The Earthquake Engineering Research Institute, a Short History of the U.S. National Earthquake Engineering Society

Susan K. Tubbesing [1] and Thalia Anagnos[2]

[1]Executive Director, Earthquake Engineering Research Institute, 499 14th Street, Oakland, CA;
[2]Professor of Engineering, San Jose State University and President, EERI;
Email: skt@eeri.org

ABSTRACT:

The Earthquake Engineering Research Institute (EERI) was founded in 1948 as a multidisciplinary national society of engineers, geoscientists, building officials, and architects dedicated to advancing the science and practice of earthquake engineering and reducing the impacts of earthquakes on society. The founding members came together from teaching, research, governmental regulation, and practice in engineering, and architecture with the intention to establish a research institution. Today EERI has approximately 2,400 members. As the field of earthquake hazard mitigation expands, EERI takes on tasks that reflect its unique interdisciplinary membership, fostering communication between different disciplines and bridging the gap between new knowledge, design, practice, and risk reduction policies. This paper traces the evolution of the Earthquake Engineering Research Institute from a small technical society to its current role as a major voice in earthquake engineering and seismic policy.

KEYWORDS: history, earthquake engineering, professional society

1. THE EARLY YEARS

The Earthquake Engineering Research Institute was founded in 1948, with sixteen charter members. The organization grew out of the Advisory Committee on Engineering Seismology of the U.S. Coast and Geodetic Survey, an agency of the U.S. Department of Commerce. Originally established shortly after World War II, the Advisory Committee was intended to act in a consultant capacity to the Coast and Geodetic Survey and to aid in making the strong motion seismology work of the Survey more immediately applicable to engineering problems. The Advisory Committee first met in September 1947 (EERI 1951). One of the primary goals of the committee was to encourage the U.S. Geodetic Survey to install more accelerographs in the western U.S. to capture strong ground motions during earthquakes. The committee was not successful in this effort, and as George Housner recalled, "finally, out of frustration, the advisory committee decided to form its own organization and work through it to raise funds to sponsor research projects" (Scott 1997, p 132).

The Institute was incorporated as a non-profit independent organization "dedicated to serving the public welfare in the field of engineering seismology. Its objective is to promote and sponsor intensive and continuing research on how and why man-man structures fail under the action of earthquake motions and similar destructive causes, and to develop and disseminate increased knowledge and methods for most economically minimizing damage and loss of life" (EERI 1951, forward.)

The original bylaws stipulated a seven member board, no more than three of whom could be from any one of the following fields: professional practice, teaching and research, and government regulation, in order to create a balance and better exchange between the different groups (Scott 1994). The Board was composed of: Lydik Jacobsen, Franklin P. Ulrich, Samuel B. Morris, DC Willett, John A. Blume, John S. Bolles, and George W. Housner. Lydik Jacobsen, professor of mechanical engineering at Stanford University, was elected to a one-year term as the first president. George Housner of California Institute of Technology served

as Vice-President, Blume as Secretary, and Ulrich as Treasurer. Jacobsen was followed as President by Housner in 1950. Paul Jeffers, a Los Angeles consulting engineer, served as the third President for a one-year term, and then Housner returned as President; a position he would hold for the next eleven years, from 1954 – 1965. The bylaws were amended in 1980 to bring the board to the current eight directors, with two directors rotating on and off each year, to serve a three year term. The President, counted as one of the eight directors, serves a four- year term, including one year as President–Elect and one year as Past-President, resulting in election of a new president every two years.. The secretary-treasurer, who is now elected annually by the members of the Board to a one-year term, cannot exceed six consecutive terms. The Secretary Treasurer is also a voting member of the Board, bringing the total to nine members.

Dedicated to carrying out original research, albeit with no research facilities of its own, the young Institute took advantage of laboratory facilities at the research institutions of its members, including the Universities of California and Washington, the California Institute of Technology, the Office of Naval Research, the Coast and Geodetic Survey, and Columbia University, where improved seismometers and strain recorders were developed and records analyzed from recent events, including the El Centro records from the Imperial Valley Earthquake of May 18, 1940 and records from the Seattle-Olympia earthquake of 1949. The founders were adamant that they would not engage in research of a private or secret nature or with restrictions on publication of results. The long range plan was to obtain research contracts, grants and subscriptions "to establish an institute building with laboratory facilities, library and staff as necessary to carry on and coordinate a complete research program in engineering seismology" (EERI 1951).

