one another...and combine with one another in various ways. The'soup' changes...While many ideas float around in this policy primeval soup, the ones that last, as in a natural selection system, meet some critiera. Some ideas survive and prosper; some proposals are taken more seriously than others.

One of the ways for an idea to survive and prosper is for it to be particularly relevant for an elected policy maker. The fact that Long Beach was the site of the last great "killer quake" (prior to enactment of the seismic safety policies) probably made the issue more salient to the Long Beach City Council than to city councils in other parts of southern California--areas equally at risk that have not been hit by such an earthquake--particularly because Long Beach is geographically a fairly small city and all areas of the city suffered from the earthquake. In Los Angeles, Councilman Bernson played a major role in promoting the seismic safety ordinance, and it was no accident that the district Bernson represented in the council was the one hit hardest in the 1971 San Fernando Valley earthquake. It was, however, serendipity that Bernson chaired the council's Building and Safety Committee during much of the policy formation period.

The extent to which elected policy makers saw unreinforced masonry buildings and the earthquake potential as an issue worth addressing appears to have depended on the extent to which it was personally salient to the individual and the extent to which the issue could compete for time, attention, and energy with other issues. The garbage can theory would lead us to predict that council members would not make space on the agenda for dealing with URM building safety unless there were a confluence of the four main policy streams: there would have to be sufficient agreement that a problem exists and there would have to be a proposal that seemed to be an acceptable solution.

<u>The Solution Stream</u>

The garbage can model predicts that a policy will not be decided upon unless there is a policy option--a solution--that appears to match a definition of the problem and can be agreed upon at a general level. There was not a universally accepted problem definition concerning URM buildings and seismic safety for most of the half century of efforts to enact a policy. Moreover, there was no well-defined solution to the problem until very late in the policy-making process. This, we believe, was perhaps one of the major obstacles to enactment of the mitigation ordinances.

There are several elements to the solution stream. One of these, of course, is the technological element; it was necessary for engineers and building officials to develop effective, practical techniques for either strengthening buildings or for removing them from the building inventory. Second, there is a legal component; it took some time to develop the basis for a workable solution to the URM building hazard through a series of legal cases and legislation. Third, there is a cost component; one of the common threads through the cases was a continuing concern over how much hazard mitigation would cost, who would bear the costs, and how the structural improvements would be financed. An important aspect of this element, though one which was largely buried in the discussions, was concern about how safe would be safe enough. Finally, a key element of a workable solution is the extent to which it deals with the major concerns of the various stakeholders. Each of these elements is examined below.

The proposed solutions to the URM hazard evolved slowly over time. Long Beach building officials worked at developing ways to alleviate the URM hazard through the '30's and 40's, but it wasn't until the early '50's that municipal officials in California obtained the necessary legal authority to order the strengthening or repair of parapets and other appendages to existing buildings. The authorization caused quick action in Long Beach, where parapets throughout the central business area of the city were strengthened or removed. In 1959, Long Beach took advantage of an opportunity that enabled them to classify buildings at seismic risk as nuisances, and began to condemn buildings to eliminate the earthquake hazard associated with them. This effort was hampered by the lack of a clear legal authorization to enforce new standards on old buildings--a situation that was clarified to the municipality's advantage in *Bakersfield vs. Miller* (1966).

Through 1966, two currents in the solution stream were evident. The first is that the municipality concerned with doing something to alleviate the URM building hazard was operating with little legal precedent and no clear authorization for action. Second, the solutions were primarily of the "meat cleaver" variety: if a building were determined to be unsafe, it should be brought up to standards now or it should be knocked down. This approach to the problem would meet the needs of the seismic professionals, but did little to meet the needs of occupants and owners.

Following the Miller decision, Long Beach moved more aggressively against the risky buildings. City building officials compiled a list of buildings to be condemned, with encouragement and support of seismic professionals. However, the aggressive approach to seismic safety, still based largely on the meat cleaver surgery approach, triggered a response by the United Property Owners Association. As early as 1969, that group defined the critical elements of a solution from the owners' standpoint. They asked the Long Beach City Council to stop the condemnations, to estimate the costs of making improvements, to help work out a way to finance the improvements, and to have building officials work collaboratively with owners to solve the problem (United Property Owners Association of Long Beach, 1969). The results of the value tree and nominal group analyses reveal that the basic elements of a solution acceptable to building owners did not change for more than a decade.

Technological elements of the solution stream had been under development since 1934. There were methods for strengthening parapets and for reinforcing walls to provide added lateral resistance. The effort that began in Long Beach early in 1970 to develop the basis for an ordinance provided significant technological background. Long Beach City Council members knew that the engineering aspects of seismic safety were too complex to hammer out in council session, so a consulting firm was employed to develop the basis for the proposed ordinance (Wiggins and Moran, 1970). It proposed requirements for lateral resistance, suggested the importance of creating priorities among buildings for hazard mitigation depending on the use and occupancy of the buildings, recommended taking into account the existing seismic resistance of buildings, and attempted to assess the variations in seismic risk for different parts of the city through site dynamics and soils mapping. The report also suggested that a separate study be undertaken to help deal with concerns about financing rehabilitation and about insuring URM buildings that were classified as unsafe, but had not yet been repaired.

The solution stream was not developed as easily in Los Angeles, however, primarily because Los Angeles is larger, more diverse, and had an even more adversarial relationship between proponents of the ordinance and building owners than did Long Beach. In Long Beach, toward the end, building owner representatives and local officials were actually collaborating in the development of the proposed ordinance.

Many might be quick to blame the Los Angeles city council for dallying with enactment of the ordinance. Others accuse real estate interests for blocking a desirable public policy. But this is a serious oversimplification. Admittedly, seismic safety is not a hot issue most of the time and can hardly be expected to excite much enthusiasm among most council members. Nor can anyone suggest that there were not some building owners whose overwhelming interest was with protecting their financial prospects. For the most part, however, an objective analysis would suggest that the Los Angeles City Council acted prudently and responsibly on seismic safety.

An axiom for policy scientists is this: if you can't tell your client the probable consequences of following your advice, keep your mouth shut. Each time the proposed ordinance came up for discussion, council members asked important, unanswered questions of city staff: How much is this likely to cost? What will be the impacts on occupants? How many such buildings are there and where are they? How can the improvements be financed? What will be the probable impacts on rents? What are the legal requirements and implications?

Time after time, the council asked for additional information and clarification. The cynic would argue that the demand for information and clarification was simply a convenient means for delaying the need to put one's self on the line. To some extent, this was probably true, but none of the questions was frivolous, and they were all questions for which there should have been ready answers, even if the answers were that there was no way to tell for sure what this or that consequence might be. Anyone in the positions of the council members would have wanted that information.

Does this mean that the city's staff was inept? Not really. Part of the problem is that there are several aspects to the development of the solution stream that required rather considerable coordination and timing. It appears to be the case that, despite the extraordinary amount of time that passed in Los Angeles between Councilman Bradley's first call for such an ordinance in 1973 and the passage of an ordinance in 1981, there was not a lot of wasted time and effort. A well-planned and carefully excecuted policy analysis on such a complex issue, with its important direct effects and a high probability for extensive and potentially widespread dysfunctional by-products, could take three or four years.

In retrospect, the policy proposal was probably brought forward prematurely and suffered the consequences. The prematurity of the proposal put policy makers in the position of trying to decide on an important and controversial issue while still in the dark about the probable consequences of their decision. For most the of period while the policy was under development in both Long Beach and Los Angeles, the policy makers were working under conditions of ambiguity and uncertainty. In decision theory, conditions of uncertainty exist when the decision maker knows the array of potential outcomes, but has no knowledge of the proabability distribution of those outcomes. One could build an argument that policy makers in Long Beach and Los Angeles were even worse off: the next step down from decision making under conditions of uncertainty is decision making under conditions of partial information or ignorance. This condition is characterized by the decision maker not even knowing the range of possible direct consequences resulting from selecting one option over another.

In either event, no one knew the probable consequences of enacting the legislation when the early draft ordinances were brought forth for consideration. It was not until SEASC worked over the three old buildings scheduled for demolition that strengthening techniques were tested, simplified, and endowed with legitimacy in the eyes of non-engineers. It was not until Wheeler and Gray completed their cost studies that there was some semi-reliable basis for refuting the unsubstantiated, and to some degree wild, claims that had been made about the probable costs of compliance. And, it was not until the 1979 legislation that owners' fears were alleviated about having compliance with the seismic safety ordinance trigger the need for them to comply with all contemporary specialty codes.

Nor was the very important financial issue resolved; it remained a largely undeveloped part of the solution stream. Throughout the eight years that Los Angeles was working on and considering a URM building policy, efforts were being made to find or develop a financial assistance package for building owners and occupants. Financial assistance was an important component of the policy because it would help to defuse much of the opposition to the proposed policy by the more adamant owners, and because it would provide much needed help to low-income occupants of the URM buildings.

Finance was almost as important a part of the solution as were the technical means for mitigation. Despite extensive efforts by many people and agencies thoughout the city government, there was relatively little success in obtaining financial aid. The City of Los Angeles' Community Redevelopment Agency worked to provide funding for seismic rehabilitation of rental units using a rehabilitation program available through the U. S. Department of Housing and Urban Development's Section

8 housing assistance program (Community Redevelopment Agency, 1981). Councilman Bernson personally lobbied in Sacramento, the state capital, in an attempt to obtain $300 million in bonds to finance low interest loans (Asakura, 1986).

In 1980, legislation was introduced in the California legislature to provide for bonds to be issued to finance earthquake strengthening of existing buildings (Seismic Safety Commission, 1980). The legislation was still under consideration when the Los Angeles ordinance was passed, but it would appear that the efforts toward developing financial assistance were sufficient promise that it was possible to pass the ordinance even without a complete solution to the problem as perceived by owners and occupants.

The low interest loan bond issue was passed in 1982 but, for a variety of reasons, did not provide much assistance to URM building owners (Avery, 1985). In order for a lender to provide low interest loan funds to a URM building owner under the provisions of the state legislation (AB 604), it became necessary for the building to be rehabilitated to meet the current fire, plumbing, and electrical specialty codes as well as the seismic requirements. Since most buildings of the 1933 vintage do not meet current codes, leaders have been unwilling to lend for seismic rehabiltation alone. In addition, lenders looked for owners to have adequate equity in the buildings for which they sought the low interest loans. Their position was that the first trust deed (first mortgage in most states) had to be paid down sufficiently that a second trust deed (second mortgage) would provide the lender with sufficient collateral. In general, URM buildings are highly leveraged and owners do not have much equity in them. Lending institutions found it difficult to bring themselves to make loans. Most of the URM buildings did not comply with the current specialty codes and few of the buildings had been financed under simple arrangements, so very little lending took place under the provisions of AB 604. In the meantime, the city employed a variety of other programs and methods to provide assistance to owners in their attempts to comply, but the financing problem has not yet been solved.

Clearly, it was not until about 1980 that a generally acceptable solution began to emerge in Los Angeles. By that time, technogical solutions to the problem had been developed, there were generally accepted estimates of what the costs of compliance were likely to be, there was evidence of sincere efforts to find or develop means for helping to finance the improvements, and a reasonable schedule for compliance had been worked out. After the solution stream had flowed together, a concerted and carefully orchestrated effort to enact the policy was the next step.

The Actors Stream

It is difficult to overestimate the importance of a persistent advocate to enactment of a particular policy. Kingdon's findings confirm our own:

> When researching case studies, one can nearly always pinpoint a particular person, or at most a few persons, who were central in moving a subject up on the agenda and into position for enactment (1984, p. 189).

Kingdon's findings about the characteristics of these people (he calls them policy entrepreneurs and we call inside advocates) match our own conclusions. He concludes that three major characteristics contribute to the success of these persons: the person must have some claim to a hearing, must be known for his political connections or negotiating skill, and, probably most important, must be persistent (1984, pp. 189-190). Of this last point, Kingdon states:

> Persistence alone does not carry the day, but in combination with the other qualities, it is disarmingly important. In terms of our concept of entrepreneurship, persistence implies a willingness to invest large and sometimes remarkable quantities of one's resources (p. 190).

In Long Beach, O'Connor pushed tenaciously during his reign as a building official for seismic safety. His efforts were carried on by his successors. In Los Angeles, we find similar tenacity and persistence by building officials, even though the style of the Los Angeles officials contrasted markedly with the O'Connor approach. In addition, in Los Angeles, Councilman Bernson's continuing efforts marked him as a policy entrepreneur in seismic safety, providing the access and the mobilization skills essential for passage. Bernson orchestrated while the city staff provided technical leadership; in Long Beach, O'Connor performed both roles.

Finally, influential in both cities was the continuing effort by the Structural Engineers Association of Southern California (SEASC) and a number of its members--including Ben Schmid, John Kariotis, John Coil in Santa Ana, and others--who pushed ceaselessly for improved seismic safety, primarily at their own expense. Still others in other professional groups, including seismologists and geologists maintained continuing involvement in helping to ensure passage of the seismic safety ordinances. In studies of federal policy making, Kingdon found such professional associations and individuals to be listed as "very important" by persons central to policy making in 15% of the interviews conducted (p. 57), but in this case, they played a major role. SEASC developed techniques for strengthening, tested mitigation techniques, developed cost estimates, created how-to-do-it manuals, helped draft ordinances, and provided expert testimony whenever the opportunity presented itself or could be arranged. The professional associations, particularly SEASC, were well organized, had exceptional expertise on the technical aspects of the solution, and were individually deeply concerned about the issue.

We have concluded that, without the persistence of inside advocates in both Long Beach and Los Angeles, there probably would not now be earthquake hazard mitigation policies for existing buildings in southern California.

The Decision Opportunity Stream

As mentioned earlier, there must be a decision-making opportunity when the problem, the solution, and the actors are all positioned and prepared for a policy decision. In Los Angeles and Long Beach, damaging earthquakes near and far afforded "windows of opportunity" through which inside advocates for the seismic safety policies were able to launch policy initiatives.

The first two decades. It is appropriate to look at the problem, perceived solutions, and policy-making opportunities in historical context. Immediately following the 1933 earthquake, steps were taken throughout California to ensure that future buildings would not be subject to the same failures as the unreinforced masonry buildings. However, the new ordinances, including the Uniform Building Code on which they were based, were far from perfect; the seismic provisions in the UBC keep changing as more and more is learned about earthquake dynamics and about structural response. It is difficult to see that anything could have been done about the existing buildings in 1934 when the first aseismic design requirements for new buildings (in the United States) were enacted. Even though Long Beach building officials were looking for ways to attack the problems of the existing buildings, as they saw them, the nation was in the depths of its most severe economic depression. Unreinforced masonry buildings comprised a major proportion of the total number of buildings in Long Beach and the rest of southern California. Building officials and seismologists saw the hazard, but any solution requiring strengthening, density reduction, or demolition would have been simply out of the question. Had the hazard mitigation required, at that time, even nominal expenditures for each building, the sheer number of URM buildings would have demanded a massive outlay of funds at a time when few people had any money.

Moreover, although strengthening techniques were understood at the conceptual level, tested, practical methods of retrofitting buildings to increase their resistance to seismic forces simply had not been devised. Therefore, no one knew how much it would cost to make the requisite structural changes, nor could reasonable estimates be made. Finally, there were serious questions about whether local governments even had the authority to require retroactively that owners strengthen their buildings. There is little wonder that no policy requiring URM hazard mitigation was enacted during the decade of the '30's.

