

Reducing Earthquake Risk in Northern California by the 100th Anniversary of the 1906 Earthquake

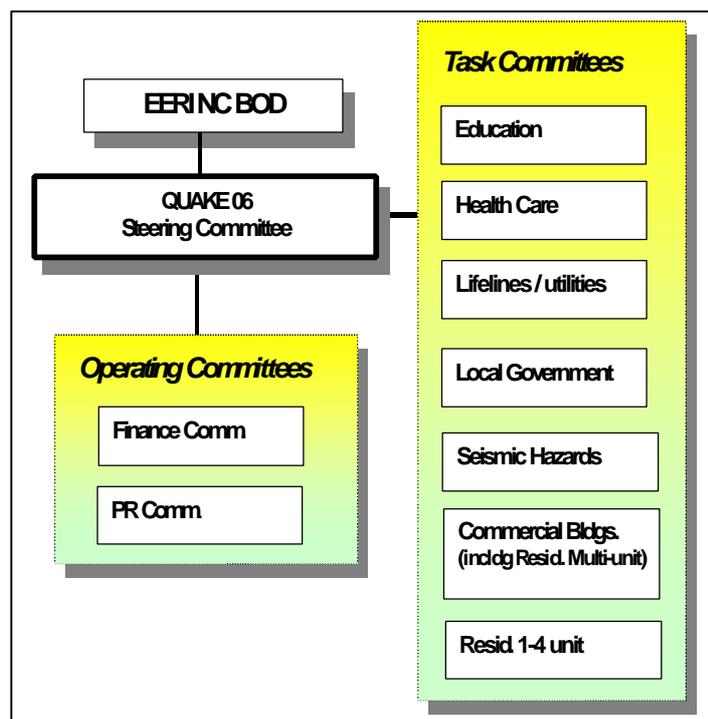
Charles Scawthorn
ABS Consulting
Oakland CA 94607 USA

A number of activities are underway in Northern California, to reduce earthquake risk significantly in the relatively near term. This paper summarizes several of those activities, involving (a) Quake '06, (b) a Toolkit for Seismic Decision-makers, (c) San Francisco's CAPSS program, and (d) an update to the FEMA 154 RVS Handbook.

Quake '06

Quake '06 is a 4-year campaign to reduce earthquake risk in Northern California, beginning April 18, 2002, the 96th anniversary of the 1906 earthquake, and ending on the 100th anniversary in 2006. The campaign is a partnership between the community of earthquake professionals in the Northern California chapter of the Earthquake Engineering Research Institute (EERI) and cities, agencies and other groups at risk in Northern California.

The Quake '06 campaign is being implemented via a series of Task Committees, one each for education, health care, etc. Each Task Committee is comprised of EERI Northern California members interested in that topic and an equal or greater number of members representing that topic. Each Task Committee is working to evaluate existing information about the topic, to provide guidance to determine seismic risk, and to develop and implement a seismic risk reduction program to be substantially completed or in-progress by April 18, 2006. TV stations, newspapers and other media are kept informed of the



progress of Quake '06, with regular press briefings every six months in April and October.

CSSC Toolkit for Seismic Decision-makers

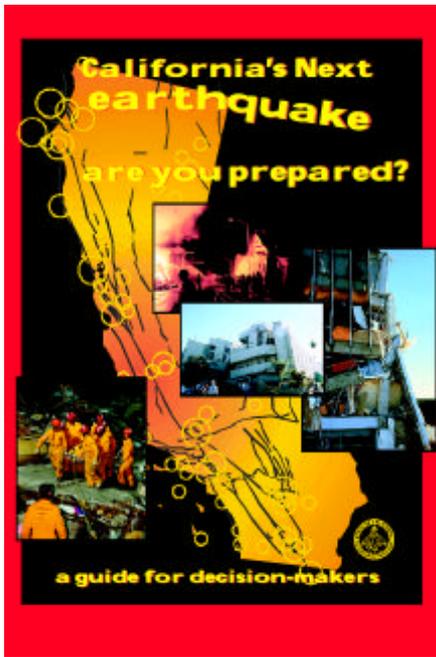
Seismic mitigation for local governments involves a multi-step process of capturing the attention of key decision-makers, developing a compelling case for proceeding with mitigation, and providing evidence of cost-effective mitigation projects. To encourage this process in California, Earthquake Risk Management Tools for Decision-makers, consisting of three publications were developed by the California Seismic Safety Commission. These publications are: a Guide – an 8 page colorful brochure, intended to give a 'one-minute' message to key decision-makers; a Toolkit – a 200 page manual describing the details and 'how to' implementation of a seismic risk reduction program; and Success Stories – a colorful 50+ page brochure describing the "how's and what's" of five risk reduction programs in California. The three documents have received widespread acceptance, are a model for other states and entities to freely adapt for their own seismic risk mitigation programs, and are available at www.seismic.ca.gov

