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EARTHQUAKE ENGINEERING RESEARCH CENTER

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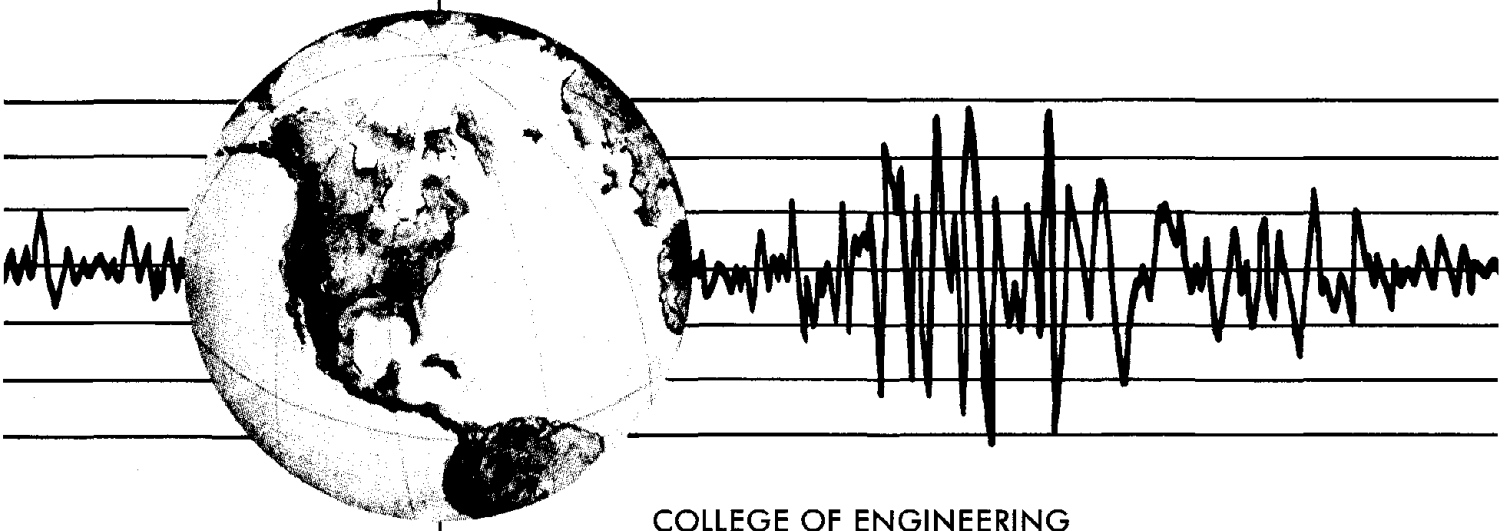

COLLEGE OF ENGINEERING

UNIVERSITY OF CALIFORNIA AT BERKELEY

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I. INTRODUCTION

MISSION OF THE EARTHQUAKE ENGINEERING RESEARCH CENTER

The Earthquake Engineering Research Center exists to conduct research and develop technical information in all areas pertaining to earthquake engineering, including strong ground motion, response of natural and manmade structures to earthquakes, design of structures to resist earthquakes, development of new systems for earthquake protection, and development of architectural and public policy aspects of earthquake engineering.

The purpose of the Center is achieved through three major functions. The first and primary function is academic research that is performed by graduate students, research engineers, and visiting postdoctoral scholars working with the Center's faculty participants. This research is funded by extramural grants awarded to individual faculty participants from private, state, and federal agencies.

The second function is to provide research capabilities to industry. This activity consists primarily in conducting experimental programs in the Earthquake Simulator Laboratory and other laboratories, and frequently involves students, staff, and faculty researchers.

The third function is the dissemination of knowledge. This function is achieved through publications, lectures, and professional work of the Center participants, and through the National Information Service for Earthquake Engineering (NISEE). The NISEE project supports the EERC library, the *Abstract Journal in Earthquake Engineering*, the Earthquake Engineering Abstracts online database, and Computer Applications, all of which provide national and international access to a broad spectrum of technical information in earthquake engineering.

HIGHLIGHTS 1991-92

The 1991-1992 fiscal year was a very active period, and witnessed many changes in organization, operations, and activities. These changes will continue energetically into the next year as the Center grows to meet the new challenges in earthquake engineering.

Organizational Changes:

• Professor Jack Moehle assumed the position of EERC Director on 1 July 1991. Professor Moehle has been a member of the Civil Engineering faculty at the University of California at Berkeley and a Faculty Participant at EERC since 1980. Dr. Moehle is actively involved in analytical and experimental research on seismic behavior of structures at EERC. He is also active in professional organizations, and brings to EERC a commitment to develop the Center's effectiveness and reputation as a multi-disciplinary resource in earthquake engineering.

• The organizational structure at EERC has been changed to incorporate a full-time professional engineer position having the working title of Associate Director. The Associate Director oversees all research activities at EERC, providing day-to-day management as well as leadership in long-range planning efforts. The position has been recruited and will be filled effective 1 January 1993.

• Darlene Wright assumed the position of EERC Administrative Assistant, and has worked ably in guiding the EERC reorganization and daily operations. The clerical staff has been increased to provide additional services to the EERC Faculty Participants.

• Reference Librarian Joy Švihra left the staff at the EERC Library in 1992; her expertise surely will be missed. As part of a Library reorganization, Information Services Manager Katie Frohmberg has assumed the reference activities. The reorganization includes hiring of a permanent cataloger/indexer, which is currently pending.

Research Facilities:

• Upgrading of the earthquake simulator continues toward complete digital control and three-degree-of-freedom input capability. The digital control system was completed during 1990-91, and has been tested extensively as part of ongoing research experiments during 1991-1992. The required hydraulic fluid supply system for the three-degree-of-freedom system has been designed, and contracts signed for construction (scheduled to begin 1 February 1993 and be complete 1 July 1993). The new system should be operational for research experiments by November of 1993. A hydraulic system will be available continually so that experimentation can continue elsewhere in the laboratory.

• The primary data acquisition in use on the earthquake simulator has been greatly enhanced in speed and capacity by replacing its controlling computer, an old Vax 11/750, with a Sun workstation.

• The number and sophistication of the computer systems at the Center is consistently increasing. We now operate twelve UNIX workstations and 21 IBM PCs connected to the EERC network. We have plans to add six new workstations in the near future.

• A major service-to-industry project has resulted in acquisition of a large in-plane testing frame capable of reversed lateral load tests on ten-foot by twenty-foot planar systems with lateral load capacity up to 2000 tons.

Research Activities:

• Research funding levels for the 1991-1992 fiscal year continued the upward trend of the past few years. Research funds include significant support from the National Science Foundation, California Department of Transportation, the CUREe/Kajima research program, and several private entities. The research projects are summarized elsewhere in this report.

• Several major experimental research projects were carried out during 1991-1992, including extensive earthquake simulator tests on base isolated structures and static lateral load tests on models of existing and upgraded bridge structures. These and other experimental and analytical research projects are summarized elsewhere in this report.

• Research results were reported in 18 EERC Research reports, as well as numerous technical articles and invited lectures. The publications and invited lectures are reported elsewhere in this report.

Public Service Programs:

• The National Information Service for Earthquake Engineering (NISEE) continued as a public service project of the National Science Foundation. The Computer Applications Unit of NISEE began distributing eleven new programs or program versions, distributing a total of 381 software packages and 723 user documents worldwide this year. The Earthquake Engineering Abstracts Unit published Volume 20, issue 1 and 2 (covering 1990 literature) and Volume 21, issue 1 (covering 1991 literature) of the *Abstract Journal in Earthquake Engineering*, published two issues of the *EERC News*, and entered 3,257 abstracts in the online database. In addition, NISEE continued to serve as the National Clearinghouse for Loma Prieta Earthquake Information, publishing two new catalogs this year.

• The EERC Library continued to provide service on the international level, answering 1500 requests for assistance and circulating over 5000 items. 725 new items were cataloged for the collection. Expansion of the collection in recent years has required a complete physical reorganization of the library, which was completed this summer. The 1989 Loma Prieta earthquake demonstrated the vulnerability of the library stacks to damage during a moderate or major earthquake, and highlighted the need to brace the stacks so the collection is accessible during the critical post-earthquake period. Funding is required to undertake this upgrade.

• The EERC Library continues to receive donations of material from earthquake engineers. Most notable this year were 1000 books from Frank E. McClure and a major slide and photograph collection of some 20,000 items from Karl V. Steinbrugge. Funding is being sought to load this punctiliously documented slide and photograph collection into a digital slide retrieval system.

• Access to the NISEE databases has improved markedly during the year. Through a grant from the California State Library, the entire holdings of the EERC Library (10,000 titles) was converted to

machine-readable form and loaded on MELVYL, so that items can be located online and retrieved from remote sites. In addition, the Earthquake Engineering Abstracts database was mounted in experimental mode on MELVYL and will be available on public menus some time during Fall 1992.

• EERC/NISEE staff participated in 26 meetings, displaying its services at professional engineering meetings and demonstrating its technical developments at workshops and seminars held by various library and information dissemination organizations.

• EERC/NISEE received a joint USGS/NSF grant for the Loma Prieta Data Archive Project, and will be responsible to collect, organize, and distribute machine-readable data files from the Loma Prieta earthquake on CD-ROM.

• EERC organized and participated in several workshops and seminars. These included a seminar on earthquake preparedness on the Berkeley campus to mark the second anniversary of the Loma Prieta earthquake, and a Seismic Design and Retrofit of Bridges seminar organized jointly with the Department of Civil Engineering and California Department of Transportation and attended by over 350 engineers. In addition, Professor Bertero was invited to present the opening keynote lecture at the Tenth World Conference on Earthquake Engineering in Madrid, Spain. Also invited to present state-of-the-art reports at the Conference were Faculty Participants Bruce Bolt, Armen Der Kiureghian, and James Kelly.

• EERC donated a complete set of EERC Reports and of the *Abstract Journal in Earthquake Engineering* to the American University of Armenia, School of Engineering, as a contribution to the International Decade for Natural Disaster Reduction.

• EERC has continued good relations with several other institutions in the field of earthquake engineering. Notably, EERC has begun to develop the basis for sharing its Earthquake Engineering Abstracts database with a related service provided by NCEER. EERC has also begun to develop closer ties with the University of California at Berkeley Seismographic Station, including initial planning for a rapid earthquake response and information dissemination program for northern California (joint with the Seismographic Station and USGS).

Awards:

Several of our research participants have received awards and honors of excellence, or have assumed prestigious positions, in the past year. Among them are:

• **Professor Richard E. Barlow** received the John Von Neumann Theory Prize which was jointly awarded by Operations Research Society of America and the Institute of Management Sciences for fundamental work in reliability theory.

• **Professor Emeritus Vitelmo V. Bertero** received the 1991 NOVA Award from the Construction Innovation Forum. He was also appointed Honorary Professor by the Facultad Regional Mendoza, Argentina.

• **Professor Bruce A. Bolt** was the annual visiting lecturer of the New Zealand National Society for Earthquake Engineering. He lectured at the Universities of Auckland, Otago, Canterbury, and Wellington on the topic of "Earthquake Source Processes and Their Implications for Engineers."

• **Professor David R. Brillinger** was awarded the 1991 R. A. Fisher Award by the Committee of Presidents of Statistical Societies in Northern California; was the 1991 Distinguished Lecturer at the University of Texas, Dallas; served as consulting editor for the Committee and Journal of Statistics; was selected as the Herzberg Lecturer at Carleton University, Ottawa, Canada and was elected as a member to the Scientific Advisory Panel, Fields Institute, Ontario, Canada. In 1992, he was awarded the Gold Medal by the Statistical Society of Canada.

• **Professor Anil K. Chopra** was named to the Horace, Dorothy, and Katherine Johnson Chair in Engineering. Professor Chopra was also elected a member of the Board of Directors of the California Universities for Research in Earthquake Engineering (CUREe).

• **Associate Professor Mary C. Comerio** was the recipient of the 1992 Award for Community Service for her work on preliminary design alternatives for the Center of Independent Living.

• **Professor James M. Kelly** was awarded the Miller Research Professorship for 1993-94. The competitive award, sponsored by the Miller Institute for Basic Research in Sciences, releases faculty from their teaching and administrative duties for one semester to devote their time solely to research.

• **Professor Emeritus Henry J. Lagorio** received the 1992 Distinguished Service Award from the Directorate of Engineering at the National Science Foundation.

• **Professor Steven A. Mahin** was named to the Byron and Elvira Nishkian Chair in Structural Engineering.

• **Professor Jack P. Moehle** was elected a member of the Board of Directors of the California Universities for Research in Earthquake Engineering (CUREe) and the Board of Directors of the Structural Engineers Association of Northern California (SEAONC).

• **Professor Egor P. Popov** was selected by the Earthquake Engineering Research Institute to receive the Distinguished Lecturer Award for 1993 in honor of his many contributions to earthquake engineering. The award will enable Professor Popov to prepare a written lecture to be published by EERI and presented by him at the Institute's annual meeting and at regional chapters and university departments on request.

• **Professor Emeritus Jerome L. Sackman** was elected to the National Academy of Engineering in April 1992.

• **Professor Nicholas Sitar** received the 1991 Best Professor Award by the Student Chapter of ASCE, University of California at Berkeley.

• **Professor Robert L. Taylor** was named to the T. Y. and Margaret Lin Chair in Engineering.

SUMMARY:

The Earthquake Engineering Research Center has implemented a number of new and vital activities in the past year, and has seen great productivity in its new and continuing endeavors. The Center continues to produce valuable innovations through its basic and applied research, as evinced by strong extramural support and by the many honors and demands placed on its research participants. Its role as a contributor in public and professional service has been expanded considerably. The contributions of a bright and dedicated staff have been key in the recent accomplishments of EERC.

The past success of EERC has relied largely on the notable achievements of its individual researchers and research teams. Doubtless, these individual achievements will continue to be an essential element of EERC. Nonetheless, the beneficial aspects of collaboration in the research, industry, and public service areas of earthquakes and earthquake engineering must not be overlooked. A major goal during the 1992-1993 year will be the strengthening of external relations and activities so that the promise of enhanced growth and productivity can be assured for the future.