Nor is there much question about why very little was done during the decade of the '40's. The first half of the decade was spent with the war effort; southern California was deeply involved in building the new aircraft industry and providing a launching platform for the war in the Pacific. The second half of the decade was spent on new home construction and the economic expansion in southern California resulting from the post-war boom and from the migration to California by large numbers of people.

Windows of opportunity. The first real opportunities for URM hazard mitigation came with the decade of the '50's, but why did it take from 1950 to 1971 to develop the ordinance in Long Beach and until 1981 to enact one in Los Angeles? For part of the answer to this question, we must look to the windows of opportunity that helped get the proposed mitigation policy on the decision agenda.

The big problem for the policy advocate is to make sure that the problem, solution, and actors are in place when interest is high and when an opportunity to get on the agenda either arises or can be generated. Students of policy analysis have called such opportunities "policy windows." Kingdon, in his application of the garbage can model to national policy issues, explains that policy windows open, but they also close:

> Once the window opens, it does not stay open long. An idea's time comes, but it also passes. There is no irresistible momentum that builds for a given initiative. The window closes for a variety of reasons. First, participants may feel they have addressed the problem through decision or enactment. Even if they have not, the fact that some action has been taken brings down the curtain on the subject for the time being...Second...participants may fail to get action. If they fail, they are unwilling to invest further time, energy, political capital, or other resources in the endeavor...Third, the events that prompted the window to open may pass from the scene. A crisis or focusing event, for example, is by its nature of short duration. People can stay excited about an airline crash or a railroad collapse for only so long (1984, p. 177).

Policy windows for hazard mitigation, particularly for low-probability/high-consequence hazards, open almost randomly and usually without advance notice--at least without notice in a time frame that is at all relevant for policy makers. In the case of earthquake hazard mitigation, the windows are typically opened by strong earthquakes in populated areas.

While Long Beach building officials plugged away trying to find ways to require unreinforced masonry building hazard mitigation, the first real window opened in 1964 with the devastating Alaskan earthquake. That disaster intensified interest in earthquake safety in California and provided impetus for the Long Beach officials to continue their efforts. The *Bakersfield vs. Miller* decision (1966), closely following the Alaskan earthquake, afforded an opportunity for the Long Beach officials to intensify their continuing activities.

The critical policy window for Long Beach seismic safety advocates came with the 1971 San Fernando Valley earthquake in which, as we've noted previously, 60 died, 2,400 were injured, and there was over $1 billion in damage (1980 $). Long Beach officials were prepared for that window. The Wiggins-Moran consulting report had been completed in August of 1970 and was already under study by the city council's ordinance committee. The council was aware of the problem, a solution was already available (from the consulting report), and the actors were poised for an intensive effort. The San Fernando Valley earthquake on February 9 provided the window, and a draft ordinance, complete with the legitimizing force of the consultant study and the urgency imposed by the killer quake, was proposed to the council in April. The ordinance was approved in principle by the council in May and was adopted in final form on June 29, just five months after the earthquake.

It was not until two years later, early in 1973, that Councilman Bradley called for development of a report on the Long Beach ordinance to see whether a similar ordinance might be applicable to Los Angeles. It then took eight years of fairly concentrated effort to get the ordinance passed. Because Los Angeles had not been prepared to use the policy window opened by virtue of the 1971 earthquake, the window had to be forced open by persistence and by careful orchestration. Los Angeles officials were given an assist in their efforts to pry open the window when credible reports were issued warning that there is a very high probability of a severe earthquake in southern California by the turn of the century. The Long Beach seismic safety advocates had been both prudent and fortunate. Los Angeles advocates were neither so prudent nor so fortunate.

However, Los Angeles advocates learned the lesson and learned it well. In September, 1985, when Mexico City was struck by an earthquake that killed thousands and was covered extensively by television and other media, the Los Angeles officials were fully prepared. Almost immediately after the Mexico City earthquake, the city's seismic safety ordinance for existing buildings was modified and made tougher. Marvin Braude was chair of the council's Building and Safety Committee and, on September 25, just days after the Mexico City earthquake, the Los Angeles City Council adopted a motion put forth by Councilmen Bernson and Braude:

> ...to have the Department of Building and Safety report back within one week on the feasibility of accelerating the compliance [of unreinforced masonry buildings with the existing ordinance] to within one year for Category III residential and mixed residential buildings.
>
> The motion...referred to the recent earthquake tragedy in Mexico and the need to review the compliance schedule on our Unreinforced masonry Building Repair Program with the view of bringing the buildings into compliance as rapidly as feasible (City of Los Angeles, 1985).

The report was made and the city council adopted an ordinance accelerating the compliance schedule for unreinforced masonry buildings on October 22, 1985. The Los Angeles advocates were prepared and utilized the policy window to full advantage.

Innovation, Garbage Cans, and Mitigation Policy Making

Innovation is always difficult and fraught with uncertainties; innovation is even more difficult when the issue is controversial. In this case, Long Beach was the innovator, testing this approach and that, pushing on the frontier of what was thought to be permissable under the laws governing municipalities. Eventually, Long Beach adopted an important mitigation policy and devised the administrative mechanisms needed for implementation. The city did so without any fanfare and without much thought about being innovators.

Los Angeles was an early follower, even though, for reasons we have discussed, it took a decade. The policy window in that city had to be forced open and a policy had to be fashioned that would, at least at some minimal level, meet the demands of diverse interests in that heterogenous, enormous, sprawling city. It is impressive that the ordinance was adopted in a policy-making environment in which it is particularly difficult to enact controversial policies. Thurow has characterized such an environment as a zero-sum game situation (a situations in which, if you win, I must necessarily lose, and vice versa):

> To protect our own income, we will fight to stop economic change from occurring or fight to prevent society from imposing the public policies that hurt us...We want a solution to the problem...that does not reduce our income, but all solutions reduce someone's income...The problem with zero-sum games is that the essence of problem solving is loss allocation. But this is precisely what our political process is least capable of doing. When there are economic gains to be allocated, our political process can allocate them. When there are large economic losses to be allocated, our political process is paralyzed (1980).

There are two particularly interesting aspects about Santa Ana's the enactment of the seismic safety ordinance the year before Los Angeles did. First is the way in which policy proponents became fully aware of both the Long Beach policy and the activities that were taking place in Los Angeles--through a meeting of the Structural Engineers Association of Southern California in San Diego. John Coil, who became an active policy entrepreneur in Santa Ana, participated in the meeting as a structural engineer and was already active in Santa Ana local government. This aspect is interesting because it points out one of the ways that innovations in municipal policy are disseminated--through professional associations--and because, once again, it emphasizes the role of the inside advocate.

Second, the Santa Ana case is interesting because it demonstrates an important technique for opening policy windows. The garbage can model suggest that decision opportunities are often tied to other issues in order to make them more palatable or to pry open a window. Santa Ana officials tied the URM seismic safety ordinance to the city's redevelopment project because the two projects affected many of the same parts of town and many of the same buildings. Retrospectively, one could reason that it might prove difficult to enact and implement the renewal program but, at least, there were economic advantages to stakeholders from such renewal. Unless the seismic ordinance were piggy-backed to the redevelopment program, it might never get enacted. However, if the seismic safety ordinance came first, opponents would argue that they would just get the buildings strengthened in time to have them razed for renewal. If it came second, opponents would argue that they had just undergone enormous financial hardship in the renewal program--loss of business during reconstruction and so forth--and could not possibly take on the expense of structural rehabilitation.

The three cities--Long Beach, Los Angeles, and Santa Ana--represent a spectrum of innovation and early follower experience, and they attest to the utility of the garbage can model for appreciating the policy making process. In each city, the tasks associated with enacting the ordinances were different. In Long Beach, the dominant task was to create a policy intervention where little existed previously. In Los Angeles, it was refinement of the policy and development of accommodations to diverse stakeholders. In Santa Ana, which almost literally adopted a copy of the Los Angeles draft ordinance while it was still being debated in that city, the dominant task was finding a convenient way to pry open the policy window. These experiences should make it much easier for other municipalities to adopt similar ordinances.

PART FOUR
OUTCOMES AND CONCLUSIONS

CHAPTER XIII
IMPACTS OF THE ORDINANCES

Municipalities sometimes pass ordinances for largely symbolic purposes, but in other instances, they want and expect tangible changes in the community. We think that Long Beach, Los Angeles, and Santa Ana enacted earthquake hazard reduction ordinances for pre-1934 buildings with the expectation that they would reduce the earthquake hazards in those cities. Had the municipal councils been intent on making gestures toward safety, that could have been accomplished with a lot less pain. In fact, the ordinances have had an impact in both Long Beach and Los Angeles--the URM building earthquake hazard has been reduced. This chapter examines the desired effects in two of those three cities and analyzes the extent to which there might have been unintended consequences as well.

The Long Beach ordinance was enacted in 1971 but, for practical purposes, its implementation really began in 1976 after the substantial revisions made at that time. The Los Angeles ordinance, enacted early in 1981, has been in force for about five years. Thus, there are sufficient years of experience to demonstrate shorter-term consequences. The tough test for the ordinances will come when a moderate or severe earthquake causes failure in URM buildings that have not been strengthened. In such an event, one could ascertain rather easily the extent to which the rehabilitation done because of the ordinances reduced loss of life and property.

Fortunately, no such test has yet been administered, so we have to use indirect means to estimate impacts of the ordinances. There are several important questions to answer, among them the general one of whether the ordinances, once passed, were implemented--particularly since some argue that it is difficult, if not impossible, to implement controversial hazard mitigation policies. Second, we want to know about the reduction in the URM seismic hazard. Third, we will determine the unanticipated consequences for owners and occupants, and for other communities. Finally, it is appropriate to ask whether the struggle was worth it.

Changes in the URM Building Stock

One measure of the effectiveness of the URM earthquake hazard reduction ordinances is the decline in the number of URM buildings since the ordinances were enacted. This method provides some indication, but it is a crude measure at best. The number of unreinforced masonry buildings in southern California has been declining right along, ever since the Uniform Building Code incorporated aseismic design requirements after the Long Beach earthquake. No one knows how many URM buildings have been bulldozed away to make room for condominiums, parking lots, and fast food outlets. If one were able to determine the attrition rate due to the dynamics of urban land use succession, one could presumably subtract the number of expected demolitions in each city since the ordinance was passed, and attribute any number over that to the impact of the ordinances.

Long Beach

In 1971, the City of Long Beach identified 928 hazardous unreinforced masonry buildings. These buildings included 3060 dwelling units (primarily apartments) and 2023 guest (single occupancy) rooms. As of October 15, 1985, according to Eugene Zeller, Superintendent of Building and Safety, the buildings:

> ...have been surveyed, and systematically rated into degrees of hazard considering factors for importance of the building in an emergency, amount of human exposure, and extent of structural weakness. Under a three phase program based on hazard grade, owners of Grade I-Excessive Hazard and Grade II-High Hazard have been directed to strengthen or demolish their buildings. The remaining buildings in the Grade III-Intermediate Hazard category will be given notice in 1991 as prescribed by ordinance.

By October, 1985, 288 of the URM buildings had been brought into compliance with the city's ordinance. No URM buildings in the city in the *Immediate Hazards* class remained, only two remained in the *Grade I-Excessive Hazard* class, and 32 in the *Grade II-High Hazard* class. The remaining 606 buildings are not scheduled for notification until 1991, at which time they will be ordered to comply with the ordinance. The 288 buildings brought into compliance represent 24.7% of the URM hazardous dwelling units and 44.3% of the single room occupancy units. In both cases, they represent, primarily, the most hazardous units that existed in the city at the time the ordinance was passed.

Of the 288 buildings brought into compliance, 242 were demolished and 46 were repaired to meet standards imposed by the ordinance. Those who described the Long Beach policy as a "demolition ordinance" and the Los Angeles approach as a "rehabilitation ordinance" might be tempted to say "I told you so," but it is important to point out that only some of the 242 buildings were demolished as a consequence of the ordinance; many more were demolished because of Long Beach's extensive urban renewal activities over the past decade. Most of the URM buildings were in the older parts of the city's core and in the path of redevelopment.

Nevertheless, Long Beach officials do believe that city's ordinance is "tougher" than the Los Angeles ordinance (Zeller, 1986); it is technically more difficult and financially more costly to bring comparable buildings into compliance in Long Beach code than it is in Los Angeles. Which code is better depends on one's values; Long Beach has opteds for what it believes to be greater seismic safety, and it is willing to pay the price for it. Los Angeles has apparently decided that it is buying a sufficient reduction in the earthquake hazard with its ordinance and the costs associated with it. In any event, there has been a significant reduction in the hazardousness of unreinforced masonry buildings since Long Beach's ordinance was passed, a sizable proportion of which can be attributed to the ordinance.

Los Angeles

Similar headway has been made in Los Angeles. A survey conducted by the city during the policy debates prior to enactment found 7,863 unreinforced masonry buildings (see Table XIII-1). Implementation of the ordinance began almost immediately upon passage. By the end of January, 1986, the city's Earthquake Safety Division had issued orders on 2,097 buildings, and owners of 276 buildings had come into the program voluntarily. A total of 458 buildings had been brought into full compliance with the ordinance. Of these, 348 were rehabilitated and 67 were either demolished or exempted from compliance for one or another reason. Together, these account for 5.8% of all the URM buildings identified in 1980 (City of Los Angeles, 1986).

Another 13% (1022) of all URM buildings had been placed in an inactive category by the end of March, 1986. These included 714 buildings in which wall anchors were installed (thus providing additional time for achieving full compliance), 185 buildings that were reclassified after notice was issued to the owner, and buildings that were vacated, and 78 buildings presumably not in compliance over which legal proceedings were being initiated.

From the time the ordinance was enacted in 1981 through March of 1985, 3,750 building surveys were completed, 2,920 plans had been filed, 2,887 plans had been checked, 1,860 jobs had been issued permits, and 1,480 buildings had been brought into compliance (although 1,022 of those had opted for the dual compliance approach).

About 100 of the hazardous URM buildings in Los Angeles were city property; some of them even housed emergency organizations. City officials responded by evaluating all essential buildings owned by the city (primarily fire and police stations), reviewing plans for scheduled new

TABLE XIII-1 PRE-ORDINANCE USES OF UNREINFORCED MASONRY BUILDINGS, LOS ANGELES, CALIFORNIA, 1980

Use	Number	Percent
Commercial	2,769	35.2
Industrial	1,944	24.7
Mixed Use	1,583	20.1
Residential	790	10.0
Garages	502	6.4
Public Buildings	100	1.3
Churches	92	1.2
Theaters	19	0.2
Others	32	0.4
Totals	7,863	100.0

(City of Los Angeles, 1980b)

buildings, and vacating existing ones. Temporary fixes to buildings were approved until construction was finished on new buildings. One police station was vacated. Most hazardous city-owned office buildings and warehouses have been vacated. City-owned libraries are next on the list for analysis and action (Askura, 1986).

Just as in Long Beach, program implementation has pressed forward in Los Angeles. There has been a significant reduction in the number of buildings that do not meet the structural requirements of the hazard reduction ordinances in both cities. In Los Angeles, the largest proportion of the buildings was upgraded, but almost half (48.2%) of those brought into compliance had only anchors installed; they still need work to be brought into full compliance.