Guide

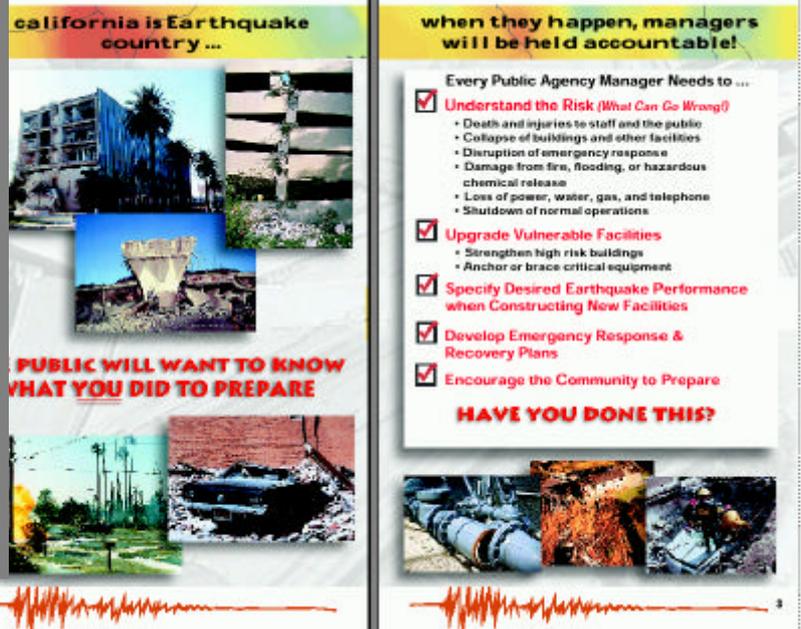
The Guide (Figure 1) consists of a front cover, which asks '*are you prepared?*' Pages 2-3 confront the decision-maker with the fact that California is 'earthquake country', that the public will want to know what you did to prepare, and asks if the decision-maker understands the city or agency's risk, have they upgraded vulnerable facilities, developed emergency response and recovery plans, and encouraged the community to prepare? Pages 4-5 shows shaking intensity in the major urban areas of San Francisco and Los Angeles, and provides a 'post-card' view of public mitigation. Pages 6-7 elaborates the solutions to the questions posed on Pages 2-3, while the back cover finally tells the decision-maker that the Next Steps are to Estimate Your Risk, Develop and Fund a Program, and that to Find Out How, request the Toolkit and Success Stories from the California Seismic Safety Commission.

Toolkit

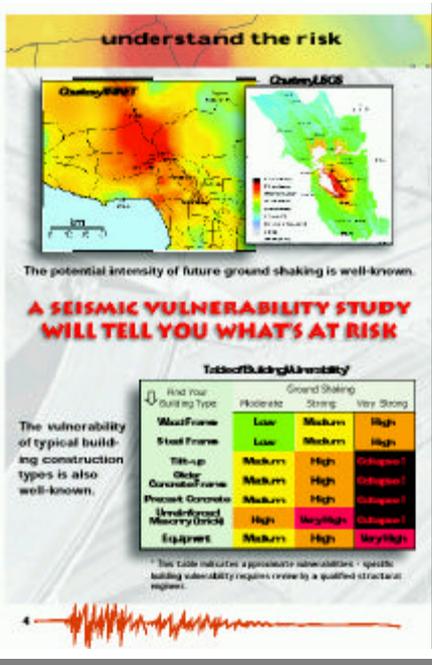
The Toolkit (Figure 2), The **Toolkit** is a 200 page manual describing the details and 'how to' implementation of a seismic risk reduction program. It is intended for the key staff person (risk manager, financial analyst) receiving this task. It begins with an overview of earthquake loss process, and the spectrum of opportunities for earthquake risk mitigation (Figure 3), and then provides relatively in-depth explanations of earthquake hazards, and building and equipment vulnerabilities and their consequences, written for an educated lay audience. It also provides step-by-step explanation on how to assess a city's or agency's earthquake risk, guidance on how to develop a process on deciding what to do about this risk (Figure 4), and clear explanation on implementing the earthquake risk mitigation program (Figure 5). In this, the concept of Performance Objectives is introduced, for several levels of earthquake, (Figure 6).