JACK P. MOEHLE
Director

II. SCHOLARLY ACTIVITIES

A. CURRENT RESEARCH PROGRAMS

The EERC research program addresses a broad range of topics in the area of earthquake hazard mitigation. Research interests and activities of participants include:

- Seismology and Seismic Strong Ground Motion
- Coastal Engineering and Wave Mechanics
- Geotechnical Engineering, including soil dynamics; cyclic response of soils; soil liquefaction; slope stability; and ground improvement.
- Structural Engineering, including dynamics of structures; computer-aided engineering; behavior and design of steel, structural concrete, timber, masonry structures; base isolation, active control, passive energy dissipators; evaluation and rehabilitation of existing structures; structural reliability; and optimization.
- Architectural Aspects of Earthquake Engineering
- Public Policy Aspects of Earthquake Engineering

Research proposals are prepared by faculty and staff and are submitted to funding agencies either through individual academic Departments or through EERC. In this annual report, EERC funded projects are summarized briefly in the following pages. The projects are organized by primary research area. Principal investigators (listed with each summary) can be contacted directly for additional information.

SEISMIC STRONG GROUND MOTION AND DAMAGEABILITY

Integrated Analysis of the Data Recorded During the Whittier Narrows Earthquake of 10/1/87 and Implications for a Major Earthquake in the Los Angeles Area

The purpose of this project was to investigate full-scale data on strong ground shaking and its effects on structures, obtained during the Whittier Narrows earthquake sequence, which started on October 1, 1987. The data recorded during this earthquake and its aftershocks offer for the first time a sound full-scale experimental hazard basis on which to calibrate our ability to analyze and predict the response of many different structures and of their geological environment to excitation by seismic waves: furthermore a recent code change in the city of Los Angeles has reduced the seismic instrumentation to only a single instrument at the roof level. The data also offer for the first time the opportunity to extrapolate beyond the shaking levels of this moderate earthquake and to estimate with improved confidence the nature of shaking during a future major earthquake in the entire Los Angeles basin. Since the geological evidence indicates that a large earthquake is due to occur at any time in Southern California, it is not only timely but also essential to test the adequacy of all aspects of seismic design procedures as soon as possible and to isolate the highest priority items which need correction or modification for the reduction of overall earthquake hazards to society in Southern California. Two detailed EERC reports have been published with the results of the investigation. (V. V. Bertero)

Implications of Recorded Data on Earthquake Resistant Design

The goal of this research is to improve the earthquake resistant design of structures through a better understanding of the damage potential of structures to earthquake ground motions and to suggest improved design procedures based on inelastic response spectra. To do this, extensive use has been made of the database of recorded data that has been collected from buildings instrumented by the U.S. Geological Survey and the California Division of Mines and Geology during previous earthquakes. The data have been used to judge the reliability of present code recommended values for the strength reduction factors R and R_W, and to improve understanding of the factors affecting these values. The effect of soil conditions, in particular very soft soils, has been emphasized. Guidelines for a rational seismic evaluation of existing buildings have been developed. (V. V. Bertero)

Implications of Response of Structures to Ground Motions Recorded During the Loma Prieta Earthquake: Evaluation of Structural Response Factors

The information that has been gathered from recent earthquakes is of primary importance for specifying more reliable smoothed linear elastic design response spectra, and deriving more reliable values for the response modification factors (R_W). Enhanced smoothed linear elastic design response spectra and R_W factors, on which present procedures for defining seismic design forces are based, would improve structural safety significantly. In this study strength demand and strength reduction spectra were computed using simplified elastic and inelastic SDOF structural models and 36 ground motions recorded during the 1989 Loma Prieta earthquake. Special emphasis was given to local site conditions. Results show that strength reduction factors are significantly affected by the level of inelastic deformation, the period of vibration and by local site conditions. The use of period-independent strength reduction factors, as currently specified in many seismic design recommendations, may lead to unconservative designs. (V. V. Bertero)

GEOTECHNICAL ENGINEERING

Investigation of Soil Liquefaction at Critical East San Francisco Bay Area Sites in the 1989 Loma Prieta Earthquake

This research is contributing to ongoing studies involving (1) investigation and documentation of soil liquefaction, geotechnical conditions and site response characteristics at a number of critical sites in the Oakland, Alameda, Emeryville, and Treasure Island areas, and (2) the use of these important site-specific engineering field case studies as a basis for refinement and verification of techniques for evaluation of in-situ soil liquefaction resistance. The first of these objectives will contribute to an eventual comprehensive report on various aspects of the 1989 Loma Prieta Earthquake. The second objective will provide invaluable insight into the reliability of the most widely used techniques for evaluation of in-situ liquefaction potential. In addition, in conjunction with recent research efforts at U.C. Berkeley, these studies provide a basis for refinement and validation of recently developed techniques for evaluation of in-situ liquefaction potential based on Cone Penetration Testing (CPT). These studies can be expected to result in significant advances in the use of SPT and CPT as engineering tools for liquefaction investigations. (R. B. Seed)

Verification of Soil Liquefaction Analysis by Coordinated Geotechnical Centrifuge Studies

Dynamic centrifuge model tests, cyclic simple shear tests and numerical analyses were performed to investigate seismic pore pressure generation and post-liquefaction strength and deformation behavior of embankments consisting in part of saturated sandy soils. (R. B. Seed)

Seismic Response of Deep Soil Sites in the San Francisco Bay Area

The Loma Prieta Earthquake of October 17, 1989 caused considerable damage to transportation structures founded on deep soil deposits in and around the San Francisco Bay. Structures on shallow and firm sites suffered little or no damage. This is clear evidence that the damage pattern was largely determined by geotechnical factors. Research performed over the past 30 years at U.C. Berkeley has demonstrated that the amplified motions which will occur during a given earthquake can be predicted by site response analyses, and it is clearly of interest to perform such analyses in order to evaluate how the San Francisco Bay Area transportation system will respond to future earthquakes. The large number of seismic records obtained during the Loma Prieta event presents an unprecedented opportunity to refine and verify currently available methods of site response analysis to the long-term benefit of the entire state of California. In this research, seismological and geotechnical data required for good ground motion predictions at deep soil sites in the San Francisco Bay Area were collected. Existing methods of site response analysis are being validated and, if necessary, improved by checking the predicted motions against the large set of seismic recordings made during the Loma Prieta earthquake, and specific response predictions for deep soil sites beneath Caltrans facilities in and around the San Francisco Bay are being developed. (J. Lysmer, J. K. Mitchell, R. B. Seed and N. Sitar)

COMPUTER-AIDED ENGINEERING, STRUCTURAL ANALYSIS, AND STRUCTURAL DESIGN

Earthquake Analysis, Design and Safety Evaluation of Asymmetric-Plan Buildings

This program is concerned with the development of improved procedures for earthquake analysis and design of buildings with asymmetric plan which tend to suffer greater damage during earthquakes. The adequacy of torsional provisions in current building codes is being considered and the optimal choice determined for the reference center (the point on the floor from which the design eccentricity is measured) to determine the code-specified equivalent lateral forces. This research should improve the capability of assessing the safety of existing buildings and of designs proposed for structures to be constructed. (A. K. Chopra)

Nonlinear Analysis of Reinforced Concrete Three-Dimensional Structures

This research developed a three-dimensional program for the static and dynamic response analysis of reinforced concrete buildings of different structural systems by extending the DRAIN-2DX program to accommodate three-dimensional elements, to include slaving constraints and to enhance presently available pre- and post-processing tools while refining current procedures for the nonlinear static and dynamic analyses of structures. A major effort was the documentation of the modelling and the analysis procedures to facilitate the future addition of elements by other researchers and to guide engineers in the practical use of the program. (F. C. Filippou and G. H. Powell)

Earthquake Analysis, Design and Safety Evaluation of Concrete Dams and Intake-Outlet Towers

The purpose of this study is to improve procedures for earthquake analysis and design of concrete dams by addressing some important unresolved issues: consideration of spatial variations in the earthquake input around the canyon and their influence on arch dam response; rigorous treatment of dam-foundation rock interaction in analyzing arch dams; computation of earthquake-induced sliding and rocking displacements of a gravity-dam monolith, and the development of improved criteria for overturning and sliding stability; and improved modelling of water-sediment-rock interaction. A computer program was released for practical application that analyzes the earthquake response of intake-outlet towers with a plan of any shape considering structure-water-foundation rock interaction effects. A systematic series of analyses increased the understanding of these interaction effects in the earthquake response of the towers. A simplified procedure was developed appropriate for earthquake response analysis during the preliminary design and evaluation stage of intake-outlet towers. These results should enable better evaluation of the response of concrete dams and intake-outlet towers to earthquake ground motion, thus improving the capability to assess the safety of existing structures and of designs proposed for structures to be constructed. Results have been obtained for concrete gravity dams and concrete arch dams. Further research should lead to major improvements in the current state of practice computer programs for analyzing the earthquake response of concrete dams, and in the currently used criteria for overturning and sliding stability of gravity dams. (A. K. Chopra)

ADAP-88 Phase Two Parameter Study

This project was aimed at increasing the understanding of the effects of contraction joint opening on the earthquake response of arch dams by numerical investigations of Morrow Point dam using the newly-developed computer program for the earthquake analysis of arch dams, ADAP-88. Modelling and analysis

guidelines have been developed so the program can be used efficiently in arch dam safety evaluations. (G. L. Fenves and R. C. Reimer)

Precast Seismic Structural Systems (PRESSS) - Task 1.4 Analytical Platform Development

This research is part of a general investigation of the seismic behavior of precast prestressed structural systems (PRESSS). A flexible analytical platform is being developed in order to study the behavior of two broad types of structural system; namely, strong connection type and ductile connection type. This platform will be an extension of the program DRAIN-2DX to accommodate the development of three-dimensional elements, to include slaving constraints and to enhance presently available pre- and post-processing tools while refining current procedures for the nonlinear static and dynamic analyses of structures. (G. H. Powell and F. C. Filippou)

Guidelines for Effective Use of Nonlinear Structural Analysis for Bridge Structures

Nonlinear structural analysis is needed increasingly as a tool for the investigation of bridge structures, particularly with regard to the retrofitting of existing structures and the development of the specifications for base isolation. Nonlinear analysis is, however, still a relatively new area. There are no well-defined principles for practical application of nonlinear analysis techniques, and few engineers have the training to use the tool effectively. The objective of this research has been to develop guidelines, examples, educational materials and long term plans for the effective and practical use of nonlinear analysis for bridge structures. (G. H. Powell)

Response Spectrum Analysis of Bridges Subjected to Differential Support Motions Based on Loma Prieta Earthquake Data

The Loma Prieta data were used to develop a new response spectrum method for analysis of bridges and other multiply-supported structures that are subjected to differential ground motion. The earthquake data were used to construct and calibrate a correlation model for the support motions of the Bay Bridge, accounting for the effects of travelling waves, attenuation, propagation path, and local soil and geologic structures. The method is simple and appropriate for engineering analysis and design of bridges. The new response method will be used to investigate the response of the Bay Bridge during the Loma Prieta earthquake and to determine the causes of its failure. The results of this analysis will be compared with planned time-history analysis of the bridge by a separate research team at Berkeley, thus verifying the response spectrum method. The method will then be used to predict the response of the Bay Bridge to a potential earthquake of large magnitude on the San Andreas or Hayward faults. This part will be carried out in parallel with other planned studies of the Bay Bridge at UCB. (A. Der Kiureghian)

Evaluation of Code Accidental Torsional Provisions Using Strong Motion Records from Regular Buildings

This research continues a program to develop an improved understanding of the seismic torsional response of buildings with nominally-symmetric plan. Recorded earthquake motions provide the most direct basis for investigating this problem because it is not amenable to traditional analytical approaches. The results of this study will enable evaluation of code torsional provisions and provide a basis for improvements in these provisions. The purpose of the present research is to determine how well the effects of plan-asymmetry (or torsional coupling) are represented by torsional provisions in seismic codes. (A. K. Chopra)

Design Guidelines for Ductility and Drift Limits

The ultimate goal of this project was to develop a methodology for the preliminary design of earthquake-resistant structures that is more practical and more reliable than those methods currently available in the United States and Japan. Emphasis has been on improving the definition of "acceptable damage" and then quantifying "more reliable seismic design coefficients" for the estimation of seismic forces and interstory drift limits than are presently specified in the seismic codes. Special attention was paid to large buildings and freeway structures with different types of foundation and superstructure systems, although such a methodology could be applied for different engineering structures. The results of this study are available in three EERC reports. (V. V. Bertero)

Use of Special Connections to Reduce Seismic Response of Steel Structures

This part of the "Innovative Approach to Controlling the Seismic Response of Buildings" project under the CUREe-Kajima Research Program is exploring the feasibility of using special beam-to-column connections to control and to reduce the seismic response. A comprehensive analytical study is underway to investigate dynamic behavior of the proposed system. Currently, specimens for the proposed experimental program are being fabricated and preparation is being made to pour the concrete slabs. (A. Astaneh-Asl, G. L. Fenves and K. McMullin)

Design of High-Rise Reinforced Concrete Buildings

The goal of this CUREe-Kajima project is to advance, through an evaluation of present knowledge and through coordinated research, the states of the art and practice in seismic design of high-rise reinforced concrete buildings. EERC researchers are involved in three current tasks:

Task 1: Review of Earthquake Resistant Design of High-Rise Reinforced Concrete Buildings
This part focuses on a review of the different structural systems and seismic design criteria that have been used in regions of high seismic risk and on sites with soft soil conditions. Analysis methods and design procedures will be reviewed and critiqued. Research on the linear and nonlinear seismic response of a reinforced concrete tubular structure is continuing. (V. V. Bertero)

Task 2: Review of Seismic Performance
In this part the observed and recorded performances of various tall building systems during past earthquakes are being reviewed and evaluated. (V. V. Bertero)

Task 3: Dynamic Response Analysis of Promising Systems
From the reviews conducted in Tasks 1 and 2, the more promising structural systems will be selected for detailed evaluation of their design and their dynamic response to selected critical ground motions. Representative systems will be designed according to the lateral force requirements in current building codes. Two dimensional and three dimensional models of these structures will be developed for linear and nonlinear response analysis under earthquake motions representative of soft soil sites. Simplified modeling, incorporating soil and foundation behavior, will be used to study the sensitivity of different parameters on the dynamic response of the total structure-foundation system. Preliminary designs of the 30-story S-K building based on U.S. practice have been completed and a report on linear and nonlinear seismic responses prepared. (G. H. Powell and F. C. Filippou)