These plans never came to pass. Instead, EERI functioned as a clearinghouse for research information and policymaking, with funds for research channeled to the universities. EERI's committees often identified research needs that were picked up by faculty at various universities (Scott 1994.)

1.1. Growth of EERI

For many years, EERI remained a small, exclusive organization of scientists and engineers with an invitational membership. In 1973 EERI opened its doors to applications from all who had a serious commitment to earthquake engineering. The number of members jumped from 126 in 1973 to nearly 200, one year later, and 721 within five years. Dedicated to the advancement of the science and practice of earthquake engineering and the solution of national earthquake engineering problems, EERI provided a vital forum for communication among a wide range of earthquake specialists.

For many years, the EERI administrative office was in space provided by various EERI board members. Soon after opening up its membership, the Board recognized the need for increased professional staff to handle the anticipated growth. Late in 1973, EERI established an office in space shared with the Seismological Society of America in Oakland, CA; subsequently both organizations moved to downtown Berkeley, then El Cerrito, CA. By 1988, EERI had grown significantly. A management study pointed to the need to have a professional staff with a dedicated Executive Director. Following a national search, Susan K. Tubbesing was hired as EERI's first Executive Director. At the same time, the EERI Board of Directors recognized that sharing space with SSA was not conducive to continued growth of the organization. SSA also welcomed the opportunity to have its own office and offered to move with a small number of existing staff to a nearby location. In 1991, EERI moved to downtown Oakland, CA, where it remains today.

One of EERI's founding fathers, George Housner helped to organize the first U.S. National and World conferences on earthquake engineering, out of which grew the International Association for Earthquake Engineering (IAEE). In 1951 he and his colleagues decided to hold an earthquake engineering conference, but fearing lack of interest, combined it with bomb blast issues to increase attendance. C. Martin Duke of the University of California Los Angles (UCLA) chaired the EERI organizing committee and in 1952, the first Conference on Earthquake Engineering was held at UCLA. Housner recalls that approximately 200 people attended this conference where 23 papers were given (Scott 1997.)

In 1955 a group of the San Francisco Bay Area members decided to hold an international conference on earthquake engineering for the first time. Headed by EERI's Vice President, John Rinne, arrangements were made with the University of California Extension for a meeting hall and housing. Approximately 140 participants came from twenty countries to attend the five-day conference in June of 1956. John Blume, an EERI founding father and later President, recalled that approximately forty papers were presented by authors from thirteen countries (Scott 1994.) In 1960, the Japanese held a second World Conference, at which time the IAEE was established.

The successful 1956 conference helped EERI financially, enabling the organization to issue a small number of publications and promote the design, construction and use of shaking machines (EERI 1997.) Nearly thirty years later, in 1984, EERI hosted the 8th World Conference in San Francisco. That conference was also a great success, with more than 1,800 attendees from 54 countries, and with an international impact far beyond the wildest dreams of the organizers. Dr. Frank Press of the National Academy of Sciences opened the conference with a call to establish an International Decade for Natural Hazard Reduction to be led by the international earthquake engineering community. This plan was ultimately adopted by the United Nations and implemented during the decade beginning in 1990.

Beginning as a closed invitational society, whose members were all male, EERI has evolved greatly, becoming increasingly diverse, attracting younger members, women and members from widely disparate disciplines and countries. In 1984, Anne Stevens, a geophysicist from Canada, became the first woman elected to the EERI Board of Directors. In 1989, Joanne Nigg, a sociologist was elected to the board and subsequently the first woman elected EERI President, serving in 1997/98.

For many years EERI had regional chapters in Alaska, the Great Lakes region and the Southeast. In recent years, EERI has established additional regional chapters in the New Madrid Area, Northern and Southern California, to focus on issues of seismic risk, design and public policy, unique to those areas. The New Madrid and Northern California chapters are currently developing scenarios to bring increased attention to the specific seismic challenges they face.

1.2. Significant EERI Publications

EERI has created many publications over the years, a monthly *Newsletter*, a quarterly technical journal, earthquake reconnaissance reports, meeting and conference proceedings, monographs, a design series, an oral history series, slide-sets, CD ROMs, occasional special publications, and live videos from technical seminars that can be downloaded from the web. The EERI Newsletter has been continuously published since 1966. It provides a regular vehicle to keep the membership apprised of current events, and provides news of the Institute, news of the membership, solicitations of abstracts, employment opportunities and a calendar of upcoming conferences. It is made available to all EERI members and is now publicly available on the EERI website: www.eeri.org.

