CHAPTER VI

Reducing Earthquake Risk in California

The 167 recommendations presented in the previous five chapters of this report cannot make California safer from earthquakes unless state and local governments, businesses, and individuals start to pay more attention to reducing earthquake risks. This report provides a prescription for giving seismic safety a level of priority consistent with the enormity of California's earthquake threat.

The Seismic Safety Commission aims to clarify the responsibility and ensure the accountability of those expected to address seismic safety issues, especially those who must carry out the recommendations in this report. The Commission believes that the strategy of integrating seismic safety with other public- and private-sector programs is appropriate, but it recommends taking the additional steps needed to get meaningful results. Seismic efforts must overcome benign neglect, denial, procrastination, and ignorance. The Commission's response to these concerns is woven into many of the recommendations.

Los Angeles Times

The Santa Monica Freeway was one of several major roadways disabled.

Funding is essential to apply the lessons learned from Northridge. Many of the recommendations are not expensive to implement, but significant funding in both the public and private sectors is needed to provide incentives to reduce risk in existing structures and support focused research. The more costly recommendations must not be avoided because of current fiscal problems; instead, modest and affordable commitments should be made now, with a long-term obligation to complete the tasks as funding becomes available. The Commission urges the state to aim for continuous progress even if it is funded with only a modest annual budget.

Seismic efforts must overcome benign neglect, denial, procrastination, and ignorance.

This report's recommendations, listed at the end of the "Executive Summary" and summarized at the end of each section of this chapter, combine to support four fundamental seismic safety goals:

- Make seismic safety a priority
- Improve the quality of construction
- Reduce the risk from seismically vulnerable structures
- Improve the performance of lifelines

To achieve these goals, it is necessary to:

- Define acceptable earthquake risk
- Provide incentives for risk reduction
- Improve the use of earth science knowledge to reduce risk
- Improve the use of land use planning to reduce risk
- Improve the building code development process
- Support focused research
- Improve state seismic programs

The recommendations largely build on existing laws, state and local government efforts, and activities in the private sector. All recommendations are listed under one of two headings: "Immediate Action" (actions the Governor can initiate) or "Legislation" (actions that require new or changed laws). Few of the recommendations suggest dramatic short-term change. Instead, the Commission recommends doing what we already do, but doing it better and more efficiently than in the past. Though amendments to existing statutes are needed, the legal tools generally are in place to reduce and manage seismic risk effectively. Providing policy direction and information, increasing priority, assigning responsibility, and demanding accountability are inexpensive but powerful ways to improve seismic safety efforts.

Making Seismic Safety a Priority

Many of the shortcomings in existing seismic safety programs in both the public and private sectors are caused by a lack of understanding of and support for seismic concerns. Seismic safety is seldom the primary interest of any business, individual, or agency. Responsibility for decisions involving earthquake risk is often vague; agencies lack clear authority and adequate resources; and accountability is not clearly established. Even if the public and private sectors endorse new programs and increase spending, carrying out these efforts must be afforded the priority to ensure consistently high-quality work.

The Commission recognizes that seismic safety must be balanced with other concerns to be successful over the long term, but planning and building decisions too often ignore seismic safety or incorrectly assume that it has already been addressed in some other way. Although state and local governments have a responsibility to protect public health and safety, earthquake risk-reduction efforts typically do not receive the attention necessary in light of California's earthquake risk. Seismic safety is emphasized after earthquakes strike but is gradually pushed aside by other concerns. Seismic efforts push uphill against a prevailing perspective that they can be delayed—or may not be necessary. Earthquake programs are often regarded as too expensive or only marginally relevant to an agency's program or a business' line of work. Seismic safety is treated too casually and inconsistently for the public safety or the economic issues at stake.

Ensuring that seismic risk receives proper consideration in planning and building deci-

sions involves making pertinent information available to responsible decision makers and ensuring the competence of the licensed professionals involved. Responsibility and authority must be clear, resources must be provided, and accountability must be demanded from organizations and agencies whose missions affect seismic safety if California is to reduce seismic risk in the manner expected by its citizens.

The place to start raising the priority of seismic programs is with state agencies and state-supported programs, which either affect state government interests directly or provide leadership, information, and standards to local governments and the private sector. The Commission recommends that the Governor, by executive order, direct each agency secretary to initiate efforts to raise the priority of the seismic safety efforts carried out within his or her agency. As high-level administration officials, the secretaries are ideally situated to review state agencies' progress in carrying out existing seismic programs and ensure that each agency provide appropriate priority to seismic concerns.

