Examples of Successful Seismic Safety Advocacy

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INTRODUCTION

This paper has several purposes. The first is to provide tangible examples to support the guidance advice in *Promoting Seismic Safety: Guidance for Advocates*. It can be viewed as providing the "illustrations" for that document. Second, as the first such collection I am aware of, it begins to identify some common themes of seismic safety advocacy. Third, I hope that these stories will serve as an inspiration to present and future advocates.

Why were these particular eight examples selected? I used three criteria to identify candidate examples:

- Collectively, the examples needed to represent different parts of the country and various levels of seismic risk.
- Each one needed to include a successful seismic safety action. This ruled out a few advocacy efforts that did not succeed, as well as several outstanding educational programs that have not (as yet) yielded an easily identifiable action. In two examples, I emphasized the work of prominent advocates, rather than actions, because their path-breaking efforts clearly led to a variety of actions.
- Each one needed an advocate or set of advocates who clearly played crucial roles in the success of the action.

Using previous publications, personal contacts, and on-line resources, we identified a list of 25 candidate examples. After preliminary research, this list was reduced to 12 examples that most clearly met the above three criteria. Because some of them were closely related, they were eventually combined into the eight examples presented here.

These stories exhibit a number of common themes. Collectively, they support most of the advice provided in *Promoting Seismic Safety: Guidance for Advocates.* In particular, all of them show the importance of persistence (and patience) and the value of seeking partnerships. Personal contacts are crucial; all the cases illustrate the importance of building personal networks, knowing whom to call, and establishing mutual trust with others in the field. They also show the importance of post-earthquake windows of opportunity; every action owes either its origin or a boost in support to a particular earthquake event. In several of the cases, community actions for seismic safety emanate from concerns about school safety, confirming that linking these two issues can be an effective way for advocates to advance seismic safety. Finally, several of the cases demonstrate how initial efforts and seed funding provided by FEMA and USGS can catalyze substantial community actions.

In these 12 successful examples, most of the advocates are dedicated public employees who go beyond the minimum requirements of their jobs. The next most common group of advocates consists of technical professionals and academics in engineering or the earth sciences. We also identified several legislators who took their charge seriously and became passionate advocates for the importance of seismic safety (the stories include accounts of two of them leaving hospital beds to ensure the success of their efforts). Citizen advocates—promoting seismic safety purely on a voluntary basis—are identified in only two of these cases.

The report presents the eight cases in geographical order, from northeast to southwest. I hope this will help readers first to appreciate the advocacy challenges and successes in the less seismically active parts of the country before reading the progressively more successful accounts in western states, culminating with three vignettes in California.

I would like to thank my two research assistants, Chisaki Muraki and Reshmi Thecketil, for their long hours of searching the internet, locating advocates (some of whom have retired), and creating a sense of order out of mountains of material. Finally, I thank the advocates for their hard work over the years and for generously giving their time to speak to us and to review drafts of their stories. For some of them I hope it was a positive experience to see a summary of all their accomplishments, cleansed of all the obstacles they are accustomed to seeing on a daily basis.

THE EXAMPLES

One
New York City Seismic Code and Building Inventory
A seismologist and engineer spearhead the effort to create a seismic building code for New York City and to inventory vulnerable buildings in Manhattan; the effort bears fruit after the attacks on September 11, 2001.

Two
Otto W. Nuttli
A dedicated seismologist single-handedly raised awareness of the New Madrid Seismic Zone.

Three
Seismic Safety Activities In The State Of Arkansas
Dedicated and persistent state employees helped to enact legislation and promote seismic safety

Four
Seismic Safety Legislation In The State Of Missouri
A reporter interested in seismic safety and a concerned legislator made a difference.

Five
Utah: School Retrofit, Seismic Safety Commission and More
Several dedicated advocates persevered over two decades beginning in the 1970s to gain support for seismic safety.

Six
Seattle, Washington: School Safety
A determined citizen advocate and a dedicated professional improved the seismic safety of Seattle's schools and increased community awareness of the earthquake threat.

Seven
Building Rehabilitation and Seismic Code Laws in Oregon
Sustained long term efforts by Oregon Seismic Safety Policy Advisory Council, staff of the state geologic agency, and a supportive legislator lead to successful passage of two ballot measures.

Eight
Advocacy Vignettes From California
I. Karl Steinbrugge: Seismic Safety Pioneer
II. California Seismic Hazard Mapping Act: Using A Window Of Opportunity
III. City Of Berkeley: A Community Champion Acts As A Catalyst For Action

Example One

New York City Seismic Code and Building Inventory

A seismologist and engineer spearheaded the effort to create a seismic building code for New York City and to inventory vulnerable buildings in Manhattan; the effort bears fruit after the attacks on September 11, 2001.

Seismic Hazard of New York City

According to a report by the New York City Seismic Code Committee, the seismicity of the New York City area is "moderate," with earthquakes of about Modified Mercalli Intensity VII occurring every 100 years. The last damaging event, with a magnitude estimated at about 5.2, occurred in 1884. Larger earthquakes, with Intensity VIII-IX, or Magnitude 5.75 to 6.75, may also occur. The seismicity of the New York City area is similar to that of the Boston area, which was affected by an earthquake in 1755, and has had seismic design requirements since the 1970s. In addition, New York City sits on a combination of solid bedrock and soft sediments (many such areas are artificial fill or former marshes); the contrasts in stiffness between these materials can cause significant amplification of ground shaking. The soft soils are also subject to liquefaction.

According to the New York Geological Survey, earthquakes of up to magnitude 6.0-6.5 are believed to be possible anywhere in New York State, and earthquakes of up to magnitude 7.0-7.5 are believed to be possible in southeastern New York. The state has experienced 16 significant earthquakes since 1853.

Action #1: New York City Seismic Code

New York City has its own building code. Because most other cities adopt updated versions of one of the model building codes, they are able to routinely adopt the latest seismic provisions of those codes. Such is not the case in New York City, which prior to 1996 had no seismic code.

Several forces in the 1980s led to an interest in a seismic code for New York City (this account comes from a report by the New York City Seismic Zone Committee, ca. 1999, and an interview with Klaus Jacob). One important trigger was that national seismic maps, such as those in ANSI A58.1 (1982) and ATC 3-06 (1978), were beginning to identify New York City as being in a seismic hazard zone. In the early 1980s, the New York City Building Commissioner asked the New York Association of Consulting Engineers (NYACE) to review the issue. They in turn asked for advice from a group of seismologists and engineers. This committee in 1986 concluded that New York's seismic hazard warrants concern, and in June 1987 the NYACE Board unanimously recommended that New York City adopt seismic design provisions modeled after those in the Uniform Building Code (UBC).[1]

[1] This time period also included the disastrous Mexico City earthquake of 1985, as well as a M 4.0 earthquake in nearby Westchester County that was widely felt in New York City.

At the same time, what was then called the National Center for Earthquake Engineering Research (NCEER) was established at SUNY Buffalo. To initiate the work of this new Center, several workshops were held, starting in October 1987. Following an initial brainstorming workshop, NCEER funded a highly visible conference in New York City in February 1988, hosted by the New York Academy of Sciences and open to professionals and the media. This began to inform a wider audience of the seismic risk in New York City.

The increasing evidence that New York City was in UBC zone 2 (or its equivalent in other codes and standards) began to create concerns for practicing engineers, not the least of which was their liability if they ignored seismic design. In December 1988, the Armenia earthquake occurred, and NCEER held a briefing on the implications of this earthquake for New York City, which, like Armenia, had not constructed its buildings with earthquakes in mind. In February 1989, a TV reporter for the local NBC affiliate did a three-part, prime-time piece on this subject, based on interviews he had conducted with local seismologists right after the Armenia earthquake and a more recent interview with the New York City Building Commissioner. This TV coverage brought attention to the subject in general and created discomfort in the Commissioner's office in particular. In April 1989 the Commissioner appointed a Seismic Code Committee to draft the appropriate provisions. They submitted their report to the Commissioner in April 1991.

Although the technical work was completed in 1991, political resistance remained. The mayor and City Council dragged their feet on the issue, and in 1994 a Republican, Rudy Giuliani, took office. A similar process had been going on at the state level and the new Republican governor objected to a state building code, under the principle of regulatory reform. Klaus Jacob and others (more details below) decided to press the City on the issue, lest the effort wither away. Eventually, the Commissioner met again with the committee, and agreed with Giuliani to submit it to the Council. Longtime New Yorkers on the Council refused to believe that earthquakes are a threat to their city, but immigrants from South America, the Caribbean, and California, were concerned. With the support of these immigrants, the Council approved the code, the Mayor signed it in February 1995, and it took effect on February 21, 1996.

The Advocates: Klaus Jacob and Guy Nordenson

The December 11, 1995 issue of *New York Magazine* included, as its cover story, a lengthy article on "Waiting for the Big One" in New York. Over 80 people interviewed for the piece all agreed: "It's coming. They disagreed on how big, how devastating, how soon. But this, no one denies--we're going to see an earthquake. In New York City. And we're not ready for it."[2] Much of the article focuses on Klaus Jacob, a seismologist from Columbia University, stating that, "Jacob is the acknowledged leader of this tangled web of eastern seismologists, geophysicists, and engineers, many of whom have never

[2] The article also contains a prophetically wrong quote by Tom Mullen, head of the New York Police Department's Office for Emergency Management: "We had the World Trade Center [referring to the 1993 bombing]. That was our rehearsal for an earthquake."

actually been through an earthquake." Jacob's colorful, down-to-earth quotes in the article give one hint as to why he has been influential. His energy and dedication are other important qualities.

Klaus Jacob joined Columbia University as a seismologist after receiving his doctorate from the University of Frankfurt, Germany in 1968. For about twenty years he pursued scientific research on seismotectonics and engineering seismology. Since the mid-1980s, he shifted his research first to probabilistic seismic hazard assessment and site response, then to disaster loss estimation and mitigation research. Thus, over the years he gradually shifted from purely scientific concerns to issues of public policy. This evolution is now complete, as he currently is teaching at Columbia's School of International and Public Affairs on human dimensions of disasters. According to Jacob, this shift came about partly from experiences in seeing the results of disasters. But the key moment was his involvement in developing the proposal for NCEER and helping to launch the new organization. The latter is an important point for seismic safety advocacy: the creation of such earthquake institutions provide forums, credibility, and funding for the advancement of seismic safety.

Interest in earthquakes in New York actually began a few years before the advent of NCEER. The New York State Emergency Management Agency (NYSEMO) began to perform some earthquake scenarios for upper New York state. At the same time two key personnel changes brought earthquake program managers to the FEMA regional office (Bruce Swiren) and NYSEMO (Dan O'Brien). That both are still in those positions twenty years later has provided important continuity in the work of these agencies and their contacts throughout the state.

At about the same time, in the early 1980s, Klaus Jacob became chair of the NYSEMO Technical Advisory Committee. He prepared a plan for a thorough assessment of earthquake risk in New York (both the state and the city). Although the $3 million price tag was too high at the time, development of this plan was a worthwhile exercise both because it provided a vision of how to complete this important task and because many years later some funding became available.

Around the time of the formation of NCEER, Jacob became acquainted with Guy Nordenson, a consulting structural engineer who had recently moved from California. According to Nordenson, he had never felt comfortable limiting himself to the narrow technical aspects of engineering. While in graduate school in California, he was losing interest in the field until he discovered the Structural Engineers Association, a group of engineers who were concerned with the social, political, and economic aspects of their work. When he returned to the east coast from California in 1982 he carried these interests with him, hoping to eventually create a similar organization in New York. This eventually occurred (see below), but it took many years to accomplish.

Nordenson's move to New York in 1982 coincided with the new ANSI standards that increased the seismic considerations for the New York City area. Nordenson became actively involved in the NYACE's review of the issue for its implications for New York

City's building code. He eventually took the lead of the committee designated to perform the review, and he is the lead author of the 1987 final report of the "Seismology Liaison Committee" to the NYACE, entitled *Seismic Hazard Evaluation for New York City*.

As noted above, the advent of NCEER was a crucial event, according to Jacob. It provided an organizational mechanism for discussing seismic risk, facilities for meetings, and credibility for its products. Suddenly, seismic safety advocates had an institution with stature. In the words of Jacob, because they now had an orchestra they could start playing symphonies. The set of highly visible workshops in its early years provided a foundation for public consideration of seismic risk in New York City. NCEER also provided outreach services and was a source of information to the public. Jacob estimates that he gave over 20 talks to a variety of professional organizations who made speaker requests largely through NCEER. Robert Ketter, the founding director of NCEER, was astute in positioning his new organization to provide meaningful information for the region. The work by NCEER and the work by New York City engineers nicely dovetailed during the late 1980s, each reinforcing the other.

When the New York City Seismic Code Committee was formed in 1989 by the Commissioner of Buildings, Nordenson was appointed chair of the committee, and Jacob headed the Geotechnical Subcommittee. The Committee and its subcommittees put considerable effort into developing a consensus code over the next two years. Their work included reports by several subcommittees as well as a trip to see the effects of the 1989 Loma Prieta earthquake. As described above, the Committee completed its work in April 1991 and submitted it to the Commissioner of Buildings.

According to Jacob, the committee made a concerted effort from the start to involve all interested parties. They identified potential opponents (primarily from the real estate industry) and invited them to participate. This allowed the committee to address the concerns of all stakeholders. Conversely, the development industry realized that they would all benefit from safer buildings. In the end, the final product had a larger base of support, and organized opposition was reduced.

By 1994, Jacob, Nordenson, and the others had become increasingly concerned about the lack of progress in City approval of the code, which they had completed three years previously. This concern was underscored by the Northridge earthquake of January 1994, as well as by the changes in administration both in New York City and in Albany. Jacob, as a member of the seismic code committee, decided to help force the issue by visiting the new Building Commissioner. In his meeting with the Commissioner, he argued that Presidential Executive Order 12699 required all federal agencies to incorporate seismic safety measures for all federal buildings starting in 1993. This was a clear federal commitment to seismic codes. Thus, to best facilitate the possibility of federal investment in local buildings, New York would be well advised to adopt a seismic code. In addition, existence of an acceptable seismic building code would facilitate receiving federal relief funds after a disaster. This financial argument was persuasive. Shortly thereafter, the Commissioner contacted the Code Committee, met with the mayor,

and submitted the code to the City Council. As described above, the Mayor approved the new code in February 1995.[3]

Mayor Giuliani signs Local Law 17/95, New York City Building Code, 21 February 1995, flanked by Klaus Jacob on the right

According to Jacob, the initiation of the new code in 1996 went very smoothly. He attributes this to the broad awareness and support developed in the engineering community over the years (12 years since the effort first began!). The Code Committee continued to meet through 1997 to help the Building Department formulate guidelines for code implementation.

Furthermore, completion of the new seismic code (and the culmination of the work of the 31-member Seismic Code Committee) finally provided the appropriate moment for the creation of the Structural Engineers Association of New York (SEAONY) in 1996. Nordenson was a co-founder of this organization, and became its second president in 1997. Creation of this organization was later to prove to be an additional benefit to New York City.

