

# John A. Blume

## Earthquake Engineering Center

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### LETTER FROM THE DIRECTORS

This is the first edition of a newsletter that will become our quarterly communication link to our affiliates, alumni, and other friends. Our sincere thanks go to Allison Smith who has taken the initiative to create this newsletter and has volunteered to be its editor-in-chief for many decades to come. The intent of this newsletter is to keep you up-to-date on Blume Center news, and equally, to maintain our personal contact with you. We invite our alumni and professional affiliates to provide us with personal and/or professional news, which we will publish, as space permits, in Alumni and Affiliates Corners of future editions. Please write to the address above or send e-mail to Jeanne Cosby at [cosby@cive.stanford.edu](mailto:cosby@cive.stanford.edu).

This year the Blume Center is celebrating its 20th anniversary. This is a good time to reflect on the past and look to the future. We believe we can be proud of past accomplishments, which include the creation of a stimulating environment for productive and innovative research, the publication of more than 120 technical reports, and the hosting of national and international workshops and conferences. Our faculty has been very successful in increasing our earthquake engineering research program despite the decline in funding available for academic research. All signs indicate that we will grow further in the years to come. We expect to maintain our present strengths and add new ones, particularly in the areas of geographic information systems, sensor technology, structural control, and advanced material technology.

A major change will take place during the next year. Our home, Bldg. 540, will be seismically upgraded. We want to take this opportunity to expand our office and laboratory spaces and consolidate most of the structural engineering research activities in a seismically strengthened and architecturally rejuvenated building. The plan is to vacate Bldg. 540 by summer of 1995 and move back into our expanded quarters by spring 1996.

Before closing, we want to take this opportunity to welcome back our colleague Haresh Shah, one of the two original co-directors of the Blume Center. Haresh, who has been the Chairman of our Civil Engineering Department for nine years, is presently on leave, and will be back next year as a member of the Blume Center faculty. We all owe him much thanks for his superb job as CE Chairman, and we are most happy to see him back within our group. Best wishes, and let's keep in touch!  
Helmut Krawinkler & Anne Kiremidjian

### CENTER NEWS

After nine years, **Prof. Haresh C. Shah** stepped down as chair of the Civil Engineering Department, effective September 1, 1994. During the '94-'95 academic year, he will be taking a combined sabbatical and leave of absence from university activities. He will rejoin the Structural Engineering and Geomechanics Program in the Autumn, 1995.

Effective this quarter, **Prof. Peter Pinsky** has assumed the responsibility as coordinator of the Structural Engineering and Geomechanics Program. We thank **Prof. Helmut Krawinkler**, who served as coordinator for the past six years, for his hard work and dedication.

**Prof. H. Allison Smith** was one of sixteen recipients of the Office of Naval Research Young Investigator Program Award for 1994.

In April, **Prof. Anne Kiremidjian** gave an invited presentation entitled, "Summary of the Damage from the Northridge Earthquake of January 17, 1994" at the Second China-Japan-U.S. Trilateral Symposium on Lifeline Earthquake Engineering in Xian, China. Professor Kiremidjian was a member of the U.S. Delegation of the National Science Foundation for the Joint Protocol Meeting of the U.S.-China Joint Cooperative Agreement on Earthquake Engineering.

**Prof. Ronnie Borja** has returned to Stanford's Geomechanics Program after spending three of the past four quarters on sabbatical at the University of Madrid in Spain.

We welcome **Dr. Timothy J. McCarthy**, Lecturer in the Department of Civil Engineering and Structural Engineering at U.M.I.S.T. in Manchester, England, and **Prof. Jean H. Prevost**, former Chair of the Department of Civil Engineering at Princeton University, as Visiting Scholars.