Immediate Action

The Commission recommends that:

- The Governor direct agency secretaries to be responsible for the progress of every department, board, and commission under their jurisdiction in carrying out their seismic safety responsibilities.

Improving the Quality of Construction

The need to improve the quality of construction is one of the most important lessons from the Northridge earthquake. The recommended actions will improve the quality of design and engineering, design review, and construction inspection. The earthquake performance of public school buildings, which are built using a code similar to that used for normal buildings but with higher quality control standards, showed that markedly better earthquake performance can be achieved at minimal additional cost.

Immediate Action

The Commission recommends that:

- The Governor direct that California's codes and regulations be amended to:
  - Require that a single design professional be responsible for the complete seismic design of each engineered building, indicate earthquake bracing elements and connections on plans, specify quality assurance plans, and observe construction of critical elements.
  - Improve the way licensing boards test engineers, architects, and geologists on seismic principles and aggressively enforce licensing board rules regarding professional competence in seismic safety matters.
  - Require plan checkers to review the lateral force resisting elements and inspectors to inspect these elements thoroughly, require independent peer review of important or complex buildings and authorize state and local government building departments to reject incomplete or incompetent plans, collect additional fees when the poor quality of design creates additional review work, and file complaints with licensing boards.

Seismic safety is treated too casually and inconsistently for the public safety or the economic issues at stake.

Legislation

The Commission recommends that:

- The Governor support legislation during the 1995 session of the Legislature to:
  - Amend the practice acts for professional engineers and architects to require continuing education and the title act for structural engineers to define the level of seismic expertise necessary to attain and keep the license and to require structural plan checking of engineered buildings by licensed professional engineers or architects.
  - Require testing of contractor license candidates on basic seismic safety principles in construction and continuing education of licensees.

- Require building inspectors and plan checkers to be trained and certified under programs provided by recognized organizations.

Reducing the Risk from Seismically Vulnerable Structures

Local governments must take the lead, but the state and federal governments must provide information and incentives.

In California the greatest seismic risk comes from existing buildings. Although only a small percentage of them are vulnerable to life-threatening failures or collapse in earthquakes, identifying specific buildings, deciding on the level of retrofit necessary, and setting priorities remains a difficult engineering, economic, and political challenge. Local governments, which are responsible for privately owned buildings, must take the lead, but the state and federal governments must provide design and building code information and financial incentives if significant progress is to be realized. Executive action and legislation are needed to improve the manner in which the state deals with state-owned buildings and to reduce the risks from the most hazardous of privately owned buildings.

Immediate Action

The Commission recommends that:

- The Governor require state agencies to carry out the recommendations in the report *Policy on Acceptable Levels of Earthquake Risk in State Buildings* (Seismic Safety Commission report SSC 91-01).
- The Governor require the University of California (UC) and the California State University (CSU) systems to prepare capital budget plans for seismic retrofitting of all university buildings that pose unacceptably high risks to life by the year 2005, to determine whether they have the ability to restore critical educational and research programs following damaging earthquakes, and to begin addressing this concern in retrofit programs.

Legislation

The Commission recommends that:

- The Governor support legislation during the 1995 session of the Legislature to:
  - Amend planning laws to require general plan safety elements to include a generalized description of seismically vulnerable building types by neighborhood and a plan to mitigate the risk from these buildings.
  - Enact legislation to require state and local building code enforcement agencies to identify potentially hazardous buildings and to adopt mandatory mitigation programs by the year 2000 that will significantly reduce hazardous and unsafe buildings by the target year of 2020.
  - Require public-school and community college districts to evaluate the seismic vulnerability of school structures built before 1976 and retrofit structures with significant life safety risks and to evaluate and abate life-threatening nonstructural hazards.
  - Require a portion of future school bond proceeds be used to abate life-threatening structural, nonstructural, and building contents seismic deficiencies.
  - Require that private-school buildings, including preschool buildings housing more than 25 students, be evaluated for structural, nonstructural, and building contents seismic hazards upon sale or lease renewal, and that life-threatening risks be mitigated.
  - Require the UC and CSU systems to adopt guidelines that require seismic retrofit as a condition of carrying out major renovations, reoccupancies, additions, and repairs.
  - Place a general obligation bond measure on the 1996 ballot to fund the retrofit of seismically vulnerable state-owned buildings and local government essential services buildings.

