



RECENT AWARDS: JULY-SEPTEMBER 1978

NATIONAL SCIENCE FOUNDATION
Division of Problem-Focused Research Applications
DIRECTORATE FOR APPLIED SCIENCE AND RESEARCH APPLICATIONS
WASHINGTON, D.C. 20550

INTRODUCTION

RECENT AWARDS keeps researchers, research users, and policy makers informed about projects being supported by NSF's Division of Problem-Focused Research Applications (PFRA).

This brochure presents brief descriptions of awards made by PFRA during the period July 1, 1978 through September 30, 1978; in addition, Fiscal Year 1978 awards made between October 1, 1977 and June 30, 1978 but inadvertently omitted from earlier editions of RECENT AWARDS are also included. The data collected and contained herein has been reconciled with the NSF's Management Information System.

Readers wishing information on PFRA, ASRA, NSF, or any of the individual projects listed in this brochure should complete and return the post card on page 16. This post card can be used to request PFRA's SUMMARY OF AWARDS FISCAL YEAR 1978. Also available upon request is ASRA GUIDELINES FOR PREPARATION OF UNSOLICITED PROPOSALS, which contains information on proposal preparation, format, and procedures for submission.

PFRA welcomes reader comments and suggestions for improving the utility of this publication.

HOW TO OBTAIN PFRA RESEARCH FINDINGS AND RESULTS

One of the most important objectives of PFRA is the timely and widespread dissemination of the results of PFRA-supported research to potential users. The name and mailing address of the Principal Investigator and Grantee Institution is contained in each project description in this brochure. Persons wishing to obtain information on project findings including project reports, monographs, journal articles, technical reports, and other such relevant materials should write to the Principal Investigator at the Grantee Institution to determine what information is available and at what, if any, cost it may be obtained. The Grantee Institution may charge a nominal amount for the duplication and mailing of such materials to cover costs. The Principal Investigator may furnish information on how interested persons may acquire reports and other materials as appropriate from the National Technical Information Service (NTIS) of the Department of Commerce in lieu of furnishing the report or other material directly. NTIS is the central point in the United States for the public sale of Government-funded research and development reports and other analyses prepared by Federal agencies, their contractors, and grantees. The Principal Investigator may also cite journals or other publications where project information may be looked up instead of furnishing a copy of the article.

DEFINITIONS AND EXPLANATION OF FORMAT

Formulation and Expression of Seismic Design Provisions;¹ Steven J. Fenves;² Carnegie-Mellon University, Department of Civil Engineering, Pittsburgh, PA 15213;³ Award #76-19033 A04⁴

1. **Title of the Specific Grant**
2. **Principal Investigator:** the chief scientist or administrator who is responsible for the research plan and fiscal expenditures as an NSF-sponsored awardee. Co-Principal Investigators will also be listed.
3. **Institution Conducting the Research:** any college, university, laboratory, industry, or other organization, whether operating on a profit or nonprofit basis, as well as State governments and Federal organizations.
4. **Award Number:** the award number and amendment number, if applicable.



Alternative Biological Sources of Materials

The Alternative Biological Sources of Materials program deals with selected aspects of the problem of meeting the Nation's future needs for raw materials. This program is directed toward alleviating national dependence on selected scarce resources by making alternative biological sources of materials available in the United States. Three particular topics have been selected for investigation in Fiscal Year 1979: biological conversion of lignocellulosic materials to useful chemicals; biological nitrogen fixation; and production of speciality chemicals from arid land plants (specifically, production of rubber from the guayule plant).

1. Pretreatment Methods for the Degradation of Lignin; Billy R. Allen; Battelle Memorial Institute, Columbus Division, 505 King Avenue, Columbus, OH 43202; Award #77-25833
Evaluate present and potential methods for pretreating lignocellulosic substrates to separate and modify the lignin for conversion into valuable industrial materials.
2. Feasibility of Producing Natural Rubber from the Guayule Plant; Daniel M. Bragg; Texas A&M Research Foundation, F. E. Box H, College Station, TX 77843; Award #78-12713
Evaluate the feasibility of developing guayule as an alternative, domestic source of natural rubber in the

United States: evaluate the market for guayule rubber in 1985 and 1990, and analyze the economics of guayule rubber production including the costs of production, transportation, and extraction, and guayule's competitiveness with other crops.