Action #2: The New York City Area Consortium for Earthquake Loss Mitigation (NYCEM)

In about 1998, Bruce Swiren of FEMA dusted off Klaus Jacob's old proposal for earthquake risk assessment of New York. With FEMA's renewed interest in mitigation, as well as their interest in funding pilot HAZUS earthquake loss estimates, FEMA was

[3] This signing date had been set the previous December, so it had no relationship to the January 1995 Kobe earthquake. Still, the recent earthquake helped everyone to feel more confident that they were doing the right thing, and it also facilitated implementation of the code.

able to provide $250,000 to initiate a partnership of FEMA, MCEER (NCEER, renamed), NYSEMO, Columbia University, Princeton University, the New Jersey Office of Emergency Management, and other relevant organizations. With MCEER coordinating the funding to the universities, the purpose of the project was to initiate an earthquake loss estimation for the New York metropolitan area. The initial objective was to characterize risk for Manhattan below 59th Street, with parallel efforts for northern New Jersey and downstate New York. An important purpose of the partnership was to promote private-public cooperation to increase regional appreciation for preparedness and response planning.

The key research participants were:

> **Columbia University's** Lamont-Doherty Earth Observatory, led by Klaus Jacob. They used data from over 150 geotechnical borings to create a census-tract based soil map for Manhattan. **City College of New York**, led by George Mylonakis, surveyed 600 buildings in Manhattan to provide additional validation of the building inventory.
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> **Princeton University**. This team consisted of Guy Nordenson (by now a professor at Princeton, as well as principal of his own consulting firm), George Deodatis, Michael Tantala, and Amanda Kumpff. They used a combination of Department of Finance data and field surveys to create an inventory of 37,000 buildings for Manhattan.

In addition, loss estimates were performed by respective state agencies for Westchester County, New York, and parts of New Jersey.

The Consortium issued a report in 2001, held a number of workshops, and continues to maintain a website. A key purpose of creating the Consortium was to create networks and partnerships that could improve regional preparedness and communication. This investment paid off following September 11, 2001.

Application: September 11, 2001

Jacob and colleagues had presented the NYCEM findings to the City Office of Emergency Management in August 2001. According to Jacob's recollection, OEM was particularly impressed with the issue of how to clear away hundreds of millions of tons of debris. As it turns out, the briefing was held in World Trade Center #7, in the emergency operations center that was supposed to be self-sustainable for one month. One month later it was to collapse on the afternoon of September 11.

The aftermath of September 11 presented several engineering challenges. First was the need to perform rapid safety inspections of buildings. Second was the need to assist with search and rescue, demolition, and site safety. Third was the need to perform a more substantial inspection of buildings in lower Manhattan. The Structural Engineers Association of New York was just the organization for the job, post-earthquake

inspection methods were the most appropriate available tool, and the best available database was the NYCEM building inventory. The following account comes primarily from: remarks by Nordenson at a commemorative assembly at Princeton University on the first anniversary of the attack, an article from the *Princeton Weekly Bulletin* (Dienst, 2001), and an article in the November 2001 *ATC News Bulletin*.

Nordenson (whose office was one block from Ground Zero) began to contact SEAONY colleagues on the afternoon of September 11 to discuss how they could help. By Friday the 14th, they had mobilized 100 engineers to help out around the clock in small teams in various parts of the site. They were there to advise on safety, demolition and whatever else needed their expertise. When Nordenson visited the site that day, he observed that no one knew how to go about inspecting the surrounding buildings, which clearly need to be done. He realized that he had all the ingredients at his fingertips: knowledge of the ATC-20 post-earthquake inspection procedure, a database of all the buildings, and a team of qualified engineers. Within 24 hours he had approval for the work, ATC had shipped 200 copies of their field manual from California, and he spent the weekend mobilizing teams of four to five engineers and a chain of command that enabled them to start work on Monday. By Tuesday, they had completed preliminary inspection of 400 buildings, assisted by current aerial photography being taken daily. They (Princeton graduate students, experienced with the NYCEM study) then merged the results with their existing building databases in order to present the information visually to decision makers. On Wednesday the 19th the team presented preliminary results to the Department of Buildings. Most buildings were found to be safe for occupancy, but about 30 required a closer look. They prepared new, detailed checklists for these 30 buildings, and dispatched four new teams to complete the inspections on Friday. By the end of the day on Friday the 21st they had completed a full report of 415 buildings: 384 were safe for occupancy, 18 had moderate but repairable damage, nine had major damage and required restricted access, and four were partially collapsed. This work was invaluable in helping emergency personnel to focus their efforts. Teams continued to work on the site, with 16 teams alternating 12-hour shifts every three days, until January 2002.

The NYCEM effort produced other less measurable benefits as well. The partnerships provided channels of communication that were useful in the days and weeks following the attacks. The inventory and the earthquake loss estimates provided a point of reference that made it easier for officials to estimate how much financial assistance to provide to New York. And a variety of other considerations, such as the issue of debris removal, had at least been introduced to emergency management officials.

Lessons for Advocates

- Take advantage of windows of opportunity to advance the cause of seismic safety. Many such windows—often serendipitous—opened in this case: earthquakes, opportune meetings with key people, chances to present results to a key audience, chances to organize a seminar or workshop that can garner interest from relevant sources, sudden attention by the press, and so on. You need to be prepared to step in when such opportunities present themselves. September 11 presented an

opportunity to apply many of the achievements of the seismic safety efforts. It, in turn, helped to prepare New York City for other disasters (natural disasters, we hope) in the future.

- Formulate sound and well justified proposals for future action and funding, even when there is little chance for immediate support. They can be used when unforeseeable windows of opportunity open in the future.

- Earthquakes elsewhere help to boost your message. The earthquakes in Mexico City in 1985, Armenia in 1988, Loma Prieta in 1989, Northridge in 1994, and Kobe in 1995 all helped the seismic code effort.

- Personal contacts are important. In the end, it is networks of people that get things done. Jacob says that he learned that a handful of people can put their heads together and accomplish much. At many points in all his efforts, he was able to draw upon long-term relationships and acquaintances developed over the years.

- Institutions are important. NCEER provided a credible forum, a voice for seismic safety issues, and funding for a variety of seismic safety efforts. NYCEM has provided a voice for a united effort and also a mechanism for inter-agency and inter-jurisdictional communication and cooperation. (It is gratifying for FEMA and NSF to see that the seed money they invest in these institutions pays off.)

- Professional networks are important. SEAONY and NYACE provided credible sources of expertise as well as mechanisms for mobilizing technical talent for the tasks at hand. It is also important to use professional networks to build a constituency for action.

- Take the initiative to meet with key decision makers. If you don't talk to them, they won't know of the earthquake problem. If you don't talk to them about seismic safety, who will?

- Present arguments in terms the audience understands (often, this is in financial terms).

- Identify potential opponents, gain their perspective, involve them in the decisions.

- Think of connecting the needs of people, advises Nordenson. Understand their needs as well as your own needs, and find opportunities to solve their problems.

- If you are a scientist or engineer, don't be afraid to jump into the policy arena. Jacob, Nordenson, and others are all technical specialists with broader social interests. They were able to successfully mix these talents and interests over the years.

- If appropriate, you should refer to national standards and those of nearby states. It is persuasive to argue that your jurisdiction is not following widely-accepted standards. Liability issues implicitly lurk behind.

- The press can be very helpful in publicizing your cause, but use them wisely and with caution. In this case, they were very effective in gaining the attention of decision makers. Professional organizations, no matter how credible, simply do not have the same influence on the voting public as the media. But, as Jacob warns, you never know what the media reports will look like, and you always run the risk of having them misrepresent the facts.

- With regard to the media, Jacob has another tip: it helps to have consensus among professional networks before you tip off the media to a story. In other words, it is comforting to know that if the media interview 80 people the story will be quite consistent.

- Persistence and continuity pay off. It took approximately 12 years of effort to adopt the New York City seismic code. It took approximately 15 years from the initial idea of a seismic risk analysis of New York City to the inception of NYCEM; it will take many more years to complete the effort. The persistence and continued presence of Jacob, Nordenson, Swiren, O'Brien and others has enabled this progress (however slow and frustrating it has been) to occur.

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Example Two

Otto W. Nuttli

A dedicated seismologist single-handedly raised awareness of the New Madrid Seismic Zone.

The central United States is a region with a low probability of damaging earthquakes, but the consequences of an earthquake could be severe. Scientists have long known about the great 1811-1812 earthquakes in the New Madrid region, but popular knowledge of them over the years has amounted to little more than folklore. In a 1912 U.S. Geological Survey Bulletin published 100 years after these events, Myron Fuller wrote, "although scientific literature in this country and in Europe has given it a place among the great earthquake of the world, the memory of it has lapsed from the public mind." If this was true in 1912, it is certainly true today, particularly because the last major earthquake in the region occurred in 1895.

Despite these obstacles to earthquake awareness in the region, the last two to three decades have seen a resurgence in scientific and public interest in the seismicity of the New Madrid area. The U.S. Geological Survey began a series of investigations in 1973, and the Nuclear Regulatory Commission subsequently provided funding to assist in this effort. The results of this work were summarized in a 1982 U.S. Geological Survey Professional Paper. The 1977 National Earthquake Hazards Reduction Act provided further continuing funding for research and regional workshops. Efforts by FEMA and state emergency management agencies led to the creation of the Central U.S. Earthquake Preparedness Project in 1981, and that same year saw the first conference focusing on earthquakes in the central and eastern U.S. In 1984, seven states formed the Central U.S. Earthquake Consortium (CUSEC). The Tennessee Earthquake Information Center (now Center for Earthquake Research and Information) was formed at Memphis State University in 1977. And extensive research in the region is now conducted by the seven universities of the Mid-America Earthquake Center (MAEC), formed in 1997.

What made all these efforts begin in 1973 and 1974? It is no coincidence that 1973 was the year of publication of Otto Nuttli's paper, "The Mississippi Valley Earthquakes of 1811 and 1812; Intensities, Ground Motion, and Magnitudes," in the prestigious *Bulletin of the Seismological Society of America.* This paper, and related work by Nuttli, profoundly affected seismic safety awareness and preparedness activities throughout the region.

Nuttli's Research

In the early 1970s, earthquake awareness in the Central U.S. was minimal, according to a monograph by the Committee on Preparedness, Awareness, and Public Education of the 1993 National Earthquake Conference. Not only was public awareness low, but scientific knowledge had not advanced since Myron Fuller's 1912 study. The term, "New Madrid Seismic Zone," did not exist.

Otto Nuttli, a seismology professor at St. Louis University, stepped into this void. He meticulously gathered information on effects and locations of historic earthquakes in the region. By studying the observations recorded in newspapers and journals, Nuttli estimated the locations, magnitudes, and areas affected by the three largest events in the 1811-12 New Madrid earthquake sequence. He estimated that the New Madrid earthquakes over a five-month period in 1811-1812 had Richter magnitudes as high as 8.0 to 8.8 and that the magnitudes of 15 to 18 of the aftershocks ranged from 6.5 to 7.0.

He also compiled an extensive database of Central United States earthquakes that have occurred in historic time. His historic research, informed by his seismological knowledge, enabled Nuttli to make estimates of earthquake activity in the Central United States: magnitudes, general location, and average number of years of recurrence for large earthquakes. His work also clearly demonstrated that earthquakes in this part of the country affect much larger areas than earthquakes of similar magnitude in the western U.S.

Nuttli was an outstanding seismologist, and was duly recognized by his peers. He served as President of the Seismological Society of America in 1976-77 and received the Medal of that society in 1987. But his influence went beyond that of just a scientist.

Nuttli's Public Awareness Activities

Otto Nuttli took it as his personal mission to increase awareness of the earthquake threat posed by the New Madrid Seismic Zone. Although we were unable to find any records of dates and locations of his presentations—nor could we find any estimates of how many public talks he gave—everyone in this field speaks of Nuttli's tireless efforts to spread the word. Everyone who began working on Central U.S. earthquakes in the 1980s cites the publications and public presentations by Nuttli at that time. His popular monograph, "The Effects of Earthquakes in the Central United States," published by CUSEC in 1987, has been subsequently republished and is currently available via several internet booksellers. According to the Committee on Preparedness, Awareness, and Public Education of the 1993 National Earthquake Conference, "More than any other individual, he began public awareness, education, and preparedness efforts in the central United States."

Sadly, we could not speak with Dr. Nuttli, because he died in 1988, at the peak of his career. In a memorial published in the *Bulletin of the Seismological Society of America* in June 1988, his colleague Brian Mitchell wrote,

> Otto's gentleness and accessibility extended beyond his dealings with professional colleagues. He received numerous phone calls and much correspondence from residents of the St. Louis area, some of whom might have an irrational fear of an impending earthquake. Otto would always listen patiently and, if necessary, would attempt to allay their fears. He gave freely of his talents and time regardless of the station of the person with whom he was interacting.

When he passed away in 1988 Nuttli left a legacy that inspired various geologists and earthquake safety advocates throughout the country to take up the cause of seismic safety.

Nuttli's Legacy

Nuttli's research on the danger of earthquakes in the central United States not only increased awareness but also led to the establishment of various organizations. His research contributed conclusive evidence that led seven states to form CUSEC. Over the past two decades, CUSEC has held frequent conferences and workshops throughout the region, designed to help earthquake preparedness and mitigation activities by professionals in the member states. Some of their recent activities have included promoting disaster resistant communities, formation of a transportation task force and development of a New Madrid housing recovery initiative. Nuttli's work also continues through the work of the Mid America Earthquake Center, of which Saint Louis University is a charter member.

Advocates can help to inspire others to take action. Otto Nuttli has had this effect in the central U.S. Among the advocates influenced by Nuttli, two deserve mention: Jim Beavers and Corrine Whitehead.

In the 1970s Jim Beavers, while working for the Union Carbide Corporation at Oak Ridge, Tennessee, was given the responsibility of developing a project proposal for a hazardous chemical facility. For this he needed more information on the seismicity of the New Madrid area, which led him to the work of Otto Nuttli. Inspired by Nuttli, and realizing the significance of increasing understanding of New Madrid seismic hazard, he organized the first National Earthquake Conference in Oak Ridge, Tennessee in 1981. The purpose of the conference was to understand seismic safety, spread awareness, and exchange information. In 1993 he organized the 2nd National Earthquake conference, with funding from FEMA. These two conferences not only spread the knowledge about earthquake hazard in the central United States but also served as a common platform for the exchange of ideas and information between academia and the practitioners in several fields. He continues to work as an active earthquake safety advocate, most recently with the Mid-America Earthquake Center.

Corrine Whitehead, a citizen activist with the League of Women Voters in western Kentucky, was also influenced by Dr. Otto Nuttli. After reading one of his publications in 1980, she contacted the state Division of Disaster and Emergency Services (DES), whereupon she discovered that the state was totally unprepared for a major earthquake. The League then captured the attention of the director of DES, and both organizations sponsored a series of meetings in the region. The DES director at the time, Wilbur Buntin, was, by all accounts, a prime mover behind Kentucky's early earthquake preparedness efforts. He convinced the Governor to appoint a task force to examine the hazard and make recommendations. This was the forerunner of what became a permanent advisory panel in Kentucky, and it was the first such organization in the central U.S., preceding the advent of CUSEC.

These two cases illustrate how Nuttli's work led to a chain of activities by others. We are sure that there are many more examples of advocates inspired by Otto Nuttli, as well as advocates in turn inspired by them. It is rare that one individual can have such an effect, and should serve as an example for others to follow.

Lessons for Advocates

- Nuttli's research reshaped the way we think about seismic hazard in the central U.S., and as such it catalyzed policies and funding for both research and mitigation activities.

- Awareness building alone can affect public perception and public policy actions. In this case, it is because Nuttli combined scientific credibility with a clear message

- Perseverance pays off—both in research and in building public awareness.

- Scientists *can* have an effect. Nuttli combined publicly accessible research with a drive to communicate it to the public.