Effects on Seismic Safety

In risk assessment, one generally 1) estimates the probability of the event producing the risk, 2) estimates the exposure of life and property to the event, 3) evaluates the vulnerability of life and prop-

TABLE XIII-2 CHANGES IN THE STOCK OF UNREINFORCED MASONRY BUILDINGS IN LONG BEACH AND LOS ANGELES

Long Beach: June 29, 1971--October 15, 1985			
Total URM Buildings in 1971		928	100.0%
Completed Cases	100.0%	288	31.0
Demolitions	84.0	242	26.1
Repaired	16.0	46	5.0
Inactive Cases (partial compliance)		0	0.0
Remaining Cases		640	69.0
Los Angeles: January, 1981--January 31, 1986			
Total URM Buildings in 1980		7,863	100.0%
Completed Cases	100.0%	458	5.8
Demolition	14.6	67	0.9
Full Compliance	85.4	391	5.0
Inactive Cases (partial compliance)		1,022	13.0
Remaining Cases		6.383	81.2

(Zeller, 1985; City of Los Angeles, 1986) erty exposed to the event, and 4) calculates the probable loss of life and property in the event. The URM building policy is aimed at reducing the vulnerability of persons and property by strengthening or demolishing hazardous buildings. In order to evaluate the effectiveness of the ordinances, it would be appropriate to estimate the reduction in vulnerability because of the strengthened buildings. To do so retroactively is virtually impossible, however, because calculating the aggregate reduction in vulnerability requires that we know the vulnerability of each building before and after rehabiliation. In the case of buildings that have been demolished, it requires that we know the vulnerability of the building prior to demolition and the vulnerability of the new building in which the former occupants are now located. As can be seen, the practical problems associated with such analysis are overwhelming.

Nevertheless, some observations can be made about increases in seismic safety. In Long Beach, almost a third of all pre-1934 URM buildings have been demolished or brought up to 1970 UBC seismic standards (the standards established in the rehabilitation ordinance). The 1970 standards are not as stringent as the current ones, but they are far superior to having no standards--which was the case for the old brick buildings. The remaining buildings, for the most part, are a lot less hazardous than were the ones that have already been put into the file marked "completed." In Los Angeles, about 6% of all pre-1934 URM buildings have been brought into approximate compliance with the 1970 UBC seismic standards. Another 13% have been strengthened with wall anchors so that the primary threats to life safety, in the event of smaller and moderate earthquakes, have been largely eliminated in those buildings (judging from the arguments made by Kariotis, 1985). About 20% of Los Angeles' hazardous URM buildings have had the hazard eliminated or reduced substantially in the five years since the ordinance was enacted. It would appear that most of the URM buildings removed from the Los Angeles inventory were targeted by the city's hazard mitigation efforts, in contrast with the situation in Long Beach, where removal was a function of both the ordinance and urban renewal.

During the last days of the process leading to enactment of the Los Angeles ordinance, the council was reminded that a major earthquake could result in 12,000 fatalities and that most of those would be in unreinforced masonry buildings. Estimates had also been produced for potential deaths directly attributable to URM buildings should there be an earthquake during working hours. The city staff estimated that 7,000 would be killed. If one assumes the deaths to be proportional to the number of buildings, then one might conclude that 1400 premature deaths have been averted with 20% of the buildings strengthened. It is likely, however, that work began on more hazardous buildings, so the percent of deaths averted is likely to be substantially higher than the proportion might indicate.

The experiences in Long Beach and Los Angeles demonstrate that controversial hazard mitigation ordinances can be enacted and implemented, can survive legal attacks, and can reduce the hazard exposure of large numbers of persons. In Long Beach, the implementation process has been slower than was anticipated in 1971, partly because of the 1976 amendments. But since the 1971 ordinance was not being implemented effectively, Long Beach traded a little bit of watering down for a lot more implementation. Los Angeles was able to use the window opened by the Mexico City earthquake to change its ordinance so that compliance times were accelerated substantially. While there has been the normal array of fits and starts in implementation, it now seems to be generally accepted in both communities that URM buildings will be brought into compliance in accord with the timelines set forth in the ordinances.

Effects on Owners and Occupants

One of the continuing concerns throughout the policy-making periods in all three cities we studied was the prices that would have to be paid for the hazard reduction by building owners and occupants. The concern was expressed again when the City of Los Angeles amended its ordinance to speed up compliance. As is often the case, however, no one has managed to track the impacts on the owners and occupants in any systematic way, so it is particularly difficult to talk about what has happened to them.

Building Owners

We have only anecdotal information about the financial impacts of ordinance implementation on URM building owners. We don't know how many, if any, went bankrupt or defaulted on their building loans because of the ordinance. We can infer that the ordinances' financial impact has been more than trivial. As was pointed out earlier, costs for installing wall anchors tends to run about $2 per square foot, while full compliance with the Los Angeles ordinance is on the order of $9 per square foot, plus or minus several dollars depending on the design, construction, and configuration of the building. The City of Los Angeles estimated in 1979 that compliance costs could run from $500 million to $1 billion over a ten-year period. In 1978, the annual expected compliance costs would have amounted to 3.3%-6.7% of the annual dollar volume of building permits issued in the city (City of Los Angeles, 1979).

Some inferences can be drawn about the impacts of these costs from the results of a survey conducted in 1983 by the Housing Division of the Los Angeles Community Development Department (City of Los Angeles, 1983a). The survey, mailed to building owners, was self-administered and, as in most mail surveys, the response rate was low (11.9%), with unknown response bias. The owners responding represented 3,519 housing units, consisting of 289 single rooms, 2,461 efficiency apartments (no bedroom), 760 one-bedroom units, and nine two-bedroom units. Rents were comparatively low and tenants had exceptionally low incomes. About 8% of the owners owned their buildings free and clear. Over half had a first trust deed (mortgage), 22.6% also had a second trust deed, and 6% had three or more loans against the property. Almost half the properties had balloon payments associated with the loans. City staff estimated that only about 10% of the buildings on the seismic deficiency list would qualify for a loan under normal underwriting criteria. There still is not a completely workable way to finance the reconstruction, so many building owners probably have run into financial difficulty financing repairs, unless they have access to funds from other sources. There is anecdotal information that a significant number of the buildings are being sold at discounted prices by owners who cannot finance the madated improvements.

Other things have happened to benefit owners. In 1983, the voters of California passed Proposition 23, a constitutional amendment exempting from property tax assessments improvements made to property for purposes of seismic safety. In general, various percentages of income tax credits are permitted for non-residential buildings and for residential buildings that have been certified as historical structures. In addition, building owners who strengthen their buildings to comply with the seismic safety ordinance do not automatically trigger requirements to comply with current specialty codes (plumbing, electrical, and so forth) unless the current condition constitutes a hazard to life and property.

There is one catch: a recent disastrous fire in an old residential building led to a change in the Los Angeles fire codes called the Dorothy Mae ordinance. If a URM building is a hotel or apartment with three or more stories, the owner may also be required to comply with changes required by the Dorothy Mae ordinance, thus increasing costs of compliance substantially, but also reducing the fire hazard for occupants.

Finally, the City of Los Angeles has enacted a policy that provides URM building owners with certain benefits if they decide to demolish their buildings rather than strengthen them. The benefits take the form of permitting non-conformance with current codes in such areas as parking, side yard, and setback requirements (City of Los Angeles, 1983b).

Occupants

The Los Angeles survey referenced above also asked building owners for their perceptions of tenant incomes. Such best-guess information by landlords is highly suspect, but the landlords are at least in a position to estimate. Landlords estimate that three-fourths of the tenants in the buildings for which there are responses had incomes of less than $10,000 per year. Another 20% had incomes from $10,000 to $13,600. Virtually none had incomes over $20,000 per year.

Our survey of unreinforced masonry building occupants (see Chapter X) confirms the impressions of the landlords' impressions about tenant incomes. Almost three-fifths of all respondents (59.1%) had an annual income under $10,000 in 1981 and two-thirds (66.7%) paid under $300 per month rent. Only 38.3% were gainfully employed; 5% were full-time homemakers, 11.1% were unemployed, and 45.7% were retired. Even though both surveys suffer from low response rates, there is a reasonable basis for concluding that a very large proportion of URM building residents are poor and have limited housing options.

TABLE XIII-3 INCOME DISTRIBUTION OF HOUSEHOLDS OCCUPYING UNREINFORCED MASONRY BUILDINGS IN LOS ANGELES, 1981

Total Income in 1981	Percent of Respondents	Cumulative Percentage
Under $3000	15.2%	15.2%
$3000-$4999	12.1	27.3
$5000-$6999	16.7	43.9
$7000-$9999	15.2	59.1
$10000-$12999	12.1	71.2
$13000-$15999	12.1	83.3
$16000-$19999	7.8	90.9
$20000 or more	9.1	100.0

Los Angeles city staff conducted a series of analyses of the costs of compliance with the seismic safety ordinance for 11 URM buildings for which they had information. The analyses examined the impacts on rents of a range of conceptually possible financing alternatives for owners, ranging from conventional loans through subsidized, low-interest loans in which the owner would pay Davis-Bacon wages for rehabilitation. The analyses assume that the owners would pass the seismic rehabilitation costs on to tenants and 20-year amortizations of loans.

Under conventional financing at 15% interest, given the estimated costs for rehabilitation, rents in the 11 units would increase from a low of $23 per month to a high of $61 per month. The proportion of tenants' incomes going for rent would increase from 27% to 30% in the building with the lowest rent increases and, in two buildings that tied for the greatest dollar increase in rents, the rents would increase from 36%-50% and from 25%-34%. Under the most favorable financing packages, including 0% interest deferred repayment loans, rents would still increase in about half the units (since available favorable rate loans would not cover all repairs), and tenants would still pay anywhere from 33%-42% of their total incomes in rent--far above the 30% that tenants are expected to pay in federally assisted housing programs.

All the empirical evidence, as well as micro-economics logic, shows that the seismic rehabilitation will place an increased burden on low-income households, except to the extent that rent controls in Los Angeles may force owners to absorb the costs. The increases in rental costs, coupled with the cut-backs in federal housing assistance funding during the Reagan Administration, mean that times are going to be particularly tough for the poor who live in old brick buildings in southern California. This raises the issue of the extent to which a community should help with the costs when it forces people to buy more safety than they can afford or would buy of their own volition.

The problem for low-income persons is compounded because not all of the old buildings are being rehabilitated; some are being razed. Under normal circumstances, one might expect the trickle-down model of housing supply to come into play--households with higher incomes would be busy buying new housing, thus expanding the housing supply, so poor people would be able to upgrade into housing not previously available to them. However, the high interest rates of the early 1980's, coupled with the deep and protracted recesssion, resulted in a very slow expansion of the housing market, so there was little housing available to trickle down.

Anecdotal evidence indicates that the dislocation effects of the actual rehabilitation work have caused only minor occupant inconvenience in some cases where contractors do the work in the units on weekends. In other cases, however, landlords attempt, despite city efforts to the contrary, to use the rehabilitation work as a way to remove existing tenants and replace them with higher-income tenants.

Effects on Other Communities

The primary external effect of the Long Beach and Los Angeles ordinances is that interest in mitigating the unreinforced masonry building earthquake hazard has spread throughout California. Long Beach officials worked hard for almost 40 years to adopt an effective policy for mitigating the hazard, and, after they managed it, other cities were able to do so much more easily. However, it was not until Los Angeles was seriously considering such an ordinance that other municipalities got on the bandwagon. Such is the case with innovation: the innovator works against great odds to to create the innovation, the innovator is followed by "early followers," and the early followers are followed by the mainstream of organizations. There is inevitably a cadre of die-hards who persist in denying the utility of the innovation, but when Los Angeles, California's largest city, became the early follower, it gave a dramatic assist to the spread of the innovation.

On October 2, 1985, California's governor signed SB 548, establishing the California Earthquake Hazards Reduction Act (Southern California Earthquake Preparedness Project, 1986). The bill, authored by Senator Alfred Alquist, consists of a series of five-year programs to be prepared by the California Seismic Safety Commission and other state agencies. The overall objective of the program is to reduce significantly earthquake hazards in the state by January 1, 2000. A top priority for the program is said to be a substantial reduction in the number of existing hazardous buildings.

The California Seismic Safety Commission's Committee on Hazardous Buildings produced, in December of 1985, <u>Rehabilitating Hazardous Masonry Buildings: A Draft Model Ordinance</u> (1985). The model ordinance is patterned closely after the Los Angeles ordinance, and was drafted by the Subcommittee on a Model Ordinance for Older Masonry Buildings, chaired by Earl Schwartz, Deputy Superintendent of Building for Los Angeles' Department of Building and Safety. Included in the report is a recommendation that local governments review the safety of their local building stock and establish appropropriate local hazard-reduction and rehabilitation programs, including adoption of a rehabilitation ordinance (1985, p. 46.)

Early in 1986, Senator Alquist introduced into the California legislature SB 547, sponsored by the Seismic Safety Commission. The bill would require all cities and counties in Seismic Zone 4 (an area with high risk of earthquakes including southern California) to inventory unreinforced masonry buildings and to adopt hazardous buildings mitigation programs, and it would require the Seismic Safety Commission to develop criteria and procedures for the mitigation programs. It would also, as orginally drafted, appropriate $5 million to help cities and counties carry out the program. The legislation passed both houses in the California legislature, but was vetoed by the governor. Anecdotal evidence indicates that the governor vetoed the bill because of potential financial impacts on the state and a feeling that URM building hazards were a local and not a state problem. Subsequently, the bill was redrafted without the provision for financial assistance to local government and was again passed by both houses. The governor had not yet signed the bill when this was being written.

Meanwhile, cities in both the Los Angeles metropolitan area and in the San Francisco Bay area are considering URM building rehabilitation ordinances. The City of Palo Alto, south of San Francisco, is considering an ordinance requiring a structural analysis and evaluation of all pre-1935 unreinforced masonry buildings in that city with more than 25 occupants and all pre-1976 buildings with more than 100 occupants within a five year period. Owners of hazardous buildings would have six months in which to advise the city of how they plan to correct the deficiencies. The Los Angeles Times (April 14, 1986) reports that the City of Burbank is considering an ordinance to establish minimum standards for structural seismic resistance for unreinforced masonry buildings built before 1934.

Was It Worth The Effort?

We have concluded that seismic risk has been reduced in both Long Beach and Los Angeles because the URM building seismic safety ordinances were enacted and are being implemented, but an important question remains: Was it worth the effort? In attempting to answer this question, one might first ask whether government should have done anything at all about the hazard. The answer to this question depends on one's disciplinary interests and on one's political ideology. From one standpoint, the "should" question is largely irrelevant. The policies have been tested in the courts and have been declared constitutional in California. For pragmatists, that's usually enough. However, it is appropriate from time to time to look at general principles to ascertain whether there is a reasonable rationale for government to engage in various activities. Since the building owners chose not to reduce the risk to their property and tenants from earthquakes, why should government get involved?