EVALUATION AND REHABILITATION OF EXISTING STRUCTURES

Seismic Resistance and Retrofit of Post-Tensioned Flat-Plate Floors

In regions of high seismicity in the U.S., the flat-plate floor system is still one of the most widely used systems in multistory buildings braced by stiffer ductile frames or structural walls. Recent research has shown that even in these braced structures the conventionally-reinforced flat plate is susceptible to failures if gravity shear stresses on the floor and lateral drifts are not controlled to acceptable values. The performance of the unbonded post-tensioned flat-plate floor in a similar situation is not well known and was studied in this project. Retrofitting measures were also studied. (J. P. Moehle and F. C. Filippou)

Seismic Condition Assessment of the Bay Bridge

The interruption of traffic flow on the Bay Bridge following the Loma Prieta earthquake has had an immense economic impact. Unless corrective measures are taken, it is possible that the impact will be even more severe in a future strong earthquake. This study has four phases: (1) in-depth investigation of the damage caused by the Loma Prieta earthquake; (2) extensive studies of the expected dynamic behavior during future strong earthquakes; (3) development of design recommendations for retrofitting; and (4) development of plans to instrument the East Bay crossing. Phases 1 and 2 involved developing a realistic computer model of the East Bay crossing and conducting dynamic analyses using the model and credible ground motions related to known faults in the area. In Phase 3, the results of Phases 1 and 2 are being used to develop recommendations on retrofitting. (A. Astaneh-Asl, B. A. Bolt, G. L. Fenves, J. Lysmer, P. Monteiro, G. H. Powell and R. Stephen)

Evaluation of Dumbarton Bridge Response in the Loma Prieta Earthquake

The Department of Transportation instrumented the Dumbarton Bridge with twenty-four strong motion accelerometers after construction of the replacement structure. These instruments triggered in the Loma Prieta earthquake. The objective of this investigation was to evaluate the processed strong motion records and assess the dynamic response of the bridge during the earthquake. A mathematical model of the bridge superstructure and substructure was developed and used in the seismic analysis of the Dumbarton Bridge in order to correlate the analytical response with the measured response. Although the model incorporates the essential aspects of the motion of the Dumbarton Bridge in the Loma Prieta earthquake, several shortcomings were identified and further research should concentrate on three factors - nonlinear effects of joints, soil-structure interaction and input ground motion. This investigation provided a better understanding of the earthquake response of the bridge and improved guidelines for the seismic instrumentation, evaluation and modelling of long, multiple-span girder bridges. (G. L. Fenves, F. C. Filippou, J. Lysmer and A. Astaneh-Asl)

Evaluation and Retrofitting of Multi-Level and Multiple-Column Structures (Phase 3)

A significant number of elevated roadways in California and other seismically active areas of the United States were constructed before the modern fundamentals of earthquake resistant design had been established. Many of these are in need of re-evaluation and seismic upgrading to improve their earthquake safety. The prevalence of these older structures and the enormous cost associated with their upgrading demand that safe and efficient techniques be available. However, current understanding of the behavior of many of these older structures, particularly those of reinforced concrete, is insufficient to enable

efficient and effective seismic evaluation and retrofitting. There is an immediate need to develop the technology needed to accomplish the required evaluation and upgrading. The objective of this research has been to develop an understanding of the seismic behavior of existing and new reinforced concrete multilevel and multiple-column elevated structures, to determine methods for retrofitting such structures, and to present an evaluation and retrofitting methodology for implementation. This phase of the study addresses the specific information and procedures required by Caltrans to initiate its retrofit efforts. (S. A. Mahin, V. V. Bertero, G. L. Fenves, F. C. Filippou, J. P. Moehle, and C. R. Thewalt)

Evaluation of Retrofit Effectiveness

The focus of this research was to assess the performance of previously retrofitted buildings, to carry out field or laboratory investigations to understand or improve deficiencies detected in the retrofitting procedures and, where opportunities exist, develop and verify emergency retrofit techniques. Specifically, two areas of research were undertaken: seismic performance of previously retrofitted structures and retrofitting of plywood shear walls. The end result of this phase of the investigation was a report summarizing the general character of damage to retrofitted structures, a review of available damage statistics, detailed reports on the case study buildings and on the results of any field test, observations for improved retrofit procedures, and recommendations for future research. (S. A. Mahin)

Evaluation of Existing Reinforced Concrete Columns

Reinforced concrete frames constructed prior to the 1970s pose one of the greatest hazards for loss of life due to collapse during strong ground shaking. One of the key deficiencies of such structures is inadequate proportioning and detailing of columns. This project, which is a collaboration between researchers and practicing engineers, is an experimentally based study of the behavior of deficient columns, from which methods will be developed for calculating strength and deformability of existing columns for use by structural engineers. (J. P. Moehle and S. A. Mahin)

Proof Testing of Double Deck Viaduct Retrofit Strategies

A number of new design concepts and construction technologies are to be utilized in the earthquake repair and retrofit of double deck freeway structures damaged in the San Francisco area during the Loma Prieta earthquake. A series of five large-scale test specimens are being studied, experimentally and analytically, to verify the efficacy of these concepts and technologies and to validate many of the fundamental design bases of this retrofit. (S. A. Mahin, J. P. Moehle and C. R. Thewalt)

BASE ISOLATION, PASSIVE ENERGY DISSIPATION, AND ACTIVE CONTROL

Testing and Evaluation of Base-Isolated Structures

A model of a base-isolated experimental building at the Tohoku University at Sendai was tested on the shake table at EERC to determine the response to very large earthquakes. The building and its identical but conventionally based partner, have been subjected to many earthquakes for which the ground motion and structural responses have been recorded. These earthquakes, however, have all been of low intensity and it is unlikely that the buildings will experience an extreme earthquake in the short term. The building was accommodated on the shake table at a scale factor of 2.5. The experimental results are being evaluated to determine the correlation between shake table testing of base-isolated structures and the response of full-scale structures to real earthquakes; to determine the accuracy of available analysis programs for the prediction of the seismic response of base-isolated structures; to compare the behavior of conventional reinforced concrete structures to base-isolated reinforced concrete structures at various levels of earthquake intensity from low level to beyond design level events; and to investigate the failure mechanisms of base-isolated structures under extreme earthquake loading. (J. M. Kelly)

Active Isolation for Critical Structural Systems

This research effort continued a project devoted to verifying that a previously developed theoretical control algorithm can be implemented in a real system and be effective. To this end, a three-story structural model was mounted on the EERC shake table and tested as a fixed-base structure, a base-isolated structure without control, and as a base-isolated structure with Robust Control Algorithm providing active control. In follow-up research, the lessons learned from this test program have been extended to a larger structural model. A 16-bit accuracy analogue-digital board was used to obtain absolute velocities and displacements from measured accelerations. An algorithm was developed to compute the best gain to be used based on the physical variables of the system and the limitations of the analogue-digital conversions. (J. M. Kelly and G. Leitmann)

Long Period Isolation System for Nuclear Facilities

Tests were performed on scale models of the HWR-NPR plant in order to assess the safety of the base isolation designs for NPR under a number of realistic ground motions characteristic of the Savannah site. These ground motions, which were developed by Argonne National Laboratory and furnished to EERC included effects of the site frequency, the degree of embedment of the structure and anticipated soil-structure interaction of the isolated structure. (J. M. Kelly)

Isolated Computer Floor Tests

Tests on a concrete base floor slab with a raised computer floor, and isolated by four sliders and a rubber bearing, were conducted on the EERC shake table. (J. M. Kelly)

Innovative Support Methods for Secondary Systems and Non-Structural Components

Efforts have concentrated on the optimum design for nonlinear hybrid systems for computer floor isolation, and the use of shape memory alloy rods as energy-dissipating devices. The approach is based

on a probabilistic characterization of the ground motion process and the constraints in terms of deformability and active system capacity. A constrained minimization problem was formulated with acceleration response as its objective function. The use of shape memory alloys in tuned mass dampers is being evaluated in an experimental program. The results so far are promising. (J. M. Kelly)

Seismic Retrofit and Energy Dissipators

In this investigation, earlier studies of slotted bolted connections have been extended to a larger range of bolt sizes and types of cyclic loading. The behavior of several bolts at a connection under cyclic loading has also been investigated. After analysis of these results, a model test frame for experiments on the shake table was designed. The test frames were subjected to several simulated earthquakes, the results analyzed, and practical design procedures for energy dissipating connections and the range of their applicability were developed. It is believed that the proposed system utilizing conventional fabrication procedures is exceptionally cost effective. (E. P. Popov)

II. SCHOLARLY ACTIVITIES

A. CURRENT RESEARCH PROGRAMS
Contracts and Grants

Principal Investigator	Funding Agency	Project Title	Period of Funding	Fund Type
NEW AWARDS:				
Astaneh-Asl, A. Fenves, G. L.	CUREe/Kajima	Use of Special Connections to Reduce Seismic Response of Steel Structures	1/92-1/93	G
Bertero, V. V.	CUREe/Kajima	Design of High-Rise Reinforced Concrete Buildings	7/91-1/93	G
Chopra, A. K.	CAL DOC	Evaluation of Code Accidental Torsional Provisions Using Strong Motion Records From Regular Buildings	7/91-9/92	C
Chopra, A. K.	NSF	Earthquake Analysis, Design, and Safety Evaluation of Concrete Dams	4/92-3/93	G
Filippou, F. C. Powell, G. H.	CUREe/Kajima	Design of High-Rise Reinforced Concrete Buildings	7/91-1/93	G
Kelly, J. M.	GE	ALMR Seismic Isolation Tasks	6/92-9/92	C
Kelly, J. M.	NCEER	Innovative Support Methods For Secondary Systems	9/91-8/92	SC
Mahin, S. A.	EPS	Fixed and Isolated Unreinforced Masonry Panel Tests	4/92-9/92	C
Moehle, J. P.	LSCA	California State Library - Title III On-Line Conversion Of Holdings	8/91-9/92	G
Moehle, J. P. Mahin, S. A.	NSF	National Clearinghouse for Loma Prieta Earthquake Information	9/91-8/93	G
Moehle, J. P.	USGS	Loma Prieta Data Archive Project	3/92-3/93	G
Moehle, J. P. Mahin, S. A.	NSF	Evaluation of Existing Reinforced Concrete Columns	9/91-8/93	G

Principal Investigator	Funding Agency	Project Title	Period of Funding	Fund Type
CONTINUING AWARDS:				
Astaneh-Asl, A. Bolt, B. A. Fenves, G. L. Lysmer, J. Powell, G. H. Monteiro, P. J. Stephen, R. M.	CALTRANS	Seismic Condition Assessment of the Bay Bridge	7/90-7/92	C
Bertero, V. V.	CAL DOC	Implications of Response of Structures to Ground Motions Recorded During the Loma Prieta Earthquake: Evaluation of Structural Response Factors	6/90-11/91	C
Bertero, V. V.	CUREe-Kajima	Design Guidelines for Ductility and Drift Limits	1/90-7/91	G
Bertero, V. V.	NSF	Implications of Recorded Data on Earthquake Resistant Design	3/90-8/92	G
Bertero, V. V.	NSF	Integrated Analysis of the Data Recorded During the Whittier Narrows Earthquake of 10/1/87 and Implications for a Major Earthquake in the Los Angeles Area	3/88-10/91	G
Chopra, A. K.	NSF	Earthquake Analysis, Design and Safety Evaluation of Concrete Dams and Intake-Outlet Towers	12/87-6/92	G
Chopra, A. K.	NSF	Earthquake Analysis Design and Safety Evaluation of Asymmetric - Plan Buildings	2/90-1/93	G
Der Kiureghian, A.	NSF	Response Spectrum Analysis of Bridges Subjected to Differential Support Motions Based on Loma Prieta Earthquake Data	5/90-5/92	G

Principal Investigator	Funding Agency	Project Title	Period of Funding	Fund Type
CONTINUING AWARDS: cont'd.				
Fenves, G. L. Filippou, F. C. Lysmer, J. Astaneh-Asl, A.	CALTRANS	Evaluation of Dumbarton Bridge Response in the Loma Prieta Earthquake	5/90-6/92	C
Fenves, G. L. Reimer, R. C.	US-COE	ADAP-88 Phase Two Parameter Study	5/91-3/92	C
Filippou, F. C. Powell, G. H.	CUREe/Kajima	Nonlinear Analysis of Reinforced Concrete Three-Dimensional Structures	1/90-7/91	G
Kelly, J. M.	Argonne	Test Matrix for Isolator Bearings	4/90-10/91	SC
Kelly, J. M. Leitmann, G.	NSF	Active Isolation For Critical Structural Systems	3/88-6/92	G
Lysmer, J. Seed, R. B. Sitar, N. Mitchell, J. K.	CALTRANS	Seismic Response of Deep Soil Sites in the San Francisco Bay Area	7/90-12/91	C
Mahin, S. A. Moehle, J. P. Thewalt, C. R.	CALTRANS	Proof Testing of Double Deck Viaduct Retrofit Strategies	3/91-6/93	C
Mahin, S. A. Bertero, V. V. Moehle, J. P. Filippou, F. C. Fenves, G. L. Thewalt, C. R.	CALTRANS	Phase 3 Retrofitting Multi-Level/Multiple Column Structures	3/90-12/92	C

Principal Investigator	Funding Agency	Project Title	Period of Funding	Fund Type
CONTINUING AWARDS: (cont'd.)				
Mahin, S. A.	NSF	Evaluation of Retrofit Effectiveness	12/89-11/91	G
Moehle, J. P.	NSF	National Clearing House for Loma Prieta Earthquake Information	6/90-5/93	G
Moehle, J. P. Fenves, G. L.	NSF	National Information Service for Earthquake Engineering	10/90-12/92	G
Moehle, J. P. Filippou, F. C.	NSF	Seismic Resistance and Retrofit of Post-Tensioned Flat-Plate Floors	1/89-12/91	G
Popov, E. P.	NSF	Seismic Retrofit with Energy Dissipators	11/90-10/92	G
Powell, G. H.	CALTRANS	Guidelines for Effective Use of Nonlinear Structural Analysis for Bridge Structures	5/90-6/92	C
Powell, G. H. Filippou, F. C.	NSF	Precast Seismic Structural Systems (Presss) - Task 1.4: Analytical Platform Development	5/90-4/93	G
Seed, R. B.	NSF	Verification of Soil Liquefaction Analysis by Coordinated Geotechnical Centrifuge Studies	11/89-10/91	G