In 1984, EERI inaugurated its technical Journal, *Earthquake Spectra,* a quarterly devoted to current research pertaining to earthquake risk reduction. The journal is provided to members and available by subscription to individuals and libraries throughout the world. *Earthquake Spectra* is intended to serve the informational needs of many active professions: engineers, code officials, geologists and seismologists, planners and public officials. Today the journal reaches thousands of members of the earthquake community throughout the world.

Originally, seven monographs grew out of a series of seminars organized by EERI in the late 1970s. The volumes were intended to acquaint engineers, building officials, and members of government with the basics of earthquake engineering. Each was written by a nationally recognized expert and focuses on the essential elements of that topic in a manner intended to be readily understood by engineers with no particular expertise

in that subject. They have long been popular as classroom texts and valued by practicing engineers. In 2001 EERI embarked on the publication of a second series of monographs, with the fifth and final volume to be published in 2008.

In the early 1990s EERI created an Oral History Series to preserve the recollections of those who pioneered earthquake engineering and seismic design. The series provides a vehicle to transmit the accounts of individuals who were present at the beginning of important developments in the field, documenting little-known facts and recording their impressions, judgments, and memories of the individuals and events that influenced their thinking, ideas and theories. Nearly all the interviews were carried out as a volunteer effort by Stanley Scott (1921– 2002), a long time EERI member and research political scientist in the Institute of Governmental Studies at the University of California, Berkeley. The first nine volumes were published during Scott's lifetime. The manuscripts and interview transcripts left to EERI will enable the eventual publication of many other volumes. In addition, the EERI Oral History Committee has carried out interviews with other subjects who: 1) have made an outstanding career-long contribution to earthquake engineering, 2) have valuable first-person accounts to offer concerning the history of earthquake engineering, and 3) whose backgrounds, considering the series as a whole, appropriately span the various disciplines that are included in the field of earthquake engineering. In 2008, EERI will issue the 15th volume in the *Connections* series.

2. EERI TODAY

Today EERI is a national, multi-disciplinary society of engineers, geoscientists, architects, planners, and social scientists, with approximately 2,300 members in 48 states, 1 district, two US territories, and 56 other countries. As the field of earthquake hazard mitigation expands, EERI takes on tasks that reflect its unique interdisciplinary membership, fostering communication between different disciplines and bridging the gap between new knowledge, design, practice, and risk reduction policies through meetings and conferences, administrative and technical committees, publications, and a comprehensive website www.eeri.org. EERI carries out many programs with funding from U.S. federal agencies, including the National Science Foundation (NSF), Federal Emergency Management Agency (FEMA), the U.S. Geological Survey (USGS), and the National Institute of Standards and Technology (NIST). The EERI staff handle administration; membership; publications; seminars, meetings, and conferences; and programs that are supported with government funding. However, the lifeblood is the EERI membership. Scores of members generously contribute untold hours of professional time to EERI's Administrative and Technical Committees, where the work of EERI is carried out. The members of these committees develop and provide oversight for all of EERI's technical programs.

2.1. Learning From Earthquakes Program

Among all of EERI's activities designed to improve the exchange and application of knowledge, the Institute is probably best known for its field investigations and reports of the effects of destructive earthquakes. The Learning from Earthquakes Program was initially funded by the National Science Foundation in 1973, in response to a proposal submitted by EERI's president, C. Martin Duke, a professor of soil mechanics at UCLA, and passionate advocate of field study of damaging earthquakes. At the heart of this program are the multidisciplinary reconnaissance teams that are sent to damaging earthquakes around the world, bringing back observations and lessons. In the more than 30 years since its inception, this program has produced nearly 200 reconnaissance reports and contributed to advances in engineering, the earth sciences, public policy and the social sciences. Systematic field observation has improved understanding in the basic science of earthquake ground motions and fault mechanics, soil liquefaction and ground failure; led to fundamental changes in building codes and construction practices, better understanding of highway, bridge and lifeline performance, and changed emergency response, recovery and reconstruction programs and procedures. Work carried out after the Great Sumatra Earthquakes and Tsunami has contributed to major advances in understanding tsunami behavior and impacts. In addition to the more than 50 comprehensive reports and dedicated issues of *Earthquake*