Rationale for Intervention

Milliman and Roberts (1985, p. 645) make the case that the rationale for public intervention in risk reduction is very seldom questioned: reduction of hazards, such as those posed by earthquakes, is regarded, at least by those involved with hazard mitigation, as an important public function. Indeed, in this case, there seems to have been no explicit rationalization in Long Beach, Los Angeles, or Santa Ana about *why* local government ought to get involved, except that there were hazards associated with the URM buildings. Milliman and Roberts suggest there are several reasons, generally, for government intervention to mitigate earthquake hazards: 1) when "ignorance of earthquake risks causes unwise siting decisions, unwise construction practices," and mis-processing of information concerning low-probability/high-consequence events; 2) when earthquake hazard mitigation produces a "public good" available to everyone so that one's consumption does not interfere with consumption by others; and 3) when "private decisions ...in seismic zones have spill-over costs for the community at large instead of costs borne soley by [the private] decision makers" (1985, pp. 646-47). Cohen and Noll (1981, p. 2) elaborate the third reason:

> The primary economic justification for seismic building codes is that the structural soundness of a building has a social value that is not likely to be taken into account by its owner. If a building collapses during an earthquake, the owner suffers a financial loss....But the collapse...can have a higher social cost than its simple asset value. First, occupants of the building or persons in its immediate vicinity may be killed or maimed....Second,...adjacent buildings or vehicles may be damaged....Third, government resources are used to clean up part of the damage...and to maintain order.

Cohen and Noll go on to argue that the owner may be liable, but is unlikely to pay the full social costs incurred because of the limits of assets and insurance, the arbitrary settlements in such instances as death to victims, and because liability is difficult to place in the case of secondary effects and much earthquake damage is from secondary effects such as water damage from broken pipes and parts of buildings falling on automobiles. They conclude, in essence, that owners are very likely to externalize the expected social costs of earthquakes and that "a properly designed code can effect an approximate internalization of the social costs of earthquake damage (p. 4).

How Much Risk is Acceptable?

The rationale for public intervention seems sufficient, yet another important question remains: How much hazard mitigation is appropriate? According to Milliman and Roberts "...this is *the* earthquake hazard mitigation problem...[H]ow can we compare expected benefits of losses averted with expected costs of mitigation and what is an acceptable level of residual risk?" (1985, p. 646).

There are two other issues buried within this single question, and both are nearly intractable. First, determing what constitutes acceptable risk is particularly complicated. For an individual, levels of acceptable risks depend on personal values and trade-offs, the extent to which one is risk-neutral, risk-seeking, or risk-averse, and a host of other variables that we don't yet fully understand. For entire communities, it is virtually impossible to conceive a consensus concerning acceptable risk except in highly unusual cases: acceptable risk is what a majority of authorized policy makers (typically legislators) agree that it is.

What is acceptable risk changes with time and circumstance. Consequently, it is very likely that standards will seem fairly arbitrary for the most part, with some exceptions. In a few cases, it is possible to determine threshold levels required for system integrity or survival, and standards can be based on those threshold levels. However, when dealing in aggregate with a city or a society, deciding on acceptable levels of risk is difficult because risk reduction is seldom free. One purchases risk reductions in the form of cash or other tradeoffs. Tradeoffs imply valuations and human value preferences vary dramatically even within smaller, largely homogenous communities.

Do the Costs Exceed the Benefits?

The second question alluded to above has to do with whether the benefits expected from the hazard mitigation outweigh the costs of the mitigation. The question flows from the reasonable proposition that one should not spend more to solve a problem than the problem itself will cost. From a strictly economic standpoint, Milliman and Roberts (1985) make the case that the optimal level of hazard mitigation is the one that minimizes the sum of the total costs of the mitigation and the expected losses from the hazard. Although the two points may be near one another, assuming one could make the calculations, the level of mitigation deriving from their logic is not necessarily the same as the point where costs of mitigation are equal to expected losses from the hazard.

Other analysts have actually attempted to calculate benefits and costs of earthquake hazard mitigation. Cohen and Noll devised a model applicable to individual buildings. They develop a theoretical model of the choice of an optimal building code, "given that differing codes imply differing cost increments for structures and provide differing degrees of protection from seismic shock" (1981, p 4.). The authors treat the earthquake hazard problem for the individual building as a situation characterized by decision making under conditions of risk and apply optimization techniques to ascertain appropriate expenditures for hazard mitigation for specific buildings. This can be done by making certain assumptions, which they have made. The approach and model they formulated is useful, at the very least, as an aid to conceptualizing and communicating the problem, and it may be useful in constructing ordinance standards.

Schulze et al. (1985) developed a model for estimating expected benefits and costs of seismic building codes, and applied the model--with appropriate caveats--to southern California. The model looks at codes that apply to new construction, not the retroactive seismic policies examined here. However, the model could be applied to retroactive policies. Their work points out clearly the enormous complexity and estimating problems involved in such an undertaking. Pate'-Cornell (1985) developed a benefit-cost model for seismic strengthening of building upgradings in the Boston area. Platt and Shepherd (1985) examined the costs of complying with the Los Angeles seismic rehabilitation ordinance from the perspective of the building owner. Using cost estimates from Wheeler and Gray (1980) and Steinberg (1983), they examined the probable costs to owners for full compliance with the Los Angeles ordinance in light of tax benefits to the owners, including accelerated depreciation. Using hypothetical cases, Platt and Shepherd examined two hypothetical cases to compare the owners' alternatives of rehabilitation or demolition. They conclude that the tax advantages, particularly for high income owners, may provide sufficient inducement to rehabilitate rather than demolish.

Each of these efforts contributed to greater appreciation of the technical and informational problems associated with conducting benefit-cost analyses on complex problems involving many probabilities and requiring many assumptions. Yet, the work suggests that it is possible to conduct benefit-cost analyses that will, at the very least, shed light on the consequences of policy alternatives.

Sarin (1983) conducted a benefit-cost analysis for aspects of the Los Angeles ordinance. The approach is well-conceived and has the potential for fairly widespread application. The author was forced to make some heroic assumptions and to work with data based on small samples, but the intent was to provide a demonstration of an analytical approach and to illuminate the consequences of choice. Sarin agrees that:

> ...risks to the occupants of the unreinforced masonry buildings are significant. If no upgrading [were to take place] an individual occupant faces approximately 5-in-1000 chance of death, and 25-in-1000 chance of serious injury due to an earthquake in the next 10 years. This risk is about 10 times the risk due to fire and flames and about 40 times the risk due to electivity current in the home during the same time period (1983, p. 48).

However, Sarin is hard-pressed to ascertain which levels of seismic strengthening might result in benefits exceedings costs, given the nature of the data used and the assumptions that had to be made. He argues for upgrading *essential* buildings to *today's* standards. He also suggests requiring strengthening of residential properties to what we interpret to be the level of wall anchors currently permitted in Los

Angeles' dual-time-phase compliance approach, and not regulating non-residential buildings that do not fall into the *essential* and *high-hazard* categories.

Many of Sarin's conclusions seem to flow from the calculation that the seismic strengthening does not result in positive net benefits to the owners. However, we knew that; if the programs were to have a net positive benefit, it would have to be from the societal standpoint. We do agree with Sarin's conclusion that "a policy that does not account for owners' interests has a low likelihood of success." We are also interested in Sarin's independent calculation that full compliance upgrading in Los Angeles would cost approximately $800 million, thus corroborating the city's estimate that full compliance would cost between $500 million and $1 billion.

We don't know the answers, but recent efforts by scholars to develop improved applications of risk assessment, risk-benefit, and benefit-cost analyses have brought us collectively to the point where it is now quite possible to make calculations at a level to give sufficient confidence in the results of the analyses. Thus, we can indicate to policy makers whether proposed mitigation policies are moving in the right direction. The attention to this issue by scholars and analysts has helped to clarify the issues by illuminating relevant models and by providing a solid basis for the development of future approaches to hazard mitigation.

CHAPTER XIV
THE PROCESS AND THE PROSPECTS

Summarized in this chapter are the key points about the processes involved in developing and enacting hazard mitigation policies. This is not a checklist, but we do intend it as prescriptive. Conclusions from the three case studies are set forth in the form of propositions. We think they are valid inferences from the cases, and can serve as useful guides to would-be hazard mitigators.

One of the basic questions we've tried to answer is why it took so long to enact URM building hazard mitigations in southern California. We think that the garbage can model of organizational decision making helps to explain why. The four main components described in that model as prerequisites for a decision on a policy--problems, solutions, actors, and decision opportunities--are are dealt with in the first five propositions. The last seven propositions enlarge on the political nature of adopting a hazard mitigation ordinance.

Proposition 1:

> *There has to be recognition by a reasonably large proportion of the policy community that there is a problem--that the hazard exists, that the probabilities of loss are more than trivial, and that something can be done about it that will be politically acceptable.*

The first of the aforementioned streams is the problem: it must be recognized by more than a few of the faithful. There must be a perception that the current situation--a phenomonen or set of phenomona--reflects a disparity between what is and what ought to be, and the perception has to be shared by a large enough proportion of potential stakeholders to be taken seriously in policy-making forums.

In the case of low-probability/high-consequence hazards, this is not easy. Everybody has problems every day. It is difficult to convince a landlord in the Baldwin Hills or Westchester who is worried about having sufficient funds to make an upcoming balloon payment on his mortgage that he ought to take seriously a 1 in 1000 chance each year that the maximum credible earthquake will strike on the Newport-Inglewood Fault. It is equally difficult to get an elderly or impoverished tenant to get excited about a 1 in 50, or even a 1 in 20, chance each year that there will be a major earth-quake on the San Andreas Fault, which is miles away, when there is daily danger from street crimes and a continual struggle to make ends meet. It is similarly challenging to get policy makers to become enthusiastic about working on a low-probability problem when the agenda is full of generally acknowledged problems about which constituents call every day. This is especially true when those problems generate substantial front-end costs and there is a low probability that the benefits may be realized. People typically place a low value on low-probability/high-consequence events. Moreover, many people believe that such events are "Acts of God," and have little sense that anything can really be done to protect themselves from the events.

Proposition 2:

> *In order for hazard mitigation policy to be enacted, there must be an available policy option that includes a technical solution viewed as practical and efficacious by nontechnical policy makers.*

The garbage can model suggests that a solution to the problem is necessary in order to have a policy enacted. The solution needs credibility--credibility that can be enhanced by support from technical experts, but which also benefits from some practical demonstration of efficacy. The primary issues in Long Beach were technical. The proposed mitigation languished until a consultant report provided a policy alternative that made sense to policy makers. The alternative also has the legitimacy that frequently comes with having a local official's recommendation confirmed by an outside consultant. Once the mechanisms for mitigation were available and legitimized, the ordinance was enacted as soon as the policy window opened.

Proposition 3:

The probability that hazard mitigations will be enacted is in direct proportion to the extent that there are inside policy advocates who are persistent and tenacious in their pursuit of the policy, who have access to policy makers, and who have credibility among policy makers.

There must be strong advocates for the hazard mitigation who have access to policy makers and who, by virtue of technical expertise, political power, the prospects for exceptional longevity in office, or some personal characteristics, have high legitimacy in the eyes of the policy makers. To a somewhat lesser extent, the advocates should also appeal to other stakeholders concerned with the issue. Of all the characteristics of the inside advocate, persistency is probably the most essential. The inside advocate or advocates must orchestrate the policy development and enactment process, framing the issue, creating or taking advantage of windows of opportunity, and ensuring that there is a workable solution to the problem.

Corollary 3.1:

The need for the persistent inside advocate is a prerequisite for hazard mitigation enactment in the case of innovators and early followers, but diminishes gradually in other communities as the mitigation policy is adopted by increasing numbers of jurisdictions.

Life is tough for the innovator.

Proposition 4:

Windows of opportunity are essential for hazard mitigation policy to be enacted. Windows can be pryed open with enormous, continuing effort, but they open automatically in the event of a low-probability/high-consequence event that demands community attention because of geographic proximity or other reasons.

It's become commonplace to point out that hazards are low-salience issues. However, that isn't exactly the case: their salience varies dramatically through time. The hazards of low-probability/ high-consequence events get attention sporadically--when there is a related disaster close enough to home to scare people, or when a disaster makes the televison news more than one night in a row or resultsin special televised reports. Geographic proximity helps, but is not essential. The Mexico City earthquake was a long way from Los Angeles, but it was relevant to many southern Californians of Mexican descent and to others because Mexico is immediately adjacent to southern California. Even then, though, people's attention span for such things tends to be relatively short. Therefore, in the period immediately after such an event, while the memory of the television reports is still fresh in the minds of policy makers and the electorate, it is relatively easy to enact hazard mitigations. In the absence of a relevant low-probability /high-consequence event, it takes a major campaign to inform people of the risks and potential consequences for them if hazard mitigators hope to pry open a window of opportunity.

Corollary 4.1:

It is not necessary for there to be an earthquake or other hazardous event for a window of opportunity to open; a credible forecast or foreshadowing of the event will frequently open the window at least a crack.

Los Angeles enacted its ordinance in 1981; there had been no earthquake at the time, but inside advocates were working hard on the ordinance and there were new and credible forecasts indicating high probabilities of a severe earthquake on the southern end of the San Andreas Fault by the turn of the century. The combination of the hard work inside and the forecasts seemed to be sufficient to open the window.

Proposition 5:

Most hazard mitigation policies are enacted in the period immediately following a low-probability/high-consequence event.

In the rush to do something useful, many policy makers who are not normally concerned about hazard mitigation will search for appropriate legislation to enact; this is predictable behavior. Policy makers seem to want to show that something is being done. The probability that bad policy--policy that doesn't accomplish what was intended or has extensive dysfunctional consequences--will be enacted is highest immediately after a disastrous event.

Corollary 5.1:

Most inside advocates for hazard mitigations are not prepared when windows of opportunity open.

We think that Long Beach passed its ordinance a decade before any other municipality because there were dedicated inside advocates of seismic safety there who worked tirelessly and persistently toward their objectives, and who, when a window was opened by the 1971 San Fernado Valley earthquake, had an ordinance in hand. They were ready when no one else was even thinking about the hazards posed by old brick buildings. Los Angeles passed its ordinance because dedicated insiders --both appointed and elected--sincerely cared about seismic safety and worked hard to achieve their objectives. They were able, through a major effort and predictions of a devastating earthquake, to pry open a window of opportunity and get the ordinance passed.

Proposition 6:

Hazard mitigation is not a technical exercise; it is inherently and often intensely political because mitigation usually involves placing cost burdens on some stakeholders, and may involve a redistribution of resources. Hazard mitigators must, therefore, develop political as well as technical solutions.

The focus in Long Beach was on developing the mitigation technology. Los Angeles improved on the technical aspects of the mitigation, largely because officials there had the benefit of an additional decade of research and testing and far more resources for developing the technology. However, the innovations in Los Angeles were more along the lines of developing political aspects of the mitigation policy--and the road was long and arduous.

Frequently, there is political and legal infrastructure that can help to grease the way for policy enactment. Working to get such infrastructure in place is part of the political solution. For most of the four decades from the Long Beach earthquake in 1933 until the first retroactive seismic strengthening policy in 1971, key components of a generally acceptable solution were missing. First, it was not at all clear under California law until 1966 that municipalities could abate hazards in buildings that met codes when they were built. A legal case eliminated that uncertainty. Second, it wasn't even clear until *after* Long Beach passed its ordinance that the city could legally enact building standards for the rehabilitation of pre-1934 URM buildings that were lower than those in the current UBC. The state legislature affirmed the ability of municipalities to do that in 1980, thus making it more comfortable for Los Angeles to move ahead.

An acceptable solution is one that is typically at least minimally acceptable to enough actors in the policy-making process. Stakeholders perceive and value risks differently; burdens are often placed on persons and institutions that have externalized those costs to others and who do not want to bear them. Frequently, there are consequences for innocent bystanders--in this case, the poor who, for the most part, occupied the residential units and worked in the nonresidential buildings.