- His work led to the development of institutions. These, in turn, have been able to extend the efforts, maintain public awareness, increase credibility of the message, develop and promote solutions, and build off of previous successes.

- Advocates can inspire others to become advocates.

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Example Three

Seismic Safety Activities In The State Of Arkansas

Dedicated and persistent state employees helped to enact legislation and promote seismic safety

The Actions

In 1989 and 1990, the Arkansas legislature enacted two pieces of legislation, establishing a state earthquake program and requiring seismic design of public buildings:

> **Act 247 (1989)** established a State Earthquake Preparedness Program within the Office of Emergency Services (OES). It also required the full cooperation of all state and local government agencies, departments, offices and personnel to accomplish effective earthquake mitigation, preparation, response and recovery capabilities.
>
> **Act 1100 (1991)** was an act to "safeguard life, health, and property by requiring earthquake resistant design for all public structures to be constructed or remodeled within the boundaries of this state beginning September 1, 1991." The act requires that all "public structures" (buildings open to the public as well as all public works) be designed to resist seismic forces, in accordance with the minumum requirement of the latest edition of the SBC. Although the state already has a building code, Act 1100 legislatively underscores that the state requires seismic design, establishes zones more explicit than those in the SBC, and sets forth penalties for noncompliance.

These two actions were part of a larger set of seismic safety activities that both preceded their enactment and continue to the present day. We highlight these two pieces of legislation, however, because they represent successful mobilization of a coalition that persuaded both the state legislature and the governor to enact these important statements of statewide policy.

Enacting the Legislation: Two Key Players

Both of these pieces of legislation owe their success to many people who helped write and support the two bills. Furthermore, Act 1100 was successful in part because it occurred during a time period of heightened earthquake awareness, owing to the 1989 Loma Prieta earthquake and ensuing New Madrid earthquake "prediction" by self-proclaimed expert Iben Browning. Even so, two key people stand out among all the supporters as being critical to the introduction and enactment of the bills, as well as to continued seismic safety activities in Arkansas.

Dan Cicirello has run the earthquake program in Arkansas OES since 1984. As an active contributor in the field of emergency service since 1965, Cicirello was the perfect point man of the OES. His expertise in nuclear war response was useful in application to earthquakes, because both are similar in having widespread consequences. Beginning in December of 1984 he gained the assistance of a newly-formed Governor's Arkansas Earthquake Advisory Council, which was established by Governor Bill Clinton. At the

encouragement of FEMA, OES (and Cicirello) had promoted the formation of this Council and convinced the Governor of the need. It began with 17 members, eventually growing to nearly 40 by 1991 and 45 by 2002. Members consist of representatives of state agencies, utilities, universities, hospitals, local agencies, and other interested parties. Cicirello coordinates and staffs its meetings, which occur at least twice a year. It provides a forum for most of the major constituencies to get together and exchange ideas, alert one another to the latest news in the field, and boost each other's morale. It brought concerned professionals together into a network. Its large size is helpful because it provides for cross-fertilization among a variety of professions and interests. Furthermore, when they need to convince key actors about the importance of seismic mitigation, the message can come from many different sources.

The ideas for Act 247 and Act 1100 originated in the Advisory Council. Several key members were responsible for drafting Act 1100, and Dan Cicirello is the person who wrote Act 247. Without the Advisory Council, neither act would have happened. In particular, the Council developed the idea for Act 1100 several years earlier, prepared drafts of the bill, and argued for seismic codes whenever members gave public presentations. It was a long-term strategy to create both public and professional support.

Arkansas Earthquake Advisory Council
Source: Dan Cicirello

John David McFarland was the Chair of the Advisory Council at the time of these bills, and he is still Chair today. He works for the Arkansas Geological Commission, and he became involved in the Advisory Council because of his work in geological education. For many years he has spoken to civic clubs and school groups regarding geological issues in general and earthquakes in particular. When FEMA began to encourage OES to develop earthquake preparedness materials, McFarland became OES's source of information within state government. As McFarland puts it, he became Chair of the Council because he knew more about earthquakes than anyone else.

The Advisory Council agreed early on that they should place priority on a bill to improve implementation of seismic codes in Arkansas. After articulating a strategy, the members started to give talks to civic and professional groups to draw statewide attention to the

importance of seismic design. Because of the heightened earthquake concerns in 1990, they saw their window of opportunity to pass the bill. McFarland completed the final draft and moved into action.

Every bill, of course, needs a legislator to introduce and promote it. In this case, the Advisory Council had a legislator as part of their group. The Governor appointed Rep. Owen Miller to the Council when it formed in 1984. This is a common practice for state earthquake advisory councils, because it provides them with a legislative contact. Rep. Miller was an obvious choice, because he is a lifelong resident of the most seismically active part of the state, near Marked Tree. Rep. Miller had long been aware of the state's earthquake risk, and was glad to participate. Rep. Miller sponsored both Act 247 and Act 1100 in the legislature.

Act 1100 required the active involvement of McFarland, Cicirello, Miller, and others. Both bills also enjoyed the support of the Director of OES, James Lee Witt, who was able to personally meet with legislators on the floor. According to McFarland, Act 1100 required constant "baby-sitting"; he had to be ready to respond instantly to any questions from legislators. After the bill passed the legislature, and only three days before the end of the legislative session, a key group identified an objectionable clause and asked for a veto. Through personal intervention, the Advisory Council was able to save the bill. McFarland personally took the bill from the Governor's office, and Miller personally walked the amended bill all the way back through the legislature (three days after receiving triple heart bypass surgery). This was an impressive achievement.

In the end, neither bill received any negative votes. This was gratifying evidence of the broad support the Advisory Council had gained for both measures, both from the public and from key interest groups. McFarland claims to be a scientist who lacks political skills. We respectfully disagree.

Other Factors

It is true that policy change and implementation are collective efforts, and they depend on the confluence of various forces. In this case, FEMA provided the framework for facilitating Arkansas to begin an earthquake program and establish an Advisory Committee. And the Committee, in turn, was able to institutionalize seismic safety as a goal of the state and of all the interests represented on the Committee.

But other external influences were important as well. If not for the work of Otto Nuttli and the subsequent research efforts by USGS, FEMA would never have focused any attention on seismic safety in Arkansas in the first place. And, as regrettable as was the hysteria surrounding the 1990 Browning earthquake "prediction," it was this climate of earthquake concern that provided the Advisory Council with its opening to enact Act 1100. More recently, FEMA's Project Impact program has brought funding to encourage mitigation in Arkansas.

Current Activities

The work of Cicirello, McFarland, and the Council did not stop in 1991, although the Acts set important precedents to facilitate future seismic safety enactments. Cicirello is proud of his work on disaster safety in schools over the years, and this work continues. The Council's latest initiative is to develop incentives to encourage the public to build disaster resistant homes.

In addition, every two years (when the legislature meets), Cicirello and McFarland find themselves standing in front of the House and Senate to defend the Building Code from those who want to weaken it. They also must continually work on keeping officials and engineers informed regarding implementation of the seismic code.

For Act 247 and Act 1100, as well as for the continuing efforts of Rep. Richard Simmons, the Western States Seismic Policy Council in 2000 presented one of their annual awards to the Arkansas State Legislature. This award also recognized the continuing vigilance of Simmons and the Council in maintaining the effectiveness of Act 1100 in the face of constant amendment attempts. Simmons also was instrumental in writing and sponsoring legislation that appropriated $125,000/year for the Arkansas Center for Earthquake Education and Technology Transfer, housed at the University of Arkansas at Little Rock. Until recently, Simmons was the legislative member of the Advisory Council. Although he lost his legislative seat due to term limits, he remains an active member of the Advisory Council.

One More Story: Partnership in Clay County

Clay County (population about 17,000) in 1997 was the first county in Arkansas selected for FEMA's Project Impact. This was because they were seeking mitigation assistance following an ice storm and flood. With the assistance of Dan Cicirello and Rep. Simmons, County Judge Gary Howell was successful in obtaining FEMA funding and in receiving technical assistance from the University of Arkansas at Little Rock (UALR). The County received $5 million from FEMA, and the Clay County Disaster Resistant Community Council, a volunteer organization, leveraged it into a number of activities throughout the community. They emphasized earthquake safety of schools, hospitals and businesses, as well as increasing community awareness. Their work included preparing a county hazard mitigation plan (done by several groups at UALR), installing earthquake-sensitive gas valves on all school buildings, and completing a seismic engineering survey and structural seismic retrofits for the school districts.

Their enthusiasm and broad community support have made the Clay County effort a model project frequently cited by FEMA and by CUSEC as an example for other communities in the region. Its success came from the technical assistance from UALR, the State and FEMA. More importantly, it also came from the dedication of the local council and from Judge Howell, who credits his success to "a lot of chicken dinners" that he paid for at his home, in order to encourage people to join and continue participating in the effort.

Lessons for Advocates

- Educate and inspire the public. This can provide an important foundation for future efforts.
- Develop a long-term strategy, and be patient and persistent in pursuing it.
- Develop and maintain personal contacts with key individuals who can help in the long run. Seek support from the public and from important professional groups.
- Find and cultivate other advocates.
- Learn from one another in your network. The Advisory Council works as a forum for information exchange, moral support, and formulating new ideas.
- Advisory councils or commissions are highly effective ways of institutionalizing seismic safety concerns and building a constituency for seismic safety.
- Be patient, and maintain your energy and enthusiasm.
- Be prepared with drafts of programs or policies, and take advantage when windows of opportunity open up.
- Work on communication and building partnerships.

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Example Four

Seismic Safety Legislation In The State Of Missouri

A reporter interested in seismic safety and a concerned legislator made a difference.

Background

In a community with problems such as financially strapped public schools, guns in schools, drugs, and teenage pregnancy, seismic safety was not an easy sell. Yet, a St. Louis reporter was able to increase public awareness of seismic safety, and a state legislator was able to lead the enactment of two key pieces of legislation. In July 1990, the Missouri General Assembly passed the Geologic Hazard Preparedness Act (S.B. 539), which addressed seismic building codes, earthquake emergency procedures for schools, and geologic hazard assessment. In 1993, Missouri legislatively established a seismic safety commission. The bill (SB 142), signed by the Governor on June 25, 1993, created a 17-member Seismic Safety Commission, including two legislators and public members representing 15 specified professions. It is highly unlikely that these two legislative acts would have been achieved without the key efforts of William Allen and Sen. Irene Treppler.

William Allen: Science Reporter

William Allen joined the *St.Louis Post-Dispatch* in January 1989 with the assignment to cover the science beat. He wasn't any more interested in earthquakes than anyone else. Before coming to St. Louis he knew only a little about the New Madrid Seismic Zone. As a science writer at the University of Illinois news bureau in the 1980s he was familiar with basic geologic concerns in the region.

To begin his job as a local science reporter in St. Louis, he sought out area scientists. From his initial conversations, one of the issues that came to the fore was that of the earthquake risk posed by the New Madrid Seismic Zone. As a result, he began covering educational meetings held by the Central U.S. Earthquake Consortium (CUSEC) in Memphis and the earthquake center at Southeast Missouri State University in Cape Girardeau, Missouri. The speakers discussed the earthquake hazard in the New Madrid area and how an earthquake could affect people and society. As he reported on these meetings, he realized that the region was vulnerable to a threat that scientists had been warning about for years. He realized that this was both a good "news" story and an important public service story. Fortunately, he had the full support of his editors to pursue this story, and in September 1989 the Post-Dispatch published a three-part series, “Earthquake: Ready or Not,” providing an overview of the earthquake threat and its potential consequences.

These articles, as well as Allen’s newfound expertise, were, in retrospect, perfectly timed one month before the Loma Prieta earthquake, which struck the San Francisco area on October 17, 1989. According to the Director of the State Emergency Management Agency at the time, these articles primed the public to support earthquake preparedness efforts. Three days after the earthquake, Allen and colleagues produced a special report, entitled “Earthquake: Is St. Louis Ready?” According to Allen, the issue in his articles that got the

most attention was the vulnerability of St. Louis school buildings, which are largely constructed of unreinforced masonry. *Post-Dispatch* writers, including Allen, continued to follow seismic safety news over the ensuing months.

Irene Treppler: State Legislator

Irene Treppler, a Republican state senator from south St. Louis County was very much influenced by the *Post-Dispatch* articles. Sen. Treppler was born in St. Louis County and attended local public schools, so she was well aware of the traditional school construction style. Her realization that earthquake preparedness actions could prevent most of these casualties moved her to act.

At that time Missouri –similar to most other states in the central United States--lacked coordinated plans for responding to major earthquake disasters. Neither the public nor key professionals were very aware of how they could address the earthquake threat. There were no required building codes that would lessen the impact of a quake on large buildings and schools. Despite estimates that a quarter or more of the fatalities from a major daytime earthquake in the New Madrid fault zone would be school children, the state of Missouri neither required new schools to be built to withstand earthquakes nor required strengthening or surveys of older vulnerable schools.

In November 1989, Sen. Treppler initiated a proposal to require all Missouri school districts to have an earthquake emergency-procedure system for each school, and a second proposal to require that new school buildings and renovations be designed according to accepted seismic building codes to withstand damage from an earthquake. She found an ally in Larry Thomason, a Democrat from Kennett, which is in the most seismically active part of the state. They combined both proposals into one bill, and, in order to gain the support of the Missouri Municipal League, they deleted a requirement for local inspection and enforcement of seismic building codes.

Missouri's Geologic Hazard Preparedness Act (S.B. 539), was passed in May 1990, and became effective in October 1990. It requires each school district in the 47 most seismically hazardous counties to establish an earthquake emergency procedure system. This includes a school building disaster plan, an earthquake exercise to be held twice each year, protective measures, and a training program. The Act specifically requires the annual distribution to all students of materials prepared by FEMA and SEMA, addressing awareness, understanding, and specific safety measures. With regard to the issue of seismic design, each jurisdiction within these 47 counties must adopt an ordinance stating that all new buildings (all public and educational buildings, as well as all private structures larger than 10,000 square feet) must "comply with the standards for seismic design and construction" of the BOCA or UBC model building codes. This comprehensive earthquake preparedness bill was one of the most publicized and important pieces of legislation passed during the 1990 session of the legislature.

In 1991 Sen.Treppler sponsored a resolution that would allow cities, counties and school districts to sell bonds to finance the renovation of buildings to withstand earthquakes.

This constitutional amendment required approval by voters. Because of anti-tax sentiment, however, the measure was defeated at the polls.

Sen. Treppler's bill creating a seismic safety commission won passage during the 1993 session of the Missouri General Assembly. The commission is responsible for developing a comprehensive program to prepare the state for appropriate response in case of a major earthquake. According to Sen. Treppler's web page, in 1993 she received the national Otto Nuttli Earthquake Hazard Mitigation Award for her relentless efforts towards seismic safety in the State of Missouri.

These bills were major steps toward seismic safety in Missouri. The increased awareness of seismic safety in Missouri brought other benefits as well. For example, the St. Louis county emergency preparedness office and Missouri emergency management agency increased their public outreach efforts. Local hospitals and utilities increased their preparedness improved seismic designs for new buildings.

Reasons for success

Clearly, the early 1990s represented a confluence of events that encouraged seismic safety in Missouri. Longstanding efforts by the U.S. Geological Survey and FEMA began to bear fruit. CUSEC had been initiated in 1985, and news reports of the 1985 Mexico City and 1988 Armenia earthquakes had gotten attention in the New Madrid region. The Missouri Emergency Management Agency and the Missouri Division of Geology and Land Survey were increasing their efforts regarding seismic safety issues. The 1989 Loma Prieta earthquake—as well as the ensuing "prediction" of a major New Madrid earthquake in December 1990 by self-styled expert Iben Browning—greatly contributed to the climate of earthquake awareness and concern.