Spectra, several EERI publications summarize or reference the lessons that have been learned, including: *The EERI Learning from Earthquakes Program: A Brief Synopsis of Major Contributions* (EERI 2004); *Contributions of Earthquake Engineering* (EERI 2008); *Securing Society Against Catastrophic Earthquake Losses* (EERI 2003); *Practical Lessons from the Loma Prieta Earthquake* (National Academy Press 1994); *Reducing Earthquake Hazards: Lessons Learned from Earthquakes* (EERI 1986); and *Lessons Learned from the 1985 Mexico Earthquake* (EERI 1989.)

In 1998, EERI initiated a Lessons Learned Over Time series under the LFE program to fund investigations that would chronicle significant developments years after an event, or to re-evaluate original observations in the light of new understanding and knowledge. The complex, multidisciplinary and interdisciplinary challenges to recovery in India after the Maharashtra and Bhuj earthquakes, and in California after the Loma Prieta and Northridge earthquakes, have been chronicled and published in a series of reports issued by EERI beginning in 1999 and in Murty, et al 2005.)

2.2 FEMA Cooperative Agreement

In 1991, EERI entered into a Cooperative Agreement with the Federal Emergency Management Agency (FEMA). FEMA has provided annual funding to the Institute to carry out numerous tasks designed to improve earthquake hazard reduction, including the development of technical seminars, numerous publications, national conferences, etc. This funding has also enabled EERI to award two annual NEHRP fellowships, to encourage the transfer of research to practice and advance the goals of the National Earthquake Hazard Reduction Program (NEHRP). One fellowship supports graduate study. The other is a mid-career fellowship to provide an opportunity for a practicing professional to gain greater skills and broader expertise in earthquake hazards reduction by enhancing knowledge in the applicant's own field or in a related but unfamiliar discipline. Reports growing out of the year of study are available on the EERI website: http://www.eeri.org/home/fellowships.html .

2.3 The Endowment Fund

In 1993, EERI created an Endowment Fund. Each year EERI carries out an annual appeal to members, seeking financial contributions to the Endowment Fund. Currently the Endowment has over $1 million and interest from these funds is used to stimulate new and unique ventures that address gaps in research, improve application and practice, or facilitate public policy to reduce earthquake risks. A series of White Papers has documented the results of several Endowment projects over the past decade.

In 1996 the EERI Endowment Committee (now known as the Special Projects and Initiatives Committee), established a Visiting Professional Program. The purpose of this program was to match potential visiting professionals with host institutions, usually universities, for a two to three day workshop of current topics related to earthquake engineering and earthquake risk reduction. This exchange is meant to be part lecture and part informal discussion with faculty and students. The visiting professionals come from a wide range of disciplines, including engineering, earth science, seismology, architecture, planning, public policy and the social sciences. In 2001, David Friedman, of Forell/Elsesser Engineers, and his family endowed the program with a generous gift to keep the program running in perpetuity. At the time the gift was made, the name of the program was formally changed to the Friedman Family Visiting Professional Program.

2.4 International Activities

Successful reconnaissance investigations require the cooperation of local engineers, scientists, and policymakers in order to help teams from other countries or outside the earthquake area fully understand the technical, cultural and social context within which the earthquake, the emergency response, and the recovery take place. Over the years, the LFE Program has stimulated international collaboration of scientists and engineers that have had lasting benefits, far beyond the initial earthquake investigation.

In 2000, EERI in partnership with the IAEE launched the World Housing Encyclopedia (WHE) project, under the auspices of the EERI Endowment. Today the WHE is a uniquely successful web-based global network of over 200 individuals from 57 countries committed to making communities safer in earthquakes. The network is committed to improving global construction practices by sharing technically accurate, peer-reviewed, consensus-based resources on appropriate construction materials and technologies, leading to the improved performance of housing in earthquakes, in an environmentally appropriate and sustainable manner. All publications and resources developed by project participants and other authoritative sources are available free of charge on the project web site (www.world-housing.net). At the core of this network are reports on housing construction practices and technologies from 40 countries. Today the network continues to expand, with a new emphasis on the development and publication of tutorials dealing with common building construction technologies and practices, with an emphasis on techniques to improve seismic performance. The tutorials offer recommendations to improve earthquake-resistant construction practices for new buildings and for strengthening existing buildings at risk, and include links to relevant publications and web sites as well as video clips. The following tutorials are available on the WHE website: Adobe Buildings (English/Spanish); Confined Masonry Dwellings (English/Spanish); Reinforced Concrete Frame Buildings (English).