Principal Investigator	Funding Agency	Project Title	Period of Funding	Fund Type
PROPOSED AWARDS:				
Astaneh-Asl, A.	Caltrans	Seismic Condition Assessment of the Bay Bridge	7/92-7/93	C
Fenves, G. L. Filippou, F. C.	CAL DOC	Engineering Evaluation of the Dumbarton Bridge in the Loma Prieta Earthquake	5/92-5/93	C
Fenves, G. L.	CAL DOC	Evaluation of Building Code Provisions for Soil Structure Interaction Using Strong Motion Records	5/92-5/93	C
Fenves, G. L.	US Reclam.	Constitutive Models for Earthquake Analysis of Concrete Dams	9/92-8/93	G
Filippou, F. C.	CAL DOC	Seismic Response of URM Infill Frame Buildings	5/92-5/93	C
Mahin, S. A.	CAL DOC	Nonlinear Response of Buildings in the Loma Prieta Earthquake	7/90-6/91	C
Mahin, S. A.	NSF	US-Japan Seminar: Development and Future Dimensions of Structural Testing Techniques	1/93-12/93	G
McNiven, H. D.	AID	Improvement of the Earthquake Resistance of Low Strength Masonry by Means of Bamboo Reinforcement	10/91-7/93	G
Mitchell, J. K.	NCEER	Seismic Vulnerability of Existing Highway Construction	10/92-9/93	SC
Powell, G. H. Filippou, F. C.	Caltrans	Inelastic Modelling of Bridge Bent Behavior with Emphasis on Shear, Bond Skip, and Torsional Effects	1/92-9/93	C
Thewalt, C. R.	CAL DOC	Seismic Data Manipulation and Visualization Package	7/90-6/91	C
Thewalt, C. R. Moehle, J. P.	NSF	An Archival Standard for Experimental Data in Earthquake Engineering	10/92-9/94	G

Principal Investigator	Funding Agency	Project Title
GIFTS:		
Bertero, V. V.	R.C. Croop	Earthquake Research
Kelly, J. M.	Malaysian Rubber Producer's Res. Assoc.	Research in the area of low cost base isolation systems
Kelly, J. M.	Malaysian Rubber Producer's Res. Assoc.	Research in the area of developing low cost base isolation systems for seismic protection of public housing and other structures in developing countries
Kelly, J. M.	Malaysian Rubber Producer's Res. Assoc.	Research on the development of low cost base isolation systems for seismic protection of structures in developing countries with earthquake hazards

Principal Investigator	Agency	Project Title	Period of Project
Service-To-Industry:			
Kelly, J. M.	IBM	Computer Restraint Tests	5/91-3/92
Kelly, J. M.	Shimizu	Testing Evaluation of Base Isolated Structures	6/90-6/92
Kelly, J. M.	Shimizu	Testing Evaluation of Base Isolated Structures	9/90-indef.

II. SCHOLARLY ACTIVITIES

B. PUBLIC SERVICE PROGRAMS

National Information Service for Earthquake Engineering

The National Information Service for Earthquake Engineering (NISEE) is a public service project of the National Science Foundation. It is housed and operated at the Earthquake Engineering Research Center. The objective of NISEE is to disseminate information on earthquake engineering and allied fields to practicing engineers and related professionals, academic researchers, government agencies, and the general public. The program is divided into three main functions:

- **Computer Applications** provides software in the fields of earthquake engineering, structural analysis, and risk assessment. This software is used by engineering practitioners and other researchers in design and analysis.

- The **EERC Library** gathers earthquake engineering literature, organizes it through the library catalog and other information retrieval tools, and uses these tools to provide research results directly to researchers and practitioners.

- **Earthquake Engineering Abstracts** gathers abstracts and citations from earthquake engineering literature world-wide and distributes the information in a condensed form through the *Abstract Journal in Earthquake Engineering* and the NISEE Database.

The NISEE project also publishes the *EERC News* and assists in publishing the EERC Reports series.

During 1991-92, NISEE continued its program of distributing software, publishing, and providing library services. In addition, it received follow-on funding for the National Clearinghouse for Loma Prieta Earthquake Information and issued the November 1991 and April 1992 Loma Prieta Clearinghouse catalogs. In March 1992, NISEE received a joint U.S. Geological Survey/National Science Foundation grant for the Loma Prieta Data Archive Project. For this project, NISEE will distribute the machine-readable data files from the Loma Prieta earthquake on CD-ROM. In August 1991, the EERC Library received a grant to convert its holdings to machine-readable form.

Publicity continued to be a major activity and is detailed on the attached list. Notable events included the Tenth World Conference in Earthquake Engineering and the American Library Association Conference in San Francisco.

The NISEE Advisory Committee met on February 10, 1992 and commended NISEE for its progress for the year.

The EERC Library received a major gift of 5800 slides and 15,000 photographs from Karl V. Steinbrugge. These images document forty years of earthquake damage and represent a very important addition to the collection. NISEE is exploring methods of indexing and digitizing the slides and making them available on the Internet.

Computer Applications

The Computer Applications Unit of NISEE collects and disseminates computer software produced as a result of National Science Foundation and other research grants. Software is deposited with NISEE not only by researchers at the University of California at Berkeley but other institutions as well. Since July 1, 1991, more than 381 software packages and 723 user documents were distributed. New or revised versions of the following programs were received this year: BIAX-2, SUPER-ETABS (Windows), DRAIN-2DX (PC-DOS, Windows, Workstation), WEBTAP, DRAIN-3DX (PC-DOS), PC-ANSR, SAP-IV (Fujitsu-UXP/M), ADAP-88, COMBAT.PC, 3D-BASIS (PC-DOS, Windows) and TEMPO. A total of 109 software packages are listed in the catalog, thirty of which have PC versions.

The NISEE Database

The NISEE database is a specialized bibliographic database devoted to coverage of the world's literature in earthquake engineering and earthquake hazards mitigation. Currently the database contains more than 17,530 items published since 1983. More than 3257 abstracts were added to the database this year, including more than 583 items on the 1989 Loma Prieta earthquake. Coverage includes primarily technical journal papers, research reports, books, and conference proceedings. Loma Prieta materials also include audiovisual materials, slides, maps, and strong-motion records.

Usage of the NISEE database continues to grow. During the Summer of 1992, the NISEE database was mounted in experimental mode on Melvyl, the University of California union online catalog. It will be available on public menus some time this fall. The number of searches for all classes of users averaged over 140 per month with more than 74 accounts assigned. The NISEE Database is featured at all NISEE exhibits.

Earthquake Engineering Abstracts

The Earthquake Engineering Abstracts unit is responsible for the contents of the NISEE Database and the *Abstract Journal in Earthquake Engineering*. In addition, it performs editorial and publishing functions for the *EERC News*.

This year, Volume 20, Issue 1 and 2 (covering 1990 literature), and Volume 21, Issue 1 (covering 1991 literature) were published. Important efficiencies were introduced into the production process as the older data entry system was superseded by a WordPerfect data entry system. In addition, student workers were introduced into the work flow for data entry and proofreading.

Two issues of the *EERC News* were published this year, highlighting research on a new response spectrum method for multiply supported structures, on the performance of improved ground during the Loma Prieta earthquake, and on behavior and repair of outriggers and knee joints.

EERC Library

The staff answered 1500 requests for assistance in 1991-92, and the library circulated over 5000 items. About 100 searches per month were made in the NISEE Database, NCEER's Quakeline, and commercial databases such as COMPENDEX. New items cataloged for the collection numbered 725.

Through a Library Services and Construction Act grant from the California State Library, the Library's entire holdings of 10,000 titles were converted to machine-readable form. In September 1992, the card catalog was moved out of the public area. Staff and users now rely on MELVYL, the University of California union catalog for access to the collection.

The Library maintains a list of 100 institutions with whom publications are exchanged. This list was reviewed in 1991-92, and adjustments were made to the mailing list.

The EERC Library regularly receives donations of material from earthquake engineers. Most notable this year were 1000 books from Frank E. McClure and a major slide and photograph collection from Karl V. Steinbrugge. The Steinbrugge collection contains 5800 slides and 15,000 black and white photographs documenting the last forty years of earthquakes. The unique aspect of this collection is that it is extremely well documented, providing for excellent access by users. The Library has access to a slide retrieval system called ImageQuery, by which slides are digitized and retrieved by subject key words. We are exploring funding sources and hope to make these slides available on the Internet.

National Clearinghouse on Loma Prieta Earthquake Information

In May 1991, the National Science Foundation renewed the charge for EERC to be the National Clearinghouse for Loma Prieta Earthquake Information. The function of the project is to collect, disseminate, and publicize material related to the Loma Prieta earthquake.

For the second year, EERC staff continued efforts established for the first year. The mailing list now stands at 900 persons. Publicity efforts and press releases continue to be mounted as each catalog is published. In November 1991, the third Loma Prieta catalog was published with 439 citations. In April 1992, a fourth catalog was published with 142 citations. The entire set of catalogs is sold for a $10.00 shipping/handling charge.

For the coming year, catalogs will be published in October 1992 and April 1993. A final, cumulative Loma Prieta catalog will be published as a supplemental issue to *Earthquake Spectra*, thus placing the catalog in the open literature and making the information available through a broad range of resources.

Loma Prieta Data Archive

Under the general editorship of the U.S. Geological Survey (USGS), the National Earthquake Hazards Reduction Program (NEHRP) will issue the official report to Congress describing the post-earthquake investigation of the October 17, 1989, Loma Prieta, California earthquake. That report will synthesize results of earthquake research funded and performed by a wide range of investigators. These investigators have produced or gathered a variety of data sets generated by the earthquake or produced as a result of research into the earthquake. Of necessity, the NEHRP report will not be a suitable medium for distributing these extensive data.

In March 1992, NISEE was funded by the USGS and National Science Foundation to establish the Loma Prieta Data Archive. This project will gather, organize, and issue the raw data associated with the Loma Prieta earthquake in one coherent format. A printed guide to the data will be issued as an addendum to the U.S. Geological Survey (USGS) Professional Paper series, which will constitute the NEHRP Report to Congress. The CD-ROMs themselves will be distributed by NISEE at cost. In particular, NISEE will

- **identify** the data sources produced as a result of the earthquake
- **gather** the data together
- **organize and issue** the data on CD-ROM with a printed user's guide
- **deposit** the guide and CD-ROMs in selected national and university libraries throughout the country as well as distribute them at cost to those interested
- **publicize and disseminate** the archive to researchers worldwide

During the first four months of the project, NISEE has distributed a mailing to contributors to the Professional Paper series, advertised the project in professional journals, and begun to receive files. By March 1993, processing of data will begin.

Earthquake Engineering Research Center Library Bibliographic Outreach Project

In August 1991, the California State Library provided a grant to the EERC Library to convert its holdings to machine-readable form. The grant is made available through Federal Library Services and Construction Act funds. Before this grant, the EERC Library card catalog was the only index to EERC holdings. Patrons could discover the nature of the collection only by visiting or telephoning the EERC Library. By converting our holdings to machine-readable form, library holdings are publicized on international networks and made available to a wide range of users.

Between August 1991 and August 1992, the EERC Library, using OCLC as a contract conversion agent, mailed its shelflist cards to OCLC, and OCLC converted them to machine-readable form. Of the 10,000 cards sent, about 47% were found already on the OCLC database, the remainder were new to the system. This emphasizes the unique nature of the EERC Library collection in that no other library in the country had previously cataloged these items. Response to the addition of these items to the database was almost immediate. The EERC Library's lending of materials doubled within one week and has continued to grow as more items have been added to the OCLC database.

As items were converted on OCLC, they were also loaded into Melvyl, the University of California online library catalog. The effect of this step was also immediate. Libraries in the UC system began to request materials from us, and students from the Berkeley campus began to visit the EERC Library indicating they had found our holdings in Melvyl.

In September 1992, the card catalog was moved from the public area and replaced with terminals.

Future Plans

Publication of the *Abstract Journal* continues according to the new schedule. Volume 21, Issue 2 will be published by early 1993 and Volume 16 (1986 literature) will be completed by the end of 1992. Volume 17 and 18 (covering 1987 and 1988 literature) will be published in 1993 as well as Volume 22 (covering 1992 literature).

A personal computer supporting the desktop publishing system PageMaker has been ordered. It will be used for layout of the *EERC News* and production of NISEE and EERC brochures and flyers.

In September 1992, NISEE staff and personnel from the National Center for Earthquake Engineering Research (NCEER) reached an agreement to jointly process the proceedings of the Tenth World Conference in Earthquake Engineering. NISEE staff will process 600 abstracts, and NCEER staff will process 600 abstracts. These machine-readable files will be loaded into each others' databases as a test

for exchanging future files. The entire proceedings of the Tenth World Conference will be published in Volume 22 of the *Abstract Journal in Earthquake Engineering.*

In 1992-93, NISEE staff will continue regular activities of software dissemination, publishing, and responding to requests for service. In addition, the final, cumulative, Loma Prieta Clearinghouse catalog will be published in October 1993 as a supplemental issue to *Earthquake Spectra.* Work will continue on developing funding for the Steinbrugge slide collection. Data collection will continue for the Loma Prieta Data Archive project.

NISEE Meeting/Activity List

1. American Library Association, Atlanta, June 28-July 2, 1991. Joint exhibit with the National Center for Earthquake Engineering Research (NCEER), Federal Emergency Management Agency (FEMA), NISEE-Caltech, and the Natural Hazards Research and Applications Information Center (NHRAIC).

2. Natural Hazards Workshop, Boulder, Colorado, July 15-17, 1991. Poster session on Loma Prieta Clearinghouse.

3. UC Berkeley, Committee on Professional and Career Development. Presentation on July 24, 1991 about American Library Assn meeting, described NISEE activities.

4. Third U.S. Conference on Lifeline Earthquake Engineering, Los Angeles, August 22-23, 1991.

5. Fourth International Conference on Seismic Zonation, Stanford University, August 25-29, 1991.

6. First U.S.-Japan Conference on Corporate Earthquake Programs, San Jose State University, September, 1991. Brochures only.

7. Structural Engineers Association of California Annual Meeting, Palm Springs, October 10-12, 1991.

8. "Are we prepared for the next earthquake? A nontechnical seminar on possible effects of a major Bay Area earthquake." October 16, 1991, Berkeley campus. Display on EERC and NISEE.

9. Military Librarian's Annual Workshop, Asilomar Conference Center, Pacific Grove, California, November 14, 1991. Presentation on sources of information in earthquake engineering.

10. Seismic Retrofit of Historic Buildings, San Francisco, November 18-19, 1991. Brochures only.

11. International Masonry Institute, travelling workshop on "Seismic Retrofit of Unreinforced Masonry Buildings" between November 7 and December 10, 1991. Sample NISEE database search included in registration packets.