Even so, William Allen and Irene Treppler played critical roles.

Allen's articles caught the public's attention and made readers aware or reminded them of the earthquake threat to Missouri. His writing was authoritative (using respected sources), clearly written, engaging, and of obvious public interest (identifying the potential for injuries, death and financial loss). Furthermore, the articles appeared in the region's most authoritative news medium, the daily newspaper for the St. Louis region.

According to Allen, the key to his articles was the information he obtained over several months of listening to and interviewing scientists, earthquake preparedness officials and other experts on the issue. They provided "mentoring" by inviting Allen to earthquake preparedness meetings and other programs, showing him their field projects and labs, and generally taking the time to answer his questions. The issues are complex and multidisciplinary--science, engineering, economics, politics, law enforcement, sociology—and so it takes some effort for a journalist to attain an appropriate level of understanding. Thus, his articles required both an interested journalist and a community of seismic safety experts who were willing to actively teach him about their field.

Sen. Treppler's active role ensured the success of these bills. First, she appreciated that Allen had identified serious problems that could affect the lives of future Missouri residents. Second, she was able to identify actions that the state could feasibly take to address seismic safety. Third, she was persistent in her efforts, despite initial failures. Finally, as an experienced legislator (she was elected to the Senate in 1984, having previously served six terms in the Missouri House of Representatives), she knew how to build alliances with other legislators and how to respond to the concerns of interest groups whose support or opposition could be key to the bills' success. She also knew how to work with key officials from state agencies who could help with technical aspects of the bills.

Lessons for Advocates:

- Awareness building is an important first step.

- It is important both to find interested reporters and to actively work with them to understand the issues and possible solutions. Active involvement by seismic safety professionals can ensure both the accuracy and credibility of news reports.

- Judicious use of media can help the professional community to convey a clear message.

- Earthquakes provide windows of opportunity to advance seismic safety policy, because they gain the attention of both the public and policy makers.

- Because earthquakes are not the topmost priority, it is important to demonstrate how seismic safety addresses other community issues such as safety of school children, fiscal health of local government and long-term sustainability of the local economy. School safety is a particularly salient issue.

- Enactment of legislation requires committed and persistent legislators concerned about public safety and welfare.

- Experienced legislators know how a bill becomes law and how to build support among fellow legislators. But advocates can help by drafting appropriate language, providing technical advice, and gaining support from key groups.

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Example Five

Utah: School Retrofit, Seismic Safety Commission And More

Several dedicated advocates persevered over two decades beginning in the 1970s to gain support for seismic safety.

Seismic Hazard in Utah

According to the Utah Geological Survey, earthquakes can occur virtually anywhere in Utah, but especially in a north-south band that cuts a central swath through the state. In the northern part of Utah, the earthquake belt is roughly centered on the Wasatch fault where the Wasatch Mountains meet the desert. Since 1850, 16 earthquakes of magnitude 5.5 or greater have occurred in this seismic belt in Utah. The largest historic earthquake was a magnitude 6.6 event in Hansel Valley in 1934, which caused surface ruptures across the mudflats of Great Salt Lake. The most damaging earthquake was a 1962 magnitude 5.7 event in Richmond, that caused one million dollars (1962 dollars) in damage. The most recent damaging earthquake was a magnitude 5.8 event near St. George, that cost about $1 million in 1992 dollars, mostly from a large landslide 28 miles away in Springdale that destroyed three houses.

Utah's Wasatch fault presents the greatest earthquake hazard to the state's population because of its length and proximity to the majority of residents. More than 80% of Utah's population of two million is concentrated on or near the Wasatch fault. Over the past 6,000 years, at least 19 earthquakes large enough to rupture the ground surface have occurred on the Wasatch fault. Approximately every 350 years a large earthquake happens somewhere on the fault.

In short, geologists and seismologists know that Utah contains a region of significant earthquake hazard, and the greatest hazard is where most of the population lives. But the state's most heavily urbanized region, from Provo to Ogden, has not experienced a serious local earthquake greater than magnitude 5.5 in historic time. The last disruptive local shock was a magnitude 5.2 earthquake in the western Salt Lake Valley in 1962.

The Action: $200 Million in School Seismic Retrofit Bonds

Despite the lack of an earthquake experience in most of the community's memory—and no experience of a "Big One" in historic time—the citizens of Salt Lake City have taken two stunning actions over the past decade. In 1993, the Salt Lake City School Board of Education went to the voters and requested the passage of a $70 million bond to mitigate the condition of school buildings. The bond passed with an 81% voter approval. After it began, they decided to augment it with $50 million dollars on-going capital. The $120 million covered retrofitting two high schools, replacing the main building of one high school, replacing one high school, and mitigating non-structural life hazards in all school buildings.

The School Board then identified the need to retrofit all 27 elementary school buildings and the five middle school buildings. The total cost—including building two additional elementary schools, air conditioning all buildings, and building to seismic zone 4—was estimated at $278 million, and would require bond approval for $136 million. In May 1999 this bond issue passed with the support of 69% of the voters.

Overwhelming voter support for $200 million of debt--most of which was targeted at an earthquake that must seem very remote to the populace--demands some explanation. Part of the answer is that the School Board is highly respected and has a reputation for being fiscally responsible. Another part of the answer is that the School Board ran a very sophisticated election campaign, with the assistance of a respected polling company, and they also worked hard to gain the support of all school employees as well as every city community council and special interest group. But we think an important part of the answer lies elsewhere: in the climate of seismic safety awareness that has slowly grown over the past three decades in Utah in general and Salt Lake City in particular. And this climate is largely due to the persistent work of a small set of advocates over many years.

This climate of seismic safety awareness is further illustrated by a more recent undertaking: the $200 million renovation of the State Capitol complex in Salt Lake City. The major part of this project, which will be completed in 2008 (and also improves the heating and cooling systems), is a seismic base isolation system beneath the building.

Finally, the two generations of seismic safety commissions in Utah provide evidence of interest in seismic safety, and they also both have played important roles in contributing to that climate. The Utah Seismic Safety Advisory Council was

Utah Chronology (from Mittler, 1998)

1975	Pocatello Valley (magnitude 6.0) EQ
1976	USGS study estimated 63% chance that an earthquake exceeding or equaling magnitude 7.5 may occur in 100 years
1977	Legislature created the Utah Seismic Safety Advisory Council (USSAC), which reached its sunset date in four years (1981)
1981	FEMA funded the position of Earthquake Program Officer in DES
1982	NEHRP organized a meeting to discuss future direction of program
1983	Governor's Conference on Geological Hazards in Salt Lake City; EQ (magnitude 7.3) in Borah Peak, Idaho
1983	On NEHRP mandate, USGS initiates 3-year (extended to 5-year) program to study EQ s in Utah and to work of the implementation of EQ mitigation policies
1984	Enactment of Geologic Hazards Information Act
1989	Atwood and Arabasz present recommendations to Utah Advisory Council on Intergovernmental Relations (UACIR), legislation supported by UACIR but all failed; Loma Prieta EQ
1990	Sixth Annual Wasatch Front EQ Conference, which lead to the creation of the EQ Task Force
1991	The state, through executive action, created the Utah Earthquake Advisory Board, funded by FEMA as a one year grant to DES, prepared a draft of *Utah at Risk* that later quickened the process for the Bill/the creation of USSC
1994	Northridge EQ; Utah legislature enacted House Bill 358, establishing the Utah Seismic Safety Commission (USSC), sponsored by Rep. Ken Burningham

created by the state legislature in 1977, with a four-year sunset clause. In 1991, executive action created the Utah Earthquake Advisory Board. And the 1994 legislature created the Utah Seismic Safety Commission, which is still in existence. Both of these will be described in more detail within the following stories.

The Advocates

As with the other stories in this collection, advocates do not work alone. They work with allies and supporters, and their initial efforts owe much to the critical assistance provided by federal NEHRP agencies, such as the U.S. Geological Survey and FEMA. Even so, success requires the hard work of a few key individuals who can keep the idea alive, make it grow over the years, develop creative strategies, and take advantage of opportunities as they arise over time. We think some of the key advocates in Utah during the period we examine have been: Walter Arabasz, Genevieve Atwood, Lorayne Frank, and Lawrence Reaveley. There have been many others as well, and we apologize for not listing them all. Furthermore, they, in turn, not only depended on the work of individuals and agencies that preceded them, but also on important efforts by their staff and colleagues.

The U.S. Geological Survey (and key individuals within it) also played an important role in getting things started. In 1983, the USGS initiated the Utah Regional Earthquake Hazards Assessment Program, in conjunction with the Utah Geological Survey, as well as a variety of other governmental and university partners. This program had the conscious intent to both encourage research and to create interaction between researchers and users so as to increase the relevance and use of the research. Over a five-year period, the USGS held annual workshops. One particularly innovative part of this program was the funding, for three years, of placing geologists within the county planning staffs of five Wasatch Front counties. The October 1983 magnitude 7.3 earthquake at Borah Peak, Idaho, further helped to underscore the hazard in this part of the country.

Genevieve Atwood: Geologist, Legislator

Genevieve Atwood was always interested in geology, education, and public service. Fresh from receiving her degrees in history and geology, and after working two years for the National Academy of Sciences, she was elected to the Utah State House of Representatives in 1974 at the age of 28. She served for six years, while also working as a staff geologist at an engineering firm.

A key achievement of Atwood's time in the legislature was her sponsorship of the Seismic Safety Advisory Council Act in 1977. According to Olson and Olson's account, the act was successful for three reasons: sufficient funds were available that year, Atwood wrote in a four-year sunset clause for the Council, and many

legislators personally liked her and respected her knowledge of earthquake issues. The scene was set for this bill by the previous existence of a Governor's Committee on Geologic Hazards, and by the precedent of the California Seismic Safety Commission, but it took Atwood—an articulate and credible advocate within the legislature—to make it happen.

Unfortunately, the Council was not successful in enacting legislation before its demise four years later; and Atwood was no longer in the legislature to promote it. Atwood now calls the 4-year sunset both a blessing and a curse. It was a blessing because the agency was independent, which increased its credibility and effectiveness. But it was a curse because it had no patron to protect it. The Council did, however, make an important start in creating a network of seismic safety advocates, providing a factual basis for future actions, and providing legitimacy for promotion of seismic safety as a public policy issue in Utah. It provided an important foundation that the USGS/UGS work would build on in the 1980s.

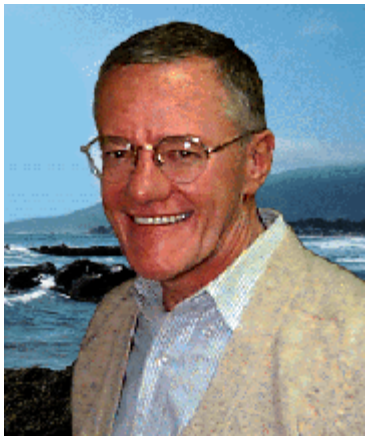
Genevieve Atwood, as it turns out, also played a key role in the efforts of the 1980s. From 1981 to 1989 she was the State Geologist and Director of the Utah Geological Survey. Thus, when the USGS came to Utah, seeking local partners, they found that the state geological agency was led by a young, energetic, policy-minded individual who was already steeped in seismic safety issues (as a result of the four years of the Council that she had created).

Atwood says she was always interested in "big issues" and was inspired by her work at the National Academy of Sciences and especially by the career of Gilbert White. Thus, from early on she was interested in the interface of science and policy. When a legislative seat came open, several people encouraged her to run. Once elected, she found herself instantly successful in the legislature, because colleagues respected her expertise. And they also trusted her personally. She took advantage of the opportunity to begin sponsoring appropriate legislation. The USGS and others concerned with geologic hazards quickly learned to come to her, because she was an inside advocate for their concerns. She believes that scientists can, and should, make a difference. And, pointing to her current position on the Board of Trustees of the Metropolitan Water District of Salt Lake, she says that one does not need to be a legislator or state geologist to use science to inform policy.

Atwood's current passion is earth science education. She creates courses and resource materials to improve the teaching of earth science. This is her way of helping to create a new generation of scientifically informed citizens.

Her advice for future advocates: a scientist who cares can be effective in many ways. Science and policy need each other, and anyone who takes the time to act can make a difference. Finally, she points out that, although one person can make a difference, organizations are also important. Since she left state government, many others have continued the work she began.

Walter Arabasz: Seismologist



Walter Arabasz is a research professor of geology and geophysics at the University of Utah, where he has worked as a seismologist since 1974 and has been director of the University's seismograph stations since 1985.

A December 2002 article in *Salt Lake Magazine* nicely summarizes his work:

> In 1996 he received the Governor's Medal for Science and Technology for his "tireless efforts to help residents and leaders understand and prepare for Utah's earthquake hazards." Tireless may be an understatement. Over the years Arabasz has fought to obtain funding to monitor and combat a threat many Utahns aren't even aware of, and which may not happen in their lifetime. He has been involved in the Utah Seismic Safety Commission since its inception in 1994, and served as Chair from 1997-2001. His dedication has paid off in ways that the general public will see only when the big quake hits the Wasatch Front.

Arabasz says that as a seismologist he gradually came to have a keen sense of responsibility to the needs of the public. As result, he became involved in policy making at both the state and national level. As the University's seismograph stations became more prominent in Utah, his involvement put him in the public view. The media frequently seeks him out as a spokesperson for seismic issues. He has used this visibility as an opportunity to inform the public of earthquake risks and what actions they can take. A 1997 article in the Salt Lake Tribune quotes a TV reporter saying that Arabasz has, with experience, developed the knack for "talking with analogies and homespun terms you could understand."

A major effort of Arabasz over the years has been to constantly work on improving seismic monitoring in Utah, including the recent successful creation of a real-time earthquake information system as part of an Advanced National Seismic System. This work is both of scientific and public importance, and it requires public policy skills to make a case for funding. The Salt Lake Tribune article describes him as being credible, savvy, calm, and determined. Rather than being an alarmist, he is a voice of reason, and this makes him effective in communicating to the public and in persuading policy makers.

Arabasz's and Atwood's stories of their initial interest in geology are remarkably similar. Neither one was aware of geology when starting college. Arabasz began as an English major, and Atwood received an undergraduate degree in history. But both were hooked when they took their first course in geology, and both have maintained that passion over the years, while successfully educating others about the significance of understanding the earth we live upon.

Arabasz attributes Utah's successes in seismic policy actions during the 1980s through the mid-1990s to the initial USGS efforts and to a partnership that was forged among Atwood, Frank, and himself as the respective heads of the Utah Geological Survey (UGS), Utah Division of Comprehensive Emergency Management (CEM), and the University of Utah Seismograph Stations (UUSS). The partnering of these three organizations continues to provide the underpinnings of Utah's state earthquake program, with key roles by Lee Allison and Gary Christenson of the UGS, Jim Tingey and Bob Carey of CEM, and Sue Nava of UUSS. Arabasz also credits the Northridge Earthquake with helping to spur the initiation of the Utah Seismic Safety Commission in 1994.

Arabasz has several words of advice for future advocates. First, they need to be patient. The process takes time, and advocates might even need an earthquake before action can occur. Second, advocates need to become knowledgeable about the political process, and then interact directly with legislators and the community. Personal contact with legislators is vital, whether at the state or federal levels. Third, successes will be small and incremental; it is always a work in progress.