Throughout the policy development period in Long Beach, Los Angeles, and Santa Ana, comparatively little attention was given to non-engineering components in the design of the policy intervention. The successful elements of the policy interventions were the technical aspects, including difficult questions, such as how much credit should be given for lateral resistance in existing walls. This is not to say that Los Angeles officials did not pay serious attention to who was to bear what burdens, but that the nontechnical aspects of the mitigation policies did not work out very well. Even today, it doesn't look as though there are solutions to stakeholder concerns about how to finance improvements and about how to help those renters who were seriously and adversely affected.

We think that not being able to deal effectively with stakeholder concerns hindered passage of the ordinance in Los Angeles. If more attention had been paid earlier to the concerns that the owners voiced as early as the the 1960's in Long Beach, the ordinance could have been passed earlier in Los Angeles and been implemented sooner in Long Beach. We do not think that the owners' rehabilitation costs for compliance should have been paid from public funds, but more effective methods could have been developed to help ensure that owners could arrange for financing, particularly since such a large proportion of the buildings appear to have been financed unconventionally.

We are also concerned about the consequences of the mitigation policy for the persons who appear to have been innocent bystanders in this process. Most of the renters could not really afford the rent increases generated by the mandated rehabilitation, and building owners were not about to absorb those increased costs. Clearly, efforts were made to develop financial assistance for both renters and owners--a fairly substantial report was developed in Los Angeles on alternative funding sources available to assist owners and renters (City of Los Angeles, 1979)-- and sincere attempts were made to obtain a workable low-interest loan program, but key elements to help owners and tenants were not in place when the ordinance was passed and it is not at all clear that the ones now in place are adequate.

Proposition 7:

Because values and perceptions are so different among stakeholders, it is difficult, if not impossible, to reach consensus about appropriate mitigation policy interventions.

Corollary 7.1:

Because stakeholders in hazard mitigation politics have dramatically different perceptions of the situation and hold different values of risks and outcomes, achieving sufficient political agreement on a mitigation policy requires that trade-offs be made among the extent of hazard reduction, the total costs of mitigation, who pays various costs of mitigation, the level of safety achieved, adverse economic impacts, the level of residual hazard, and political possibilities of passage.

Obviously, some critical problems were worked out in Los Angeles that enabled a sufficient number of votes to be put together to enact the ordinance. The Department of Buildings and Safety developed what we believe to be the key trade-off: the dual time-phased option for compliance. That approach bought the community a major reduction in threats to life-safety, but eased the immediate cost burden on URM building owners. It was probably this compromise that made possible passage of the ordinance less than a year later, despite the fact that other political parts of the solution were not fully in place. In Long

Beach, the situation was different. The ordinance was passed when the San Fernando Valley earthquake opened the window; the compromises came in 1976 when the ordinance was revised because of continuing controversy about it.

The Long Beach case illustrates that it is not necessary to reach consensus to pass a hazard mitigation ordinance, nor is it necessary to make sure that the primary stakeholders' needs are taken care of. In some cases, advocates may be able to rely on raw political power to enact hazard mitigations and make them stick, but we think that those are rare. Unless the interests of the various stakeholders are accommodated at some minimally acceptable level, it is likely hat the mitigation will cause guerilla warfare and be subject to subsequent watering-down or repeal.

Corollary 7.2:

> *Hazard mitigation policies that cost stakeholders money and threaten their livelihood will be challenged in court.*

Both the Long Beach and Los Angeles ordinances were challenged in court. The hazard mitigator should assume that any hazard mitigation policy will be challenged and should design the ordinance and the intervention with that in mind.

Proposition 8:

> *Hazard mitigation policies can be enacted even when policy makers have 1) no explicit rationale for government action to mitigate the risk, 2) no information concerning whether the benefits deriving from the mitigation will exceed the costs, and 3) no information about whether the proposed mitigation is more or less cost-effective than alternative intervention designs.*

Officials in Long Beach enacted the URM building hazard mitigation once they were comfortable with the technological approach, and because they had been working at mitigating the hazard for some time, but they really did not know the probable impacts of implementing the policy beyond the consequences for seismic safety. During most of the time that the ordinance was being debated in Los Angeles, policy makers there did not know the probable consequences of enacting the policy. Policy makers were not provided initially with the kinds of information that they should have had to make an informed decision. Only as issues were raised by the council or by opponents, was information developed to help answer the questions. Since the elected officials were dealing with a controversial policy issue, and were taking heat from seismic safety opponents, it was doubly easy for council members to send the proposal back for more information. It was not only appropriate for them to have the information they asked for, but it was a convenient way to set the issue aside.

Prudent advocates of the policy might have taken care to ensure that all the pertinent questions could be answered before the policy was forced into the arena, but it was difficult to do--the data were being generated as the issue was being debated. This led us to conclude in an earlier chapter that the ordinance was brought forth prematurely; nevertheless, if it hadn't been brought forward, many of the questions might never have been answered.

Practical methods for strengthening URM buildings retroactively were still fairly primitive even when the Long Beach ordinance was passed. It wasn't until after Long Beach started its efforts and until SEASC tested methods on the three old buildings that the methods acquired credibility. In fact, the tests on those old buildings resulted in improved methods for mitigating the hazards at reduced costs. For much of the period from 1933 through 1971 and 1981, the technological approaches to the mitigation were still being developed as engineers and seismologists learned more about earthquake dynamics and the responses of structures to them.

During most of the time the policy was being debated in Los Angeles, there were not even reliable estimates of how much it would cost owners to comply with the draft proposal. Not until the Wheeler and Gray report and the SEASC testing in 1978, was there reasonably reliable data on how much rehabilitation would cost. Nor were there solid estimates of how many URM buildings were out there until well into the debate. A lot of important information about the probable consequences of implementing the ordinance simply didn't exist, and much of the information that might have informed a carefully reasoned judgement was never developed.

Proposition 9:

Hazard mitigators are frequently willing to require other people to spend more of their money on hazard mitigation than they want to or may be able to afford, given other priorities. On the other hand, most people discount low-probability/high-consequence events heavily, have faulty perceptions about the probabilities of risky events, and often expect others to bear their costs when the hazard strikes.

In the cities we looked at, the seismic safety advocates concentrated on the benefits that would be derived from the hazard reduction and not on the preferences of those who were likely to be affected most directly. The opponents concentrated on the adverse consequences for them. A sensible policy should take into account the highly probable consequences for the stakeholders, including both the desirable intended consequences and the less-than-desirable unintended consequences. The public has a right to act to mitigate hazards, primarily because of spill-over effects of hazards and because there are persons who, knowing the risks they are taking, intentionally or unintentionally externalize their costs to others who choose not to take those risks. Society has to make judgements continually about whether subsidies should be granted, but our general rule of thumb is that we aren't interested in subsidizing knowing risk takers when there are no obvious spill-over benefits to society.

Proposition 10:

Policy makers tend to look at relatively simple data about financial costs and the allocation of cost burdens, rather than at more sophisticated and complex analyses concerning economic impacts, optimality, net present value, and cost-effectiveness.

Corollary 10.1

Most elected policy makers are relatively naive about contemporary methods of policy analysis that can provide information about the consequences of alternative choices available to them.

Corollary 10.2:

So are most hazard mitigation advocates.

It is neither an accident nor a surprise that the most sophisticated parts of the hazard mitigation interventions are technical and legal: municipal governments employ engineers and lawyers, and those in city government who are most concerned about mitigating hazards with old buildings are typically engineers. Most local governments do not employ many, if any, highly trained policy analysts well-versed in contemporary decision theory, mathematical modeling, and statistical analysis. Even though these methods have been applied in some governmental activities, such as defense, they are still not part of the normal way of doing business for most local governments or for all academicians and consultants who concern themselves with local government or hazard mitigation.

Consequently, only a relatively small number of applications of these techniques exist, and local officials have not yet had it demonstrated that they are appreciably more useful than the current way of doing things. Does this mean we recommend not applying such models? Quite the contrary. It's past time for more of these models to be applied to issues of local government choice. Policy makers don't ask for the information such models can generate because they typically are not well-versed in the methods, do not know the potential benefits to be derived from them, and have rarely been given such information.

We think that developing and enacting hazard mitigation policies can be easier than it has been, but only to the extent that hazard mitigators learn that it takes more than a workable technology and good looks to bring about enactment; its is necessary to learn from what has gone before. Hazard mitigators are in a better position, for the most part, than their opponents in this regard. While they still have a major uphill battle, hazard mitigators can learn from one another; the opponents typically don't.

Proposition 11:

> *Professional associations are a primary means of communicating innovations in hazard mitigation among jurisdictions; jurisdictions that have frequent representation at professional meetings and conferences will tend to adopt innovative policies more rapidly than jurisdictions that do not.*

Proposition 12:

The probability that mitigation policies will be enacted is directly proportional to: 1) the extent to which the mitigation technology is known and tested, 2) the ability of advocates to describe the consequences of implementation, including the level of costs, who will bear the costs, and the level of hazard reduction being purchased by the mitigation, 3) the number of other similar jurisdictions that have enacted similar hazard mitigations, and 4) the perceived imminence of the hazard.

The garbage can model of organzational decision making holds that, in order for mitigation policies to be enacted, there must be an agreed upon problem, a solution that is generally acceptable, actors interested in matching the solution and the problem, and an opportunity for a decision to be made. Only when all those came together in Long Beach, Santa Ana, and Los Angeles were the ordinances passed. However, there is a question whether the lesson is being learned elsewhere. We noted previously that Burbank is considering a seismic hazard reduction ordinance for URM buildings. The Los Angeles Times recently quoted that city's Director of Public Works:

> The real impetus to this being done now were the Mexico City earthquakes...The biggest step we could take now to make Burbank safe is the elimination of hazards presented by these buildings (April 14, 1986).

Certainly, the Mexico City earthquake opened the window, but Burbank wasn't ready on other fronts. By the time the ordinance is drafted and the stakeholders are taken care of, the window will probably be closed--unless the state mandates action. The arguments and issues are no different in Burbank than in the other communities. Reading the comments of Burbank property owners in the newspaper gives one a strong sense of deja vu:

> I can tell you from a practical sense that it's going to be so costly that no one will be able to afford it...It would put all the businesses in that building out of business, because you have to build an Erector Set inside a building to reinforce it and earthquake-proof it. Do they think we're all Howard Hughes?

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APPENDICES

- Current Long Beach Ordinance
- Current Los Angeles Ordinance

Chapter 18.68

EARTHQUAKE HAZARD REGULATIONS

Sections:

18.68.010 Purpose.
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18.68.040 Special and intermediate hazards.
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18.68.180 Notification to owners of buildings four stories or more in height.
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18.68.010 Purpose.

The purpose of this chapter is to define a systematic procedure for identifying and assessing earthquake-generated hazards associated with certain existing structures within the city and to develop a flexible, yet uniform and practical procedure for correcting or reducing those hazards to tolerable hazard levels. It is not the purpose of this chapter to preclude or affect the assessment and abatement, pursuant to existing laws, of other hazards which may involve fire, exit, plumbing, electrical, and other such problems with existing buildings. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8000).

18.68.020 Scope.

This chapter shall apply to all Type I, Type II and Type III buildings located within the city and built prior to January 9, 1934. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8001).

18.68.030 Prima facie hazard grading.

A. All structures covered by this chapter and constructed before January 9, 1934, shall be inspected and graded in accordance with the provisions set forth in this chapter. such inspection to determine the relative prima facie earthquake hazard associated with same, and graded to establish a priority for subsequent correction. Such buildings which are three stories or less in height shall be inspected and graded by the building official and all others shall be inspected and graded in accordance with Section 18.68.050. Grading shall consist of an evaluation based upon an examination of the building plans, specifications or reports that are available, a visual inspection and consideration of the occupancy classification and occupant load. The evaluation shall include an analytical evaluation which shall determine the resistance to earthquake forces of the primary structural system of the structure. The analysis shall be based insofar as possible on the same procedures and assumptions used in seismic design of new buildings, and for purposes of evaluation. shall consist of a comparison of the seismic resistance of the existing building to the seismic resistance required of a new building designed and constructed under the building regulations of the 1970 Uniform Building Code, and otherwise identical to the existing building insofar as location, use, configuration, structural system and materials of construction are concerned. Such comparison can be expressed in terms of a capacity ratio R_S defined as follows:

$$R_S = \frac{V_{CAP}}{V_{REQ}}$$

Where V_{CAP} is the lateral force resistive capacity of a particular existing structure, calculated for the critical mode of failure of a significant portion of the building and V_{REQ} is the required lateral force resistive capacity of the same structure calculated for those specified earthquake conditions set forth in the building regulations of the 1970 Uniform Building Code. For the purposes of assessing the lateral force capacity of existing construction, certain stresses, values and procedures will be established as acceptable, such values to be set forth in a specification entitled "Specifications for Assessing the Capacity of Unreinforced Masonry Buildings, Long Beach Department of Building and Safety," to be prepared by the department of building and safety, which specifications may be amended from time to time at the discretion of the department. Assessment of the capacity ratio R_S shall take into account the following elements:

1. Stability of the wall system and vertical framing;
2. Horizontal diaphragm and/or bracing system;
3. Connections;
4. Shear resisting elements;
5. Special hazards, either structural or nonstructural.

B. In the assignment of a building to a particular hazard grade, the building official shall first determine its location on a hazardous index which shall reflect relative degrees of hazard. Such hazardous index shall be established in the specifications entitled "Specifications for Assessing the Capacity of Unreinforced Masonry Buildings, Long Beach Department of Building and Safety," and shall be a function of the capacity ratio R_S as defined in this section, the occupancy classification of the building and an occupancy potential which is a measure of the human exposure in and near the building. Occupancy classification and occupancy potential shall be as set forth in the above-mentioned specifications.

C. Location of a building on the Hazardous Index shall be the determining factor in the assignment of a building to a particular hazard grade. Assignment shall be by the building official and shall be in one of the following three hazardous grades if the capacity of the building has been determined to be less than that required under the building regulations of the 1970 Uniform Building Code:

Excessive Hazard	Grade I
High Hazard	Grade II
Intermediate Hazard	Grade III

D. Limits on the Hazardous Index which will determine placement in particular hazard grades shall be as established in the above-mentioned specifications and shall in general limit Excessive Hazard – Grade I to approximately ten percent of the buildings occupying the highest hazards on the Hazardous Index; the High Hazard – Grade II to approximately thirty percent of the buildings occupying the middle portion of the Hazardous Index; and the Intermediate Hazard – Grade III to approximately sixty percent of the buildings occupying the lowest hazards on the Hazardous Index.

E. If an assessment results in a capacity virtually equal to that required under the building regulations of the 1970 Uniform Building Code, or if a repair is accomplished to affect conformance with the seismic requirements of the building regulations of the 1970 Uniform Building Code, the building shall be deemed as having no hazards and shall be so classified. (Ord. C-5372 § 1, 1977: Ord. C-5276 § 1 (part), 1976: prior code § 8100.8002).

18.68.040 Special and intermediate hazards.

In addition to evaluation of the primary structural systems, any structural or nonstructural element of the building, including parapets, ornamentation or other appendages attached to the building or any structural or nonstructural architectural, mechanical or electrical system that is determined by reason of lack of attachment, anchorage or condition, to become dangerous to persons in the building or in the vicinity, will be classed as an immediate hazard. Any immediate hazard identified in buildings classified as high or intermediate hazard shall be treated as an excessive hazard and shall be abated under the procedures established for excessive hazard. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8003).