12. Earthquake Engineering Research Institute, Annual Meeting February 6-8, 1992, San Francisco

13. College of Engineering Industrial Liaison Program, March 11-12, 1992, UC Berkeley

14. Second Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, Hayward, March 25-27, 1992.

NISEE Meeting/Activity List (continued)

15. Computer Workshop on the Seismic Analysis, Design and Retrofitting of Bridges. Jointly sponsored with UC Extension, March 23-27, 1992.

16. Association of Small Information and Dissemination Centers, annual meeting, New Orleans, April 1992.

17. Stanford Public Retrieval Information System (SPIRES) Spring Meeting, Palo Alto, April 1992.

18. College of Engineering Alumni Day, April 11, 1992

19. Fifth Short Course on Soil Dynamics and Foundation Engineering, San Francisco, April 20-24, 1992.

20. Strong Motion Instrumentation Program, SMIP-92, Sacramento, California, May 21, 1992.

21. Seismic Design and Retrofit of Bridges, Berkeley campus, June 8-9, 1992.

22. Special Libraries Assn, June 8, 1992, San Francisco. Presentation to the Geography and Map Division on "How Earthquake Engineers Use Maps."

23. Special Libraries Assn, June 8, 1992, San Francisco, Social Science and Transportation Division, "Putting the Pieces Back Together: the Loma Prieta Earthquake's Effect on Regional Planning, Transportation and Housing in the San Francisco Bay Area," J. Zerneke moderator.

24. American Society for Civil Engineers, 8th Conference on Computing in Civil Engineering, Dallas, Texas, June 7-11, 1992.

25. American Library Assn, June 27-30, 1992, San Francisco. Joint exhibit with Southern California Earthquake Preparedness Project (SCEPP), Bay Area Regional Earthquake Preparedness Project (BAREPP), National Center for Earthquake Engineering Research (NCEER), California Division of Mines and Geology (CDMG), NISEE-Caltech and Natural Hazards Research and Applications Information Center (NHRAIC).

26. Tenth World Conference on Earthquake Engineering, July 19-24, Madrid, Spain.

II. SCHOLARLY ACTIVITIES

B. PUBLIC SERVICE PROGRAMS - Joint Seminars and Training Programs

DATE	SPEAKER(S)	SUBJECT
October 17, 1991	Professors Vitelmo V. Bertero, Bruce A. Bolt, Nadesan Permaul, Stephen A. Mahin, and Mary Comerio.	**Are We Prepared for the Next Earthquake?** A non-technical seminar on possible effects of a major Bay Area earthquake.
March 11-12, 1992	Professors Abolhassan Astaneh-Asl, Jack P. Moehle, Graham Powell, and Joseph Penzien; Dr. James Roberts, CAL DOT.	**Seismic Design and Retrofitting of Transportation Structures**, during the 14th Annual Conference, Industrial Liaison Program, University of California at Berkeley campus.
March 23-27, 1992	Ken Wong and Jeanette Zerneke.	**Computer Workshop on the Seismic Analysis, Design and Retrofitting of Bridges**, University Extension, University of California at Berkeley campus.
May 12, 1992	Professors Vitelmo V. Bertero, and Bruce A. Bolt; graduate students Scott Ashford, José Martinez-Cruzado, and Allah N. Qaisrani.	Special lectures on the seismological, geotechnical engineering, and structural engineering aspects of the Petrolia, California earthquakes of 25-26 April 1992, and the Erzincan, Turkey earthquake of 13 March 1992.
June 8-9, 1992	Professors Abolhassan Astaneh-Asl, Bruce A. Bolt, Armen Der Kiureghian, Gregory L. Fenves, Filip Filippou, Stephen A. Mahin, James K. Mitchell, Graham Powell, Raymond B. Seed, Nicholas Sitar, and Christopher Thewalt; Kenneth A. Jackura, Mark Yashinsky, and Thomas R. Cooper, CALDOT; Ronald L. Mayes, Dynamic Isolation Systems.	**Seismic Design and Retrofit of Bridges**, jointly sponsored by the Department of Civil Engineering, Earthquake Engineering Research Center, and California Department of Transportation.

II. SCHOLARLY ACTIVITIES

C. PUBLICATIONS, Part I. (EERC AND NISEE)

EERC PUBLICATIONS

Author(s)	Report No.	Title	Press Date
Kelly, J. M. Chalhoub, M. S.	UCB/EERC-87/04	Earthquake Simulator Testing of a Combined Sliding Bearing and Rubber Bearing Isolation System	February 1992
Aiken, I. D. Kelly, J. M.	UCB/EERC-90/03	Earthquake Simulator Testing and Analytical Studies of Two Energy-Absorbing Systems for Multistory Structures	August 1991
Clark, P. W. Kelly, J. M.	UCB/EERC-90/10	Experimental Testing of the Resilient-Friction Base Isolation System	November 1991
Bollo, M. Mahin, S. A. Moehle, J. P. Stephen, R. M. Qi, X.	UCB/EERC-90/21	Observations and Implications of Tests on the Cypress Street Viaduct Test Structure	August 1991
Kelly, J. M.	UCB/EERC-91/03	A Long-Period Isolation System Using Low-Modulus High-Damping Isolators for Nuclear Facilities at Soft-Soil Sites	March 1992
Kelly, J. M.	UCB/EERC-91/04	Dynamic and Failure Characteristics of Bridgestone Isolation Bearings	September 1991
Chiou, S.-J.	UCB/EERC-91/07	Estimation of Seismic Source Processes Using Strong Motion Array Data	August 1991
Der Kiureghian, A. Neuenhofer, A.	UCB/EERC-91/08	A Response Spectrum Method for Multiple-Support Seismic Excitations	September 1991
Cohen, J. M. Powell, G. H.	UCB/EERC-91/09	A Preliminary Study on Energy Dissipating Cladding-to-Frame Connections	January 1992

II. SCHOLARLY ACTIVITIES

EERC PUBLICATIONS - Continued

Author(s)	Report No.	Title	Press Date
Miranda, E. Bertero, V. V.	UCB/EERC-91/10	Evaluation of Seismic Performance of a Ten-Story RC Building During the Whittier Narrows Earthquake	May 1992
Anderson, J. C. Bertero, V. V.	UCB/EERC-91/11	Seismic Performance of an Instrumented Six Story Steel Building	March 1992
Mitchell, J. K. Wentz, Jr., F. J.	UCB/EERC-91/12	Performance of Improved Ground During the Loma Prieta Earthquake	December 1991
Rinawi, A. M. Clough, R. W.	UCB/EERC-91/13	Shaking Table - Structure Interaction	May 1992
Mazzoni, S. Moehle, J. P. Thewalt, C. R.	UCB/EERC-91/14	Cyclic Response of RC Beam-Column Knee Joints: Test and Retrofit	December 1991
Bertero, V. V. Anderson, J. C. Krawinkler, H. Miranda, E. The CUREe and the Kajima Research Teams	UCB/EERC-91/15	Design Guidelines for Ductility and Drift Limits: Review of State-of-the-Practice and State-of-the-Art in Ductility and Drift-Based Earthquake Resistant Design of Buildings	January 1992
Anderson, J. C. Miranda, E. Bertero, V. V. The Kajima Project Research Team	UCB/EERC-91/16	Evaluation of the Seismic Performance of a Thirty-Story RC Building	May 1992
Mengi, Y. McNiven, H. D. Tanrikulu, A. K.	UCB/EERC-92/03	Models for Nonlinear Earthquake Analysis of Brick Masonry Buildings	June 1992

II. SCHOLARLY ACTIVITIES

EERC PUBLICATIONS - Continued

Author(s)	Report No.	Title	Press Date
Aschheim, M. Moehle, J. P.	UCB/EERC-92/04	Shear Strength and Deformability of RC Bridge Columns Subjected to Inelastic Cyclic Displacements	June 1992

NISEE PUBLICATIONS

Volume 20, Issues 1 & 2	*Abstract Journal in Earthquake Engineering*	September 1991 February 1992
Volume 21 Issue 1	*Abstract Journal in Earthquake Engineering*	June 1992
Volume 12, No. 2	*EERC News*	July 1991
Volume 13, No. 1	*EERC News*	January 1992
	Computer Software Catalog	June 1992
	National Clearinghouse for Loma Prieta Earthquake Information Catalog	November 1991
	National Clearinghouse for Loma Prieta Earthquake Information Catalog	April 1992

Author(s)	Title	Publisher	Press Run/Date
CONFERENCE AND REFEREED PUBLICATIONS:			
Astaneh, A. and M. N. Nader	"Dynamic Behavior of Flexible, Semi-Rigid and Rigid Steel Frames"	*Journal of Constructional Steel Research*	Vol. 20, No. 3 1991
Astaneh, A. and M. De Stefano	"Analytical and Empirical Models of Axial Force-Displacement Behavior of Steel Double Angles"	*Journal of Constructional Steel Research*	Vol. 21, No. 2 1992
Astaneh, A.	"Flexibility on Design and Seismic Resistance of Buildings"	*Report*, Technical Journal of Structural Engineers Association of Iran (in Farsi)	January 1992
Bertero, V. V. and C.-M. Uang	"UBC Seismic Serviceability Regulations: A Critical Review"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 7 July 1991
Bertero, V. V. and C.-M. Uang	"Seismic Behavior of Concentrically Braced Frames"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 7 July 1991
Bertero, V. V.	"Structural Engineering Aspects of Seismic Zonation"	*Proceedings*, 4th International Conference on Seismic Zonation, Stanford	Vol. I August 1991
Bertero, V. V. and E. Miranda	"Site-Dependent Structural Response Modification Factors"	*Proceedings*, 4th International Conference on Seismic Zonation, Stanford	Vol. II August 1991
Bertero, V. V. and E. Miranda	"Evaluation of the Cypress Viaduct in the Loma Prieta Earthquake"	*Bulletin, Seismological Society of America*	Vol. 81, No. 5 October 1991
Bolt, B. and R. Uhrhammer	"The Seismic Magnitude of the 1989 Loma Prieta Main Shock Determined from Strong Motion Records"	*Bulletin, Seismological Society of America*	Vol. 81, No. 5 October 1991
Chopra, A. and L. Zhang	"Three-Dimensional Analysis of Spatially-Varying Ground Motions Around a Uniform Canyon in a Homogeneous Half-Space"	*Earthquake Engineering and Structural Dynamics*	Vol. 20, No. 10 October 1991

Author(s)	Title	Publisher	Press Run/Date
Chopra, A. and L. Zhang	"Impedance Functions for Three-Dimensional Foundations Supported on an Infinitely-Long Canyon of Uniform Cross-Section in a Homogeneous Half-Space"	*Earthquake Engineering and Structural Dynamics*	Vol. 20, No. 11 November 1991
Chopra, A. and L. Zhang	"Earthquake-Induced Base Sliding of Concrete Gravity Dams"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 12 December 1991
Chopra, A. and R. K. Goel	"Evaluation of Torsional Provisions in Seismic Codes"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 12 December 1991
Comerio, M. C.	"Impacts of the Los Angeles Retrofit Ordinance on Residential Buildings"	*Earthquake Spectra*, EERI	February 1992
Comerio, M. C. et al.	"Estimating Seismic Rehabilitation Costs," and "Local Contexts in the Nine Study Cities"	Sections in *A Benefit-Cost Model for the Seismic Rehabilitation of Buildings*, Federal Emergency Management Agency	Vol. 1, No. 227 and Vol. 2, No. 228 April 1992
Comerio, M. C.	"Hazards Mitigation and Housing Recovery: Watsonville and San Francisco, One Year Later"	Chapter in *Disasters and the Small Dwelling*, James & James Science Publishers	June 1992
Der Kiureghian, A. and P.-L. Liu	"Finite Element Reliability of Geometrically Nonlinear Uncertain Structures"	*Journal of Engineering Mechanics*, ASCE	Vol. 117, No. 8 August 1991
Der Kiureghian, A. and M. De Stefano	"An Efficient Algorithm for Second-Order Reliability Analysis"	*Journal of Engineering Mechanics*, ASCE	Vol. 117, No. 12 December 1991
Der Kiureghian, A. and T. Igusa	"Interaction in Primary-Secondary Systems"	*Journal of Pressure Vessel Technology*, ASME	Vol. 114, No. 1 February 1992
Der Kiureghian, A. and C.-D. Wung	"A Computer-Assisted Learning System for Random Vibrations"	*Computers and Structures*	Vol. 43, No. 5

Author(s)	Title	Publisher	Press Run/Date
Der Kiureghian, A.	"CQC Modal Combination Rule for High-Frequency Modes"	*Transactions*, 11th International Conference on Structural Mechanics in Reactor Technology	August 1991
Der Kiureghian, A. et al.	"Application of Fail-Safe Structural Design to Piping System"	*Transactions*, 11th International Conference on Structural Mechanics in Reactor Technology	August 1991
Fenves, G. L., R. W. Furlong, and E. P. Kasl	"Welded Structural Wire Reinforcement for Columns"	*ACI Structural Journal*	Vol. 88, No. 5 Sept.-Oct. 1991
Fenves, G. L., S. Mojtahedi, and R. B. Reimer	"Effect of Contraction Joints on Earthquake Response of an Arch Dam"	*Journal of Structural Engineering*, ASCE	Vol. 118, No. 4 April 1992
Fenves, G. L. and L. M. Bozzo	"Qualitative Evaluation of Preliminary Structural Designs"	*Proceedings*, 8th Conference on Computing in Civil Engineering, Dallas, Texas	June 1992
Foda, M. A.	"A Kelvin-Helmholtz Instability Mechanism for Seismic Faulting"	*Proceedings*, The Royal Society (London A)	Vol. 435 1991
Kelly, J. M. and M. S. Chalhoub	"Analysis of Infinite Spring-Shaped Base Isolator with Elastomer Bulk Compression"	*Journal of Engineering Mechanics*	Vol. 117, No. 8 August 1991
Kelly, J. M. and J.-P. Pu	"Active Control and Seismic Isolation"	*Journal of Engineering Mechanics*	Vol. 117, No. 10 October 1991
Kelly, J. M.	"Shear Deformation and the Buckling of Columns"	*Applied Mechanics Review*	Vol. 44, No. 11 November 1991
Kelly, J. M., J. L. Sackman, and A. Javid	"The Influence of Preform on the Modes of Vibrating Beams"	*Earthquake Engineering and Structural Dynamics*	Vol. 20, No. 12 December 1991
Kelly, J. M., N. Mostaghel, and P. W. Clark	"Stability of R-FBI Bearings: Analysis and Experiment"	*Earthquake Spectra*, EERI	Vol. 8, No. 2 May 1992