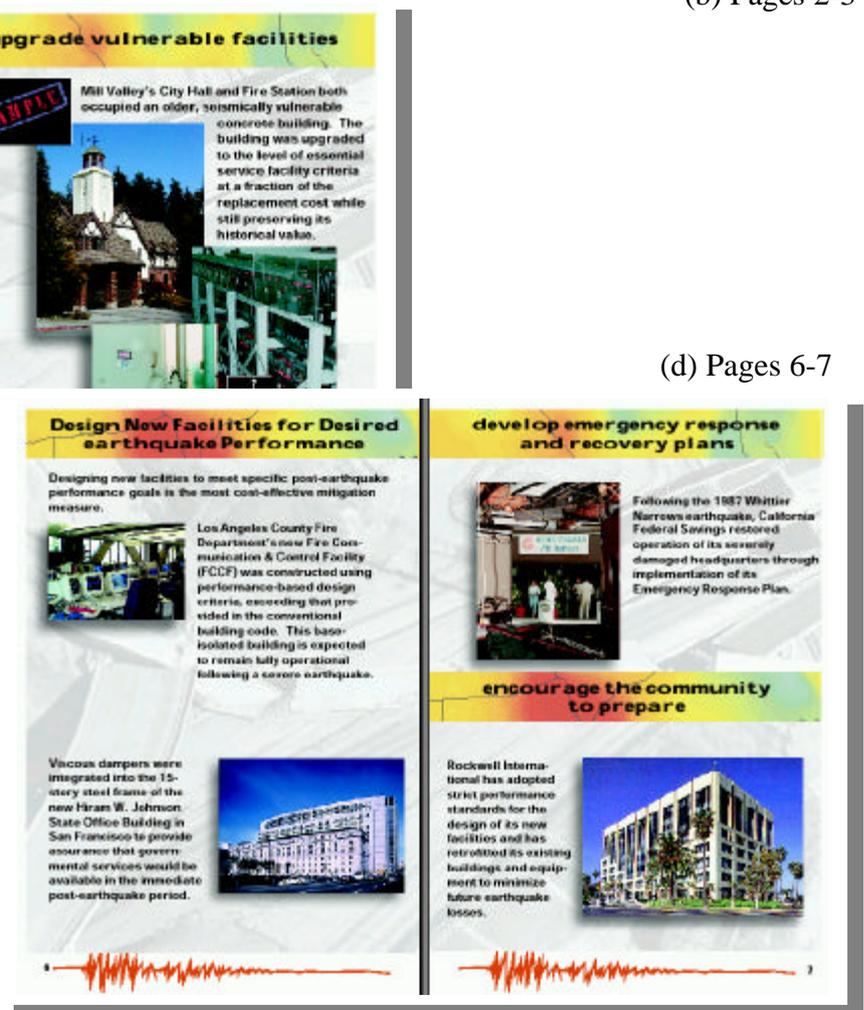
(a) Front Cover



(b) Pages 2-3



(c) Pages 4-5



(d) Pages 6-7

Figure 1 - Guide: (a) Front Cover; (b) Pages 2-3; (c) Pages 4-5; (d) Pages 6-7

Earthquake Risk Reduction Activities in Northern California
C. Scawthorn

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Figure 2 – Toolkit Cover and Table of Contents