18.68.050 Priority and method of grading.

A. Buildings shall in general be graded on a priority system but in three phases: Phase I shall consist of inspection and grading of all buildings less than four stories in height and within occupancy classifications A, B, C, D and E; Phase II will consist of inspection and grading of all buildings two and three stories in height and classified F, G and H; and Phase III will consist of inspection and grading of all buildings remaining to be graded. Grading of all structures in each phase shall be accomplished insofar as is possible by a date established by the building department, and on that date, owners and interested parties will be promptly notified of the hazard grade in which their building has been placed. Such notification shall give notice to the owner of the hazard grade in which the building is being placed, a procedure to be followed if the owner is in disagreement with the grading, and that the grade assigned will be recorded with the county recorder after sixty days unless a change in grade has been initiated as set forth in Section 18.68.190.

B. Buildings four stories or more in height shall be placed in the appropriate hazard grade by the building official after receipt from the building owner of such information and data as is necessary to adequately grade the building. Such information and data shall be gathered for the owner at his expense by a structural or civil engineer or an architect licensed under the laws of the state and shall be submitted to the building official by such dates as he will set consistent with those occupancy classifications established for other buildings as set forth in this section for Phases I, II and III. Notice to require gathering of such information by the owner shall be substantially in the form set forth in Section 18.68.180. The building official shall, after reviewing the information and data submitted, place the building in the appropriate hazard grade and shall promptly notify the owner of the hazard grade in which his building has been placed. Failure to provide the building official with the required information and data by such established dates will result in placement of the building in Excessive Hazard – Grade I, until such information is submitted and the building is graded in accordance with the provisions of this chapter. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8004).

18.68.060 Calculation of actual lateral force capacity ^{V}CAP.

The actual lateral force capacity, ^{V}CAP, of a particular structure shall be computed using those values and stresses set forth in specifications entitled "Specifications for Assessing Capacity of Unreinforced Masonry Buildings. Long Beach Department of Building and Safety." (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8005).

18.68.070 Hazardous grading and dates of corrective action.

A. Owners of structures that have been graded Excessive Hazard – Grade I will be given notice of the need for corrective action as soon as such grading has been accomplished. Such notification shall take the form of notice of corrective action as set forth in Section 18.68.090.

B. Owners of structures that have been graded High Hazard – Grade II will be notified of the need for corrective action on January 1, 1984, or as soon thereafter as departmental office procedures will permit. Such notification shall take the form of notice of corrective action as set forth in Section 18.68.090.

C. Owners of structures that have been graded Intermediate Hazard – Grade III will be notified of the need for corrective action on January 1, 1991, or as soon thereafter as departmental office procedures will permit. Such notification shall take the form of Notice of Corrective Action as set forth in Section 18.68.090. (Ord. C-5582 § 1, 1980: Ord. C-5276 § 1 (part), 1976: prior code § 8100.8006).

18.68.080 Hazardous grading subject to change.

A. Buildings placed in a particular hazardous grade may be changed to a lesser grade if corrective repairs are undertaken and accomplished. Hazardous grading may also be changed when competent engineering data is submitted substantiating such a change. Such data may consist of analytical assessments, tests, data substantiating a higher capacity ratio or a modification of use or occupancy potential. Corrective repair plans and/or data substantiating a change in hazardous grading shall be prepared by a structural or civil engineer or architect licensed under the laws of the state to practice said profession. Partial repair designed to correct or strengthen individual and/or critical elements of a building will be permitted provided a suitable plan indicating the method of total and eventual correction and the schedule of expected dates of correction is submitted and the method of eventual correction is approved. Buildings so repaired will be regarded reflecting repairs so accomplished.

B. Complete repair and removal from any hazardous classification will be deemed to have been accomplished when the building has been repaired in accordance with the provisions for repair to remove structures from hazardous classifications in the "Specifications for Assessing the Capacity of Unreinforced Masonry Buildings, Long Beach Department of Building and Safety." (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8007).

18.68.090 Notice of corrective action.

After completion of grading, the building official shall send to owners of buildings deemed to be Excessive Hazard – Grade I, a notice of corrective action via certified United States mail. Owners of structures that have been graded High Hazard – Grade II and Intermediate Hazard – Grade III, will be sent such a notice at such time as specified in Section 18.68.070. This notice shall be in substantially the following form:

NOTICE OF CORRECTIVE ACTION

PLEASE TAKE NOTICE that an inspection and evaluation of your structure located at ____________________ indicates that said structure carries an (excessive, high, intermediate) hazard of major damage in the event of earthquake which would endanger the safety of persons and property located in, on or about said structure at the time of such event. Within sixty (60) days from the date of this notice, you shall present to this office a plan of action for reducing the earthquake hazard associated with said structure to an acceptable level.

An extension of the aforesaid sixty (60) day period may be obtained, for good cause shown, by requesting same in writing filed with this office at least seven (7) calendar days prior to the expiration of said sixty (60) day period. Such request shall be accompanied by a written statement of your contemplated action, the accomplishments toward same up to the time of the request, an estimate of the time required to complete the formulation of your proposed plan of action, and the name and address of the engineer, or architect, if any, whom you may have engaged.

In the event your proposed plan of action contemplates repair or some action other than abandonment and demolition, within one hundred twenty (120) calendar days, you shall submit to this office proposed repairs or strengthening measures which will increase the lateral force withstanding capability of the structure to a level commensurate with the acceptable level of earthquake hazard for your prospective use or occupancy. Information as to the magnitude of the lateral force withstanding capability associated with your structure in its present condition, as well as information as to proposed repairs or strengthening measures intended to increase the lateral force withstanding capability, shall be prepared by a structural or civil engineer or architect licensed under the laws of the State of California to practice said profession.

An extension of the aforesaid one hundred twenty (120) days may be granted for good cause shown by requesting same in writing filed with this office at least seven (7) calendar days prior to the expiration of the said one hundred twenty (120) day period. Such request shall be accompanied by a written statement explaining the reason for such an extension and an estimate of the date on which plans will be completed, the degree to which plans have already been completed, and other information which will document the fact that work is progressing.

In the event abandonment and demolition is contemplated, a date certain for such abandonment and demolition shall be submitted to the Building Official for evaluation and approval.

A copy of the ordinance, by authority of which this notice is sent, may be obtained from the office of the City Clerk, upon payment of an appropriate fee.

(Ord. C-5276 § 1 (part), 1976: prior code § 8100.8008).

18.68.100 Application for order of abatement of nuisance.

A. In the event the owner of a structure is notified pursuant to Section 18.68.090 and a plan of action satisfactory to the building official is not presented within sixty days after the notice has been mailed or within such extension of time as may have been granted in writing by the building official; or if the proposed plan of action, contemplated repair, or some action other than abandonment and demolition, has not been submitted and agreed upon by the building official within the one hundred twenty days provided in Section 18.68.090 or within such extension of time as the building official may have granted; then the building official shall apply in writing to the board of examiners, appeals and condemnation for an order declaring the structure to be a nuisance and ordering the certificate of occupancy to be revoked, or that it be demolished or repaired in a manner satisfactory to the building official, all by a date certain. The written application shall set forth in the form of factual allegations all facts which, if proven, are necessary to justify an order of condemnation, including, but not limited to, the following:

1. The location and legal description of the structure;

2. A concise calculation sheet indicating the ratio R_S for each of the elements of the structural system;

3. The structure's present occupancy;

4. The date upon which the owner of the structure was notified pursuant to Section 18.68.090;

5. A statement as to whether the structure owner has submitted a plan of action pursuant to Section 18.68.090;

6. The date certain by which the structure must be repaired or demolished, in the building official's opinion, in order to keep the earthquake

hazard associated with it at or below the applicable tolerable level.

B. A copy of the written application shall be mailed by certified United States mail to the person to whom the notice of Section 18.68.090 was mailed. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8009).

18.68.110 Hearing by board.

In the event the building official files an application pursuant to Section 18.68.100, he shall set a date and time for a hearing before the board of examiners, appeals and condemnation in accordance with Section 18.20.230. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8010).

18.68.120 Appeals to city council.

Whenever the owner of any structure is aggrieved by any final order of the board of examiners, appeals and condemnation, dealing with the abatement of a nuisance as provided in this chapter, such owner may within five days of notice of such ruling or act appeal to the city council as provided in Section 18.20.240. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8011).

18.68.130 Owner responsibility to demolish structure.

In the event the board orders a structure demolished, immediately upon the effective date of its order, the structure's owner shall arrange for the vacation and demolition of the structure within sixty days after the board's order becomes effective, unless such order is modified or reversed by the city council or is stayed by a court of competent jurisdiction. Should the structure owner fail to inform the building official within five days after the board's order becomes effective that such arrangements have been made or should the owner's scheduled demolition not in fact be completed within the aforesaid sixty-day period, then the building official may arrange for the demolition of the subject structure and impose a lien upon the property for the costs of same. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8012(a)).

18.68.140 Notice of pending order of demolition.

A. In the event the board orders the demolition of the subject structure by a date certain which is three months or more after the effective date of the order, and the order is not modified or reversed by the city council or is not stayed by a court of competent jurisdiction, the building official shall prepare a notice of pending order of demolition and arrange for the recordation of same in the office of the county recorder of Los Angeles County. The notice shall be in substantially the following form:

NOTICE OF PENDING
ORDER OF DEMOLITION

TO WHOM IT MAY CONCERN:

NOTICE IS HEREBY GIVEN that by order of the Board of Examiners, Appeals and Condemnation of the City of Long Beach, State of California, dated ______________, 19____, that certain structure now standing at ________________________________ and described generally as ________________________________ must and shall be demolished on or before ______________, 19____.

A certified copy of said order may be obtained from the office of the Department of Building and Safety of the City of Long Beach upon the payment of the appropriate fee. If said structure is not demolished in accordance with the aforesaid order, the same may be demolished by the City of Long Beach and the costs therefor assessed as a lien upon the land upon which the structure stood. A lien in the amount of $__________ in favor of the City of Long Beach is hereby assessed against said property for the costs of recording this notice.

B. The notice shall be recorded under the names of each and every person to whom the notice of Section 18.68.090 was mailed. The structure's owner may pay the recording fees for the aforesaid notice and thereby avoid the imposition of lien for same against the property. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8012(b)).

18.68.150 Owner responsibility to accomplish hazard reduction measures.

In the event the board or the city council certifies to the validity of any or all of any measures the owner has proposed as a means of reducing the earthquake hazard, and finds that the accomplishment of such measures will reduce the earthquake hazard associated with the structure to or below the applicable tolerable level, it shall order the owner to immediately initiate the accomplishment of such measures and to complete the same within a reasonable time. The board or the city council shall designate in its order, based on evidence presented to it during the hearing, that date certain which represents a reasonable time in its opinion for the accomplishment of the proposed measures. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8012(c)).

18.68.160 Jurisdiction of board or council over certain cases.

The board or the city council shall retain jurisdiction over cases in which it has approved owner-proposed measures for reducing earthquake hazard until such measures have been timely accomplished. In the event written evidence of the completion of the approved measures is not presented to the board or the city council within ten days after the designated date for the completion of such measures shall have passed, the board or the city council may revise its decision and order the immediate vacation and demolition of the structure. The board or city council may consider a time extension for the completion of the proposed measures if, prior to said date, the structure's owner has so applied. Any application for such an extension shall be in writing, setting forth what has actually been accomplished, what remains to be done, and the reasons for the requested extension. Should the board or the city council conclude that good cause has been shown for an extension, it may grant such an extension in writing for a period deemed necessary to complete the approved repairs. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8012(d)).

18.68.170 Hearing—Failure of owner to proceed in good faith.

In the event the building official or any interested person presents written affidavits to the board or the city council indicating the owner is not proceeding in good faith to timely accomplish any measures approved by the board or the city council in its original decision and order, the board or city council shall, on ten days' written notice mailed via certified United States mail to the owner of the structure, schedule and conduct a hearing on the matter. At such hearing, evidence, oral and written, may be presented as in the original hearing, and if the board or the city council is convinced that the owner is not proceeding in good faith to timely carry out its original order, then it shall revoke the order and order instead the immediate vacation and demolition of the structure. Written affidavits shall not, however, be received by the board or the city council under this section until at least fifty percent of the time allowed in its original order has expired. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8012(e)).

18.68.180 Notification to owners of buildings four stories or more in height.

Pursuant to Section 18.68.050, notification shall be sent via certified United States mail to owners of buildings four stories or more in height, on such dates as are determined in

Section 18.68.050. Such notification shall require the owner to have gathered and submitted to the building official information and data relating to the building's capabilities to withstand earthquake forces in sufficient detail to permit grading of the building in accordance with Section 18.68.030. Such information and data shall be gathered by a structural or civil engineer or architect licensed under the laws of the state. The notification shall state the date by which the information and data shall be transmitted to the building official, and that failure to so transmit shall result in arbitrarily placing the building in the Excessive Hazard – Grade I category. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8013).

18.68.190 Notice to county recorder.

Upon expiration of the sixty-day period after notification to owners and interested parties of the hazardous grade in which their building is being placed, all in accordance with Section 18.68.050, and if such hazardous grading has not been changed or required data substantiating a change has not been submitted as set forth in Section 18.68.080, the building official shall prepare and cause to be recorded with the county recorder a certificate stating that the building has been graded and assigned the particular hazardous grade determined under Section 18.68.030. When and if all required repairs are made to the building and it is removed from the hazardous grading, or certain corrective action is taken to change it to a different grade, the building official shall cause to be recorded with the county recorder records indicating the removal from said hazardous grading or reflecting the change to the different grade. (Ord. C-5276 § 1 (part), 1976: prior code § 8100.8014).

DIVISION 88

EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

SEC. 91.8801. PURPOSE

The purpose of this division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this division are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This division shall not require existing electrical, plumbing, mechanical or fire safety systems to be altered unless they constitute a hazard to life or property.

This division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their present use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this division requires the building to be strengthened or demolished.

Portions of the State Historical Building Code (SHBC) established under Part 8, Title 24 of the California Administrative Code are included in this division.

SEC. 91.8802. SCOPE

The provisions of this division shall apply to all buildings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

> **EXCEPTION:** This division shall not apply to detached one- or two-family dwellings and detached apartment houses containing fewer than five dwelling units and used solely for residential purposes.

SEC. 91.8803. DEFINITIONS

For purposes of this division, the applicable definitions in Sections 91.2302 and 91.2312 of this code and the following shall apply:

ESSENTIAL BUILDING. Any building housing a hospital or other medical facility having surgery or emergency treatment areas, fire or police stations, municipal government disaster operation and communication centers.

HIGH-RISK BUILDING. Any building not classified an essential building having an occupant load as determined by Section 91.3301 (d) of this code of 100 occupants or more.

EXCEPTION: A high-risk building shall not include the following:

A. Any building having exterior walls braced with masonry cross walls or wood-frame cross walls spaced less than 40 feet apart in each story. Cross walls shall be full-story height with a minimum length of 1½ times the story height.

B. Any building used for its intended purpose, as determined by the department, for less than 20 hours per week.

HISTORICAL BUILDING. Any building designated as a historical building by an appropriate federal, state or city jurisdiction.

LOW-RISK BUILDING. Any building not classified an essential building having an occupant load as determined by Section 91.3301 (d) of less than 20 occupants.

MEDIUM-RISK BUILDING. Any building not classified as a high-risk building or an essential building having an occupant load as determined by Section 91.3301 (d) of 20 occupants or more.