Author(s)	Title	Publisher	Press Run/Date
Lagorio, H. J. et al.	"U.S.-Japan Earthquake Engineering Research: A Harmonic World of Cooperation"	*JSEEP News Journal*, Tokyo	No. 120 September 1991
Lagorio, H. J.	"Architectural and Nonstructural Components Research"	*National Earthquake Hazards Reduction Program: Five Year Plan for 1992-1996*, NEHRP, Washington, DC	October 1991
Lagorio, H. J. and S. C. Liu	"Status of U.S. Research on Structural Control"	*Earthquake Spectra*, EERI	Vol. 7, No. 4 November 1991
Lagorio, H. J. et al.	"U.S. Research in Structural Control: Program Evaluation and Initiation"	*Intelligent Structures - 2*, Monitoring and Control, Elsevier Applied Science	1992
Lagorio, H. J. et al.	"Structural Safety Control and Stochastic Aspects"	*Journal of Intelligent Materials Systems and Structures*	Vol. 3, No. 2 April 1992
Mahin, S. A. et al.	"Probabilistic Multi-Objective Optimal Design of Seismic-Resistant Braced Steel Frames Using ARMA Models"	*Computers and Structures*	Vol. 41, No. 4 1991
Mahin, S. A. and C. A. Zeris	"Behavior of Reinforced Concrete Structures Subjected to Biaxial Excitation"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 9 September 1991
Mahin, S. A. and C. A. Zeris	"Behavior of Reinforced Concrete Structures Subjected to Uniaxial Excitation"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 9 September 1991
Mahin, S. A. and M. Bruneau	"Inelastic Seismic Torsional Response of Simple Symmetric Structures"	*Canadian Journal of Civil Engineering*	Vol. 19, No. 1 February 1992
Mahin, S. A. and M. Bruneau	"Normalizing Inelastic Seismic Response of Structures Having Eccentricities in Plan"	*Journal of Structural Engineering*, ASCE	Vol. 118, No. 5 May 1992
McNiven, H. D. and H. Sucuoglu	"Seismic Shear Capacity of Reinforced Masonry Piers"	*Journal of Structural Engineering*, ASCE	Vol. 117, No. 7 July 1991

Author(s)	Title	Publisher	Press Run/Date
Mitchell, J. K. and W. A. Van Court	"The Role of Soil Modification in Environmental Engineering Applications"	*Proceedings*, ASCE Specialty Conference on Grouting, Soil Improvement and Geosynthetics, New Orleans, Louisiana	Geot. SP-30 February 1992
Mitchell, J. K., H. B. Seed, and R. B. Seed	"Kettleman Hills Waste Landfill Slope Failure, 1. Liner-System Properties"	*Journal of Geotechnical Engineering*, ASCE	Vol. 118, No. 4 April 1992
Mitchell, J. K. and R. A. Mitchell	"Stability Evaluation of Waste Landfills"	Stability and Performance of Slopes and Embankments - II, ASCE	Geot. SP-31 June/July 1992
Moehle, J. P. and S. A. Mahin	"Observations on the Behavior of Reinforced Concrete Buildings during Earthquakes"	*Earthquake-Resistant Concrete Structures, Inelastic Response & Design*, ACI	SP-127 1991
Moehle, J. P. and J. Wallace	"Ductility and Detailing Requirements of Bearing Wall Buildings"	*Journal of Structural Engineering*, ASCE	Vol. 118, No. 6 June 1992
Popov, E. P.	"U.S. Seismic Steel Codes"	*Engineering Journal*, AISC	Vol. 28, No. 3 3rd Quarter 1991
Popov, E. P., M. D. Engelhardt, and K. C. Tsai	"Stability of Beams in Eccentrically Braced Frames"	*Proceedings*, ASCE 9th Engineering Mechanics Conference, Texas A&M University	May 1992
Popov, E. P.	"Lateral Load Provisions in U.S. Seismic Codes"	*Proceedings*, AISC National Steel Construction Conference, Las Vegas, Nevada	June 1992
Powell, G. H. and K. Martini	"Geometric Modelling Approaches for Civil Engineering and Building Design"	*Microcomputers in Civil Engineering*	Vol. 7 1992
Powell, G. H.	"Nonlinear Modelling and Analysis of Reinforced Concrete Frame Structures"	*Computational Mechanics in Structural Engineering: Recent Developments and Future Trends*, Elsevier Applied Science	1992
Reimer, R. B., G. L. Fenves, and S. Mojtahedi	"Effect of Contraction Joints on Earthquake Response of an Arch Dam"	*Journal of Structural Engineering*, ASCE	Vol. 118, No. 4 April 1992

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Seed, R. B. et al.	"Steady-State Strength Analysis of Lower San Fernando Dam Slide"	*Journal of Geotechnical Engineering*, ASCE	Vol. 118, No. 3 March 1992
Seed, R. B., J. K. Mitchell, and H. B. Seed	"Kettleman Hills Waste Landfill Slope Failure, 1. Liner-System Properties"	*Journal of Geotechnical Engineering*, ASCE	Vol. 118, No. 4 April 1992
Seed, R. B., M. D. Evans, and H. B. Seed	"Membrane Compliance and Liquefaction of Sluiced Gravel Specimens"	*Journal of Geotechnical Engineering*, ASCE	Vol. 118. No. 6 June 1992
Sitar, N., S. E. Shewbridge, et al.	"Deformation Characteristics of Reinforced Sand in Direct Shear"	*Journal of Geotechnical Engineering*, ASCE	Vol. 117, No. 11 November 1991
Sitar, N., S. E. Shewbridge, et al.	"Strain Compatibility Design Method for Reinforced Earth Walls"	*Journal of Geotechnical Engineering*, ASCE	Vol. 118, No. 2 February 1992
Thewalt, C. R. et al.	"A Feature Based Approach to Structural Design"	*Engineering with Computers*	Vol. 7, No. 1 Winter 1991
Tobriner, S.	"An Historic Perspective on Building Damage in the Loma Prieta Earthquake"	*Proceedings*, 59th Annual SEAOC Convention, Lake Tahoe, California, September 1990	December 1991
Tobriner, S.	"Tecniche anti-sismiche nella ricostruzione di San Francisco e comportamento degli edifici in muratura"	*Costruire in Laterizio*, Italy	1991
Wilson, E. L. and J. D. Hart	"WAVES: An Efficient Microcomputer Program for Site Response Analysis"	*Microcomputers in Civil Engineering*	Vol. 6 July 1991
Wilson, E. L. and A. Ibrahimbegović	"Unified Computational Model for Static and Dynamic Frictional Contact Analysis"	*Numerical Methods in Engineering*	Vol. 34 March 1992
Wilson, E. L. and A. Ibrahimbegović	"Efficient Solution Procedures for Systems with Local Non-Linearities"	*Engineering Computations*	Vol. 9 June 1992

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Author(s)	Title	Publisher	Press Run/Date
Astaneh, A.	"Cyclic Behavior of Gusset Plate Connections in V-Braced Steel Frames"	*Proceedings*, U.S.-Japan Seminar on Cyclic Buckling of Steel Structures and Structural Elements under Dynamic Loading Conditions, Osaka, Japan	Juiy 1991
Astaneh, A. and S. Cho	"Rocking Stability of Bridge Piers During Earthquakes"	*Proceedings*, Annual Technical Session and Meeting, Structural Stability Research Council, Pittsburgh, Pennsylvania	April 1992
Astaneh, A., M. De Stefano, and A. De Luca	"Prediction of Double Angle Connection Cyclic Moment-Rotation Behavior by a Mechanical Model"	*Proceedings*, Annual Technical Session and Meeting, Structural Stability Research Council, Pittsburgh, Pennsylvania	April 1992
Astaneh, A. and M. Nader	"Seismic Design Concepts for Semi-Rigid Frames"	*Proceedings*, ASCE Structures Congress '92, San Antonio, Texas	April 1992
Astaneh, A.	"Seismic Evaluation and Retrofit of San Francisco-Oakland Bay Bridge"	*Proceedings*, ASCE Structures Congress '92, San Antonio, Texas	April 1992
Bertero, V. V. and E. Miranda	"Evaluation of Damage Potential of Recorded Ground Motions and its Implication for the Design of Structures"	A *CUREe-Kajima Research Report*, EERC	August 1991
Bertero, V. V.	"Earthquake Hazard Mitigation: The Need for Improving Earthquake-Resistant Code Regulation"	*Proceedings*, Open Forum and Fifth International Research and Training Seminar on Regional Development Planning for Disaster Prevention, Nagoya, Japan	November 1991
Bertero, V. V. et al.	"CUREe-Kajima Project, Topic 5: Design Guidelines for Ductility and Drift Limits"	A *CUREe-Kajima Research Report*, EERC	December 1991
Bertero, V. V., E. Miranda, and J. C. Anderson	"Evaluation of Seismic Response of Two RC Buildings"	*Proceedings*, ASCE Tenth Structures Congress, San Antonio, Texas	T4 April 1992

Author(s)	Title	Publisher	Press Run/Date
Bertero, V. V., J. C. Anderson, and E. Miranda	"Seismic Design Criteria and Measured Response"	*Proceedings*, ASCE Tenth Structures Congress, San Antonio, Texas	T15 April 1992
Bolt, B.	"The Importance of Phased Time Histories in Synthetic Ground Motions"	*Proceedings*, 4th International Zonation Conference, Stanford	Vol. 2 August 1991
Comerio, M. C.	"Dilemmas in Developing a Cost Benefit Model for Evaluating Seismic Retrofit"	*Proceedings*, Pacific Earthquake Conference, Auckland, New Zealand	November 1991
Der Kiureghian, A. and Y. Zhang	"Dynamic Response Sensitivity of Inelastic Structures"	*Report No. UCB/SEMM-91/06*, Department of Civil Engineering, University of California at Berkeley	October 1991
Fenves, G. L., F. C. Filippou, and D. T. Sze	"Evaluation of the Dumbarton Bridge in the Loma Prieta Earthquake"	*Proceedings*, 1st Annual Seismic Research Workshop, CALDOT, Sacramento, California	December 1991
Fenves, G. L. and F. C. Filippou	"Nonlinear Static and Dynamic Analysis of Reinforced Concrete Members, Subassemblages and Structures"	*Proceedings*, 1st Annual Seismic Research Workshop, CALDOT, Sacramento, California	December 1991
Fenves, G. L.	"Earthquake Analysis and Response of Multi-Span Bridges and Viaduct Structures"	*Proceedings*, Seismic Design and Retrofit of Bridges Seminar, University of California at Berkeley	June 1992
Fenves, G. L., S. Mojtahedi, and R. B. Reimer	"ADAP-88: A Computer Program for Nonlinear Earthquake Analysis of Concrete Arch Dams, User Guide"	*Report No. UCB/SEMM-92/10*, Department of Civil Engineering, University of California at Berkeley	May 1992
Filippou, F., G. H. Powell, K. Martini, and S. Campbell	"Nonlinear Modelling and Analysis of Reinforced Concrete Frame Structures"	*Proceedings*, Workshop on Recent Developments and Future Trends of Computational Mechanics in Structural Engineering, Beijing, China	September 1991
Kelly, J. M. and K. D. P. Papoulia	"A Constitutive Model and Numerical Simulation of Elastomers at Finite Strain"	*Proceedings*, 1st U.S. National Congress on Computational Mechanics, Chicago, Illinois	July 1991

Author(s)	Title	Publisher	Press Run/Date
Kelly, J. M. and I. D. Aiken	"Experimental and Analytical Studies of Two Energy-Absorbing Systems for Multistory Structures"	*Transactions*, 11th International Conference on Structural Mechanics in Reactor Technology (SMiRT), Tokyo, Japan	Vol. K August 1991
Kelly, J. M.	"Shake Table Tests of Long Period Isolation System for Nuclear Facilities at Soft-Soil Sites"	*Transactions*, 11th International Conference on Structural Mechanics in Reactor Technology (SMiRT), Tokyo, Japan	Vol. K August 1991
Kelly, J. M. and K. D. P. Papoulia	"Viscoelastic Analysis of Isolation Bearings"	*Proceedings*, International Conference on Computational Engineering Science, Melbourne, Australia	August 1991
Kelly, J. M.	"The Current Status of Seismic Isolation Technology in the United States"	IAEA Specialists' Meeting on Seismic Isolation Technology, San Jose, California	March 1992
Lagorio, H. J. et al.	"U.S. Program on Seismic Repair and Rehabilitation Research on Existing Buildings"	*Proceedings*, 2nd Annual Meeting on Seismic Repair of Existing Buildings, University of Texas at Austin	October 1991
Leitmann, G., C. G. Kang, and R. Horowitz	"Application of Robust Deterministic Control to Robotic Manipulators"	*Proceedings*, Third Workshop on Control Mechanics 1990	1991
Leitmann, G., M. Corless, and A. Soldatos	"Stabilizing Uncertain Systems with Bounded Control"	*Proceedings*, Third Workshop on Control Mechanics 1990	1991
Leitmann, G., M. Corless, and S. Pandey	"Deterministic Control and Exponential Convergence for a New Class of Uncertain Systems"	*Proceedings*, 30th IEEE Conference on Decision and Control, Brighton, England	December 1991
Leitmann, G., J. R. Benede, and E. P. Ryan	"Reduced-Order Output Feedback Control of a Class of Uncertain Systems"	*Proceedings*, 30th IEEE Conference on Decision and Control, Brighton, England	December 1991
Leitmann, G. and E. Reithmeier	"Robuste Positions - und Kraftregelung für Industrieroboter mit Parameterunsicherheiten"	*Automatisierungstechnik*	Vol. 39, No. 11/12 Nov./Dec. 1991