Related Story: The Utah Seismic Safety Commission and a Legislative Advocate

In a paper on the Utah Seismic Safety Commission, Mittler (1998) describes the work of Arabasz and Atwood in the late 1980s, working with the legislature to obtain funding for the seismic network. Despite their lack of success, these efforts were important, because they cemented working relationships with key legislators, while also maintaining legislative awareness of seismic safety (and the 1989 Loma Prieta earthquake did not hurt, either).

At about the same time, because the USGS project has just ended, Arabasz, Atwood, and Frank were asked by the Utah Advisory Council on Intergovernmental Relations (UACIR) to prepare a prioritized list of recommendations. This resulted in six bills introduced by eight legislators in the 1990 session, but all failed. Undaunted, the UACIR established an Earthquake Task Force, whose top priority was establishing a Seismic Safety Commission. Again in 1991, all their recommended bills failed.

Arabasz, Frank, and Lee Allison (Atwood's successor at UGS) then devised an alternate strategy for the Commission. They created a Utah Earthquake Advisory Board in 1991 within the Utah Division of Emergency Services (DES). It was funded within an existing agency, with financial assistance from FEMA. The Board set out to establish a seismic safety strategy for Utah, and a subsequent legislative resolution officially recognized the body. The January 1994 Northridge Earthquake, however, changed things. Spurred on by this event, Rep. Ken Burningham proposed an independent Seismic Safety Commission, supported through the budgets of existing agencies. The bill was passed, signed by the Governor, and the commission was authorized in July 1994. Les Youd, a highly-respected geotechnical engineer from Brigham Young University, became the commission's first chair and served in that role from 1994 to 1997.

According to Mittler, Rep. Burningham was key to passage of this bill. He championed it and worked relentlessly to enact it. He had been a school teacher, and his motivation was school safety. His involvement in the failed earthquake bills of previous years meant that he had the knowledge and the contacts to quickly draft a bill that would meet with the approval of the legislature and the agencies. It succeeded because legislators were already aware of seismic safety, the Northridge earthquake created heightened concerns, and the bill was fiscally neutral.

The creation of a Seismic Safety Commission is, of course, only a first step. And, in an environment in which the legislature has a record of rejecting any new programs that cost money, it is not likely that the Commission could create any bold new initiatives at the state level. As a result, the Commission has focused more on community outreach and encouragement of voluntary activities. As with all other state seismic safety advisory bodies, even with no specific action programs, its role is vital as a continuing conscience for seismic safety within state government.

Lorayne Frank: Emergency Manager

Lorayne Frank retired from her position as Director of the Division of Comprehensive Emergency Management in 1998, after more than 34 years of state service. All the other advocates have described the key role she played. Although we were unable to contact her, we obtained a tribute written in 1998 by the DCEM Earthquake Program Manager, and we could also see in Mittler's account the key role that Frank played over the years in seismic safety policy.

Frank was the Director of CEM for over 18 years, having begun in Utah state government in the Planning Coordinator's Office. Among the many organizations she was involved in, she was Chair of the Utah Earthquake Advisory Board and the Western States Seismic Policy Council. Her commitment to seismic safety and the continuity she provided through the 1980s and 1990s were important in maintaining seismic safety as an issue in Utah.

Seismic safety is a difficult policy issue because of the infrequency of earthquakes. This is particularly true in a state with no significant damaging earthquakes in modern times. It would be easy for the director of Utah's emergency management agency to focus entirely on the more immediate issues of fires and flooding. Clearly, this is not what happened in Utah, as Frank aggressively pursued seismic safety efforts. Conversely, seismic safety as an issue would not get very far in a state whose emergency management director did not support it.

Although we could not speak to Frank to obtain her advice for advocates, her example makes clear one piece of advice: if you can gain the enthusiastic support of your emergency management director, it will be much easier for you to succeed.

Lawrence Reaveley: Structural Engineer

Reaveley is a structural engineer. He is the chair of the Department of Civil and Environmental Engineering at the University of Utah, and is the current (2003) president of the Structural Engineers Association of Utah. He originally specialized in blast dynamics, but in the mid 1970s he learned about seismic design when working on a new University of Utah hospital, along with Degenkolb Associates from California. Because this was intended to be the hospital of last resort for the region, it was important that it be able to withstand earthquakes, and so they designed it to exceed minimum code levels. According to Reaveley, the most important event in helping him and others promote seismic safety was geologist Lloyd Cluff's trenching of the Wasatch Fault in the early 1970s. This was critical, because this work showed that the fault was active. It showed that the fault has repeatedly generated large earthquakes over the years; it showed that the new seismic building codes following the 1971 San Fernando earthquake were also relevant for Utah.[4] As a result of the fault studies and of the precedent set by the hospital, interest began to grow in the area. Reaveley and others then "made it a quest" to improve seismic construction standards in the area.

One significant action was to increase the building code seismic design provisions. According to Reaveley, based on accepted California standards, the hazard posed by the Wasatch Fault is clearly equivalent to UBC zone 4. The code battle took many years, culminating in adoption of higher provisions in the IBC 2000 code.

Reaveley also credits the Salt Lake City Board of Education. Several of the elected members were very concerned about seismic safety issues, and some were design professionals. In the 1980s, for example, they designated a citizen advisory board to examine the seismic safety of schools, and he worked for them in developing a survey of school buildings.

Reaveley is proud of what they have all accomplished over the years. They have replaced all the hospitals over 25 years, as well as a lot of fire stations, city and county buildings, and school buildings. In some cases, they teamed up with the fire marshal to make their case. In some cases, they used nearby earthquakes—such as the 1983 Borah Peak earthquake, or the 1992 St. George earthquake—to illustrate the risk posed by unreinforced masonry buildings.

[4] Why did Cluff decide to trench along the Wasatch fault? According to Cluff, he had long been interested in investigating this fault while a student at the University of Utah. While working on the Hayward Fault in the San Francisco Bay area, his interest increased. He was able to convince the USGS to fund the work, through the Utah Geological Survey. The work, including air photo analysis, extended over several years. It was completed in the mid-1970s and was published in the *Bulletin of the Seismological Society of America* in 1980.

Lessons for Advocates

Utah's experience provides a variety of lessons. This abbreviated account of a very complex history only illustrates some of them:

- Individuals can make a difference.

- Scientists have the power of information, and it works. If credible scientists speak out, people will listen.

- Individual qualities are important for advocates. Some of the qualities we see in Utah's advocates are expertise, knowledge, and trustworthiness.

- For young advocates: enthusiasm can take you far. When Atwood ran for the legislature, she probably didn't realize that she was too young to accomplish what she did.

- Collaborate and "network." Collaboration and active networking can expand resources (funding, expertise), cultivate new ideas, encourage a comprehensive approach, and broaden the base of involved advocates.

- Be persistent, and understand that the process will be long.

- Become familiar with the political process and become directly involved, interacting with legislators and community members.

- Federal agencies and their funding can be critical catalysts for action.

- A lesson for federal agencies: the USGS set out to build local awareness and capacity for effective future action, and it worked. The interactive workshops between academics and professionals were crucial elements.

- Public education establishes an important foundation. Instill awareness in children and they will become adults familiar with the issues.

- Tie in seismic safety with issues of greater public interest. In Utah, concerns about school safety have been at the center of the most dramatic accomplishments in seismic safety.

- Make information easy to understand and use the media.

- Take advantage of windows of opportunity. The Borah Peak, Loma Prieta, and Northridge earthquakes all helped to increase awareness and facilitate actions.

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Example Six

Seattle, Washington: School Safety

A determined citizen advocate and a dedicated professional improved the seismic safety of Seattle's schools and increased community awareness of the earthquake threat.

Seismic Hazard in Seattle

Seattle is in a highly seismically active part of the country, adjacent to volcanoes and situated within three earthquake source zones that together yield more than one thousand earthquakes each year. Despite not having any disastrous earthquakes in historic time, Seattle has been affected by numerous damaging quakes, and recent research confirms that great earthquakes have struck the Seattle area in the past.

According to the U.S. Geological Survey website on earthquake hazards in the Pacific Northwest, western Washington can be affected by three types of earthquake sources: deep earthquakes beneath Puget Sound, shallow faults that can severely affect localized areas, and subduction zone earthquakes that can cause strong shaking across the entire region. The largest earthquakes in historic time have been deep earthquakes of M 7.1 in 1949, M 6.5 in 1965, and M 6.8 in February 2001. Fifteen deaths were attributed to the 1949 and 1965 quakes. Research in the early 1990s concluded that great subduction zone earthquakes, of magnitude 8 to 9, repeatedly occur. The most recent one was on January 26, 1700. It lowered portions of the coastline, and also caused a tsunami in Japan (which is how researchers determined the exact date). In addition, geologists have found evidence of a large (M 7+) earthquake 1100 years ago on the Seattle fault—which runs east-west right through Seattle—and this fault may also have caused other more recent earthquakes.

According to the City of Seattle's Project Impact website, "The magnitude 7.1 1949 earthquake damaged 21 schools in the Seattle School District, resulting in the temporary closure of five schools and the condemnation of three. The magnitude 6.5 1965 earthquake resulted in the closure of eight schools, including two in West Seattle that were extensively damaged. Most damage occurred to older unreinforced masonry (brick) buildings with inferior mortar." In fact, both of these earthquakes caused disproportionate damage to school buildings throughout the region. Thirty Washington schools, normally housing 10,000 students, were damaged in 1949. Two students were killed in the 1949 earthquake—at the high school in Castle Rock and at Lowell Elementary School in Tacoma. Both students were killed by bricks falling onto exitways from the exterior of the buildings. Closure of Seattle schools for spring vacation averted fatalities and severe injuries to school children from similar building damage.

The Action: Improvement of Unsafe Schools

The Seattle School District carried out a number of facility and seismic evaluations over a thirty-year period from the mid-1960s to the mid-1990s. Four noteworthy studies that incorporate seismic evaluations as a significant element include: (1) a broad 1975

Facilities Utilitization Study, (2) a 1983 *Comprehensive Survey of Educational Facilities*, (3) a 1989 *Historic Building Survey*, and (4) a 1991 report, *Structural Evaluation of Seattle Public Schools*.

The 1975 *Facilities Utilization Study* evaluated school facility needs through the year 2000. This study was triggered by concerns for seismic safety, the need to close schools due to declining enrollments, and the need to provide racial equity in the city's schools. One recommendation of the study was that the District adopt a long-range plan to upgrade all unreinforced masonry (URM) school buildings. In 1977 the Seattle School District hired a number of structural engineering firms to assess the seismic safety of district school buildings. In particular, they were concerned that URM school buildings would share deficiencies identified in a 1976 inspection requested by the principal of a URM elementary school. This led to a study of 22 URM schools (out of 97 district schools). The report, "Seismic Survey of 22 Seattle Schools," issued in November 1977 and presented to the School Board in January 1978, concluded that there were "grave risks" that even minor earthquakes or strong winds could bring material down on people or cause collapse of these buildings. The district immediately addressed hazards in 19 of the 22 schools to remove them from the "grave risk" category. Of the remaining three schools, two were closed, only in part due to seismic hazards, and one was determined not to need immediate remediation. In 1979, 10 additional schools and 53 chimneys were evaluated based on concerns raised by the 1977 survey. Upgrades to 10 of these schools and 41 masonry chimneys were completed by October 1979.

The 1983 *Comprehensive Survey of Educational Facilities* used teams of engineers to evaluate building systems in 163 school buildings located at 101 separate sites. The study gave special attention to seismic evaluation and estimated the costs to bring buildings into compliance with the Uniform Building Code. Capital Improvement Program 1 (CIP1) in 1983 funded the remodeling or replacement of 16 older schools. The *Facilities Master Plan* (Capital Improvement Program 2), completed in 1990-1991, identified facility upgrades still needed following CIP1. The CIP2 program, funded by the passage of local bond issues in 1995 and 2001 covered the retrofit or replacement of an additional 19 school buildings. Although this completed the 30-year program to mitigate URM and other school buildings, the district is still working to address concerns regarding additional buildings.

Nonstructural hazards, however, have remained as a continuing problem in school buildings. In 1988, a grant from FEMA supported preparation of a nonstructural earthquake safety guide for all schools in Washington. The facilities department of the Washington Office of the Superintendent of Public Instruction (OSPI) distributed a copy to all state facility directors. Workshops on school nonstructural earthquake hazard mitigation were held for the Washington Association of Maintenance and Operations Adminstrators (WAMOA) and for Seattle School District maintenance personnel. In January 1998, Seattle was selected by FEMA as one of seven pilot Project Impact communities nationwide. The City received $1 million, and allocated it to three programs: hazard mapping, home retrofit, and school retrofit. The inclusion of school retrofit resulted from the substantial awareness and work already directed at school

seismic safety. Seattle used the funding to update the state's non-structural hazard guide, remove overhead hazards, and train maintenance workers to identify and reduce nonstructural hazards. The updated non-structural guide is now included with the school facilities manual on the facilities webpage of the State Office of the Superintendent of Public Instruction. As of early 2003, the program had removed overhead hazards in 46 schools, retrofitted nine schools, and trained maintenance staff to inspect for hazards. According to the director of Seattle Emergency Management, retrofit saved lives in at least one third-grade classroom during the 2001 earthquake.

The Citizen Advocate

Carole Martens was concerned when she read the 1977 structural report of the Seattle schools. Her youngest child was going to attend one of the 22 URM schools. Active in PTA and school district issues since 1970, she began researching the topic, and a new career was born. She presented her findings before the school board and met with district administrators. Martens understood the strength of a united voice through large membership organizations such at PTA, the teachers unions, and other school-related groups. She persistently presented the issue of seismic safety and the inadequacy of URM school buildings before these groups, and she coordinated an effort that led the statewide PTA legislative assembly to adopt school seismic safety as a lobbying priority at the state legislature for three successive years.

As a result of this experience, Martens became an advocate for safety of the children in the public schools. As she puts it, the adult population makes the decisions, but a vulnerable population is at risk, so we need to be their voice. She became extremely knowledgeable on the topic, through her contacts with the city and school district, and through careful research at the University of Washington and U.S. Geological Survey. She says that she was always careful to obtain original source documents, so that she could be as accurate as possible in understanding and describing the risks.

In retrospect, it looks easy. The 22 schools are no longer a hazard, and many other seismic safety improvements have been made throughout the region. At the time, however, Martens and others had to work hard to explore every possible strategy toward achieving their goals. Martens became active in the PTA. She was appointed to the City of Seattle's Building Code Advisory Board. She then went to the state legislature, in Olympia (60 miles south of Seattle), and became registered as a citizen lobbyist. She was instrumental in writing a 1981 bill that would have required URM schools to be upgraded or converted to non-school use (it died in the Senate because of the costs involved). She was also instrumental in seismic safety bills in 1983, 1985, and 1986. The 1985 bill, to establish a state seismic safety commission, passed both houses of the legislature, but was vetoed by the governor. Although the governor vetoed the creation of a new commission in the governor's office, he supported its goals and helped to create a seismic safety advisory committee within the Department of Emergency Management.

In the City of Seattle, Martens was involved in many local school bond campaigns, and she took an active role in the successful 1983 CIP 1 campaign to fund school building

improvements. She recalls that one of their efforts was to distribute a flier with a picture of each school and identification of its seismic safety condition.