**Prof. Haresh C. Shah** was the invited lecturer for the United Nations University public forum held October 12. Ms presentation was entitled, "Why is Global Earthquake Risk Increasing." Professor Shah is assisting the United Nations University (UNU) in the development of a Global Network on Disaster Risk Management (GLO-DISNET), which has been formed by UNU in cooperation with Stanford University, the World Seismic Safety Initiative, and the University of Tokyo's International Center for Disaster-Mitigation Engineering.

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# RESEARCH SPOTLIGHT

## Methodologies for Evaluating Socio-Economic Consequences of Large Earthquakes

**Project Sponsor:** California Universities for Research in Earthquake Engineering (CUREe) and Kajima Corporation

**Project Duration:** October 1, 1993 – September 30, 1996

**Principal Project Coordinator:** Prof. Anne Kiremidjian, Stanford University

**Senior Researchers:** Prof. Anne Kiremidjian, Prof. Kincho H. Law, Dr. Stephanie King (Stanford University); Mr. Robert Olson, Dr. Ken Goettel (affiliates of U.C. Berkeley); Prof. Mladen Vucetic (U.C.L.A.)

**Research Assistants:** Nesrin Basoz, Erik Straser, Ajay Singhal, Maya Belubekian, Olabunmi Folayan, Erik Osorio, Leticia Duenas, Evan Barth (Stanford University); Macan Doroudian (U.C.L.A.)

The assessment of damage and losses are of primary importance in the evaluation of the socioeconomic impact on a region due to earthquakes. Socio-economic impact analyses allow for the identification of high risk facilities, development of retrofit strategies, disaster planning and emergency response. High risk facilities are defined as buildings or lifeline components that provide essential services to a region or facilities that can result in high number of casualties. The purpose of this project is to develop innovative methods for regional earthquake damage and loss estimation, utilizing modern computing technologies, including geographic information system (GIS), relational database management system (RDBMS) and knowledge-based expert system (KBES). An integrated GIS/ Engineering modeling framework for regional seismic hazard and risk analysis and simulation is shown in Figure 1. Five major tasks have been identified for this study:

- (a) Evaluation of ground shaking hazard
- (b) Estimation of collateral hazards
- (c) Development of inventories of the built environment
- (d) Evaluation of direct structural damage as well as content and equipment damage
- (e) Assessment of losses and socioeconomic consequences

The key for the integration of the modules identified in the above tasks is the utilization of a Geographic Information System (GIS). GIS is a computer software that is designed to support the capture, management, manipulation and display of spatially distributed data and to facilitate the development of methodologies for spatial analyses and simulations. A GIS is an indispensable tool for the study of earthquake damage and loss over a large region. In this project, extensive use is made of the data storage, modeling and display capabilities of the GIS software, Arc/Info™. Regional distributions of ground shaking and secondary site effects are produced through spatial analysis of various geologic and geotechnical features in the region. Figure 2 shows an example of a surface peak ground acceleration (PGA) map for Palo Alto produced using a GIS-based methodology.

Tabular inventory data such as TIGER file, tax assessor file, bridge inventory and damage data are stored in the Info

database within Arc/Info and in the relational database management system dBASE™. A RDBMS is used to facilitate the storage, manipulation and retrieval of data relevant to a specific task. The retrieved data can then be used by the GIS or by the KBES. For example, the inventory of the built environment can be overlaid with hazard distributions to allow subsequent modeling and evaluation of damage and loss.

In order to evaluate the post-earthquake performance of a transportation (lifeline) system, the seismic behavior of the critical components of the system, such as bridges and tunnels, need to be identified. The seismic behavior of a component depends on the structural properties, the design characteristics and the seismicity at the site. Attributes for defining bridge classes are selected in a way that enables the seismic behavior of the structures in that class to be expressed in terms a set of generalized ground motion-damage relationships. Damage to components of the system governs the performance of the transportation network for post-disaster planning and emergency management. This project focuses on bridges as the critical components of the transportation system. A comprehensive set of bridge classes is defined and an expert system is being developed to classify existing bridges into bridge classes. Network analysis methods are utilized to identify the critical bridges for emergency response and economic loss estimations.