Author(s)	Title	Publisher	Press Run/Date
Leitmann, G., J. R. Benede, and E. P. Ryan	"Reduced-Order Output Feedback Control of a Class of Uncertain Systems"	*Lecture Notes in Control and Information Sciences* 170, Springer Verlag, Berlin	1992
Leitmann, G. and E. Reithmeier	"Tracking and Force Control for a Class of Robotic Manipulators"	*Lecture Notes in Control and Information Sciences* 170, Springer Verlag, Berlin	1992
Mitchell, J. K., R. Q. Coutinho, et al.	"Occurrence, Geotechnical Properties, and Special Problems of Some Soils of America"	Special Report for the IX Pan American Conference on Soil Mechanics and Foundation Engineering, Viña del Mar, Chile	August 1991
Mitchell, J. K. and R. A. Mitchell	"Stability of Landfills"	*Proceedings*, Conferenze di Geotecnica de Torino XV CICLO	November 1991
Mitchell, J. K. and C. K. Shen	"Ground Improvement in Hong Kong Infrastructure Development"	*Proceedings*, International Workshop of Technology for Hong Kong's Infrastructure Development, Hong Kong	December 1991
Mitchell, J. K.	"Mitigation of Ground Failure Risk - Some Lessons from the Loma Prieta Earthquake"	*Proceedings*, Sixth Australia-New Zealand Conference on Geomechanics, Christchurch, New Zealand	February 1992
Mitchell, J. K., R. B. Seed, et al.	"Evaluation of SPT-, CPT-, and Shear Wave-Based Methods for Liquefaction Potential Assessment Using Loma Prieta Data"	*Proceedings*, 4th U.S.-Japan Workshop on Earthquake Resistant Design of Lifeline Facilities and Countermeasures for Soil Liquefaction, Honolulu, Hawaii	May 1992
Mitchell, J. K.	"Ground Treatment for Seismic Stability of Bridge Foundations"	*Proceedings*, Seismic Design and Retrofit of Bridges Seminar, University of California at Berkeley	June 1992
Moehle, J. P., P. J. M. Monteiro, and H. T. Tang	"Aging Effects on Mechanical Properties of Power Plant Concretes"	*Transactions*, 11th International Conference on Structural Mechanics in Reactor Technology (SMiRT), Tokyo, Japan	Vol. D August 1991

Author(s)	Title	Publisher	Press Run/Date
Moehle, J. P., V. V. Bertero, et al.	"Design Guidelines for Ductility and Drift Limits"	*Task 2 CUREe -Kajima Project*, California Universities for Research in Earthquake Engineering	September 1991
Moehle, J. P.	"Issues Related to Shear and Bond in As-Built and Retrofit Columns and Joints"	*Proceedings*, CALTRANS Seismic Research Workshop, Sacramento, California	December 1991
Moehle, J. P., C. Chen, and A. Astaneh-Asl	"Behavior and Design of High-Strength Composite Columns"	*Proceedings*, Tenth Structures Congress, ASCE, San Antonio, Texas	April 1992
Moehle, J. P., M. Aschheim, and A. Astaneh	"Experimental Studies of Short Composite Columns"	*Proceedings*, Tenth Structures Congress, ASCE, San Antonio, Texas	April 1992
Moehle, J. P.	"Evaluation and Rehabilitation of Multi-Level, Multi-Column Concrete Freeway Structures"	*Proceedings*, Seismic Design and Retrofit of Bridges Seminar, University of California at Berkeley	June 1992
Powell, G. H.	"Observations on the Practical Application of Nonlinear Analysis"	*Proceedings*, Seismic Design and Retrofit of Bridges Seminar, University of California at Berkeley	June 1992
Sitar, N.	"Behavior of the San Francisco Bay Mud from the Marina District in Static and Cyclic Simple Shear"	*Proceedings*, Seismic Design and Retrofit of Bridges Seminar, University of California at Berkeley	June 1992
Sitar, N.	"Earthquake-Induced Landslides in Coastal Bluffs and Marine Terrace Deposits"	*Loma Prieta Earthquake: Engineering Geologic Perspectives*, Association of Engineering Geologists	SP-1 1991
Thewalt, C. R. and S. A. Mahin	"The Pseudodynamic Test Method: Numerical Aspects"	*Experimental and Numerical Methods in Earthquake Engineering*, J. Donea and P. M. Jones (eds.), Kluwer Academic Publishers at Berkeley	1991

Author(s)	Title	Publisher	Press Run/Date
Thewalt, C. R. and S. A. Mahin	"The Pseudodynamic Test Method: Verification and Extensions"	*Experimental and Numerical Methods in Earthquake Engineering*, J. Donea and P. M. Jones (eds.), Kluwer Academic Publishers	1991
Thewalt, C. R.	"Behavior and Retrofit of Outriggers and Knee Joints"	*Proceedings*, 1st Annual Seismic Research Workshop, CALDOT, Sacramento, California	December 1991
Thewalt, C. R. and B. I. Stojadinovic	"Behavior and Retrofit of Outrigger Beams"	*Proceedings*, Seismic Design and Retrofit of Bridges Seminar, University of California at Berkeley	June 1992

III. PERSONNEL

A. EERC CORE ADMINISTRATION

Title	Name	FTE %	Funding Source	Main Function(s)	Length of Service in Position	C=Career T=Temp
ACADEMIC ADMINISTRATOR:						
Director	J. P. Moehle	.5000	State	Director/Administrator	1 year	C
CENTRAL SUPPORT STAFF:						
Administration						
Administrative Assist. III	K. Goldberg	1.0000	State	Administrative Support	8 yrs. 2 mos.	C
Administrative Assist. III	D. Wright	1.0000	State	Administrative Support	10 months	C
Secretary II	B. Mauk	.8500	State	Secretarial Support/Reception	5 years	C
		.1500	Grant	Clerical Support to IJEESD		
Secretary II	C. Johnson	.5000	Grant	Secretarial Support/J.M. Kelly	1 year	C
Secretary II	M. Colbert	.5000	Grant	Secretarial Support/CUREe	3 months	T
Assistant Editor	B. Young	1.0000	Grant	Editorial assistance/Bertero	1 year	T
EERC Laboratory						
Assoc. Development Engineer	D. Clyde	.7500	State	Acting Laboratory Manager/	19 years	C
		.2500	Recharge	Experimental Operator		
Development Technician V	W. Neighbour	.7500	State	Welding & Instrumentation	16 years	C
		.2500	Recharge			
Sr. Development Engineer	Open Position	.7500	State			
		.2500	Recharge			
Principal Lab. Mechanician	Open Position	.7500	State			
		.2500	Recharge			
Sr. Bldg. Maintenance Worker	Open Position	.7500	State			
		.2500	Recharge			
Sr. Development Engineer	J. Dimsdale	1.0000	State	Computer Systems Development	9 years	C
Engineering Aid (student)	R. Ighani	<.4900	State	Computer Systems Assistant	5 months	T
Engineering Aid (student)	M. Thompson	<.4900	State	Computer Systems Assistant	7 months	T

III. PERSONNEL

A. EERC CORE ADMINISTRATION - cont'd.

Title	Name	FTE %	Funding Source	Main Function(s)	Length of Service in Position	C=Career T=Temp
Academic Administrator:						
Information Systems Manager	K. Frohmberg	1.0000	State	Info. Systems Manager/Librarian	3 years	C
Computer Applications						
Assoc. Development Engineer	K. Wong	1.0000	Grant	Manager of Computer Programs	19 years	C
Programmer/Analyst III	J. Zerneke	1.0000	Grant	Database Design & Development	14 years	C
Principal Clerk	M. MacCready	.5000	Grant	Software Order Processing	2 years	T
Earthquake Engineering Abstracts						
Editor	R. Denton	1.0000	Grant	Editor	20 years	C
Editorial Assistant I	C. Cameron	1.0000	Grant	Data Entry/Proofreading	2 years	C
Publications Assistant I	S. Edwards	1.0000	Grant	Subscription Management	25 years	C
Editorial Assistant I	J. Hannel	1.0000	Grant	Editorial Assistance	3 years	C
EERC Library						
Associate Librarian	S. Svihra	1.0000	State	Librarian (Academic)	14 years	C
Assistant Librarian	S. Fatemi	.6000	Grant	OCLC Cataloger (Academic)	2 1/2 yrs.	C
Library Assistant II	C. Sobey	1.0000	Grant	Library Clerical	1 year	C
EERC Reports						
Editor	B. Bolt	.5000	Grant	Manager & Editor	17 years	C
Senior Clerk (student)	H. Rhine	<.4900	Grant	Clerical Support	2 1/2 years	T
Student Support						
Clerk	S. Chan	<.4900	Grant	Library/Clerical	1 year	T
Clerk	C. Colby	<.4900	Grant	Library/Clerical	2 months	T
Clerk	B. Del Chiaro	<.4900	Grant	Library/Clerical	2 years	T
Clerk	J. Dockstader	<.4900	Grant	Library/Clerical	3 years	T
Clerk	T. Hilkey	<.4900	Grant	Library/Clerical	3 years	T
Clerk	M. McDaniel	<.4900	Grant/19900	Clerical/Library	4 months	T

Funding provided by **National Information Service for Earthquake Engineering (NISEE)**

III. PERSONNEL

COMMITTEES OF THE EARTHQUAKE ENGINEERING RESEARCH CENTER

EXECUTIVE COMMITTEE

College of Engineering:
James M. Kelly (Chair)
Gregory L. Fenves
Stephen A. Mahin
Nicholas Sitar

College of Environmental Design:
Stephen Tobriner

College of Letters and Science:
Bruce A. Bolt (also Civil Engineering)

EXPERIMENTAL FACILITIES ADVISORY COMMITTEE

College of Engineering:
Stephen A. Mahin, Chair
James M. Kelly
Chris Thewalt
Jack P. Moehle (ex officio)

NATIONAL INFORMATION SERVICE FOR EARTHQUAKE ENGINEERING (NISEE) ADVISORY COMMITTEE

Robert A. Olson, President
VSP Associates, Inc.
(Committee Chair)

Mihran S. Agbabian, President
Agbabian Associates

Patricia Ann Coty, Manager
National Center for Earthquake Engineering Research

Richard K. Eisner, Director
Bay Area Regional Earthquake Preparedness Project

Professor Wilfred D. Iwan
California Institute of Technology

Barbara Morgan, Director
Advanced Technology Planning, UC Berkeley

Christopher Rojahn, Executive Director
Applied Technology Council

Charles C. Thiel, Jr., Consulting Engineer
Telesis Consultants

Susan K. Tubbesing, Executive Director
Earthquake Engineering Research Institute

William A. Anderson, Program Director
Earthquake Hazard Mitigation Program
National Science Foundation (ex officio)

Jack P. Moehle (ex officio)

Gregory L. Fenves (ex officio)

III. PERSONNEL

B. RESEARCH PARTICIPANTS - FACULTY

Name	Official title	Home Department or Institution	Length of Affiliation	Main Function/ Contributions to Unit	Funding Source
Astaneh-Asl, Abolhassan	Associate Professor	Civil Engineering	6 years	Advisory/research	Home institution
Barlow, Richard E.	Professor	Industrial Engineering & Operations Research	12 years	Advisory/research	Home institution
Bertero, Vitelmo V.	Professor Emeritus	Civil Engineering	25 years	Advisory/research	Home institution
Black, R. Gary	Assistant Professor	Architecture	2 years	Advisory/research	Home institution
Bolt, Bruce A.	Professor	Geology & Geophysics/ Civil Engineering	25 years	Advisory/research	Home institution
Brillinger, David R.	Professor	Statistics	3 years	Advisory/research	Home institution
Chopra, Anil K.	Professor	Civil Engineering	25 years	Advisory/research	Home institution
Clough, Ray W.	Professor Emeritus	Civil Engineering	25 years	Advisory	Home institution
Comerio, Mary C.	Associate Professor	Architecture	3 years	Advisory/research	Home institution
Der Kiureghian, Armen	Professor	Civil Engineering	14 years	Advisory/research	Home institution
Fenves, Gregory L.	Associate Professor	Civil Engineering	4 years	Advisory/research	Home institution
Filippou, Filip C.	Associate Professor	Civil Engineering	9 years	Advisory/research	Home institution
Foda, Mostafa A.	Associate Professor	Civil Engineering	3 years	Advisory/research	Home institution
Gerwick, Ben C.	Professor Emeritus	Civil Engineering	21 years	Advisory/research	Home institution
Hodges, David A.	Dean	College of Engineering	2 years	Advisory	Home institution
Jones, David L.	Professor	Geology & Geophysics	3 years	Advisory/research	Home institution
Kelly, James M.	Professor	Civil Engineering	25 years	Advisory/research	Home institution
Lagorio, Henry J.	Professor Emeritus	Architecture	25 years	Advisory	Home institution
Leitmann, George	Associate Dean/ Professor	College of Engineering	6 years	Advisory/research	Home institution

B. RESEARCH PARTICIPANTS - FACULTY (continued)

Name	Official Title	Home Department or Institution	Length of Affiliation	Main Function/ Contributions to Unit	Funding Source
Lysmer, John	Professor Emeritus	Civil Engineering	20 years	Advisory/research	Home institution
Mahin, Stephen A.	Professor	Civil Engineering	15 years	Advisory/research	Home institution
McNiven, Hugh D.	Professor Emeritus	Civil Engineering	25 years	Advisory/research	Home institution
Mitchell, James K.	Professor	Civil Engineering	3 years	Advisory/research	Home institution
Moehle, Jack P.	Professor	Civil Engineering	12 years	Director of EERC/ Advisory/research	Home institution/ ORU
Penzien, Joseph	Professor Emeritus	Civil Engineering	25 years	Advisory	Home institution
Pister, Karl S.	Professor	Civil Engineering	18 years	Advisory/research	Home institution
Polak, Elijah	Professor	Electrical Engineering & Computer Science	17 years	Advisory/research	Home institution
Popov, Egor P.	Professor Emeritus	Civil Engineering	25 years	Advisory/research	Home institution
Powell, Graham H.	Professor	Civil Engineering	20 years	Advisory/research	Home institution
Reimer, Richard B.	Adjunct Professor	Civil Engineering	2 years	Advisory/research	Home institution
Sackman, Jerome L.	Professor Emeritus	Civil Engineering	25 years	Advisory	Home institution
Scott, Stanley	Research Political Scientist	Institute of Governmental Studies	3 years	Advisory/research	Home institution
Seed, Raymond B.	Professor	Civil Engineering	6 years	Advisory/research	Home institution
Sitar, Nicholas	Professor	Civil Engineering	3 years	Advisory/research	Home institution
Taylor, Robert L.	Professor	Civil Engineering	3 years	Advisory/research	Home institution
Thewalt, Christopher	Assistant Professor	Civil Engineering	3 years	Advisory/research	Home institution
Tobriner, Stephen	Professor	Architecture	3 years	Advisory/research	Home institution
Wiegel, Robert L.	Professor Emeritus	Civil Engineering	25 years	Advisory/research	Home institution
Wilson, Edward L.	Professor Emeritus	Civil Engineering	25 years	Advisory/research	Home institution