UNREINFORCED MASONRY BEARING WALL. A masonry wall having all of the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot.
3. The area of reinforcing steel is less than 50 percent of that required by Section 91.2418 (j) of this code.

SEC. 91.8804. RATING CLASSIFICATIONS

The rating classifications as exhibited in Table No. 88-A are hereby established and each building within the scope of this division shall be placed in one such rating classification by the department. The total occupant load of the entire building as determined by Section 91.3301 (d) shall be used to determine the rating classification.

EXCEPTIONS: 1. For the purpose of this division, portions of buildings constructed to act independently when resisting seismic forces may be placed in separate rating classifications.

2. For the purpose of this division, to establish the rating classification of a building containing one or more artist-in-residence spaces, as defined in Section 91.8501 of this code, the occupant load of each artist-in-residence space shall be one for each space less than 2,000 square feet in area and two for each space 2,000 square feet or more in area.

SEC. 91.8805. GENERAL REQUIREMENTS

The owner of each building within the scope of this division shall cause a structural analysis to be made of the building by a civil or structural engineer or architect licensed by the State of California, and if the building does not meet the minimum earthquake standards specified in this division, the owner shall cause it to be structurally altered to conform to such standards or cause the building to be demolished.

The owner of a building within the scope of this division shall comply with the requirements set forth above by submitting to the department for review within the stated time limits:

(a) Within 270 days after the service of the order, a structural analysis. Such analysis, which is subject to approval by the department, shall demonstrate that the building meets the minimum requirements of this division, or

(b) Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply to the minimum requirements of this division, or

(c) Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section 91.8808 (c), or

(d) Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the department, the owner shall obtain a building permit, commence and complete the required construction or demolition within the time limits set forth in Table No. 88-B. These time limits shall begin to run from the date the order is served in accordance with Subsections 91.8806 (a) and (b).

Owners electing to comply with Subsection (c) of this section are also required to comply with Subsection (b) or (d) of this section, provided, however, that the 270-day period provided for in such Subsections (b) and (d) and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in Table No. 88-B shall be extended in accordance with Table No. 88-C. Each such extended time limit, except the time limit for commencing construction, shall begin to run from the date the order is served in accordance with Section 91.8806 (b). The time limit for commencing construction shall commence to run from the date the building permit is issued.

SEC. 91.8806. ADMINISTRATION

(a) **Service of Order.** The department shall issue an order, as provided in Section 91.8806 (b), to the owner of each building within the scope of this division in accordance with the minimum time periods for service of such orders set forth in Table No. 88-C. The minimum time period for the service of such orders shall be measured from the effective date of this division. The department shall, upon receipt of a written request from the owner, order a building to comply with this division prior to the normal service date for such building set forth in this section.

(b) **Contents of Order.** The order shall be in writing and shall be served either personally or by certified or registered mail upon the owner as shown on the last equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the department to be within the scope of this division and, therefore, is required to meet the minimum seismic standards of this division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section 91.8805, which sets forth the owner's alternatives and time limits for compliance.

(c) **Appeal Form Order.** The owner or person in charge or control of the building may appeal the department's initial determination that the building is within the scope of this division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section 91.8806 (b). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor by the department, and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in Table No. 4-A of Section 98.0403 of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the department pursuant to this division shall be made in accordance with the procedures established in Section 98.0403.

(d) **Recordation.** At the time that the department serves the aforementioned order, the department shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of Division 88—Earthquake Hazard Reduction in Existing Buildings—of the Los Angeles Municipal Code. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it where compliance with Division 88 is not exhibited.

If the building is either demolished, found not to be within the scope of this division, or is structurally capable of resisting minimum seismic forces required by this division as a result of structural alterations or an analysis, the department shall file with the office of the county recorder a certificate terminating the status of the subject building as being classified within the scope of Division 88—Earthquake Hazard Reduction in Existing Buildings—of the Los Angeles Municipal Code.

(e) **Enforcement.** If the owner or other person in charge or control of the subject building fails to comply with any order issued by the department pursuant to this division within any of the time limits set forth in Section 91.8805, the department shall order that the entire building be vacated and that the building remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board, the superintendent may order its demolition in accordance with the provisions of Section 91.8903 of this code.

SEC. 91.8807. HISTORICAL BUILDINGS

(a) **General.** The standards and procedures established by this division shall apply in all aspects to a historical building except that as a means to preserve original architectural elements and facilitate restoration, a historical building may, in addition, comply with the special provisions set forth in this section.

(b) **Unburned Clay Masonry or Adobe.** Existing or re-erected walls of adobe construction shall conform to the following:

1. Unreinforced adobe masonry walls shall not exceed a height or height-to-thickness ratio of 5 for exterior bearing walls and must be provided with a reinforced bond beam at the top, interconnecting all walls. Minimum beam depth shall be 6 inches and a minimum width of 8 inches less than the wall width.

Minimum wall thickness shall be 18 inches for exterior bearing walls and 10 inches for adobe partitions. No adobe structure shall exceed one story in height unless the historic evidence indicates a two-story height. In such cases the height-to-thickness ratio shall be the same as above for the first floor based on the total two-story height, and the second floor wall thickness shall not exceed the ratio 5 by more than 20 percent. Bond beams shall be provided at the roof and second-floor levels.

2. Foundation footings shall be reinforced concrete under newly reconstructed walls and shall be 50 percent wider than the wall above, soil conditions permitting, except that the foundation wall may be 4 inches less in width than the wall above if a rock, burned brick, or stabilized adobe facing is necessary to provide authenticity.

3. New or existing unstabilized brick and adobe brick masonry shall have an average compressive strength of 225 pounds per square inch when tested in accordance with ASTM designation C 67. One sample out of five may have a compressive strength of not less than 188 pounds per square inch. Unstabilized brick may be used where existing bricks are unstabilized and where the building is not susceptible to flooding conditions or direct exposure. Adobe may be allowed a maximum value of 3 pounds per square inch for shear with no increase for lateral forces.

4. Mortar may be of the same soil composition and stabilization as the brick in lieu of cement mortar.

5. Nominal tension stresses due to seismic forces normal to the wall may be neglected if the wall meets thickness requirements and shear values allowed by this subsection.

(c) **Archaic Materials.** Allowable stresses for archaic materials not specified in this code shall be based on substantiating research data or engineering judgment, subject to the department's satisfaction.

(d) **Alternative Materials and SHBC Advisory Review.** Alternative materials, design or methods of construction will be considered as set forth in Section 91.8809 (d). In addition, when a request for an alternative proposed design, material or method of construction is being considered, the department may file written request for opinion to the State Historical Building Code Advisory Board for its consideration, advice or findings in accordance with the SHBC.

SEC. 91.8808. ANALYSIS AND DESIGN

(a) **General.** Every structure within the scope of this division shall be analyzed and constructed to resist minimum total lateral seismic forces assumed to act nonconcurrently in the direction of each of the main axes of the structure in accordance with the following equation:

$$V = IKCSW \qquad (88\text{-}1)$$

The value of *IKCS* need not exceed the values set forth in Table No. 88-D based on the applicable rating classification of the building.

(b) **Lateral Forces on Elements of Structures.** Parts or portions of structures shall be analyzed and designed for lateral loads in accordance with Subsections 91.8808 (a) and 91.2312 (e) of this code but not less than the value from the following equation:

$$Fp = IC_p SW_p \dots\dots\dots\dots\dots\dots (88\text{-}2)$$

For the provisions of this subsection, the product of IS need not exceed the values as set forth in Table No. 88-E.

> **EXCEPTION:** Unreinforced masonry walls in buildings not having a Rating Classification of I may be analyzed in accordance with Section 91.8809.

The value of C_p need not exceed the values set forth in Table 88-F.

(c) **Anchorage and Interconnection.** Anchorage and interconnection of all parts, portions and elements of the structure shall be analyzed and designed for lateral forces in accordance with Table No. 88-F of this code and the equation $Fp = IC_p SW_r$ as modified by Table No. 88-E. Minimum anchorage of masonry walls to each floor or roof shall resist a minimum force of 200 pounds per linear foot acting normal to the wall at the level of the floor or roof.

(d) **Level of Required Repair.** Alterations and repairs required to meet the provisions of this division shall comply with all other applicable requirements of this code unless specifically provided for in this division.

(e) **Required Analysis.** 1. **General.** Except as modified herein, the analysis and design relating to the structural alteration of existing structures within the scope of this division shall be in accordance with the analysis specified in Division 23 of this code.

2. **Continuous stress path.** A complete, continuous stress path from every part or portion of the structure to the ground shall be provided for the required horizontal forces.

3. **Positive connections.** All parts, portions or elements of the structure shall be interconnected by positive means.

(f) **Analysis Procedure.** 1. **General.** Stresses in materials and existing construction utilized to transfer seismic forces from the ground to parts or portions of the structure shall conform to those permitted by the code and those materials and types of construction specified in Section 91.8809.

2. **Connections.** Materials and connectors used for interconnection of parts and portions of the structure shall conform to the code. Nails may be used as part of an approved connector.

3. **Unreinforced masonry walls.** Except as modified herein, unreinforced masonry walls shall be analyzed as specified in Sections 91.2417, 91.2419 and 91.2420 to withstand all vertical loads as specified in Division 23 of this code in addition to the seismic forces required by this division. The 50 percent increase in the seismic force factor for shear walls as specified in Table No. 24-H of this code may be omitted in the computation of seismic loads to existing shear walls.

No allowable tension stress will be permitted in unreinforced masonry walls. Walls not capable of resisting the required design forces specified in this division shall be strengthened or shall be removed and replaced.

EXCEPTIONS: 1. Unreinforced masonry walls in buildings not classified as a Rating Classification I pursuant to Table No. 88-A may be analyzed in accordance with Section 91.8809.

2. Unreinforced masonry walls which carry no design loads other than their own weight may be considered as veneer if they are adequately anchored to new supporting elements.

(g) **Combination of Vertical and Seismic Forces.** 1. **New materials.** All new materials introduced into the structure to meet the requirements of this section which are subjected to combined vertical and horizontal forces shall comply with Section 91.2303(f) of this code.

2. **Existing materials.** When stresses in existing lateral force-resisting elements are due to a combination of dead loads plus seismic loads, the allowable working stress specified in the code may be increased 100 percent. However, no increase will be permitted in the stresses allowed in Section 91.8809, and the stresses in members due only to seismic and dead loads shall not exceed the values permitted by Section 91.2303 (d) of this code.

3. **Allowable reduction of bending stress by vertical load.** In calculating tensile fiber stress due to seismic forces required by this division, the maximum tensile fiber stress may be reduced by the full direct stress due to vertical dead loads.

SEC. 91.8809. MATERIALS OF CONSTRUCTION

(a) **General.** All materials permitted by this code, including their appropriate allowable stresses and those exiting configurations of materials specified herein, may be utilized to meet the requirements of this division.

(b) **Existing Materials.** 1. **Unreinforced masonry walls.** Unreinforced masonry walls analyzed in accordance with this section may provide vertical support for roof and floor construction and resistance to lateral loads. The bonding of such walls shall be as specified in Section 91.2412 (b) 1 of this code.

Tension stresses due to seismic forces normal to the wall may be neglected if the wall does not exceed the height- or length-to-thickness ratio and the in-plane shear stresses due to seismic loads as set forth in Table No. 88-J.

If the wall height-thickness ratio exceeds the specified limits, the wall may be supported by vertical bracing members designed in accordance with Division 23. The deflection of such bracing member at design loads shall not exceed one tenth of the wall thickness.

EXCEPTION: The wall may be supported by flexible vertical bracing members designed in accordance with Section 91.8808 (b) if the deflection at design loads is not less than one quarter nor more than one third of the wall thickness.

All vertical bracing members shall be attached to floor and roof construction for their design loads independently of required wall anchors. Horizontal spacing of vertical bracing members shall not exceed one half the unsupported height of the wall nor 10 feet.

The wall height may be measured vertically to bracing elements other than a floor or roof. Spacing of the bracing elements and wall anchors shall not exceed 6 feet. Bracing elements shall be detailed to minimize the horizontal displacement of the wall by components of vertical displacements of the floor or roof.

2. **Existing roof, floors, walls, footings and wood framing.** Existing materials, including wood shear walls utilized in the described configuration, may be used as part of the lateral load-resisting system, provided that the stresses in these materials do not exceed the values shown in Table No. 88-H.

(c) **Strengthening of Existing Materials.** New materials, including wood shear walls, may be utilized to strengthen portions of the existing seismic resisting system in the described configurations, provided that the stresses do not exceed the values shown in Table No. 88-I.

(d) **Alternate Materials.** Alternate materials, designs and methods of construction may be approved by the department in accordance with the provisions of Article 8, Chapter IX of the Los Angeles Municipal Code.

(e) **Minimum Acceptable Quality of Existing Unreinforced Masonry Walls.** 1. **General provisions.** All unreinforced masonry walls utilized to carry vertical loads and seismic forces parallel and perpendicular to the wall plane shall be tested as specified in this subsection. All masonry quality shall equal or exceed the minimum standards established herein or shall be removed and replaced by new materials. Alternate methods of testing may be approved by the department. The quality of mortar in all masonry walls shall be determined by performing in-place shear tests or by testing 8-inch-diameter cores. Alternative methods of testing may be approved by the department. Nothing shall prevent pointing with mortar of all the masonry wall joints before the tests are first made. Prior to any pointing, the mortar joints must be raked and cleaned to remove loose and deteriorated mortar. Mortar for pointing shall be Type S or N except masonry cements shall not be used. All preparation and mortar pointing shall be done under the continuous inspection of a registered deputy building inspector. At the conclusion of the inspection, the inspector shall submit a written report to the licensed engineer or architect responsible for the seismic analysis of the building setting forth the result of the work inspected. Such report shall be submitted to the department for approval as part of the structural analysis. All testing shall be performed in accordance with the requirements specified in this subsection by a testing agency approved by the department. An accurate record of all such tests and their location in the building shall be recorded and these results shall be submitted to the department for approval as part of the structural analysis.

2. **Number and location of tests.** The minimum number of tests shall be two per wall or line of wall elements resisting a common force, or one per 1500 square feet of wall surface, with a minimum of eight tests in any case. The exact test or core location shall be determined at the building site by the licensed engineer or architect responsible for the seismic analysis of the subject building.

3. **In-place shear tests.** The bed joints of the outer wythe of the masonry shall be tested in shear by laterally displacing a single brick relative to the adjacent bricks in that wythe. The opposite head joint of the brick to be tested shall be removed and cleaned prior to testing. The minimum quality mortar in 80 percent of the shear tests shall not be less than the total of 30 psi plus the axial stress in the wall at the point of the test. The shear stress shall be based on the gross area of both bed joints and shall be that at which movement of the brick is first observed.

4. **Core tests.** A minimum number of mortar test specimens equal to the number of required cores shall be prepared from the cores and tested as specified herein. The mortar joint of the outer wythe of the masonry core shall be tested in shear by placing the circular core section in a compression testing machine with the mortar bed joint rotated 15 degrees from the axis of the applied load. The mortar joint tested in shear shall have an average ultimate stress of 20 psi based on the gross area. The average shall be obtained from the total number of cores made. If test specimens cannot be made from cores taken then the shear value shall be reported as zero.