The seeds that Martens planted during her time working with the legislature have continued to pay off over the years. Many of the legislators and staff she worked with have since gone on to more prominent positions within the state, and they have carried their awareness of earthquakes with them. For example, in writing the seismic safety commission bill she worked with Ron Sims--at that time a legislative aide, but now the King County Executive. In Sims' current post he has promoted emergency management activities, including King County's Project Impact program and seismic retrofitting of the Harborview Medical Center, King County Medical Examiner's Office, and King County Courthouse. In 2001, he went to Washington DC to receive the Building Disaster Resistant Communities Leadership Award from the National Associations of Counties (NACo) and the Federal Emergency Management Agency.

The skills and knowledge that Martens gained led eventually to a career in seismic safety work. In 1984, she prepared a report for the Seattle Public Schools Department of Facilities Planning, entitled *Earthquake Safety of School Buildings: A Discussion of the Minimum Seismic Safety Standards for the Seattle School District*. She also prepared a 1983 report, at the request of the Superintendent, identifying alternative uses for the 22 schools. Over the years, Martens has been invited to write numerous articles on seismic safety for a variety of publications, such as "Northwest Physician" and "On Site" (an apartment owners' association newspaper). She also wrote a guest editorial in the Seattle Times in support of the February 1995 bond issue. In 1988, Martens decided that she could be more effective within state government than as an outside advocate. She was hired by the Washington Department of Emergency Management to carry out the FEMA-funded seismic safety work plan for the state. In 1990 she left state government and became a consultant in earthquake preparedness planning for schools. For nearly a decade she worked with over 50 school districts, individual private and public schools, and daycare centers. By 1998, after over 20 years of working for school earthquake safety, Martens decided it was time for other activities.

Martens is particularly proud of the thoroughness of her research and the quality of the information she provided to decision makers. She stresses that the information one provides to a legislator must be accurate, honest, and fair.

The Dedicated Professional

As Martens (and all the other advocates in our study) points out, successful advocacy depends on teamwork. Martens identifies numerous key individuals in Seattle's and Washington's seismic safety efforts, including several highly dedicated state legislators and legislative aides (Dorothy Roberts, Larry Davis, Ron Sims, Monica Wootten, Kathy Reineke), and advisors such as Peter May of the University of Washington and Patricia Bolton of the Battelle Human Affairs Research Center in Seattle. A particularly valuable person—in the school safety work, as well as many other Washington seismic safety initiatives over the years—has been Linda Noson.

For 11 years Linda Noson was a seismologist at the University of Washington. One of her duties in this public position was to provide earthquake hazard information to public agencies, the legislature, and private organizations. As she puts it, "It seemed inadequate to only address the nature of the hazard without providing some suggestions for lowering one's risk." As a result, she developed a network of seismic safety professionals and was able to connect people with others who could help them. Eventually, she became a multidisciplinary seismic safety professional herself. Since leaving the University, she has worked with engineering firms, FEMA, and on her own, preparing numerous seismic safety studies for all levels of government. Noson is the prime author of the school nonstructural hazard guide cited above (both the 1989 and 2000 editions). She also was a leader in both the school and home retrofit programs for Seattle Project Impact.

Noson is proud of her work as a "directory"—in connecting people with each other—and as one who plants seeds of earthquake preparedness in many organizations. Rather than simply deliver publications or programs to agencies, Noson sees her goal as one of institutionalizing programs and developing self-sufficiency. For example, the school nonstructural program was purposely tied to existing programs in maintenance and facility planning, and the 1988 manual was designed to be consistent with the format of the State Facilities Safer Schools manual. The initial contacts developed for the 1988 edition of the manual were what made the Project Impact funding and the 2000 edition of the manual possible. The school program's sustainability in the long term depends on its being integrated with other existing activities. For example, as part of Project Impact, the district's logistics department has helped institutionalize a nonstructural mitigation program that involves district staff and parent and student volunteers.

Development of the home retrofit program involved creating partnerships with many members of the residential construction community. These included the Seattle Department of Design, Construction and Land Use (the institutional home of the program), representatives of the Washington Association of Building Officials, two other local building departments, the International Conference of Building Officials, a retrofit contractor, a structural engineer, a FEMA representative, and a Bank of America home loan officer. The program now includes prescriptive instructions for retrofitting a single family residence and training programs for contractors, building officials, and homeowners. Noson credits the success of the program to all the enthusiastic professionals and volunteers involved in it, but she helped to ensure its success by making sure that it involved a wide range of participants so that everyone sees the final products as their own.

In both the school and home retrofit programs, Noson made sure to involve organizations that reach beyond Seattle. This would help to facilitate the spread of the programs over time. In fact, many school districts have asked the Seattle school district for assistance in establishing similar programs, and the home retrofit program is now a regional program, serving 19 local jurisdictions in Washington.

Noson continues to be involved in coalition building efforts in the region. She has been one of several key members of the Cascadia Region Earthquake Workgroup (CREW), a

nonprofit organization of public and private partners seeking to promote seismic safety throughout the Pacific Northwest. This organization, through local forums and conferences, has catalyzed new partnerships and specific projects to reduce seismic risks in the region.

As good coalition builders, Noson and Martens have crossed paths and worked together many times in the past. They met in the late 1970s when Martens first sought seismic information from the University of Washington. Noson, with two children in the Seattle School District at the time, was interested in supporting Martens' efforts. A few years later when Noson received funding to pilot test an earthquake education project, she hired Martens to help. They also worked together in developing the seismic safety commission legislation, as well as other projects.

As is true in all the other stories in this collection, many people play important roles in furthering seismic safety in the region. I would be remiss in not recognizing the efforts of Craig Weaver and Brian Atwater of the U.S. Geological Survey, Chris Jonientz-Trisler of FEMA, Jim Mullen of Seattle Emergency Management, Ed Heller and Teresa Salmon of the Seattle Public Schools, several structural engineers (e.g. Todd Perbix and Ben Emam), Roger Farris of the Phinney Neighborhood Association, and many other dedicated professionals in the Seattle area. Martens and Noson, however, stand out as long-term advocates, who, often on their own time, have taken extra efforts to advance the cause of seismic safety.

Lessons for Advocates

- Perseverance is important. Contact as many different people as possible, and be patient. As Martens says, "If five people say no, maybe the sixth will say yes."

- If you cannot make progress in one venue, consider switching to another. In the early 1980s, Martens was able to achieve some successes in Seattle that she could not achieve at the state level.

- Awareness building takes time, but it will eventually pay off. It is important to persistently keep the issue on the public agenda. In the case of the Seattle area, groundwork laid in the 1980s has resulted in broad coalitions of seismic safety interest in the current decade. Furthermore, initial efforts can attract funding and lead to expanded future efforts, as exemplified by the school nonstructural program.

- Partnerships and networks are critical to success. The more active participants, the better. They bring important perspectives to the effort, broaden the ownership of the activities, and make success more likely. Take advantage of existing networks.

- Advocates can initiate actions, but institutions sustain them. Seek appropriate partners with adequate institutional capacities to keep efforts going. Noson and others took this approach with the school and home retrofit programs in order to ensure their success and long term sustainability.

- Integrate seismic safety with existing programs. Look for opportunities to use existing programs and local leaders. According to Noson, those with existing responsibilities, such as school and hospital personnel, are most likely to have an interest in mitigation and preparedness actions.

- If you seek to influence state legislation, it is important to establish relationships with legislators and their staff. You can help them by drafting the legislation; they depend on knowledgeable people to draft legislation in areas they support. Martens reports that several supportive legislators went out of their way to provide her with assistance and even with working space. They, in turn, learned to trust her and the information she provided. Personal relationships are important.

- Seismic safety is accomplished in many ways: school district budgeting, local elections, state legislation, volunteer efforts, federal grants, implementation of local programs, building codes, and others.

- When earthquakes are not the topmost priority, demonstrate how it addresses other community issues. Public concern with school safety is an excellent place to begin creating interest in seismic safety in a community.

- The Seattle experience in the late 1970s and early 1980s shows that one can advance seismic safety even without having a big earthquake. On the other hand, it was the school experiences in the 1949 and 1965 earthquakes—coupled with increased nationwide seismic safety efforts following the 1971 San Fernando earthquake--that eventually led to the school retrofit program. And the 2001 earthquake helped to boost current efforts in Seattle.

- Although partnerships are important, dedicated individuals can make a difference.

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Example Seven

Building Rehabilitation And Seismic Code Laws In Oregon

Sustained long term efforts by Oregon Seismic Safety Policy Advisory Council, staff of the state geologic agency, and a supportive legislator lead to successful passage of two ballot measures.

Seismic Hazard in Oregon

According to the Oregon Department of Geology and Mineral Industries (DOGAMI), earthquakes from three different sources threaten communities in Oregon: crustal, subduction zone and intraplate. Oregon's location at the boundary between two great tectonic plates creates a variety of types of seismic hazards (as well as tsunami and volcanic hazards). The most common are crustal earthquakes, which are shallow earthquakes within the earth's crust. The two largest earthquakes in recent years in Oregon, the Scotts Mills (magnitude 5.6), and Klamath Falls (magnitude 5.9 and magnitude 6.0) earthquakes of 1993 were crustal earthquakes. Oregon can also be affected by great subduction zone earthquakes, where the Pacific Ocean tectonic plate dips beneath the continental plate. Some of the most powerful earthquakes ever recorded occur in such zones around the world, such as the1960 Chilean and the 1964 Great Alaska earthquakes. Recent studies suggest that such events occur about once every 600 years on average in the Pacific Northwest; the last one was in 1700. Deeper intraplate earthquakes occur within the remains of the ocean floor being subducted beneath North America.

DOGAMI estimates losses from a magnitude 8.5 subduction zone earthquake would destroy over 30,000 buildings, and cause at least 8,000 casualties and $12 billion in economic damage. Alternatively, shaking levels expected to occur once every 500 years in Oregon, would destroy over 80,000 buildings, and cause over 25,000 casualties and $31 billion in economic damage.

As with most of the other states highlighted in our study, Oregon has not had a serious earthquake in modern times. Two of the largest earthquakes in recent memory both occurred in 1993: the magnitude 5.6 Scotts Mills earthquake caused $30 million in damage and the magnitude 5.9 and 6.0 Klamath Falls earthquakes caused $10 million in damage.

The Action: State Ballot Measures for Seismic Rehabilitation of Buildings

The November 5, 2002 Oregon General Election ballot contained two measures regarding seismic rehabilitation of public buildings. Measure 15 was to allow the state to issue general obligation bonds for seismic rehabilitation of public education buildings. "Public education buildings" includes state universities, community colleges, and local public schools. The bonds could fund both evaluation of the need for rehabilitation as well as the rehabilitation itself. The measure was written to amend the state constitution, which forbids the legislature from loaning the state's credit in excess of $50,000. Measure 15 identified a variety of sources of repayment, and it limited the total amount of debt to

one-fifth of one percent of the real market value of all property in the state. Measure 16 was identical to Measure 15, except that it applied to emergency service buildings—primarily fire stations, police stations, and hospitals.

Both measures enjoyed strong support from a variety of interest groups. Measure 15 included a statement of support from the presidents of seven major universities as well as the chancellor of the Oregon University System. It also included statements by representatives of the Structural Engineers Association of Oregon, Oregon State Building and Construction Trades Council, American Council of Engineering Companies of Oregon, and Associated General Contractors Oregon-Columbia Chapter. Similarly, Measure 16 included statements of support from the Oregon State Fire Fighters Council, Oregon Fire Chiefs' Association, Oregon Fire District Directors Association, and the Oregon Association of Hospitals and Health Systems.

Both measures passed, with nearly 56% of 1.2 million voters supporting each measure. Seventeen of Oregon's 36 counties had majorities in support of Measure 15. The counties that supported it tended to be the larger urban areas; in the two largest counties, Multnomah and Washington, over 63% of voters supported the measure. Support for Measure 16 was virtually the same as for Measure 15.

Both measures built directly off of previous legislative efforts. In 2001, the Oregon legislature passed and the Governor signed the following three bills (summarized from bill texts provided on the Oregon legislature's website):

> **SB 13** requires state and local agencies and employers with 250 or more full time employees to conduct earthquake drills. The administrative rules went into effect in April 2002. The drills are to consist of "drop, cover, and hold" and evacuation actions. (passed Senate 29-1 and House 36-8).
>
> **SB 14** directs the State Board of Education and State Board of Higher Education to provide for seismic safety surveys (using FEMA's rapid visual screening method, FEMA-154) of buildings with a capacity of at least 250 people that are routinely used for student activities. Second, it provides for further evaluation of buildings, as appropriate, using FEMA-310. Third, it directs the appropriate educational board to develop a plan for seismic rehabilitation for any buildings found "to pose an undue risk to life safety during a seismic event." It further specifies that boards should rank the relative benefit of such projects "in comparison with other life safety and code requirement projects." Finally, it requires completion of all these actions by January 1, 2032, "subject to availability of funding."
>
> The latter point is key. No funding was provided in SB 14. The initial surveys were conditioned on "the provision of funding by the State Department of Geology and Mineral Industries from gifts, grants, and donations made available" for carrying them out, and the more detailed surveys and rehabilitation work was conditioned "only if the Legislative Assembly provides the funding pursuant to a

grant of bonding authority approved by the people at the first general election held throughout the state on or after January 1, 2002." The act appropriated a placeholder amount of $1 to the Department of Geology and Mineral Industries to carry out the act. (passed Senate 23-4 and House 45-1).

SB 15 was similar to SB 14, except that it applied to hospital buildings, fire stations, and law enforcement facilities. (passed Senate 23-5 and House 46-12).

Senate Joint Resolution 21 proposed a constitutional amendment to allow for the issuance of bonds to pay for seismic rehabilitation of educational buildings, subject to voter approval at the next general election. This was a necessary step toward being able to fund SB 14. This resolution was the language that was later approved by the voters as Measure 15.

Senate Joint Resolution 22 proposed a constitutional amendment to allow for the issuance of bonds to pay for seismic rehabilitation of hospitals, law enforcement, and fire facilties, subject to voter approval at the next general election. This was a necessary step toward being able to fund SB 15. This resolution was the language that was later approved by the voters as Measure 16.

Thus, Measures 15 and 16 were the direct result of two pairs of legislative actions the previous year—one establishing the approach to accomplishing seismic rehabilitation of critical facilities, and the second providing a funding mechanism, subject to voter approval.

The next step will be to implement these measures. Both measures enable the issuance of bonds, but neither one requires any action. The state will still need to establish priorities regarding issuance of bonds and allocation of funds throughout the state. Furthermore, the state must first pay for the necessary surveys. So it may still be some time before seismic rehabilitation actually occurs.

Even though the job is far from complete, legislative and voter approval of these measures is a major accomplishment. First, the legislature has made a significant step by officially recognizing that a seismic risk exists in Oregon and that critical facilities deserve priority attention. Second, SB 14 and SB 15 lay out a logical approach toward implementing seismic rehabilitation, including initial surveys, evaluation, and priority setting. Third, and most significantly, the state's voters are now on record as recognizing the seismic risk to critical facilities and authorizing the state to issue bonds to improve the seismic safety of those facilities.

How did this remarkable set of events in 2001 and 2002 come to be? It represents the culmination of many years of work by a number of dedicated people, focused primarily around the Oregon Seismic Safety Policy Advisory Council (OSSPAC) and the Department of Geology and Mineral Industries. Although many individuals played key roles—such as Chris Thompson (a structural engineer member of OSSPAC) and Mark Darienzo of Oregon Emergency Management—two people stand out for their work in bringing these legislative acts and ballot measures to completion: Yumei Wang, who was

instrumental in both OSSPAC and DOGAMI, and Senator Peter Courtney, who sponsored and promoted the bills. The following account describes the important work of these organizations, and then focuses on the roles played by Wang and Courtney.