The methodology developed in this project will be illustrated through an application to the city of Palo Alto, California. This region is selected because it is situated in close proximity to major active fault and contains wide variety of structures that are present in many California cities and towns. The results of the analysis, in tabular or in map format, will show regional distribution of hazards, damage and loss for scenario events and for probable events over a specified future time periods. The maps would identify high risk areas, the primary hazards contributing to the high risk (e.g., liquefaction, landslide, ground shaking), and high risk facilities. Emergency preparedness, earthquake risk mitigation policies, retrofit strategies and land use planning decisions can be made based on the information from these analyses.

Arc/Info™ is a trademark of ESRI, Inc.

dBASE™ is a trademark of Borland International Inc.

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# RESEARCH SPOTLIGHT cont.

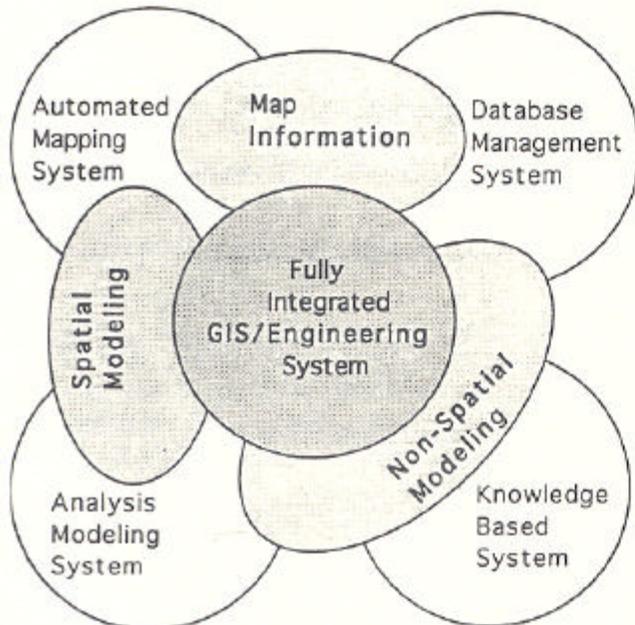


Fig. 1 A GIS/Engineering Modeling Framework

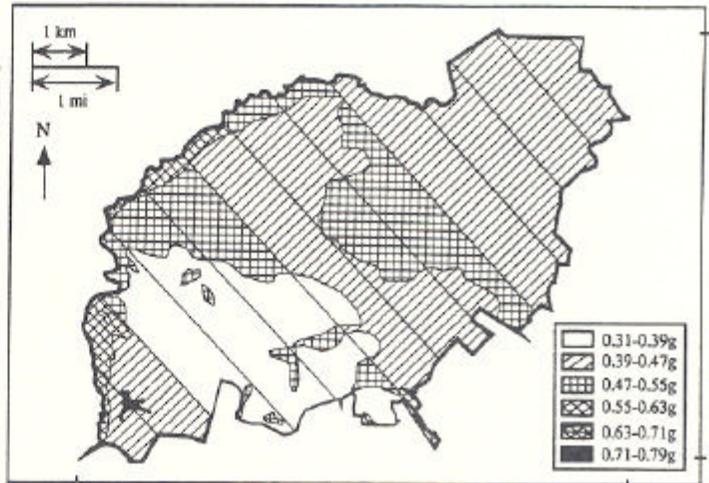


Fig. 2 Surface PGA for Magnitude 7.5 on the San Andreas fault in Palo Alto, California

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## NEWLY SPONSORED RESEARCH PROJECTS

*Iterative Methods for Generalized and Modified Eigenvalue Problems on Parallel Computers*, sponsored by the National Science Foundation. Principal Investigator: Prof. Kincho Law and Prof. Gene Golub (Dept. of Computer Science). 10/1/94 - 9/30/96