WHE project participants are currently contributing information on shelters used immediately after earthquakes, and participating in the collection of summary information on the seismic vulnerability of basic construction types in collaboration with the U.S. Geological Survey PAGER project. The project is making pioneering use of the internet as a tool to create and maintain a global community.

2.5 EERI's Sister Associations

EERI has collaborative agreements with the following earthquake engineering associations: The Canadian Association for Earthquake Engineering, the Chinese Association of Earthquake Engineering; the Sociedad Mexicana de Ingeneria Sismica, the Japan Association of Earthquake Engineering and the Australian Earthquake Engineering Association. EERI has carried out a variety of activities with these associations, including organizing a joint annual meeting and hosting a hospital workshop in Mexico, developing a joint national conference with the Canadians, promoting the World Conference for the Canadians and the Chinese, and collaborating on post-earthquake investigations with nearly all. EERI looks forward to continued collaboration with these and other international associations in the future.

2.6 Voice of the Professional Earthquake Community

The founders of EERI were cognizant of the significant role that EERI would play advising government agencies on issues pertaining to seismic risk. EERI has been sought out as an unbiased voice throughout its history. During the past two decades, EERI worked closely with NSF to define a research agernda after major earthquakes in Mexico, California, Japan, Greece, Turkey and Taiwan.

In 1984, FEMA contracted with the Applied Technology Council (ATC), the Building Seismic Safety Council (BSSC), and EERI, who had formed the ABE Joint Venture, to prepare an Action Plan to improve the seismic safety of the nation's existing buildings. The resulting workshop produced *An Action Plan for Reducing Earthquake Hazards of Existing Buildings* (FEMA 90) which laid out a systematic program to develop engineering and societal tools "to reduce the potential for loss of life and life threatening injuries in earthquakes" (FEMA 1985.)

In 1994 NSF asked EERI to help the NEHRP agencies assess national earthquake research and test facilities, as required in the 1994 NEHRP authorizing legislation. EERI's Experimental Research Committee commissioned papers to be presented in a workshop funded by NSF and the National Institute of Standards and Technology (NIST) (EERI 1995). The results led to the development of the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES). Developed with $80 million from the U.S. Congress, today NEES Inc. functions with an annual research and operations budget of $30 million.

3. ADVOCACY

In recent years, EERI's leaders have played key roles in promoting and increasing support for the National Earthquake Hazards Reduction Program, the national program that currently funds seismic research and implementation programs. In 2003, EERI convened a panel of earth scientists, engineers, and social scientists to develop a broad research and outreach plan (EERI 2003 outreach plan.) *Securing Society Against Catastrophic Earthquake Losses* provides a vision for the future of earthquake engineering research and implementation that builds on previous accomplishments, but calls for a fundamental shift in mitigation of earthquake risks that takes into account new technologies and new thinking about performance of structures and societal choices. It creates a bold initiative for seismic safety. The report was presented to Congress and its recommendations were reflected in the 2004 NEHRP reauthorization

Reflective of this move into seismic advocacy, in 2004 EERI leaders and members of the Board of Directors developed a new Strategic Plan and updated and extended the mission statement of EERI to reflect its multidisciplinary membership and increasing advocacy on behalf of earthquake loss reduction. *"The mission of EERI is to reduce earthquake risk by advancing the science and practice of earthquake engineering, improving understanding of the impact of earthquakes on the physical, social, economic, political and cultural environment, and by advocating comprehensive and realistic measures for reducing the harmful effects of earthquakes."* A few of the current action-oriented projects in which EERI is involved are indicated below.

3.1 Concrete Coalition

In keeping with concern about the seismic performance of existing buildings, EERI, along with the Pacific Earthquake Engineering Research Center (PEER) and the Applied Technology Council (ATC) created the Concrete Coalition. The Coalition is a network of individuals, governments, institutions, and agencies with shared interest in assessing the risk associated with dangerous non-ductile concrete buildings and developing strategies for fixing them. The Concrete Coalition has been awarded funding from the California Office of Emergency Services to help the state of California identify and assess the earthquake risk posed by non-ductile concrete buildings. Funds will be used to support the development of a web-based database of information on inventories, retrofits, local ordinances, etc.