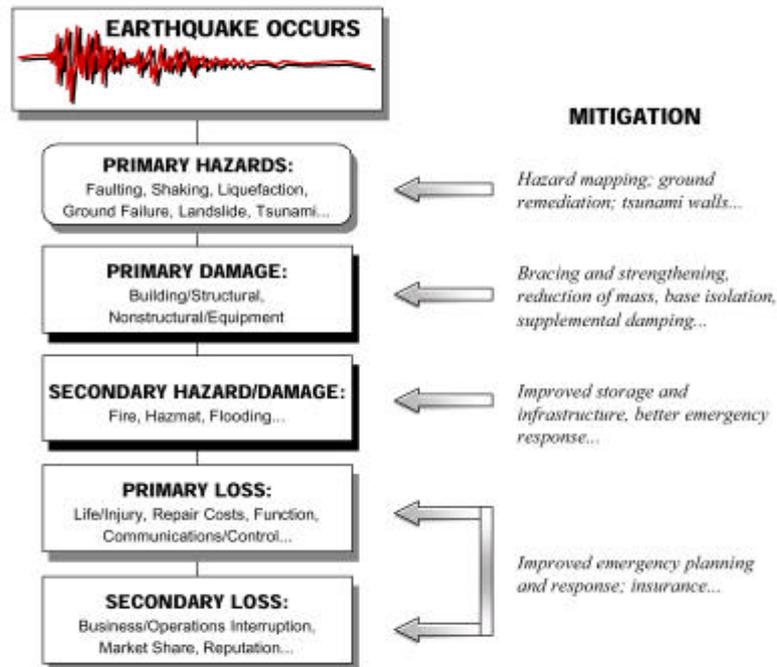


Figure 3 – Earthquake Loss Process and Mitigation Spectrum

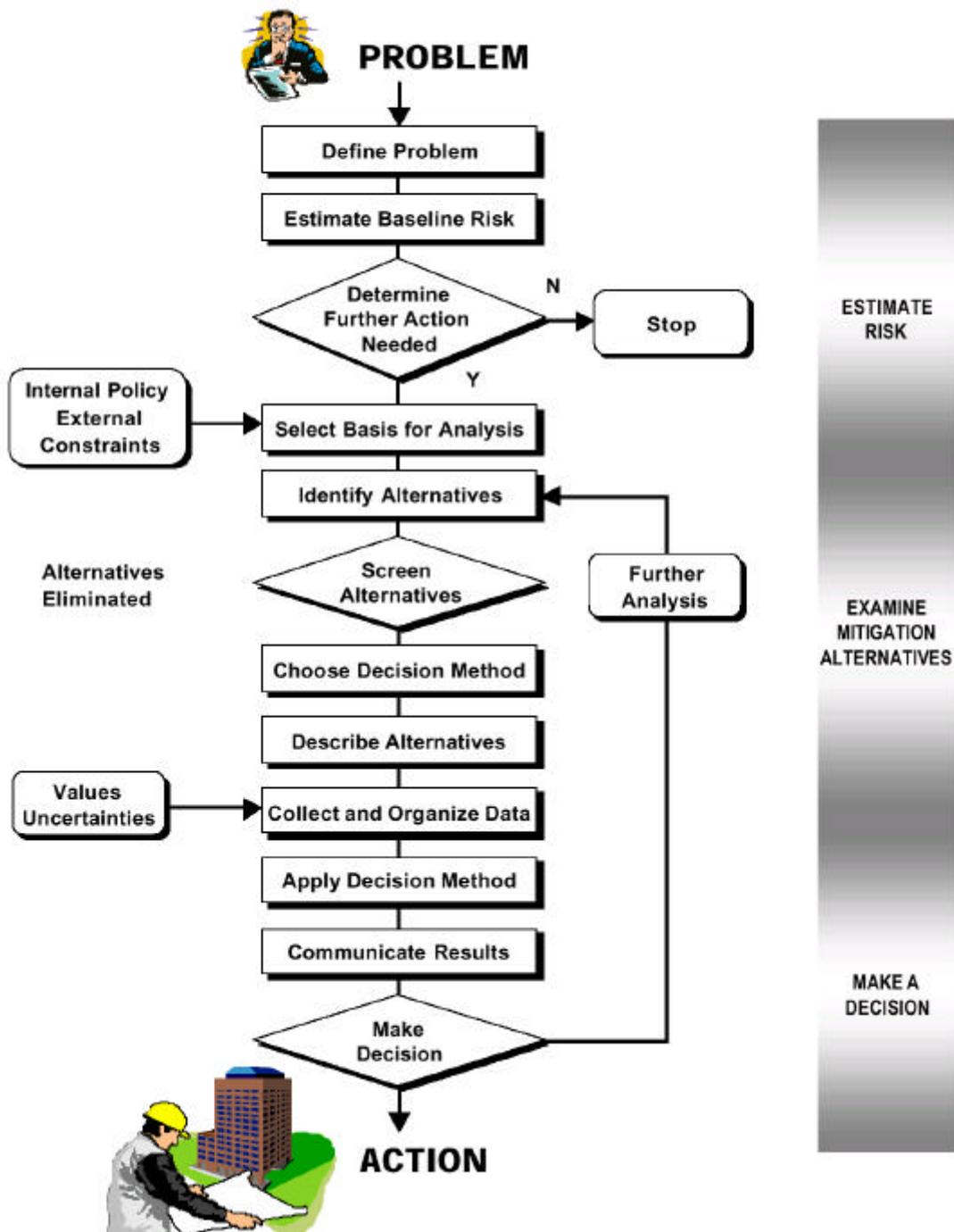


Figure 4 – Earthquake Risk Management Decision Process

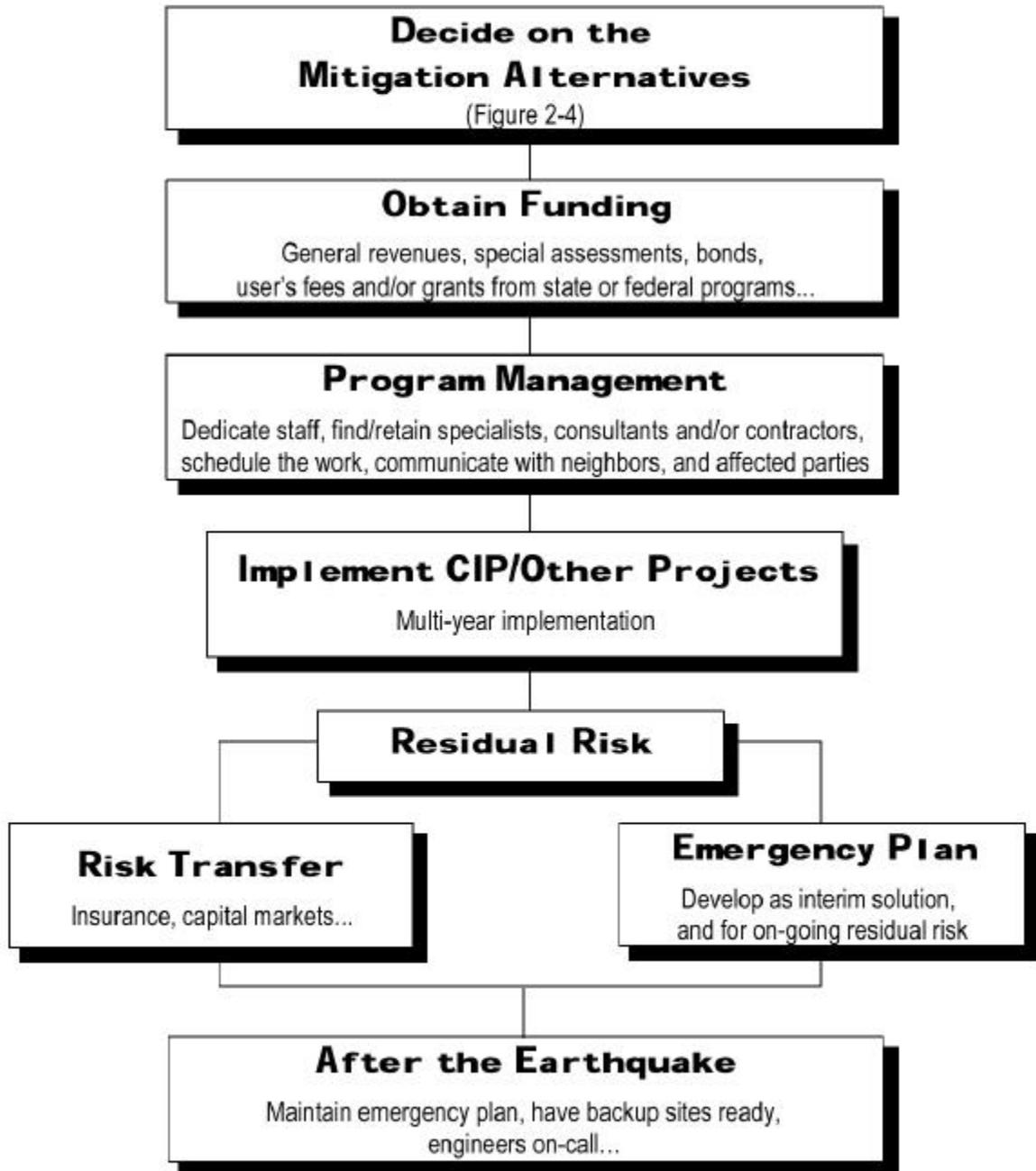


Figure 5 – Earthquake Risk Management Program

Facility-type	Earthquake Event		
	UBE (1,000-Year)	MPE (500-Year)	LE (100-Year)
Essential public facilities, <ul style="list-style-type: none"> • Hospitals • Police stations • Fire stations • Emergency communication centers 	LS ¹	IO	O
Public facilities with vulnerable occupants <ul style="list-style-type: none"> • Schools • Correctional Facilities 	CP	LS	IO
Other public facilities	CP	LS	-
Private commercial – emergency response	LS	IO	O