3. Conversion of Lignocellulose by Actinomycetes Microorganisms; Donald L. Crawford; University of Idaho, Department of Bacteriology and Biochemistry, Moscow, ID 83843; **Award #78-09453**

Use either intact microbes or isolated enzymes to effectively utilize and convert lignocellulosic materials to industrial raw materials; characterize promising lignin-degrading microbes; and examine the regulatory relationship of lignin-degradation to cellulose hydrolysis.

4. An Integrated Approach to the Conversion of Lignocellulose from Wood into Useful Chemicals; Irving S. Goldstein; North Carolina State University, Department of Wood and Paper Sciences, Raleigh, NC 27607; **Award #77-12243 A01**

The conversion of wood into chemicals for the production of most of our synthetic plastics, fibers, and rubbers is technically feasible. The objective of this project is to study the conversion of wood components (hemicelluloses, cellulose, and lignin) from low quality southern hardwoods to useful chemicals in a systematic, integrated manner and to specifically explore promising avenues of prehydrolysis, high energy electron beam radiation to increase the accessibility of cellulose to hydrolysis by strong hydrochloric acid, and the hydrogenation of the derived lignin to phenols.

5. Insecticidal Activity of *Beauveria bassiana*; Edward A. Grula; Oklahoma State University, School of Biological Sciences, Stillwater, OK 74074; **Award #76-80992 A01**

Beauveria bassiana, a fungus pathogenic to insects, has been studied extensively as a biological agent for the control of insect pests. This project will identify which products excreted by the fungus are responsible for its insecticidal activity; define the environmental conditions favorable for such activity, delineate the mechanisms of infection and resistance in the insect larvae, and develop, isolate, and establish superactive mutants suitable for wide field use. This project is part of the US-USSR Science and Technology Cooperative program.

6. Workshop on Selecting and Breeding Legumes for Enhanced Nitrogen Fixation; Thomas A. LaRue; Boyce Thompson Institute for Plant Research, Tower Road, Ithaca, NY 14853; **Award #78-16852**

Success in increasing biological nitrogen fixation is most likely to come from improvements in symbiotic fixation by agricultural legumes. A workshop will be held at the Boyce Thompson Institute, Ithaca, New York, to review recent developments in measuring symbiotic nitrogen fixation and related plant processes, present research results on plant selection and the genetic contribution of the plant, and consider the requirements of legume breeders and agronomists for simple assays related to nitrogen fixation.

7. The Enhancement of Biological Nitrogen Fixation; Karel R. Schubert; Michigan State University, Department of Biochemistry, East Lansing, MI 48824; **Award #77-24683**

This project will define factors affecting the fundamental processes involved in nitrogen fixation, dinitrogen reduction, and ammonia assimilation in symbiotic nitrogen fixing organisms. The legume-rhizobium system will be the major target of these studies. The knowledge gained from these investigations will be applied to the task of enhancing biological nitrogen fixation.

8. Pyrolytic Conversion of Lignocellulosic Materials; Fred Shafizadeh; University of Montana, Department of Chemistry, Missoula, MT 59801; **Award #78-18096**

Examine promising routes for converting lignocellulosic materials to useful chemicals through pyrolysis, the controlled thermal treatment of materials. Specific objectives include thermal depolymerization of cellulose into levoglucosan, pyrolytic processes for producing furfural, acetic acid, methanol, and carbon from hemicellulose and xylan, establishing the utility of pyrolytic products, and investigating the use of thermal treatments to increase the susceptibility of cellulose to enzyme hydrolysis.

9. Renewable Resources—Enzyme Technology Digest; Harry Sobel; NEUS, Inc., P.O. Box 1979, Santa Monica, CA 90406; **Award #77-12500**

Enzyme technology and renewable resources are two interconnected emerging areas of wide application. Enzyme technology refers to the controlled use of enzymes (biological catalysts), which provide us with renewable resources used for food, fertilizer, building materials, fuels, chemicals, and other useful materials. This grant will support an informal information exchange. The *Renewable Resources—Enzyme Technology Digest* will disseminate pertinent information concerning work in progress in these two areas. The digest will be quarterly and will be available to the public on a paid subscription basis.