3.2 Scenario Development

EERI recognizes the importance of empowering local initiatives to reduce earthquake risks and the role that local seismic scenarios can play in that process. Scenarios can be powerful tools to help communities understand and plan for the future. With funding from NEHRP, EERI is planning a National Scenario Development Workshop, and will be issuing revised *Guidelines for Scenario Development*, and creating an interactive website to assist those who wish to develop earthquake scenarios for their communities.

3.3 The Role of Students

Recognizing the need to nurture the next generation, EERI has established Student Chapters at 29 universities throughout the U.S., Canada, and Mexico, to encourage participation of students in earthquake related research and professional practice. Most recently EERI has agreed to adopt the Student Leadership Council (SLC) formerly sponsored by the three national earthquake engineering research centers. One of SLC's main activities is a national Undergraduate Seismic Design Competition which will be held each year in conjunction with the EERI Annual Meeting. The most recent competition in New Orleans, LA, attracted over 100 students from 17 schools throughout the country. It is possible to view the website and a live video of the competition: (http://peer.berkeley.edu/students/Seismic.htmlWebsite.

4. THE FUTURE

4.1 A culture of Multidisciplinary Innovations

Advances in earthquake risk reduction are accomplished through the collective enterprise of architects, emergency managers, engineers, geoscientists, and social scientists. This integrated approach is reflected in hazard-resistant design, guidelines, and codes; a national loss estimation methodology; performance-based engineering; lifeline systems management; improved decision-making; and loss reduction partnerships. Federally funded earthquake hazard reduction programs consistently emphasize the social, economic, and policy factors that govern the adoption and implementation of loss reduction measures. Strategies for research and development are guided by the broader community and socioeconomic contexts in which they are applied. This multidisciplinary nature of earthquake engineering is one of its most significant legacies, providing a model for the future mitigation of natural hazards and human threats. Substantial opportunities exist for the earthquake community to continue its leadership, with the recognition that its contributions have extraordinary value not only for seismic risk reduction, but also for multihazard mitigation and the improved performance of critical infrastructure (EERI 2008.) EERI takes great pride in being at the center of earthquake risk reduction for the past 60 years and looks forward to working with our sister associations throughout the world to ensure a safer future.

REFERENCES

Earthquake Engineering Research Institute. (1951). The Earthquake Engineering Research Institute: A Non-Profit, Engineering-Scientific Corporation Established in the Public Welfare, EERI, San Francisco, CA.

Earthquake Engineering Research Institute. (1986). Reducing Earthquake Hazards: Lessons Learned from Earthquakes, EERI, El Cerrito, CA.

Earthquake Engineering Research Institute (1989). Lessons Learned from the 1985 Mexico Earthquake, EERI, El Cerrito, CA.

Earthquake Engineering Research Institute (1995). Assessment of Earthquake Engineering Research and Testing Capabilities in the United States, EERI Publication No. WP-01, September 1995, Oakland, CA.

Earthquake Engineering Research Institute. (1999). Earthquake as Opportunity, Lessons Learned Over Time, Learning from Earthquakes Series vol. I: EERI, Oakland, CA.

Earthquake Engineering Research Institute. (2003). Securing Society Against catastrophic Earthquake Losses: A Research and Outreach Plan in Earthquake Engineering, EERI, Oakland, CA.

Earthquake Engineering Research Institute. (2004). The EERI Learning from Earthquakes Program: A Brief Synopsis of Major Contributions. Oakland, CA.

Murty, C.V.R. et al. (2005). Earthquake Rebuilding in Gujarat, India: An EERI Recovery Reconnaissance Report, 2005-02, EERI, Oakland, CA.

Earthquake Engineering Research Institute. (2008). Contributions of Earthquake Engineering. EERI, Oakland, CA

Federal Emergency Management Agency. (1985). An Action Plan for Reducing Earthquake Hazards of Existing buildings, FEMA 90. Washington DC.

National Research Council. (1994). Practical Lessons from the Loma Prieta Earthquake. National Academy Press. Washington DC.

Stanley Scott, interviewer. (1994). John A. Blume: Connections: EERI Oral History Series. EERI, Oakland, CA.

Stanley Scott, interviewer. (1997). George W. Housner: Connections: EERI Oral History Series. EERI, Oakland, CA, USA.