Private commercial with hazardous materials	LS	IO	O
Private commercial – essential operations	LS	IO	O
Private commercial – ordinary operations	CP	LS	-
Other private commercial facilities	CP	LS	-
Multi-family residential buildings	CP	LS	IO
Single-family residential buildings	CP	LS	-
Historic buildings	CP	LS	-

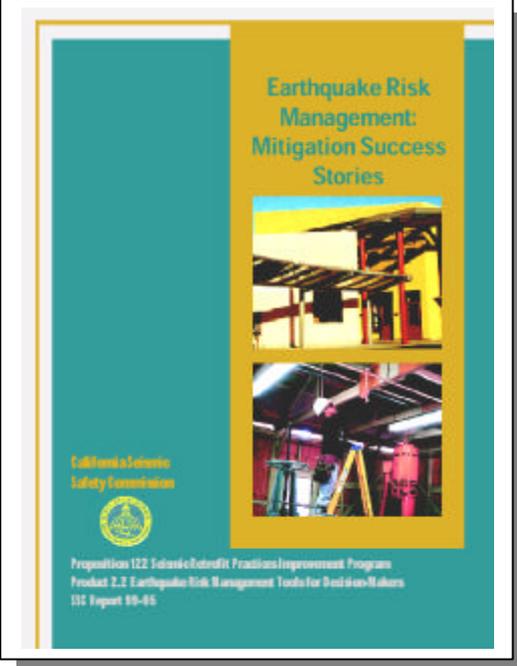
¹ Legend (refer to Table 3-4 for more detailed information):
CP – Collapse Prevention
LS – Life Safety
IO – Immediate Occupancy
O – Operational

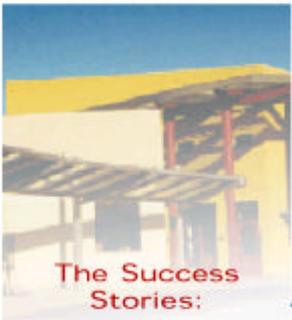
Figure 6 - Examples of Typical Performance Objectives for Various Facility-Types

Success Stories

The **Success Stories** is a colorful 50+ page brochure describing the “how’s and what’s” of five risk reduction programs in California (Figure 7). The intent of the Success Stories is to develop confidence and motivation in the audience, for development of an earthquake risk mitigation program. Four stories are drawn from public sector experience, and one from the private sector, to describe the complexities and nuances associated with the successful implementation of earthquake loss reduction programs. The practical aspects of the risk management decision-making process are highlighted to offer valuable lessons and insight into the process. The studies show that earthquake risk management can be a financially viable endeavor, especially when all the costs of potential losses, direct or otherwise, are considered.