B. RESEARCH PARTICIPANTS - PROFESSIONAL RESEARCHERS

Name	Official Title	Home Department	Length of Affiliation	Main Function Contributions to Unit	Funding Source
Aiken, Ian D.	Assist.Res. Engineer	Earthquake Engineering	1-1/2 years	Research - Base Isolation	Grant
Goel, Rakesh	Vis. Asst. Res. Engineer	Earthquake Engineering	1-1/2 years	Research - Torsion Response	Grant

B. RESEARCH PARTICIPANTS - VISITING SCHOLARS/RESEARCHERS

Name	Official Title	Home Institution	Length of Affiliation	Main Function Contributions to Unit	Funding Source
Anderson, James C.	Professor	University of Southern California	3 months	Advisory/Research	Home Institution
Chen, Pei-Lin	Professor	National Cheng Kung University	1 year	Research-Long Period Seismology	Private Funding
Di Martino, Francesco	Student Researcher	Universitá de Catania	6 months	Experimental Research in the Dynamics of Structures	Private Funding
Kikuchi, Masaru	Research Engineer	Shimizu Corp., Japan	6 months	Shimizu base isolation project	Private Industry
Li, Li	Professor	Central Research Institute of Building & Construction, China	2 years	Research-Base Isolation	Private Funding
Santana, Guillermo	Research Associate	University of Costa Rica	3 months	Research-response of bldgs. during the Limon, Costa Rica earthquake	Home institution/ Grant
To, Solomon	Professor	Ontario, Canada	1 year	Research-Active Control	NSF Grant

III. PERSONNEL

C. RESEARCH PARTICIPANTS - STUDENTS

Name	Academic Department	Faculty Supervisor	Degree & Date Awarded or Degree Goal	Project or Thesis Title	Payroll Title	Funding Source
Abbas, Humayun	Civil Eng.	Kelly	Ph.D.	Optimal Design of Visco-Elastic Dampers	GSR	Grant(s)
Aggarwal, Rajiv K.	Civil Eng.	Gerwick	D.Eng Fall'91	Methodology for Assessment by Regulatory Bodies of the Safety of Existing Steel Offshore Platforms	GSR	Grant(s)
Anderson, Scott Alan	Civil Eng.	Sitar	Ph.D. Spr.'92	The Role of Hydrologic Response and Soil Behavior in the Initiation of Rainfall-Induced Debris Flows	GSR	Grant(s)
Archer, Graham	Civil Eng.	Powell	Ph.D.	Nonlinear Seismic Response Analysis of Bridge Structures	GSR	Grant(s)
Aschheim, Mark	Civil Eng.	Astaneh Moehle	M.Eng.Spr.'92 Ph.D.	Short Composite Columns Under Axial Load Design and Evaluation of Bridge Structures	GSR	Grant(s)
Ayoub, Amir	Civil Eng.	Filippou	Ph.D.	Nonlinear Behavior of RC Structures	GSR	Grant(s)
Bertero, Raul	Civil Eng.	Bertero	M.S.	Tall Reinforced Concrete Buildings: Development of Conceptual Seismic Resistant Design Methodology	GSR	Grant(s)
Bozzo, Luis	Civil Eng.	Fenves	Ph.D.	A Methodology for Integrating Structural Designs	GSR	Grant(s)
Boroschek, Ruben	Civil Eng.	Mahin	Ph.D. Fall'91	Investigation of the Seismic Response of a Lightly Damped Torsionally Coupled Building	GSR	Grant(s)
Campbell, Scott	Civil Eng.	Filippou	Ph.D.	Nonlinear Analysis of Reinforced Concrete Three-Dimensional Structures	GSR	Grant(s)
Chang, Mu-Hsiung	Civil Eng.	Mitchell	Ph.D. Spr.'92	Slope Stability Analysis of Lined Waste Landfills	GSR	Grant(s)
Cheng, Chih-Hung	Civil Eng.	Filippou	M.Eng	Anchorage Behavior of Large Diameter Bars in Bridge Structures	GSR	Grant(s)

C. RESEARCH PARTICIPANTS - STUDENTS (continued)

Name	Academic Department	Faculty Supervisor	Degree & Date Awarded or Degree Goal	Project or Thesis Title	Payroll Title	Funding Source
Chin, Chih-Cheng	Civil Eng.	Lysmer	Ph.D.	Seismic Response of Deep Soil Sites in the San Francisco Bay Area	GSR	Grant(s)
Chiou, S. J.	Geol./Geo.	Bolt	Ph.D. Fall'91	Estimation of Seismic Source Processes Using Strong Motion Array Data	GSR	Grant(s)
Cho, Sung-Woo	Civil Eng.	Astaneh	Ph.D.	Seismic Studies of Steel Overpass Structures	GSR	Grant(s)
Clark, Peter W.	Civil Eng.	Kelly	Ph.D.	Earthquake Simulator Testing of a Base-Isolated Reinforced Concrete Frame	GSR	Grant(s)
De La Llera, Juan	Civil Eng.	Chopra	Ph.D.	Torsional Earthquake Response of Multi-Story Building Structures	GSR	Grant(s)
Deng, Nan	Civil Eng.	Lysmer	Ph.D. Fall'91	Two-Dimensional Site Response Analyses	GSR	Grant(s)
Dermatas, Dimitris	Civil Eng.	Mitchell	Ph.D. Spr.'92	An Experimental Study to Elucidate and Eliminate Ettringite-Induced Swelling in Lime-Stabilized Sulfate-Bearing Clay Soils	GSR	Grant(s)
Dickenson, Stephen	Civil Eng.	Lysmer	Ph.D.	Seismic Response of Deep Soil Sites in the San Francisco Bay Area	GSR	Grant(s)
Goucha, Hatem	Civil Eng.	Bertero	Ph.D.	Tall Buildings Subjected to Earthquakes	GSR	Grant(s)
Grigorian, Carl	Civil Eng.	Popov	Ph.D.	Experimental Studies of Slotted Bolt Connections for Energy Dissipation	GSR	Grant(s)
Inaudi, José	Civil Eng.	Kelly	Ph.D.	Active Isolation for Vibration Reduction of Sensitive Equipment	GSR	Grant(s)

C. RESEARCH PARTICIPANTS - STUDENTS (continued)

Name	Academic Department	Faculty Supervisor	Degree & Date Awarded or Degree Goal	Project or Thesis Title	Payroll Title	Funding Source
Kayen, Robert E.	Civil Eng.	Mitchell	Ph.D.	An Energy Based Method for Liquefaction Assessment	GSR	Grant(s)
Law, Wing Keung	Civil Eng.	Foda	Ph.D. Fall'91	Breakout of Half-Buried Submarine Pipeline from Sea Bed	GSR	Grant(s)
Lee, Jeeho	Civil Eng.	Fenves	Ph.D.	Application of Plasticity Models for Concrete	GSR	Grant(s)
Li, Chun-Chin	Civil Eng.	Der Kiureghian	Ph.D.	Random Fields and FE Reliability Methods	GSR	Grant(s)
Lodge, Angela	Civil Eng.	Mitchell	Ph.D.	Liquefaction Potential Assessment by Shear Wave Velocity	GSR	Grant(s)
Lynn, Abraham	Civil Eng.	Moehle	Ph.D.	Evaluation of Existing Concrete Building Columns	GSR	Grant(s)
Mahmoudi, Fariba	Civil Eng.	Astaneh	Ph.D.	Inelastic Analyses of the Bay Bridge	GSR	Grant(s)
Martinez-Cruzado, José	Civil Eng.	Moehle	Ph.D.	Behavior of Exterior Post-Tensioned Connections in Earthquake Resisting Structures	GSR	Grant(s)
Mazzoni, Silvia	Civil Eng.	Moehle	Ph.D.	Design of Beam-Column Connections with Yielding Columns	GSR	Grant(s)
McMullin, Kurt	Civil Eng.	Astaneh	Ph.D.	Behavior and Design of Column-tree Steel Frames	GSR	Grant(s)
Mirfendereski, Dariush	Civil Eng.	Der Kiureghian	Ph.D.	Microelectro-Mechanical System Response	GSR	Grant(s)
Mohd, Yassin	Civil Eng.	Filippou	Ph.D.	Nonlinear Analysis of Pre-stressed Concrete Beams	GSR	Grant(s)
Nader, Marwan N.	Civil Eng.	Astaneh	Ph.D. Spr.'92	Seismic Behavior and Design of Semi-Rigid Steel Frames	GSR	Grant(s)
Nims, Douglas	Civil Eng.	Kelly	Ph.D.	Application of Energy Dissipating Devices in Earthquake Engineering	GSR	Grant(s)

C. RESEARCH PARTICIPANTS - STUDENTS (continued)

Name	Academic Department	Faculty Supervisor	Degree & Date Awarded or Degree Goal	Project or Thesis Title	Payroll Title	Funding Source
Ortiz, Joseph L.	Civil Eng.	Fenves	M.Eng.Fall'91	Dynamic Response of Tank Structures	GSR	Grant(s)
Pantelic, Jelena	Civil Eng.	Lagorio	Ph.D.	The Impact of Earthquakes on Small Business	GSR	Grant(s)
Papoulia, Katerina	Civil Eng.	Kelly	Ph.D. Spr.'92	Aspects of the Nonlinear Analysis of Elastomeric Seismic Isolators	GSR	Grant(s)
Piepenbrock, Ted	Civil Eng.	Mahin	M. Eng	Friction Pendulum System for Base Isolation	GSR	Grant(s)
Prakash, Vipul	Civil Eng.	Powell	Ph.D.	The Drain Series of Computer Programs	GSR	Grant(s)
Qaisrani, Allah N.	Civil Eng.	Moehle	Ph.D.	Behavior of Interior Post-Tensioned Connections in Earthquake Resisting Structures	GSR	Grant(s)
Sarnoff, Robert	Civil Eng.	Filippou	M.Eng.Spr.'92	Integrated Shell Design Environment	GSR	Grant(s)
Shaw, Alison L.	Civil Eng.	Astaneh	M.Eng.Spr.'92	Behavior of Steel Connections	GSR	Grant(s)
Shen, Jie-Hua	Civil Eng.	Astaneh	Ph.D.	Behavior and Modeling of Steel Semi-rigid Connections	GSR	Grant(s)
Singh, Satinder	Civil Eng.	Fenves	Ph.D.	Techniques for Seismic Response Analysis of Bridge Structures	GSR	Grant(s)
Soyer, Claudia	Civil Eng.	Moehle	M.Eng.Spr.'92	Behavior of Exterior RC Bridge Connections	GSR	Grant(s)
Spacone, Enrico	Civil Eng.	Fenves	Ph.D.	Finite Element Modeling of Reinforced Concrete Components	GSR	Grant(s)
Stojadinović, B.	Civil Eng.	Thewalt	Ph.D.	Biaxial Behavior of RC Columns Under Seismic Loading	GSR	Grant(s)
Sze, David	Civil Eng.	Filippou	Ph.D.	Investigations of the Response of the Dumbarton Bridge During the Loma Prieta Earthquake	GSR	Grant(s)

C. RESEARCH PARTICIPANTS - STUDENTS (continued)

Name	Academic Department	Faculty Supervisor	Degree & Date Awarded or Degree Goal	Project or Thesis Title	Payroll Title	Funding Source
Tai, Tsung-Li	Civil Eng.	Chopra	Ph.D.	Earthquake Induced Base Slidings of Concrete Dams	GSR	Grant(s)
Tan, Hanchen	Civil Eng.	Chopra	Ph.D.	Seismic Response of Dams	GSR	Grant(s)
Taniwangsa, Wendy	Civil Eng.	Kelly	Ph.D	Use of Electro-Rheological Fluids in Active Control	GSR	Grant(s)
Taucer, Fabio F.	Civil Eng.	Filippou	M.Eng.Fall'91	Nonlinear Bond Slip Models in Reinforced Concrete	GSR	Grant(s)
Teran, Amador	Civil Eng.	Bertero	Ph.D.	Analysis of the Response of Tall Buildings During Earthquakes	GSR	Grant(s)
Van Court, Wade	Civil Eng.	Mitchell	Ph.D.	Mitigation of Liquefaction Potential by Deep Blasting	GSR	Grant(s)
Williams, Jeffrey S.	Civil Eng.	Mahin	M.Eng.Spr.'92	Inelastic Design for Earthquakes	GSR	Grant(s)
Yang, Tzong-Shouh	Civil Eng.	Popov	Ph.D.	Seismic Retrofit with Energy Dissipators	GSR	Grant(s)
Zayati, Foued	Civil Eng.	Mahin	Ph.D.	Studies of a Proof Test Concept for Bridge Retrofits	GSR	Grant(s)
Zhang, Dagang	Civil Eng.	Foda	Ph.D. Spr.'92	Dynamics of Large Landslides	GSR	Grant(s)
Zhang, Yan	Civil Eng.	Der Kiureghian	Ph.D.	Time-variant Reliability Methods	GSR	Grant(s)

IV. RESOURCES

B. SPACE

RICHMOND FIELD STATION	Assignable Square Feet
Building 451 This space consists of administrative, staff, academic offices and instructional research space as well as a large conference room.	5,294
Building 453 - EERC Library Facilities	3,196
Building 454 This space consists of offices used by research assistants while actively engaged in research at the Center. Office space is also provided for visiting scholars from various parts of the world who visit the Center on a temporary basis under the sponsorship of faculty.	3,076
Buildings 420 and 421 The Earthquake Simulator Laboratory is used by faculty, students and staff for research tests and Service-To-Industry projects. Use of facilities developed and operated by EERC include the earthquake simulator, component test facilities, a braced frame test system, a masonry wall test fixture, a spandrel beam-column test system, a frame-wall test fixture, and data acquisition and analysis systems.	10,774
Building 484 EERC personnel actively makes use of the Structural Research Laboratory and the structures testing facilities in Davis Hall, Berkeley Campus. Under SESM/EERC AGREEMENT dated May 16, 1984, EERC has been given management responsibility for certain identified space in Building 484. Specifically excluded are: all fire laboratory space; the 4 million pound testing machine and surrounding space; room 109; the control room above 109, and rooms 100, 101, 105, 112, and 114.	2,300
UC BERKELEY CAMPUS	
Davis Hall Rooms 402 and 404A in Davis Hall are occupied by the Computer Applications Unit of the National Information Service for Earthquake Engineering (NISEE).	900
TOTAL A.S.F.:	**25,540**