10. Feasibility of Introducing Food Crops better Adapted to Environmental Stress; Dr. Arthur A. Theisen; Soil and Land Use Technology, Inc., 11021 Wood Elves Way, Columbia, MD 21044; **Award #77-19462**

Present-day U.S. agriculture is based on a few selected crops. This project will select up to 15 new crops that appear to be well adapted to growing conditions in temperate regions of the U.S. and which can be grown on marginal land. The feasibility of introducing these species into the agricultural production-to-consumption systems of the United States will be evaluated.



Chemical Threats to Man and the Environment

The Chemical Threats to Man and the Environment program seeks to identify, understand, and reduce contamination and environmental hazard arising from the

REPORT DOCUMENTATION PAGE		1. REPORT NO. NSF/RA-790028	2.	PB 292752	
4. Title and Subtitle Recent Awards, July-September 1978 (NSF 78-63)			5. Report Date 1979		
7. Author(s)			6.		
9. Performing Organization Name and Address National Science Foundation Division of Problem-Focused Research Applications Directorate for Applied Science & Research Applications Washington, D.C. 20550			8. Performing Organization Rept. No. NSF 78-63		
12. Sponsoring Organization Name and Address Applied Science and Research Applications (ASRA) National Science Foundation 1800 G Street, N.W. Washington, D.C. 20550			10. Project/Task/Work Unit No.		
15. Supplementary Notes			11. Contract(C) or Grant(G) No. (C) (G)		
16. Abstract (Limit: 200 words) This brochure presents brief descriptions of awards made by the Division of Problem-Focused Research Applications (PFRA) during July 1, 1978 through September 30, 1978 and Fiscal Year (FY) 1978 awards made between October 1, 1977 and June 30, 1978. It describes how to obtain PFRA research findings and results and definitions and explanation of the format. The awards are divided according to subject area: ten awards are listed for alternative biological sources of materials, sixteen for chemical threats to man and his environment, fourteen for community water management, and 61 for earthquake hazards mitigation. Biological conversion of lignocellulosic materials to useful chemicals, biological nitrogen fixation, and production of speciality chemicals from arid land plants were topics selected for investigation in FY 1979. Other topics for consideration in FY 1979 include characterization and fate of carbon contaminants and techniques for environmental analysis. Also addressed are the nation's capacity to effectively manage the use of water and the reduction of risks to public health, safety, and the environment. Siting, design, and policy also are emphasized.			13. Type of Report & Period Covered		
17. Document Analysis a. Descriptors Awards Research management Research projects b. Identifiers/Open-Ended Terms c. COSATI Field/Group			Substitutes Biological surveys Chemical detection Environmental effects Water consumption Water treatment Earthquakes		
18. Availability Statement NTIS			19. Security Class (This Report)		21. No. of Pages 16
			20. Security Class (This Page)		22. Price PC, HQ, MF, FOI

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manufacture, use, and disposal of chemical products by increasing our scientific knowledge of man-made contaminants and naturally occurring toxicants and making this knowledge available to appropriate users. Priority areas for consideration in FY 1979 include characterization and fate of airborne contaminants; techniques for environmental analysis; environmental transport and models; natural toxicants; development of toxicological assays; nitrous oxide; predictive and forensic techniques; and toxicological methods.

1. Natural and Fertilizer-Induced Emissions of Nitrous Oxide from Soils; John M. Bremner; Iowa State University of Science and Technology, Department of Agronomy, Ames, IA 50011; **Award #77-23835**

Obtain information needed to assess the risk that increased use of nitrogen fertilizers may increase release of nitrous oxide from soils to the atmosphere, and study the processes of denitrification and nitrification of fertilizer nitrogen which are responsible for emission of nitrous oxide from soils.