Improving the Performance of Lifelines

Lifeline networks provide critical services to California's communities. These systems are vulnerable to earthquake-caused interruptions because they are made up of hundreds or thousands of components and cover wide areas. Although localized short-term lifeline outages should be anticipated after earthquakes, there are a number of actions that can reduce lifelines' vulnerability to earthquakes, improve their reliability, and provide reliable backup services to those who must remain in action after earthquakes.

Immediate Action

The Commission recommends that:

- The Governor direct Caltrans to revise its retrofit priorities to give more weight to the importance of structures, accelerate the toll bridge retrofit program, meet its stated project completion goals for retrofitting vulnerable structures, undertake a study of the effects of near-source ground motion on seismically isolated bridges, and continue support for research and instrumentation of bridges.
- The Governor direct the Public Utilities Commission (PUC) to take an active role in the seismic safety efforts of the utilities within its regulatory responsibilities. Specifically, the PUC should review the earthquake response and risk-reduction efforts of California's railroads and electric and gas utilities, adopt needed regulations, and draft legislation that will require an earthquake-activated natural-gas shut-off valve at each mobile home park.
- The Governor direct the Department of Water Resources to help water districts identify and address seismic vulnerabilities by disseminating a summary of the causes of earthquake failures in piping systems, tanks, and other system components, as well as a model risk-mitigation program.
- The Governor direct the Division of the Safety of Dams to review its current assessment procedures in light of data obtained from the Northridge earthquake and to conduct seismic reevaluations and increase inspection frequency of high-risk dams in zones of high seismic hazard.

Legislation

The Commission recommends that:

- The Governor support legislation during the 1995 session of the Legislature to:
  - Require owners of essential communications and other essential facilities and hospitals to provide reliable backup power.
  - Require water utilities to adopt and carry out long-term seismic risk-mitigation efforts.
  - Require dam owners to place earthquake motion recording instruments on major dams.

Defining Acceptable Risk

Though the poor performance of many structures was obvious in the Northridge earthquake, there is no explicit policy regarding what constitutes minimally acceptable levels of earthquake damage, or risk, in California. This lack of policy direction makes it difficult, if not impossible, for the Commission to recommend what should be done to achieve higher levels of seismic safety, what building designers and code writers should set as performance objectives, or how much should be spent to reduce risk. The effort to define acceptable risk and performance objectives should involve affected organizations.

The objectives of current codes for most buildings and lifelines are generally those established decades ago by the volunteers who drafted the seismic provisions of the building code. At that time it was assumed that government's role was limited to protecting life safety; damage, regardless of how costly or disruptive to the community or state, was the owner's problem. The State of California has never explicitly established modern performance objectives to describe what

levels of earthquake damage are acceptable for buildings that provide residential, commercial, industrial, and institutional space in our state. Moreover, the "building industry"—building code writers, building designers, contractors, manufacturers of building components, and building inspectors—is not set up to encourage buildings that perform better than those "built to code."

From the government's perspective, a key consideration affecting the acceptability of risk is the economic impact of damage. City and state governments are affected by the cumulative impact of individual decisions regarding earthquake risks in buildings over a long period of time. Because major urban earthquakes pose a significant threat to California's economy, an economic framework is needed to evaluate the possible impacts and risk-reduction strategies related to earthquake risk policies.

There is no explicit policy regarding what constitutes a minimally acceptable level of risk in California.

Immediate Action

The Commission recommends that:

- The Governor direct the Department of Finance and the California Office of Planning and Research and request the Joint Budget Committee to convene a panel of economists and other experts to estimate the economic impacts of likely earthquake events.
- The Governor support and participate in a special high-level task force meeting, the "California Earthquake Risk Colloquium," a meeting convened by the Commission to recommend acceptable levels of risk and performance objectives consistent with those levels.