*Damage Assessment of Transportation Systems for the Northridge Earthquake*, sponsored by the National Science Foundation. Principal Investigators: Prof. Anne S. Kiremidjian and Prof. Kincho Law. 8/11/94 - 7/31/95

*Adaptive Control of Smart Structures with Time Variant Stiffness and Damping*, sponsored by the Office of Naval Research. Principal Investigator: Prof. H. Allison Smith. 4/1/94 - 3/31/97

*New Tools for Optimal Design Decision in the Presence of Risk*, sponsored by California Universities for Research in Earthquake Engineering. Principal Investigators: Prof. H. Allison Smith, Prof. James Beck (Caltech), and Prof. Sami Masri (USC). 4/1/94 - 3/31/96

*A Deformation Based Methodology for the Evaluation and Upgrading of Existing Structures*, sponsored by the National Science Foundation. Principal Investigator: Prof. Helmut Krawinkler. 5/1/94 - 4/30/96

*Methodologies for Evaluating Socioeconomic Consequences of Large Earthquakes*, sponsored by California Universities for Research in Earthquake Engineering. Principal Investigators: Prof. Anne S. Kiremidjian, Prof. Kincho Law, Prof. Mladen Vucetic (UCLA), and Mr. Robert Olsen (UC-Berkeley). 9/1/93 - 8/31/96

*Research in Support of a Transparent Seismic Design Methodology*, sponsored by the National Science Foundation. Principal Investigator: Prof. Helmut Krawinkler. 10/1/94 - 9/30/97

*Bridging the Architecture/Engineering/Construction Gap: Development of an Interdisciplinary Computer Supported Course*, sponsored by the National Science Foundation Synthesis Coalition. Principal Investigator: Prof. Helmut Krawinkler and Dr. Renate Fruchter. 10/1/94 - 9/30/95

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## NEWLY PUBLISHED TECHNICAL REPORTS

**No. 107** - *Computer Assisted Conceptual Structural Design of Steel Buildings*, by Hiroyuki Fuyama (supervised by Prof. Helmut Krawinkler and Prof. Kincho Law). July, 1993. (\$20.00)

**No. 108** - *Effects of Soft Soil and Hysteresis Model on Seismic Demands*, by Mohsen Rahnama and Prof. Helmut Krawinkler. July, 1993 (\$20.00)

**No. 109** - *Vibration Analysis of Skeletal Systems Using a Mixed Formulation with an Arnoldi-Based Nonlinear Eigensolution Technique* by Rajesh K. Singh and Prof. H. Allison Smith. November, 1993. (\$17.50)

**No. 110** - *Wind Hazard Analysis in Hurricane-Prone Regions* by Hon Chuen Lai and Prof. Anne S. Kiremidjian. December, 1993. (\$12.50)

**No. 111** - *Regional Seismic Hazard and Risk Analysis through Geographic Information Systems* by Stephanie A. King and Prof. Anne S. Kiremidjian. June, 1994. (\$32.50)

**No. 112** - *Optimal Structural Control Considering Soil Structure Interaction Effects* by Wen-Hwa Wu and Prof. H. Allison Smith. June, 1994. (\$15.00)

**No. 113** - *Adaptive Dynamic Analysis Considering Structural Lifespan: An Approach Based on Fuzzy Mathematics* by Sara Wadia-Faseetti and Prof. H. Allison Smith. September, 1994. (\$17.50)

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## ALUMNI NEWS

**Sara Wadia-Faseetti** [M.S., 1991; Ph.D., 1994] recently joined the faculty of Northeastern University in Boston as an Assistant Professor of Civil Engineering

Wen-Hwa Wu [Ph.D., 1994] has joined the faculty of National Yunlin Institute of Technology in Taiwan as an Associate Professor of Construction Engineering.

On August 25, **Thalia Anagnos** [Ph.D., 1984] gave birth to her first daughter and second child, Chloe Bernadette Koseff.

Gregory Chiu [Ph.D., 1994] is now working at the Insurance Institute for Property Loss Reduction in Boston.

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