1. **East Bay Municipal Utility District.** Highlighted here are the actions of a large public utility in northern California that demonstrate the importance of clearly understanding the scope and magnitude of risk before making a decision to accept or mitigate it. Risk ranking is discussed, as is the importance of developing a methodical approach to assessment and mitigation.
2. **Los Angeles Unified School District.** This study illustrates the steps taken by a large school district in southern California to deal with the nonstructural elements in its many school buildings that contributed to its earthquake vulnerability. The study demonstrates the importance of mitigating nonstructural falling hazards as a means of reducing the life-safety risk to building occupants.
3. **Anheuser-Busch Van Nuys Brewery.** The actions of a single privately owned facility in southern California are the subject of this case study. Illustrated is the importance of non-direct costs (business interruption and loss of market share) in influencing the benefit-cost equation in favor of mitigation. Risk screening and ranking methodologies were employed to help focus mitigation efforts to achieve maximum loss reduction. Finally, this mitigation program was tested by an actual moderate magnitude earthquake and passed with flying colors.
4. **Berkeley Unified School District.** Described here is a situation in which public pressure and questions about school building safety prompted a small school district in northern California to initiate a risk assessment study. Perceptions of earthquake risk, prior to the assessment, underestimated the actual magnitude of the vulnerability. Also discussed are the funding difficulties and political hurdles that many public agencies must face to implement their loss reduction program.
5. **California State Building Seismic Program.** This case study presents a project of the Division of the State Architect (DSA) to assess and mitigate the earthquake vulnerabilities of nearly 16,000 state-owned buildings. This study reveals how an organization with a large building inventory reviewed and effectively screened out low-risk structures, making the loss reduction effort for the high-risk ones more cost-effective and manageable.





The Success Stories:

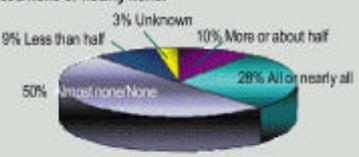
Public Leadership and Expectations

A Case Study of the Berkeley Unified School District

Public School Seismic Safety Survey

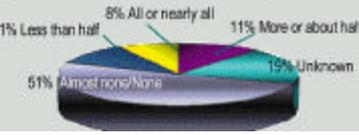
A survey reported in June 1999 by the University of California, Berkeley Graduate School of Journalism for the *Los Angeles Times* of nearly 200 public school districts in the nine Bay Area counties, as well as Los Angeles and Orange counties, revealed the following:

Structural Evaluations:
Only 28% of the surveyed districts have seismically evaluated all or some of their buildings. Nearly 50% had evaluated none or nearly none.



Evaluation Category	Percentage
All or nearly all	28%
Almost none/None	50%
Less than half	9%
Unknown	3%
More or about half	10%

Retrofits Needed:
Yet, nearly 51% of the surveyed districts believe their buildings do not need any seismic retrofitting.



Retrofit Category	Percentage
Almost none/None	51%
All or nearly all	8%
Less than half	11%
More or about half	11%
Unknown	15%

Earthquake preparedness and hazard mitigation are the most pressing daily problems for most public and private institutions in California. Public school districts are no exception. Most school administrators and teachers have many other items on their "TO DO" lists. Many also hold the popular but incorrect idea that school buildings constructed under the auspices of the California Field Act are safe by definition. In fact, school officials and parents think that earthquake preparedness consists of having water bottles and granola bars stored at school sites. Usually, they point to some bookcases or cabinets bolted to walls as evidence of a hazard mitigation program.

Without some other motivation, earthquake preparedness and hazard mitigation continue to remain a low priority. In the case of the Berkeley Unified School District (BUSD), the Loma Prieta earthquake started the seismic safety ball rolling. BUSD started its earthquake risk assessment and hazard mitigation program because parents and the school board became concerned about potential school damages in earthquakes. The BUSD story shows how the community came together to make earth

Figure 7 – Success Stories

San Francisco's Program For Seismic Safety Planning: "CAPSS – The Community Action Plan For Seismic Safety"

Following recent urban earthquakes in developed countries, San Francisco citizens and policy makers have recognized that there will be major impacts of a significant earthquake that go far beyond loss of life and structural damage. An earthquake would exacerbate current pressing social problems, including lack of affordable housing, loss of small businesses, and a fragile urban transportation system. San Francisco has initiated an integrated program of risk analysis and planning for hazard mitigation involving all stakeholders. The Community Action Plan For Seismic Safety (CAPSS) will assess building and infrastructure damage, resulting social and economic impacts, formulate post-earthquake repair standards, and define future seismic hazard mitigation programs. Topics to be explored include impacts on special needs groups (seniors, disabled, low-income), impacts on historical and cultural assets, post-earthquake housing needs, and a detailed look at earthquake impacts by neighborhood, socio-economic group, type of business or industry and other relevant categories. The final phase will identify, rank and define future seismic hazard mitigation programs.

CAPSS Phase II Activities

The CAPSS Phase II program underway includes three main tasks: Assessment, Formulation of post-earthquake repair standards, and a compilation of possible future seismic hazard mitigation programs.