  The "Colloquium" could consist of the Governor and his representatives and representatives of the Legislature, the Insurance Commissioner, the Superintendent of Public Instruction, local government, and organizations representing building owners and managers, contractors, emergency managers, health and human services, banking, insurance, lifeline operations, and seismic experts. It would consider the information developed on economic impacts along with other information on earthquake hazards, building vulnerability, construction costs, and other concerns to arrive at a policy on acceptable risk and performance objectives for residential, commercial, industrial and institutional buildings and lifelines. The "Colloquium" should make its recommendations to the Governor, and they should be incorporated into legislation and adopted before the end of 1996.
- The Governor direct the California Building Standards Commission (CBSC) to work with representatives of the engineering professions, building code groups, building inspectors, and the building industry to implement the performance objectives once they are defined.

  The CBSC should make its recommendations to the Governor, the Legislature, and the International Conference of Building Officials. These recommendations should serve as the basis for revisions to the code's design guidelines and practices in California.

Providing Incentives for Risk Reduction

Incentives are essential tools to encourage earthquake risk reduction. Most economic decisions are made on a short-term basis, considering only current fiscal realities. Mitigation actions pay dividends in the future, when lower levels of damage may make it easier for owners and tenants to resume business and avoid some costly and time-consuming repairs. It is easy to criticize these decisions as penny-wise and pound-foolish, but it is true that an investment in seismic safety may not result in increased value or revenue. If owners cannot afford retrofitting or find a lender, they have no choice but to live with the risk. Incentives can help shift this balance, making it possible and even attractive to invest in seismic safety.

Incentives should be offered by both the public and private sectors. The private sector can be the most powerful influence when it recognizes the

value of reducing seismic risk: potentially hazardous buildings are not as valuable as earthquake-resistant buildings.

Possible incentives include the following measures:

- *Reliable information*. The state and federal government can provide better information to support local government and private-sector efforts to reduce and manage seismic risk. At present, useful information is not readily available to help owners judge the seismic performance of buildings or to make decisions regarding risk, priorities, liability, and cost of retrofitting. The Commission's recommendations call for a number of state agencies to improve the nature and quality of such information.
- *Grants to local government*. The state has a strong interest in reducing damage to publicly owned essential services buildings and other important structures. Not only does earthquake damage to these facilities reduce public safety, but a share of the cost of repair falls on the state. State grants, including matching grants, can stimulate risk-reduction investments; for example, Proposition 122, passed by the voters in 1990, provided for state grants to local governments to pay 75 percent of the cost of seismic retrofit of essential services buildings. Conditions on grants for other purposes can also be used to require compliance with minimum seismic standards. The state, like private investors, should be concerned about risks affecting its potential liabilities.
- *Loans.* State and local government loans for retrofit projects could provide property owners with the capital needed to retrofit when private-sector loans are not available. This type of incentive would be appropriate for owners of single-family homes, manufactured homes, and small businesses. Since many of these borrowers would not qualify for private-sector loans, the rates and payback schedules should be established according to the borrowers' ability to pay, with the loan, interest, and associated expenses held as a lien against the property equity to be paid upon sale or transfer of title, similar to the current elderly property tax program run by the State Controller, if payments do not cover actual costs.
- *Income tax incentives.* Federal and state tax laws can affect retrofit decisions. Seismically vulnerable buildings often provide large amounts of the housing stock for persons with low incomes and for small and start-up businesses. Generally they are older urban buildings, where seismic risk is but one of a number of planning and social concerns. Tax policies that encourage these building could hasten their renewal and, in the case of historic buildings, their preservation.

  Income tax credits or deductions could be given for investments in earthquake safety, and accelerated depreciation schedules would be powerful incentives to encourage investments in seismic retrofit. The loss of tax revenue as a result of these incentives would be offset by lower costs for recovery from future earthquakes.

  Laws affecting passive income, capital gains and enterprise zones should be reviewed and amended to encourage seismic retrofit or replacement of potentially hazardous buildings.
- *Land use planning incentives.* Local governments can provide incentives to retrofit by waiving land use requirements such as dedication requirements, density and parking restrictions, and code requirements that do not affect life safety. They can also issue bonds to fund loans for retrofit projects or provide density bonuses or additional development rights.
- *Insurance, lending, and real estate incentives.* Insurers share seismic risk with owners and tenants. The more susceptible a structure is to seismic damage and the more hazardous its location, the greater the chances that earthquake damage will occur. Although

Potentially hazardous buildings are not as valuable as earthquake-resistant buildings.

earthquake insurance is the most obvious type of policy affected, fire, liability, workers' compensation, business interruption, automobile, medical, and life insurance policies also cover losses caused by earthquakes. Insurers can use premium rate reductions and deductibles to encourage mitigation actions to reduce the risks for each of these lines of coverage.