Legislative Incubator: Oregon Seismic Safety Policy Advisory Council

The 1989 Loma Prieta Earthquake in Northern California increased concerns about seismic safety in Oregon. Furthermore, during the late 1980s and early 1990s, work by Brian Atwater and others at the U.S. Geological Survey had uncovered evidence of large earthquakes along the coast of Washington and Oregon (see Rogers and others, 1996). As a result, in 1991, Senate Bill 96 created the Oregon Seismic Safety Policy Advisory Commission (OSSPAC), with the mission of reducing exposure to earthquake hazards "through planning, public information, research, mitigation of hazard, and preparation for response and recovery."[5] It consists of 18 members, half representing relevant state agencies and half representing a variety of stakeholder groups, including the legislature, local government, utilities, and the building industry. The legislation specifically charges OSSPAC with advising the Governor and legislature and with preparing legislative proposals. The legislation further states that OSSPAC is to use existing agencies to achieve its goals, with support services provided primarily by the Office of Emergency Management. "Emphasis shall be on coordination and linking of existing resources and authorities." Over the years, DOGAMI has proven to be a key resource in supporting the work of OSSPAC.

Over the past decade, OSSPAC has provided a forum for policy review and for sharing of information among stakeholders. Local and state agencies have pursued a number of seismic safety efforts during this time period (described below), and OSSPAC has provided a mechanism for sharing stakeholder knowledge and perspectives while attempting to develop viable policy directions for the future.

Seismic Safety Activities in Oregon: New Buildings, Existing Buildings, Loss Estimates

Oregon has seen a variety of seismic safety efforts throughout the 1990s, at the state and local levels. This has included strengthening of highway bridges, local school buildings, and selected public and private buildings. The Scotts Mills earthquake of 1993 damaged the State Capitol building in Salem, requiring legislators to meet elsewhere while the building was repaired. This event, reinforced by the 1993 earthquake in Klamath Falls, ensured that seismic safety remained on the minds of legislators. In particular, two areas of emphasis have been: improving building codes for new buildings and developing strategies for improving the safety of existing buildings.

The State of Oregon had no statewide building code until 1974, when it adopted the Uniform Building Code (UBC), with the entire state in seismic zone 2 (this account comes primarily from Miller, 2003, and from the Seismic Rehabilitation Task Force,

[5] The same bill also required schools to hold earthquake safety drills.

1996). In 1990, the State adopted the 1988 UBC, which changed the state's seismic zone from 2 to 2b. Over the following decade Oregon dramatically increased seismic code requirements for new buildings. In 1993, the State adopted the new 1991 UBC, which had Zone 2b east of the Cascade mountains, and Zone 3 to the west. This put Portland in Zone 3, which increased seismic design loads by 50 percent over the previous code. In 1998, the State adopted the 1997 UBC with an increase to Zone 4—the same high hazard designation used in coastal California—on the southern Oregon coast. The structural engineering committee of the Oregon State Building Codes Division held public meetings in 12 communities along the south coast prior to making this change, and found that stakeholders in these communities were firmly in support of the new zone. Soon, under the new International Building Code, the north coast will effectively be under Zone 4 as well. Thus, in 30 years, Oregon has gone from having no seismic building code to having substantial parts of the state subject to the most stringent seismic requirements for new buildings.

In 1993, the City of Portland established a Task Force on Seismic Strengthening of Existing Buildings (this account comes primarily from the Seismic Rehabilitation Task Force, 1996). Following their recommendations, the state legislature in 1995 passed SB 1057[6], which established a state Seismic Rehabilitation Task Force, with the charge of making recommendations to the legislature by September 30, 1996. The 15-member task force, led by Chair Paul Lorenzini completed an impressive task. Over a 9-month period, they held 27 meetings in Salem and Portland, plus town hall meetings in Klamath Falls, Eugene, and Newport. They reviewed an extensive list of documents, listened to 14 invited presentations, and received comments from over 70 individuals and organizations. The product was a report that carefully laid out a systematic program that defines priority buildings (according to structure type and building use) and establishes specific, feasible timelines for implementing them. It includes cost estimates and proposes specific incentives to achieve the goals of the program. Based on these recommendations, DOGAMI introduced HB 2139 in the 1997 legislature on behalf of the Task Force, but the bill did not pass. The following year, OSSPAC held hearings to try to determine new legislative priorities for seismic safety.

In 1998, DOGAMI conducted the first statewide earthquake loss estimation study in the nation, using FEMA's HAZUS software. This resulted in a summary publication for wide public use (Wang and Clark, 1999). Some parts of the state also performed more detailed local studies. For example, Portland State University conducted a loss estimate for Portland Metro, and it included an inventory of 50,000 buildings. The Oregon Institute of Technology conducted an ATC-21 survey of 1,000 buildings in Klamath County, and DOGAMI performed a HAZUS analysis. The DOGAMI statewide HAZUS study gained considerable attention throughout Oregon, and led to a number of actions by state and local agencies (Wang, Hasenberg, and Rad, 2002). One result is that several state agencies in 2001 and 2002 conducted rapid visual surveys of all their buildings with replacement values exceeding $1 million: about 400 buildings in all. This is an important first step toward identifying mitigation priorities.

[6] The 1995 legislature also introduced 13 other bills related to earthquakes and tsunamis. One bill added four members to OSSPAC, and another provided tax credits for seismic rehabilitation of historic properties.

THE ADVOCATE AND THE LEGISLATOR

DOGAMI is an independent state agency. According to its website, "It has evolved from its early focus on mining to become Oregon's major source of information to help Oregonians understand and prepare for the vast array of natural hazards that accompany the state's spectacular geology." In addition, DOGAMI has a mandate to actively reach out to potential users of the information, which means that DOGAMI is not just a scientific agency, but is also engaged in public education, advocacy, and coalition-building. Over the past decade, DOGAMI has worked at achieving a long-term goal to inventory and evaluate earthquake risks in the state. This includes geologic hazard mapping, ATC-21 building surveys, and HAZUS loss estimates. By strategically pursuing partnerships throughout the state, DOGAMI has leveraged its resources and made remarkable progress toward this goal.

Yumei Wang, Geotechnical Engineer and Geohazards Team Leader for DOGAMI, has played a key role in this work since the early 1990s. In addition to her geotechnical skills, Wang has also pursued policy interests. She was appointed to OSSPAC in 1999, and served as Chair in 2000. She also spent one year as an ASCE Congressional Fellow, serving on the staff of Senator Edward Kennedy of Massachusetts beginning in September 2000.

Wang's educational background is in geology and geotechnical engineering, and she was working as a geotechnical engineer in San Francisco[7] when DOGAMI advertised in 1994 for an earthquake engineering position. Although this involved a pay cut, Wang was intrigued by the possibilities of research, publishing, and working with the media. In addition, she says that she always found earthquakes to be the most exciting part of geotechnical engineering.

After several years of publishing maps, Wang began to ask how to best increase public *use* of the maps. More fundamentally, she realized that the larger question involved how to best advance seismic safety. She saw the public policy arena as an important way to achieve this goal. Her subsequent work for OSSPAC and as a Congressional Fellow has shown her that individuals can successfully affect policy. "It's not that hard," she says.

More recently, Wang had the opportunity in 2003 to join a post-earthquake reconnaissance of the devastating earthquake in northern Algeria. She says that seeing the actual effects of an earthquake on people's lives has given her renewed energy to make Oregon a safer place to live.

Senator Peter Courtney was elected to the Oregon State Senate after having served for seven terms as a state representative (where he was the House Democratic leader), representing the Salem area. In 2003 he was unanimously voted to be the President of the Senate. Courtney had no knowledge of earthquakes prior to his appointment to OSSPAC. He grew up in the East, went to the University of Rhode Island and Boston

[7] She was working at PG&E for Lloyd Cluff, who also appears as a key player in the Utah seismic safety advocacy story.

University, and moved to Oregon in 1969. His background is in political science and law, with little physical science education.

The Governor appointed Courtney to OSSPAC, as the legislative representative, in 2000. According to Courtney, he has no idea why this happened. He is a generalist, with primary interests in children and corrections, and he had no previous experience in any topics related to seismic safety.

When Wang became Chair of OSSPAC, she began by contacting all the members. She visited Courtney and talked to him about earthquake hazards. As his understanding of the risk increased, so did his interest, and he began to attend OSSPAC meetings. The statewide HAZUS study was influential in explaining the risk to him in human and economic terms. And, in fact, Courtney did know something about earthquakes, as he had had first-hand experience with one in 1993. He felt the earthquake at his home in Salem, he could not meet in the Capitol while it was undergoing repair, and he saw the church he was married in damaged and closed.

Sen. Peter Courtney and Yumei Wang

Photo: Robert Olshansky

OSSPAC developed the bills in 2000, after many meetings with stakeholders and key agencies. Wang called Courtney every few days about the bills, because she felt that he was a well-known legislator who was in a position to make change. He agreed to the concept of the bills and eventually agreed to sponsor them. They decided to go with a set of three bills and two joint resolutions rather than a single bill. They discussed each bill with stakeholders, such as organizations of hospitals and higher education.

Courtney took his mission seriously. Once committed to the bills, he was committed to getting them through the legislature and the election. He became "the quake kid" of the Oregon legislature, as he tried to convince others of the importance of the bills. He explained the purpose of the bills to his colleagues, and the many stakeholders who testified in support of the bill were also persuasive. Courtney says that he carefully wrote the ballot measures in simple terms so that anyone could understand them.[8] He was not optimistic, however, about the chances of the voters approving the ballot measures. The November 2002 ballot was long, and, although the measures had no opposition, neither did they have any visible constituency. Seismic rehabilitation is technical, and not a high-profile issue. Furthermore, because he was in his own brutal campaign for re-

[8] Courtney says he always tried to use the work, "quake," rather than "seismic." The latter term sounded too frighteningly technical to most people. But somehow the ballot measures said "seismic rehabilitation," and he missed the deadline for changing the words. He was worried that this simple error would doom the measures to failure.

election, he was not able to campaign for the two measures. In addition, he was hospitalized with a serious case of appendicitis the week before the election. In the end, Courtney won his re-election with 55% of the vote, and both ballot measures passed. Courtney still does not know how the measures passed; voters turned down other measures that addressed much more immediate issues. It would be helpful to readers of this case if we could pass on words of wisdom to help others pass similar measures in their states or municipalities, but we cannot quite do that. Still, it is clear that several aspects were helpful:

- DOGAMI, OSSPAC, Metro, and other agencies had successfully increased earthquake awareness among the state's population;
- The 1993 earthquakes and the 2001 Nisqually, Washington earthquake helped to increase seismic awareness;
- Through OSSPAC and through the legislative process, stakeholder groups had the opportunity to review and comment on the bills, which ensured that the legislation had no formal opposition.
- The ballot measures contained strong statements of support by respected and credible sources, with no written opposition.
- The ballot measures clearly stated that they would not raise taxes.

Courtney's mission is still not quite complete. The Ways and Means Committee must first appropriate $1.2 million to do the initial studies before the state can issue the bonds. And Oregon's budget is very tight this year, affecting many essential services. So it will still take some time. But, as Courtney notes, these five pieces of legislation are remarkable. He thought it could not be done, especially in a budget crisis. Although the job is not yet complete, these measures demonstrate public commitment to seismic safety.

Lessons for Advocates

- The scientific foundation is a critical first step, and people will pay attention if it is communicated clearly. The U.S. Geological Survey played a key initial role, not only in identifying and documenting the seismicity of the area, but also in describing it in understandable ways to public audiences.

- Advocates can develop concern for seismic safety even in the absence of major earthquakes.

- But earthquakes help. The 1993 earthquakes gained the attention of the state in general and legislators in particular. When an earthquake damages the State Capitol, legislators are ready to listen.

- The message must be clear, relevant, and repeated. It is important to personalize the issue for the intended audience. Organizations in Oregon have worked hard to describe earthquake risk in terms stakeholders can understand, using maps, lists of buildings dollar losses, and casualties.

- Seismic safety needs to be expressed in plain English. Both Courtney and Wang emphasized this advice. For example, they used the term, "quakes," rather than "seismic safety."

- State-local partnerships help to expand the constituency for seismic safety. Several Oregon localities have performed their own seismic risk studies, with state assistance. This gives them ownership of the results, and enables them to become more effective advocates and supporters of seismic safety.

- Seismic safety advisory bodies are valuable mechanisms for creating and furthering policy. Over the years, OSSPAC represented a continuing forum for seismic safety, in which agencies and experts could trade knowledge and ideas, and stakeholders could express their concerns. The legislative and ballot achievements could not have happened without such a body.

- Legislative action requires teamwork. In this case, an astute state official, an experienced legislator, and a group of dedicated commission members were able to develop and advance the legislation.

- Stakeholders need to be on board before the bill is introduced. Stakeholder participation ensures stronger bills. And it minimizes opposition—in this case, by the time the bills reached the legislature they had no organized opposition.

- Enacting legislation requires an experienced legislator. Courtney knows the mechanics of turning a bill into a law, and he knows the other legislators. He carefully wrote the bills with the legislative counsel, found an appropriate committee for them, and arranged for stakeholders to testify.

- Legislators are human, and they need the support of advocates. Courtney needed the constant positive feedback that Wang provided in order to keep him enthusiastic about the issue.

- Adoption of legislation is not the end. Policy making continues through implementation. In this case, the legislation was the first step, the ballot measures the second step, and more steps exist ahead. In fact, these steps have already begun. OSSPAC is working on a general obligation bond for $50 million, and Wang is working on mobilizing support for it in the next legislative session in 2005.

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Example Eight
Advocacy Vignettes From California

California, because of its unfortunate position as the nation's leader in damaging earthquakes, has long been a leader in seismic safety. Virtually all the nation's seismic safety innovations began in California, including the 1933 Field Act for seismic safety of public schools, development of modern seismic building codes from the 1950s through the 1970s, the 1972 Alquist-Priolo Act that prohibited construction atop active faults, the 1972 Hospital Seismic Safety Act, the 1975 advent of the Seismic Safety Commission, and the 1986 Unreinforced Masonry Building Law that required all jurisdictions to develop programs to minimize earthquake losses from URM buildings.

The various laws and initiatives are so numerous and the evolution of policies so inter-related, that an entire book could be written about them. Indeed, at least one such book exists: *Science, Risk, and the Politics of Hazard Mitigation*, by Carl-Henry Geschwind (Johns Hopkins Press, 2001). Many advocates have played important roles, they have gained the support of legislative champions, and seismic safety actions have enjoyed widespread support in many communities. [9]

Despite the institutionalization of seismic safety in California, it did not occur (and is not occurring) by itself. Innovative organizations and energetic individuals took important actions at key moments in history. And, because California is still not earthquake-safe, there continues to be need for more advocates to advance the cause. This section presents three such examples: the key role played by an early seismic safety pioneer, the Seismic Safety Commission's effective use of a window of opportunity, and the crucial role of a local city council member in initiating a wave of seismic safety activities in Berkeley.

I. KARL STEINBRUGGE: SEISMIC SAFETY PIONEER

Karl Steinbrugge was a structural engineer and Professor of Structural Design at the Department of Architecture at the University of California at Berkeley from 1950 until his retirement in 1978. He also was Manager of the Earthquake Department of the Pacific Fire Rating Bureau in San Francisco (now the Insurance Services Office). The following account comes primarily from obituaries written by Lagorio and Bertero (2001) and Lagorio and Olson (2002), as well as from Steinbrugge (1968) and Geschwind (2001).