(f) **Testing of Shear Bolts.** One fourth of all new shear bolts and dowels embedded in unreinforced masonry walls shall be tested by a registered deputy building inspector using a torque calibrated wrench to the following minimum torques:

½-inch-diameter bolts or dowels—40 foot-lbs.
⅝-inch-diameter bolts or dowels—50 foot-lbs.
¾-inch-diameter bolts or dowels—60 foot-lbs

No bolts exceeding ¾ inch shall be used. All nuts shall be installed over malleable iron or plate washers when bearing on wood and heavy cut washers when bearing on steel.

(g) **Determination of Allowable Stresses for Design Methods Based on Test Results.** 1. **Design shear values.** Design seismic in-plane shear stresses shall be substantiated by tests performed as specified in Subsections 91.8809 (e) 3 or 4

Design stresses shall be related to test results obtained in accordance with Table, No. 88-J. Intermediate values between 3 and 10 psi may be interpolated.

2. **Design compression and tension values.** Compression stresses for unreinforced masonry having a minimum design shear value of 3 psi shall not exceed 100 psi. Design tension values for unreinforced masonry shall not be permitted.

(h) Five percent of the existing rod anchors utilized as all or part of the required wall anchors shall be tested in pullout by an approved testing laboratory. The minimum number tested shall be four per floor, with two tests at walls with joists framing into the wall and two tests at walls with joists parallel to the wall. The test apparatus shall be supported on the masonry wall at a minimum distance of the wall thickness from the anchor tested. The rod anchor shall be given a preload of 300 pounds prior to establishing a datum for recording elongation. The tension test load reported shall be recorded at ⅛-inch relative movement of the anchor and the adjacent masonry surface. Results of all tests shall be reported. The report shall include the test results as related to the wall thickness and joist orientation. The allowable resistance value of the existing anchors shall be 40 percent of the average of those tested anchors having the same wall thickness and joist orientation.

(i) Qualification tests for devices used for wall anchorage shall be tested with the entire tension load carried on the enlarged head at the exterior face of the wall. Bond on the part of the device between the enlarged head and the interior wall face shall be eliminated for the qualification tests. The resistance value assigned the device shall be twenty percent of the average of the ultimate loads.

SEC. 91.8810. INFORMATION REQUIRED ON PLANS

(a) **General.** In addition to the seismic analysis required elsewhere in this division, the licensed engineer or architect responsible for the seismic analysis of the building shall determine and record the information required by this section on the approved plans.

(b) **Construction Details.** The following requirements with appropriate construction details shall be made part of the approved plans:

1. All unreinforced masonry walls shall be anchored at the roof level by tension bolts through the wall as specified in Table No. 88-I, or by approved equivalent at a maximum anchor spacing of 6 feet. Anchors installed in accordance with Section 91.8101 (q) of this code shall be accepted as conforming to this requirement.

All unreinforced masonry walls shall be anchored at all floors with tension bolts through the wall or by existing rod anchors at a maximum anchor spacing of 6 feet. All existing rod anchors shall be secured to the joists to develop the required forces. The department may require testing to verify the adequacy of the embedded ends of existing rod anchors. Tests when required shall conform to Section 91.8809 (h).

When access to the exterior face of the masonry wall is prevented by proximity of an existing building, wall anchors conforming to Items 5 and 6 in Table No. 88-I may be used.

Alternative devices to be used in lieu of tension bolts for masonry wall anchorage shall be tested as specified in Section 91.8809 (i).

2. Diaphragm chord stresses of horizontal diaphragms shall be developed in existing materials or by addition of new materials.

3. Where trusses and beams other than rafters or joists are supported on masonry, ledges or columns shall be installed to support vertical loads of the roof or floor members.

4. Parapets and exterior wall appendages not capable of resisting the forces specified in this division shall be removed, stabilized or braced to ensure that the parapets and appendages remain in their original position.

5. All deteriorated mortar joints in unreinforced masonry walls shall be pointed with Type S or N mortar. Prior to any pointing, the wall surface must be raked and cleaned to remove loose and deteriorated mortar. All preparation and pointing shall be done under the continuous inspection of a registered deputy building inspector certified to inspect masonry or concrete. At the conclusion of the project, the inspector shall submit a written report to the department setting forth the portion of work inspected.

6. Repair details of any cracked or damaged unreinforced masonry wall required to resist forces specified in this division.

(c) **Existing Construction.** The following existing construction information shall be made part of the approved plans:

1. The type and dimensions of existing walls and the size and spacing of floor and roof members.

2. The extent and type of existing wall anchorage to floors and roof.

3. The extent and type of parapet corrections which were performed in accordance with Section 91.8101 (r) of this code.

4. Accurately dimensioned floor plans and masonry wall elevations showing dimensioned openings, piers, wall thickness and heights.

5. The location of cracks or damaged portions of unreinforced masonry walls requiring repairs.

6. The type of interior wall surfaces and if reinstalling or anchoring of ceiling plaster is necessary.

7. The general condition of the mortar joints and if the joints need pointing.

TABLE NO. 88-A
RATING CLASSIFICATIONS

TYPE OF BUILDING	CLASSIFICATION
Essential building	I
High-risk building	II
Medium-risk building	III
Low-risk building	IV

TABLE NO. 88-B
TIME LIMITS FOR COMPLIANCE

REQUIRED ACTION BY OWNER	OBTAIN BUILDING PERMIT WITHIN	COMMENCE CONSTRUCTION WITHIN	COMPLETE CONSTRUCTION WITHIN
Complete structural alterations or building demolition	One year	180 days*	Three years
Wall anchor installation	180 days	270 days	One year

*Measured from date of building permit issuance.

TABLE NO. 88-C
SERVICE PRIORITIES AND EXTENDED TIME PROVISIONS

RATING CLASSIFICATION	OCCUPANT LOAD	EXTENSION OF TIME IF WALL ANCHORS ARE INSTALLED	MINIMUM TIME PERIODS FOR SERVICE OF ORDER
I (Highest priority)	Any	One year	0
II	100 or more	One year	90 days
III	100 or more	One year	One year
	More than 50, but less than 100	One year	Two years
	More than 19, but less than 51	One year	Three years
IV (Lowest priority)	Less than 20	One year	Four years

TABLE NO. 88-D
HORIZONTAL FORCE FACTORS BASED ON RATING CLASSIFICATION

RATING CLASSIFICATION	*IKCS*
I	0.186
II	0.133
III & IV	0.100

TABLE NO. 88-E
HORIZONTAL FORCE FACTORS *"IS"* FOR PARTS OR PORTIONS OF STRUCTURES

RATING CLASSIFICATION	*IS*
I	1.50
II	1.00
III & IV	0.75

TABLE NO. 88-F
HORIZONTAL FORCE FACTOR "C_p" FOR PARTS OR PORTIONS OF BUILDINGS OR OTHER STRUCTURES

PART OR PORTION OF BUILDINGS	DIRECTION OF FORCE	VALUE OF *C*
Exterior bearing and nonbearing walls; interior bearing walls and partitions; interior nonbearing walls and partitions over 10 feet in height; masonry fences over 6 feet in height.	Normal-to-flat surface	0.20
Cantilever parapet and other cantilever walls, except retaining walls.	Normal-to-flat surface	1.00
Exterior and interior ornamentations and appendages.	Any direction	1.00
When connected to or a part of a building: towers, tanks, towers and tanks plus contents, racks over 8 feet 3 inches in height plus contents, chimneys, smokestacks and penthouses.	Any direction	0.20
When connected to or a part of a building: Rigid and rigidly mounted equipment and machinery not required for continued operation of essential occupancies.	Any horizontal direction	0.20

(Continued)

TABLE NO. 88-F
HORIZONTAL FORCE FACTOR "C" FOR PARTS OR PORTIONS OF BUILDINGS OR OTHER STRUCTURES—(Continued)

PART OR PORTION OF BUILDINGS	DIRECTION OF FORCE	VALUE OF *C*
Tanks plus effective contents resting on the ground.	Any direction	0.12
Floors and roofs acting as diaphragms.	In the plane of the diaphragm	0.12
Prefabricated structural elements, other than walls, with force applied at center of gravity of assembly.	Any horizontal direction	0.30
Connections for exterior panels or elements.	Any direction	2.00

Notes:

(1) See Section 91.8808 (b) for use of C_p.

(2) When located in the upper portion of any building with a ratio of 5 to 1 or greater, the value shall be increased by 50 percent.

(3) For flexible and flexibly mounted equipment and machinery, the appropriate values for C_p shall be determined with consideration given to both the dynamic properties of the equipment and machinery and to the building or structure in which it is placed.

(4) The W_p for storage racks shall be the weight of the racks plus contents. The value of C_p for racks over two storage support levels in height shall be 0.16 for the levels below the top two levels.

(5) The design of the equipment and machinery and their anchorage is an integral part of the design and specification of such equipment and machinery. The structure to which the equipment or machinery is mounted shall be capable of resisting the anchorage forces [see also Section 91.2312 (k)].

(6) Floor and roofs acting as diaphragms shall be designed for a minimum force resulting from a C_p of .12 applied to W_p unless a greater force results from the distribution of lateral forces in accordance with Section 91.2312 (e).

TABLE NO. 88-G
ALLOWABLE VALUE OF HEIGHT-THICKNESS RATIO OF UNREINFORCED MASONRY WALLS WITH MINIMUM QUALITY MORTAR[1 2]

	BUILDINGS WITH CROSSWALLS AS DEFINED BY SECTION 91.8803	ALL OTHER BUILDINGS
Walls of one-story buildings	16	13
First-story wall of multi-story buildings	16	15
Walls in top story of multi-story buildings	14	9
All other walls	16	13

[1]Minimum quality mortar shall be determined by laboratory testing in accordance with Section 91.8809 (e).

[2]Table No. 88-G is not applicable to buildings of Rating Classification I. Walls of buildings within Rating Classification I shall be analyzed in accordance with Section 91.8808 (f).

TABLE NO. 88-H
VALUES FOR EXISTING MATERIALS

EXISTING MATERIALS OR CONFIGURATION OF MATERIALS[1]	ALLOWABLE VALUES
1. HORIZONTAL DIAPHRAGMS	
a. Roofs with straight sheathing and roofing applied directly to the sheathing.	100 lbs. per foot for seismic shear.
b. Roofs with diagonal sheathing and roofing applied directly to the sheathing.	400 lbs. per foot for seismic shear
c. Floors with straight tongue-and-groove sheathing.	150 lbs. per foot for seismic shear.
d. Floors with straight sheathing and finished wood flooring.	300 lbs. per foot for seismic shear.
e. Floors with diagonal sheathing and finished wood flooring.	450 lbs. per foot for seismic shear.
f. Floors or roofs with straight sheathing and plaster applied to the joist or rafters.[2]	Add 50 lbs. per foot to the allowable values for items 1 (a) and 1 (c).
2. SHEAR WALLS	
Wood stud walls with lath and plaster	100 lbs. per foot each side for seismic shear.
3. PLAIN CONCRETE FOOTINGS.	$f' = 1500$ psi unless otherwise shown by tests.
4. DOUGLAS FIR WOOD	Allowable stress same as No. 1 D.F.[3]
5. REINFORCING STEEL	$f_t = 18{,}000$ lbs. per square inch maximum.[3]
6. STRUCTURAL STEEL	$f_t = 20{,}000$ lbs. per square inch maximum.[3]

[1]Material must be sound and in good condition.

[2]The wood lath and plaster must be reattached to existing joists or rafters in a manner approved by the department.

[3]Stresses given may be increased for combinations of loads as specified in Section 91.8808 (g) 2.

TABLE NO. 88-I
ALLOWABLE VALUES OF NEW MATERIALS USED IN CONJUNCTION WITH EXISTING CONSTRUCTION

NEW MATERIALS OR CONFIGURATION OF MATERIALS[1]	ALLOWABLE VALUES
1. HORIZONTAL DIAPHRAGMS	
Plywood sheathing applied directly over existing straight sheathing with ends of plywood sheets bearing on joists or rafters and edges of plywood located on center of individual sheathing boards.	Same as specified in Table No. 25-J of this code for blocked diaphragms.
2. SHEAR WALLS	
a. Plywood sheathing applied directly over existing wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing.	Same as values specified in Table No. 25-K for shear walls.
b. Drywall or plaster applied directly over existing wood studs.	75 percent of the values specified in Table No. 47-I.
c. Drywall or plaster applied to plywood sheathing over existing wood studs.	33⅓ percent of the values specified in Table No. 47-I.
3. SHEAR BOLTS	
Shear bolts and shear dowels embedded a minimum of 8 inches into unreinforced masonry walls. Bolt centered in a 2½-inch-diameter hole with dry-pack or nonshrink grout around circumference of bolt or dowel.[1,3]	100 percent of the values for plain masonry specified in Table No. 24-G. No values larger than those given for ¾ inch bolts shall be used.
4. TENSION BOLTS	
Tension bolts and tension dowels extending entirely through unreinforced masonry walls secured with bearing plates on far side of wall with at least 30 square inches of area.[2,3]	1200 lbs. per bolt or dowel.
5. WALL ANCHORS [91.8810 (b) 1.]	
(a) Bolts extending to the exterior face of the wall with a 2½-inch round plate under the head. Install as specified for shear bolts. Spaced not closer than 12 inches on centers.[1,2,3]	600 lbs per bolt.
(b) Bolts or dowels extending to the exterior face of the wall with a 2½-inch round place under the head and drill at an angle of 22½ degrees to the horizontal. Installed as specified for shear bolts.[1,2,3]	1200 lbs. per bolt or dowel.

(Continued)

TABLE NO. 88-I
ALLOWABLE VALUES OF NEW MATERIALS USED IN CONJUNCTION WITH EXISTING CONSTRUCTION—(Continued)

NEW MATERIALS OR CONFIGURATION OF MATERIALS[1]	ALLOWABLE VALUES
6. INFILLED WALLS Reinforced masonry infilled openings in existing unreinforced masonry walls with keys or dowels to match reinforcing.	Same as values specified for unreinforced masonry walls.
7. REINFORCED MASONRY Masonry piers and walls reinforced per Section 91.2419	Same as values specified in Table No. 24-B.
8. REINFORCED CONCRETE Concrete footings, walls and piers reinforced as specified in Division 26 and designed for tributary loads.	Same as values specified in Division 26 of this code.
9. EXISTING FOUNDATION LOADS Foundation loads for structures exhibiting no evidence of settlement.	Calculated existing foundation loads due to maximum dead load plus live load may be increased 25 percent for dead load, and may be increased 50 percent for dead load plus seismic load required by this division.

[1]Bolts and dowels to be tested as specified in Section 91.8809 (f).
[2]Bolts and dowels to be ½-inch minimum in diameter.
[3]Drilling for bolts and dowels shall be done with an electric rotary drill. Impact tools shall not be used for drilling holes or tightening anchor and shear bolt nuts.

TABLE NO. 88-J
ALLOWABLE SHEAR STRESS FOR TESTED UNREINFORCED MASONRY WALLS

80 PERCENT OF TEST RESULTS IN PSI NOT LESS THAN	AVERAGE TEST RESULTS OF CORES IN PSI	SEISMIC IN-PLANE SHEAR BASED ON GROSS AREA
30 plus axial stress	20	3 psi*
40 plus axial stress	27	4 psi*
50 plus axial stress	33	5 psi*
100 plus axial stress or more	67 or more	10 psi max.*

*Allowable shear stress may be increased by addition of 10 percent of the axial stress due to the weight of the wall directly above.

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