2. Enzyme Monitored Receptor Assay System for Industrial Organic Chemical Environmental Contaminants; Patrick E. Guire; Kallestad Laboratories, Inc., 1000 Lake Hazeltine Drive, Chaska, MN 55318; **Award #78-19705**

Develop a highly sensitive, specific, convenient, and economical enzyme-monitored immunoassay system for detection and measurement of dinitrotoluene and antigenically related industrial environmental contaminants through the preparation and use of a co-factor derivative containing a covalently linked hapten group.

3. Cytogenic Effects of Mutagens and Mitotic Poisons on Mammalian Cells; T. C. Hsu; University of Texas—M.D. Anderson Hospital and Tumor Institute, Houston, TX 77030; **Award #76-82241 A01**

There is an urgent need for quick, inexpensive and reliable tests for screening the thirty thousand or more commercial chemicals in use in the United States every year so that those with the highest potential to cause mutations can be extensively tested and their risks assessed. This project will use mammalian cells for the rapid screening of chemicals for their ability to cause chromosome breaks or otherwise to interfere with mitosis both in cell culture and *in vitro*.

4. The Development of a Method for the Detection of Sources of Organic Pollutants Using Carbon-Isotope Ratios; Bernard Keisch; Carnegie-Mellon Institute of Research, Division of Carnegie-Mellon University, 4400 Fifth Avenue, Pittsburgh, PA 15213; **Award #78-16315**

Develop a method for detection of specific sources of organic water pollutants. The carbon-isotope ratios for the same organic compound from different sources vary considerably. This research will assist in determining culpability in the case of pollution "incidents."

5. Chemiluminescent Analysis of Hydrogen Peroxide in the Ambient Atmosphere; Gregory L. Kok; Harvey Mudd College, Department of Chemistry, Claremont, CA 91711; **Award #76-14702 A02**

Hydrogen peroxide participates in the formation of photochemical smog. Current methods for the analyti-

cal measurement of the concentration of hydrogen peroxide are unsatisfactory because they are slow and complicated. This grant is for development of a liquid-phase chemiluminescent analyzer for the determination of hydrogen peroxide in the ambient atmosphere.

6. An Evaluation of Toxicological Information Relevant to Future Testing Requirements for Hazardous Chemical Substances and Mixtures; John C. Kolojeski; Clement Associates, Inc., 1055 Thomas Jefferson Street, N.W., Washington, DC 20007; **Award #77-15417 A03**

With the passage of the Toxic Substances Control Act (PL 94-469), premarket testing for the determination of the hazardous nature of new chemical substances became a regulatory issue. The act established the Interagency Advisory Committee to advise EPA on chemical substances and mixtures which ought to require further testing. This award is to provide technical assistance to the Interagency Advisory Committee by providing information on exposure and health and environmental effects for manufactured chemical substances and mixtures, consulting during review of the data provided, support to the Committee in the selection of those substances and mixtures having the greatest potential for damage to human health and the environment, and support for the formulation of Committee recommendations.

7. An Investigation into the Chemistry of the UV-Ozone Water Purification Process; Eriks Leitis; Westgate Research Corporation, 1931 Pontius Avenue, Los Angeles, CA 90025; **Award #76-24652 A01**

There is known to be a pronounced synergistic effect in the action of ozone and ultraviolet light to decompose organic materials in water. The UV-ozone process has proven effective in decontaminating certain classes of organic wastes, but an understanding of the chemical and photochemical mechanisms involved is not yet clear. This research will determine what these mechanisms are for representative organic molecules, and will gain an understanding sufficient to enable the design of applications of the process to a variety of chemicals in waste streams or in drinking water.

8. Nitrous Oxide Environmental Measurement Program; Michael B. McElroy and Charles E. Kolb; Harvard University, Division of Engineering and Applied Physics (subcontract to Aerodyne Research, Inc.), Cambridge, MA 02138; **Award #76-24239 A03**

The major natural mechanism for destruction of ozone in the stratosphere is by reaction with oxides of nitrogen, in particular nitrous oxide. Recently there has been concern that there may be an enhanced destruction of ozone as a result of an added flux of nitrous oxide caused by the growing extensive use of synthetic nitrogen fertilizers in agriculture. Before the significance of the fertilizer effect can be assessed, more accurate estimates of natural production of nitrous oxide must be made. This project will study the nitrous oxide flux from near-shore areas such as estuaries and salt marshes, so that the relative performance of nitrous oxide production from fertilizers relative to natural processes can be determined.