Lenders also share seismic risk. After the Northridge earthquake some borrowers defaulted on mortgages when damage exceeded their ability to pay for repairs and resume use of the property. Lenders can encourage risk mitigation by requiring a seismic evaluation as a loan condition and adjusting interest rates and payback schedules to reflect their risk of foreclosure on the property should it be damaged by an earthquake.

Real estate agents can help their clients make informed decisions regarding the seismic risk associated with sales and leasing transactions and advise them on how to get reliable information for decision making. Prices should reflect the seismic vulnerability of the property.

- *Liability.* Numerous hazardous buildings throughout the state threaten the life and property of those who live and work in them. Even when the owners know of the risk, they may not inform the tenants and others of the potential for losses. Regardless of whether the owners know, under the law they are responsible for the structure. Clarifying state law regarding owners' liability and obligation to warn tenants would encourage risk-reduction efforts and allow owners and others to manage their earthquake risk more effectively.

Providing meaningful incentives requires investments with an uncertain return; they may not pay off for a long time. The loss of income, new expenditures, and commitment of key personnel to earthquake risk reduction may reduce support for other programmatic or business areas. Developing and offering incentives that are both effective and feasible will require a concerted technical and constituency-building effort.

No single government agency, local government, or business has both the responsibility and expertise to create a broad-based incentive program. Only state government is in a position to do so. Because of the state's responsibility for public safety and its strong self-interest in reducing future earthquake losses, it has the most to gain by exerting the leadership needed to create meaningful incentives for effective seismic risk management.

Immediate Action

The Commission recommends that:

- The Governor convene an ad hoc task force of the agencies and people who can provide incentives to encourage earthquake risk-reduction efforts.

  The key individuals would be administration officials and members of the Legislature responsible for housing, finance, insurance, banking, earthquake recovery, the Insurance Commissioner, and the Superintendent of Public Instruction. The task force should describe possible state-level incentives, arguments for and against, and the mechanism to create those believed to be feasible and effective. This task force should make its recommendations by the end of 1995.

Legislation

The Commission recommends that:

- The Governor support legislation to carry out the recommendations for incentives developed by the "Colloquium" during the 1996 session of the Legislature.

Improving the Use of Earth Science Knowledge to Reduce Risk

Using geological and geotechnical information results in improved decisions that balance earthquake risk with other concerns. However, most construction projects and land use planning decisions do not use the most up-to-date informa-

tion because, even when it is available, potential users do not know of it or do not know how to use it. In part, this is because programs that translate research concepts to products for use by engineers and planners are not well funded. Earth science information must be made available and engineers and architects must use it to lower losses from future earthquakes. The Commission's recommendations are intended to provide critical information in useful formats and make it readily available for land use planning and structural design.

Immediate Action

The Commission recommends that:

- The Governor direct the California Division of Mines and Geology to map areas where active buried faults exist, describe the level of hazard associated with these faults and other subtle faults, complete the Seismic Hazards Mapping Act (SHMA) by the year 2005, and use independent peer review to ensure consistency in all aspects of the SHMA program.

Legislation

The Commission recommends that:

- The Governor support legislation during the 1995 session of the Legislature to:
  - Require that state and local jurisdictions enforce as a minimum the Uniform Building Code grading provisions, that fills be designed by qualified professionals considering seismic forces, and that fills be inspected by qualified professionals.
  - Require continuing education for geologists, geophysicists, engineering geologists, and geotechnical engineers as part of the professional license renewal process.

Improving the Use of Land Use Planning to Reduce Risk

General plans, zoning, subdivision regulation, and environmental review are tools that can help local governments manage seismic risk. These planning tools allow a long-term, balanced commitment to seismic safety using existing regulatory and planning programs to achieve community goals. However, the information on natural hazards (areas of potential ground failure and areas where amplified shaking is expected) and human-made hazards (potentially hazardous buildings and hazardous materials) contained in the safety element must be reasonably complete and up to date. Local government planning and investments in infrastructure should consider the potential effects of earthquakes on the financial security of the community, its commerce and housing, and the preservation of historic buildings and the aesthetic character of the community. Although reducing risk through land use planning will take years, the changes necessary to strengthen this effort can be implemented quickly.

Developing and offering incentives that are both effective and feasible will require a concerted technical and constituency-building effort.