His greatest scientific contribution was his investigation of the effects of earthquakes on structures. His estimates of earthquake losses on different types of buildings are still widely used. After the Kern County earthquake in 1952, Steinbrugge conducted a careful inspection of the damage that occurred, and then meticulously documented and catalogued his photographs and slides. This was the beginning of a collection of photos

[9] There is even an organization—The California Earthquake Safety Foundation—that annually presents the Alquist Medal for Achievements in Seismic Safety to long-time seismic safety advocates. It is named after Alfred Alquist, one of the most significant legislative champions for seismic safety and a long-time member (and legislative author) of the Seismic Safety Commission.

of the effects of earthquakes all over the world, from 1952 through 1989. He used the collection for his own teaching, research, and consulting, and eventually it became a resource for others to use. In 1992 he donated his collection of 5,800 slides and over 10,000 photographs to the University's Earthquake Engineering Research Center. His collection is now digitized and available online at http://nisee.berkeley.edu/visual_resources/steinbrugge_collection.html.

Steinbrugge was an active member of organizations that themselves were seismic safety pioneers. He joined the Structural Engineers Association of Northern California in 1947 and the Earthquake Engineering Research Institute (EERI) in 1954, and he was the president of EERI in 1968-69. He was also a member, in the late 1960s, of the State Mining and Geology Board, where he strongly supported increasing the mapping of geologic hazards throughout the state.

What distinguished Steinbrugge from many of his engineering colleagues was his enormous contribution to seismic safety policy. In 1968 he published a monograph through U.C. Berkeley's Institute of Governmental Studies, entitled *Earthquake Hazard in the San Francisco Bay Area: A Continuing Problem in Public Policy* (the editor of this monograph series, Stanley Scott, was also a significant pioneer in seismic safety policy in California). This 80-page monograph is a masterful and concise overview of the elements of seismic safety policy. It introduces the reader to the various aspects of seismic hazard in the region, describes how earthquakes affect buildings, presents an overview of the responsibilities of relevant government agencies, and then presents policy recommendations. The Introduction makes clear that the purpose of the monograph is to emphasize "the public policy aspects of *pre*-earthquake [italics in original] planning, which can minimize the effects of a disaster."

Steinbrugge's 1968 policy recommendations provided an outline that guided the development of California earthquake policy for many years. They have three aspects. First, he observed that the standards for new buildings in California are "among the highest in world." Even so, this does not solve all the aspects of the earthquake problem. Second, he recommended land use and design restrictions for areas of geologic hazard: in active fault zones, on Bay fill lands, and in potential landslide areas. To address geologic hazards, he recommended some type of Bay Area regional government. Third, he recommended "cities to begin planning ways and means of developing programs to minimize the hazards of older buildings."

Steinbrugge's recommendation for a regional government was picked up by Stanley Scott, who argued for a Bay Area earthquake commission, modeled after the recently established Bay Conservation and Development Commission (for regulating development on the shorelines of the Bay). State Senator Alquist learned of this idea through a staff member who had met with Steinbrugge and Scott, and he drafted a bill creating a Bay Area earthquake commission. Although this never passed, it is significant in that it was Alquist's introduction both to the seismic safety issue and to Steinbrugge.

Three years later, following the 1971 San Fernando earthquake, California got serious about seismic safety, and Steinbrugge was in the lead. Steinbrugge was without a doubt the lead architect of seismic safety policy in California during its formative years. He worked with Senator Alquist, overseeing the work of nearly 70 advisors to the Joint Legislative Committee on Seismic Safety, a body (chaired by Alquist) that incubated some of the most significant pieces of California seismic safety legislation: the Hospital Seismic Safety Act of 1972, the Alquist-Priolo Special Studies Zones Act of 1972 (for regulating construction in active fault zones), and the Seismic Safety Commission Act of 1974. Steinbrugge also served on the Governor's Earthquake Council, helped to form the Seismic Safety Commission and served as its first chairman. According to Geschwind, it was Steinbrugge and geologist George Gates who, in 1972, first suggested the idea of an independent commission that would have responsibility over earthquake hazard reduction policy. Their intent was to give seismic safety a permanent presence in Sacramento after the Joint Legislative Committee expired in 1974. Steinbrugge drafted the Seismic Safety Commission bill, which the Committee called its "single most important" recommendation.

After the Federal Earthquake Hazards Reduction Act was enacted in 1977, Steinbrugge was called to Washington to help to shape that effort as well. He was appointed chairman of the Working Group on Earthquake Hazards Reduction in the President's Office of Science and Technology. In 1978, under his direction, the group published *Earthquake Hazards Reduction: Issues for an Implementation Plan.*

Shaping seismic safety policy both for California and the nation within a single decade should have been accomplishment enough for anyone. Through all of the policy work of the 1970s, however, Steinbrugge continued to investigate earthquakes and publish reports of effects of earthquakes on structures.

Lessons for Advocates

- Steinbrugge had a clear vision of where seismic safety policy should go. Although most advocates will never find themselves in the fortuitous position Steinbrugge was in—to be able to advance most of the vision—it is nonetheless helpful to have a coherent plan to guide yourself, guide the efforts of others, and communicate with others.

- Legislators need help. Once they develop an interest in seismic safety, they will turn to those with more knowledge—you—to help to craft policy and develop appropriate legislation.

- Although a large number of people were involved in this topic at the time, Steinbrugge showed that one person--with energy, dedication, and vision--can make a significant difference. Because of his policy vision, the state was able to do more than simply react to the San Fernando earthquake. The Seismic Safety Commission in particular is not only a permanent legacy that Steinbrugge left for California, but it

has served as a model for such organizations in other states as well; as we show in many of our cases, these organizations are instrumental in advancing seismic safety.

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II. CALIFORNIA SEISMIC HAZARD MAPPING ACT: USING A WINDOW OF OPPORTUNITY

This example shows how important it is to craft policies ahead of time and have them "on the shelf" when windows of opportunity open. In this case, it had not been on the shelf for very long when a particularly fortuitous window opened: the Loma Prieta earthquake, which caused ground failure in the home district of the Speaker of the California Assembly. Despite this, it took a second window—the 1994 Northridge earthquake—to secure adequate funding for the program. Incidentally, this case also shows how the legacy of Steinbrugge's vision—both in the substantive need to develop hazard zoning, and in the institutional value of a seismic safety commission—continued to guide seismic safety policy 21 years after publication of his monograph. The following account comes from the recollections of Tom Tobin (Executive Director of the Seismic Safety Commission at the time), and from this author's own previously-published summary (Olshansky, 2001), which in turn came primarily from Tobin (1991) and Real and Holden (1991).

The California Seismic Hazards Mapping Act, enacted in 1990 shortly after the 1989 Loma Prieta earthquake, extended the principles of the Alquist-Priolo Act to areas of ground failure and strong ground shaking. The genesis of this Act actually goes back to the 1971 earthquake, when the legislature rejected a broad mapping program and decided instead to focus only on fault rupture zones. The Seismic Safety Commission, however, persisted over the years in asking for a broader, more comprehensive program.

In the 1986 publication, *California At Risk* (a 5-year program statement, required by the California Earthquake Hazards Reduction Act of 1986), the Commission called for an Urban Geological Hazards map series for the most seismically active areas expecting future development. The map series—addressing fault movement, ground failure, landslides, liquefaction, and tsunami hazard—would require $300,000 per year to produce. In 1987 the legislature directed the Division of Mines and Geology to design a program that would provide improved information on seismic hazards to property owners. This study was underway when the 1989 Loma Prieta earthquake struck.

Shortly after the earthquake, Willie Brown, the powerful Speaker of the State Assembly, asked the Commission to help draft an appropriate earthquake safety bill for him to carry. The Seismic Hazards Mapping Act was the perfect bill for this situation, for several reasons. First, it was a priority activity previously identified by the Commission and supported by the California Division of Mines and Geology in their nearly completed report to the legislature. Second, although widely supported in principle, it needed explicit funding by the legislature, which would be most likely to provide it immediately after a devastating earthquake. Third, it was a major new initiative, requiring not only money but also the power to overcome the real estate interests which had for nearly 20 years resisted expansion of the Alquist-Priolo Act. The combination of the powerful Speaker of the Assembly with the wide public support for seismic safety legislation common after large earthquakes provided the necessary political will to pass this bill—in fact, this was probably the only way this initiative could ever become law. Fourth, the bill's topic was tailor-made for the support of Speaker Brown, whose home district included the Marina District of San Francisco, which, despite being far from the earthquake's epicenter, suffered considerable damage due entirely to soft soils.

In addition to directing the State Geologist to prepare appropriate maps, the SHMA requires several actions by local governments: posting of the official maps at the county offices, recording of the maps by the county recorder, requirement of a geotechnical report prior to the approval of any project in a seismic hazard zone, submittal of all approved geotechnical reports to the State Geologist, and consideration of the maps in preparing the safety element and in "adopting or revising land use planning and permitting ordinances" (Calif. Public Resources Code, Secs. 2696-2697). In contrast to the Alquist-Priolo Act, which requires only avoidance of the fault trace, the SHMA permits any appropriate mitigation of the hazard, either by siting or design. Finally, the SHMA established a permanent funding mechanism, earmarking funds from the new state earthquake insurance program, as well as from building permit fees. The Division of Mines and Geology study was completed in 1990, and it became the basis for implementing the legislation.

Because of funding delays, as well as the need to establish mapping standards, start-up of the program was slow, and none of the maps had been completed at the time of the January 1994 Northridge earthquake. Therefore, this policy, which had its origins after the 1971 earthquake, and was finally enacted after the 1989 earthquake, was not yet in effect. It was the 1994 earthquake, however, that finally gave the program the boost it needed. Shortly after the earthquake, FEMA provided immediate funding for accelerated mapping of 16 quadrangles in southern California, and FEMA along with California's Office of Emergency Services have continued to provide additional funding. According to the California Geological Survey website, as of June 2003, 81 quadrangle maps have been approved, an additional 20 have been released in draft form, and 17 are in process.

Lessons for Advocates

- Always have a carefully drafted policy or program in your drawer, ready to drop into action should an opportunity present itself.

- Be patient. In this case, it took over 20 years from Steinbrugge's first articulation of the idea until it was finally enacted and funded. Even today, 35 years later, it is still in early stages of implementation, and most of the Bay Area maps are not yet complete.

- Long-term policy plans, such as *California At Risk*, are very helpful. This document served as the source of dozens of bills following the 1989 Loma Prieta earthquake, as well as after the 1994 Northridge earthquake.

- Policy advances often proceed on separate tracks and can reinforce each other, as exemplified here by the work of the Seismic Safety Commission and Division of Mines and Geology.

- Earthquakes provide the best opportunities to make significant advances in seismic safety. Always be prepared to take advantage of them. Do you have a well-articulated policy to propose should an earthquake affect your region tomorrow?

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III. CITY OF BERKELEY: A COMMUNITY CHAMPION ACTS AS A CATALYST FOR ACTION

This example shows that even in an environment full of experts and activists, one person can play an important role in focusing community energy and initiating a set of seismic safety actions. This account comes entirely from the excellent description of seismic safety activities in Berkeley, by Chakos, Schulz, and Tobin (2002).

The City of Berkeley is a unique environment for seismic safety. It includes the active Hayward Fault, steep hillsides, and soft Bay muds. It has a highly educated, politically involved population. And U.C. Berkeley is the birthplace of much of modern earthquake engineering as well as seismic safety policy. As a result, it is not surprising that the City, the School District, and the university campus have all initiated a variety of innovative mitigation policies and safety programs, and the voters have repeatedly agreed to provide appropriate funding for the tasks. What is surprising is that most of these policies were not in existence as recently as 1989.

Chakos, Schulz, and Tobin present a detailed account of a variety of organizations, initiatives, and opportunities that led to the development of several major seismic safety actions in Berkeley. It is beyond the scope of this brief section to describe all the advocates, organizations, events, and interests that brought all this about (although it would be fair to say that the 1989 Loma Prieta earthquake and the 1991 Oakland fire both significantly helped to focus attention on the reality of the natural hazard threat). But one

advocate does stand out from the rest. In the words of Chakos et al, "Alan Goldfarb's interest in seismic safety demonstrates how the persistent efforts of a community champion can build a successful mitigation strategy."

Alan Goldfarb was elected to the Berkeley City Council in 1986. Having remembered previously reading about earthquake risks in Berkeley, he worked with student interns from the University's Institute for Governmental Studies (remember the role of IGS in publishing Steinbrugge's monograph in 1968) in researching the City's earthquake preparedness. They found that the City was not well prepared. Goldfarb was also the City's designated representative to the Association of Bay Area Governments (ABAG), which had for many years been a leader in the region in promoting earthquake hazard mapping, risk analysis, and preparedness. He obtained useful information from his involvement with ABAG, as well as from the Bay Area Earthquake Preparedness Project (BAREPP), which worked closely with ABAG. He invited the director of BAREPP to speak to the City Council about the hazard posed by the Hayward fault. The Council showed little interest.

Frustrated at the Council, Goldfarb went to the community level. He began with his Neighborhood Watch group, and then arranged for a BAREPP presentation to a citywide meeting of Neighborhood Watch groups. The response was overwhelming, and community groups became highly concerned about the earthquake threat. As a result, in 1989, the City Council approved formation of a citizen's advisory Disaster Council. After the October 1989 earthquake, Goldfarb no longer needed to convince anyone of the problem.

Berkeley has over 40 citizen commissions and boards, and participatory democracy is very real in Berkeley. But this also means that many worthwhile issues are competing for community attention. It took Goldfarb's work to raise the visibility of the issue and to create alliances between community groups and other organizations. Once set in motion, seismic safety became a community value.

The success has been stunning. In four local elections Berkeley voters have approved over $390 million in local taxes to fund mitigation projects. In addition, the City now rebates 1/3 of its real estate transfer tax, up to a maximum of $1500, for seismic retrofit—Goldfarb was the swing vote in agreeing in 1991 to increase the transfer tax only if the Council agreed to the rebate. As a result, over 39% of Berkeley's 22,000 single-family residences and over 30% of small multi-family buildings now have improved seismic resistance, at a cost to the City of over $10 million in foregone taxes. The Disaster Council—like the Seismic Safety Commission at the state level—has kept earthquake safety on the agenda of the City Council.

In summary, since 1989, some of the key actions in Berkeley have been:

August 1990	Engineering review of school buildings.
July 1991	Transfer tax rebate adopted: rebates up to $1500 of the real estate transfer tax for seismic safety improvements.
June 1992	Measure A: $158 million property tax for school safety programs (passed with 71% of the vote).
November 1992	Measure G: $55 million in general obligation bonds for municipal safety improvements.
1994	Unreinforced Masonry Safety Program: a requirement for owners to retrofit URM buildings.
November 1996	Measure S: $45 million for seismic retrofit of city buildings.
November 2000	Measures AA and Q: $116.5 million in supplemental bonds for school safety program.

Lessons for Advocates

- One dedicated individual can make a difference. This is true even in an activist-filled community such as Berkeley.

- If one strategy is not working, try another. If one audience does not listen, try another. Goldfarb could have given up after his Council colleagues initially ignored him, but he instead considered other avenues.

- The best way to get the attention of elected officials is by the support of the community.

- Advocates should seek to integrate seismic safety into related actions. Rather than design an entirely new program, Goldfarb was able to fund seismic safety through the City's existing transfer tax scheme.

- Earthquakes present windows of opportunity. In this case, the 1989 Loma Prieta earthquake reminded an already-aware population that they needed to take some long overdue actions to improve seismic safety.

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