9. Isotopic Labeling Techniques to Study the Photooxidation of Hydrocarbons in Air; G. David Mendenhall; Battelle Memorial Institute, 505 King Avenue, Columbus, OH 43201; **Award #77-20692**

Different classes of hydrocarbons in gasoline yield different photochemical oxidation products. This research will elucidate the reaction pathways connecting certain hydrocarbon types with their oxidation products. Results of this study will be a detailed understanding of the fate of organic substances in the atmosphere and the development of new methods to study such changes.

10. The Role of Primary Particulates in Urban Air Pollution; Tihomir Novakov; Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720; **Award #77-20076 A01**

Assess the direct and indirect contributions of primary carbon emissions to the degradation of visibility and total particulate loading of urban atmospheres; evaluate the roles of primary particulates in the formation of secondary species including particulate sulfate. This project is designed to explore possibilities of the formation of unsuspected carcinogens in urban air.

11. Development of Antisera to Benzo[a]pyrene and its Metabolites; Kent Painter; Western Chemical Research Corporation, 2300 N. Highway 287, Fort Collins, CO 80521; **Award #78-17839**

This is a proof-of-concept experiment to determine the feasibility of producing antisera to benzo[a]pyrene and its metabolites for use in the development of sensitive, specific immunochemical (radio-immunoassay) tests. Other applications of benzo[a]pyrene antisera include the employment of solid-phase immobilized antibody techniques to the removal of benzo[a]pyrenes from wastewater.

12. Atmospheric Transformations and Mutagenic Activity of Primary and Secondary Air Pollutants; James N. Pitts; University of California—Riverside, Statewide Air Pollution Research Center (SAPRC), Riverside, CA 92521; **Award #78-01004**

Secondary contaminants form in polluted urban air when man-made contaminants react chemically with one another and with naturally occurring atmospheric constituents. These secondary products include visibility-degrading aerosols, gaseous bioirritants, and various substances having unspecified effects on human health. Following an earlier NSF-supported project to develop a kinetic computer model of smog photochemistry, this project will attempt to clarify the roles of certain highly-active minor chemical species in smog formation; elucidate the formation and roles of particulates in photochemical air pollution; determine the chemical transformations of amines and nitrosamines in simulated polluted air; and, investigate the chemical nature and possible mutagenic properties of air-borne pollutants from agricultural burning.

13. Chemical and Physical Characterization of Submicron Aerosols; John H. Seinfeld; California Institute of Technology, Department of Chemical Engineering, Pasadena, CA 91125; **Award #76-04179 A01**

Develop a fundamental understanding of the formation and growth of submicron aerosol particles of importance in air pollution by: determining the processes which govern the emissions of submicron particles from combustion sources; developing comprehensive mathematical models capable of simulating the dynamics of the size and composition distribution of air pollution aerosols; and, developing a low pressure impactor capable of fractionating particles below 0.5 micrometer diameter for use in conjunction with combustion studies and in measurements of trace-metal concentrations in ambient air.

14. Development of Procedures for the Analysis of Organic Compounds in the Atmosphere; Robert E. Sievers; University of Colorado, Department of Chemistry, Boulder, CO 80302; **Award #77-18306**

This project will develop methods for rapid, reproducible, and efficient analysis of hydrocarbons and oxygenated hydrocarbons in the air. Samples will be collected on especially prepared absorbent traps and analyzed by gas chromatography/mass spectroscopy to identify and quantify the compounds present.

15. Prediction of Volatilization Rates of Chemicals in Water; James H. Smith; SRI, International, 333 Ravenswood Avenue, Menlo Park, CA 94025; **Award #78-10691**

Improve the volatilization rate theory, and measure the oxygen reaeration coefficient for several volatile toxic compounds at several temperatures in order to add to our ability to predict the volatilization rates of many different chemicals from water to the atmosphere.