Impact Assessment

- Casualties and other population impacts
- Impacts on special needs groups, including disabled, elderly, non-English speakers
- Impacts on historical and cultural assets
- Impacts on all building types, with emphasis on seismically vulnerable buildings
- Post-earthquake housing needs, including short-term, moderate and long-term effects on various populations
- Socio-economic impacts, including impacts by neighborhoods, socio-economic group, type of business or industry, including short term, moderate and long-term effects.
- Distribution and impacts of post-earthquake fires

Formulation of Earthquake Repair Requirements

The formulation of post-earthquake inspection and repair regulations requires user, owner and engineering consensus. The expected product of this work is a technical report presenting recommendations for post-earthquake damage evaluation and repair procedures and criteria, along with draft language for possible revisions to the San Francisco Building Code or other appropriate codes or regulations, revising the current rather general post-earthquake repair requirements. This work is critical in

meeting the FEMA requirements for establishing clear and uniform post-earthquake repair standards in order to qualify for FEMA funding.

Identification and Definition of Future Seismic Hazard Mitigation Programs.

Identification, ranking and definition of additional seismic hazard mitigation programs considering the results of Task 1 and Task 2 and considering the ideas proposed during the public outreach process. Example of anticipated programs include:

- a highly visible public information program aimed at homeowners to assist in identification and implementation of seismic risk reduction strategies
- development of retrofit incentives like transfer tax incentives, reduced permit fees

Community Involvement

One of the characteristics of governmental public policy development in San Francisco is the expectation of extensive community involvement. Because earthquakes in San Francisco involve many social and economic as well as physical issues, people representing interests in building, planning, economic development, historic preservation and housing will have strong opinions on measures to address earthquake risk. These interests must be involved in the development of risk reduction policy and resulting programs in order for the policies to be adopted or implemented successfully. Therefore community involvement is a critical component of CAPSS.

The San Francisco Building Inspection Commission (BIC) first considered this project at a series of public meetings in 1997 and 1998 that focused on major revisions to the San Francisco Building Code. Testimony at those hearings made it clear that any significant code changes related to earthquake safety and response required more than technical input. The BIC insisted that this work be under the aegis of a nonprofit organization that would include substantial public input in all phases of the work and that would work toward consensus in the many specific program areas. The current CAPSS Phase II project team working under ATC includes public administration experts, engineers, architects, urban economists, public involvement specialists and others.

An advisory panel of technical experts, stakeholders and city officials is overseeing CAPSS. In order to assure that the interests of the community are adequately addressed, the advisory panel also includes non-profit housing organizations, neighborhood groups and small business representatives, apartment owners, historical preservation advocates, members of the disabled community and others.

Bottom Line and Next Steps

San Francisco has known about its earthquake hazard for many years. It has access to advanced technical expertise and information. Many building owners and public agencies have the capital available to implement some level of seismic safety. But careful thought about this issue has made it clear that more specific information about likely impacts, a fuller understanding of the societal impacts, and the creation

of more carefully targeted programs to reduce those impacts are needed. This effort will be large. The Building Inspection Commission and the San Francisco Board of Supervisors have approved \$650,000 over a four-year period for Phases I and II of the CAPSS program. Upon completion of Phase III and with the adoption of seismic hazard mitigation programs, the entire CAPSS project is expected to cost the City of San Francisco over one million dollars. Then the implementation of these new risk reduction programs can begin.

**Rapid Visual Screening (RVS) for potential seismic hazards –
Update of FEMA 154**

Rapid visual screening for potential seismic hazards is an integral part of the seismic mitigation process, permitting more cost-effective risk reduction. The process was systematized in the mid-1980's with FEMA 154, Rapid Visual Screening of Buildings for Potential Seismic Hazards: a Handbook. Its widespread application, in the US and overseas demonstrated the utility of concept. It was consciously designed to have a non-arbitrary, rational, probabilistic basis, so as to permit updating, as new data became available. Fourteen years later, this basis has permitted a rational updating within the original framework, utilizing seismic damage experience, insights gained in applying the methodology in a wide variety of venues, utilization of the methodology in unforeseen ways, and new knowledge emerging from research and projects such as the USGS national seismic hazard maps and the developments associated with the HAZUS earthquake loss estimation software.

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