Immediate Action

The Commission recommends that:

- The Governor direct the California Office of Planning and Research to revise the State Planning Guidelines to address acutely hazardous materials and their relation to seismic hazards.
- The Governor direct the Resources Agency to amend the California Environmental Quality Act guidelines to improve the review of seismic hazards and risk-mitigation measures.

Legislation

The Commission recommends that:

- The Governor support legislation during the 1995 session of the Legislature to:
  - Amend general plan laws to require that safety elements address the seismic vulnerability of the building stock, that elements be updated every five years, that they incorporate information published under the SHMA, and that the existing optional review of draft safety elements by the California Division of Mines and Geology be mandatory.
  - Amend the Alquist-Priolo Act and SHMA to allow designation of faults as active based on geologic, geodetic, and tectonic

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evidence: to apply the acts to all publicly owned buildings, other facilities, and lifelines; and provide for alternative mitigation measures for buildings in areas of complex faulting and for lifelines.

- Amend the dam inundation mapping program to impose sanctions on dam owners who fail to prepare and submit maps by December 31, 1996, and to require updating of maps when downstream conditions change and review of maps every ten years.

Improving the Building Code Development Process

Although the current practice of relying on volunteers from professional organizations to draft and revise building codes has worked fairly well in the past, the state should fund some of the effort to make the process faster and to define accountability. The Commission believes the CBSC should be responsible for implementing and justifying the seismic provisions of the code to be enforced for all types of buildings statewide:

- It should review code changes proposed by others and, when necessary, propose new code language.
- It should identify weaknesses in the knowledge base supporting both the existing code and proposed changes and in some instances obtain and allocate funds for testing to substantiate the code.

A relatively modest level of annual funding to improve the code development process could make a significant difference in the effectiveness of the building codes in limiting earthquake damage.

Legislation

The Commission recommends that:

- The Governor support legislation during the 1995 session of the Legislature to designate the CBSC as the entity responsible to ensure that building codes and their administrative provisions meet the state's acceptable levels of seismic risk, ensure the adequacy of seismic safety requirements in the codes, and develop and adopt amendments for statewide application.

Supporting Focused Research

Every damaging earthquake reveals weaknesses in current practices and brings out new ideas to reduce risk. During the preparation of this report it was clear that focused research in engineering, geology, construction technology, and other areas was needed to answer specific questions raised by the earthquake. These issues also are contained in the Commission's *Research and Implementation Plan for Earthquake Risk Reduction in California* (SSC 94-01), a long-term plan for focusing research on California's pressing needs. The plan recognizes that applied research is an integral part of earthquake risk reduction and that the present level of funding is not commensurate with the need for information. The plan proposes establishing a Center for Earthquake Risk Reduction to manage the effort. A similar center was envisioned, but never funded, by Legislation enacted in 1986.

Legislation

The Commission recommends that:

- Legislation be enacted to create and fund a state-level Center for Earthquake Risk Reduction to implement a seismic safety research program.

Improving State Seismic Programs

The success of many of the recommendations in this report, as well as ongoing state-level programs, depends on the commitment and capabilities of responsible agencies. Because responsibility for decisions involving earthquake risk is often diffuse and vague, authority lacking, accountability missing, and resources—people and funds—inadequate, agencies may not be effective.

The Commission believes that to overcome these shortcomings, each agency should adopt measurable seismic safety objectives and a plan to meet them. The plan should have clear assignments of

responsibility and assessments of the adequacy of authority, knowledge, and resources needed to meet the objectives. Each agency should allocate the funds necessary, employ technically competent professionals, and commit to a system of external accountability.

These agencies and the responsible employees must be empowered to meet their seismic safety objectives. Oversight by persons with broader responsibilities and by control agencies is essential, but this oversight should be aimed at helping those responsible to do their job; it should not delay action. Disagreements regarding funding levels, qualifications of employees, and contracts must be resolved quickly. Seismic safety must be afforded the same level of importance as are other public-safety and fiscal matters.

Each state agency with the authority to design and construct facilities should be required by statute to meet earthquake performance objectives consistent with the recommendations of the "Colloquium." They should be required to use:

- Properly credentialed and experienced design professionals.
- An independent peer review of all important or complex structures and of designs for less complex structures that will be repeated.
- Independent plan checking by credentialed and trained individuals.
- Thorough construction inspection.

Lacking this explicit direction, public works programs may provide safe facilities most of the time, but to provide structures capable of the desired earthquake resistance consistently, these requirements should be adopted into law.

Raising earthquake safety matters to a higher level requires that the state's earthquake programs receive and use state-of-the-art information. Seismic matters require professional judgment that cannot be held by just one person or one organization. Agencies with focused missions, little flexibility in hiring and training specialists, and limitations on their ability to participate in nonagency efforts can benefit from the advice of outside, independent experts. The Commission believes each agency responsible for earthquake programs should incorporate independent peer review as part of its program. The findings of the peer review should be reported to the highest levels in agencies.

Immediate Action

The Commission recommends that:

- The Governor direct each state agency with the authority to design, construct, and lease facilities and those with responsibility for seismic safety programs, to:
  - Report to him on how seismic safety will be afforded priority attention.
  - Incorporate ongoing independent peer review on all seismic matters, including planning and priorities.

  Each report must include a plan, a schedule for implementation, a request for the financial and personnel resources to carry out the program, and an external reporting mechanism to ensure progress. Though the initial reports should be required by executive order, the State Administrative Manual should be revised by January 1, 1996, to incorporate requirements for plan contents and procedures for periodic review. The reports should be discussed with the Joint Legislative Budget Committee and reviewed and approved by the Department of Finance prior to being submitted to the Governor.

Markedly better earthquake performance can be achieved at minimal additional cost.

Role of the Seismic Safety Commission

The Seismic Safety Commission should continue to bring to state government the knowledge and views of the professions, local government agencies, and organizations responsible for seismic safety. It should continue to advise the Governor and Legislature and state and local agencies. It should continue to advocate improved earthquake risk-reduction and risk-management efforts, monitor progress, and report to the Governor, the Legislature, and the people of California.

Since 1985, California's laws have called for the state to reduce earthquake risk significantly by the year 2000. The California Earthquake Haz-

ards Reduction Act of 1986 mandates initiatives to meet this goal. The initiatives, published as a report titled *California at Risk: Reducing Earthquake Hazards 1992-1996,* provides the framework to organize, promote, and monitor the needed improvements to policies and identifies the responsible government and private entities.

California law calls for the state to reduce earthquake risk significantly by the year 2000.

In 1995 the Commission intends to launch an effort to focus this program, using the results of this study and other lessons from the Northridge earthquake. This program needs stronger backing to ensure identified organizations are accountable to their tasks. For example, at the time of the Northridge earthquake, 35 of 42 initiatives were behind schedule. Because seismic safety programs are a secondary concern for most agencies, these initiatives often do not receive the priority needed.

The deaths and injuries, damage, and economic disruption caused by the Northridge earthquake lend a new urgency to finding the funding necessary to finance the initiatives in *California at Risk* so that we can begin to act on our most pressing needs. The 1994 update of *California at Risk* identifies ten high-priority initiatives on which the Commission decided to concentrate its efforts and resources. All ten of those initiatives are still valid and critical to reducing earthquake risks statewide. Advancements on any of those initiatives will not only provide an immediate and direct benefit to the earthquake damaged area but will serve as a model for other jurisdictions to implement similar programs and, most important, further the overall goal of *California at Risk* by significantly reducing earthquake risks by the end of the century.

Conclusion

Earthquakes and damage are inevitable. More earthquakes like Northridge and possibly a major earthquake reminiscent of San Francisco in 1906 will strike before California significantly reduces its seismic risk. However, California can be better prepared and less vulnerable tomorrow than it is today. Successfully implementing these recommendations will improve management of earthquake risk and turn the losses from the Northridge earthquake into California's gain.

The Commission recommends that the Governor pursue the recommendations in this report, direct agency actions through executive orders to initiate the plans and programs where sufficient authority already exists, support a legislative program by sponsoring legislation to redirect authority and provide funds needed to carry out selected programs. The Governor should call on the federal government and private-sector organizations to help carry out the actions recommended.

The Commission believes that the effort needed to lay the necessary foundation to make seismic safety a priority can be completed, that the legislation needed can be enacted, and that the new efforts and incentives can be initiated by December 31, 1998. Investing in seismic safety is an investment in the future. The risk-reduction efforts that follow these foundation-laying efforts will continue for decades and create a cumulative and dramatic effect: lower earthquake losses in the future.