16. Pollutant Flow through the Marine Food Web; David R. Young; Southern California Coastal Water Research Project Authority, 1500 East Imperial Highway, El Segundo, CA 90245; **Award #77-15376**

Scientists suggest that toxic pollutants move both upward and downward in the marine food web. This project will pursue field investigations off the coast of Southern California to determine whether or not structured food webs exist in a major wastewater disposal zone. Species of biological life representing several growth and reproductive stages will be collected at controlled sites and analyzed for lipid content, cesium, potassium, trace metals, chlorinated hydrocarbons and petroleum derivatives to serve as the basis for an examination of the food chain amplification concept.



Community Water Management

The Community Water Management program addresses the Nation's capability and capacity to efficiently and effectively manage the use and reuse of water in the built environment, and to reduce risks to public health, safety, and the environment that arise from or are otherwise associated with the use and reuse of water.

1. Hydrometeorologic Studies of Urban Water Resource Problems; Stanley A. Changnon; University of Illinois,

Geography Department, Urbana, IL 61801; **Award #78-05693**

Support the final year of a comprehensive three-year hydrometeorological project in the Chicago metropolitan area to provide better methods of collecting and analyzing precipitation data for use in hydrologic design problems such as urban sewer systems and other hydraulic structures, using a combination of radar and raingage data.

2. Conversion of Municipal Wastewater Treatment Plant Sludges into Earthworm Castings for Use as Topsoil; Jack E. Collier; Collier Worm Ranch, 2022 Cabrillo Court, Santa Clara, CA 95051; **Award #77-16832 A01**

Determine the feasibility of utilizing earthworms to accelerate the stabilization of municipal wastewater treatment plants sludges. Determine optimum worm density, rate of reproduction, intake and retention of heavy metals including silver, cadmium, chromium, copper, nickel, lead, and zinc, and study plant growth and worm castings.

3. Symposium on Water Reuse; William J. Cooper; Department of the Army, U.S. Army Bioengineering Research and Development Lab, Fort Detrick, MD 21701; **Award #78-21313**

Support an interagency agreement for the National Symposium on Water Reuse to be held in 1979 by the American Water Works Association Research Foundation.

4. Efficacy and Impact of Intensive Plant Harvesting in Lake Management; Grant Cottam; University of Wisconsin, 750 University Avenue, Madison, WI 53706; **Award #77-10188**

Diffuse non-point sources on a lake's drainage basin can contribute nutrients capable of triggering and sustaining nuisance-type algal blooms and stimulating excessive growth of rooted aquatic vegetation. This project will evaluate the efficacy and assess the esthetic and recreational characteristics of intensive harvesting of rooted aquatic vegetation in the management of nutrients entering Lake Wingra, Wisconsin from diffuse sources.

5. Wastewater Reuse for Regional Management of Water to Meet Urban Needs; Arun K. Deb; Roy F. Weston, Inc., Weston Way, West Chester, PA 19380; **Award #76-18499 A01**

Devise and evaluate methods for the analysis of alternatives to a single, municipal water supply as an approach to solution of the problems of regional water quality and residuals management. Cost functions for typical water and wastewater treatment processes will be synthesized into a systems model for design of single and multiple approaches to water supply and wastewater management. A seminar/workshop is planned for the conclusion of this research to transfer the methodology developed to potential users.

6. Advanced Treatment of Community Wastewater by Flow-Through Cypress Strand Wetlands; Water R. Fritz; Boyle Engineering Corporation, 3025 East South Street, Orlando, FL 32803; **Award #78-19199**

Determine the feasibility of using cypress strand-type

wetlands to assist in advanced treatment for community wastewaters relating to management of nitrogen and phosphorous, numbers and distribution of coliform bacteria, and the fate of heavy metals.

7. Solid Waste Reduction and Mass Media Campaigns; Haynes C. Goddard; U.S. Environmental Production Agency, Municipal Environmental Research Lab., 26 West St. Clair Street, Cincinnati, OH 45268; **Award #78-00660**

Support an interagency agreement with the U.S. EPA to support research on solid waste reduction and determine the effectiveness of using mass media in obtaining public cooperation in a program of resource recovery from solid wastes.

8. Water Management in New England: A Method for Integrating Short-Run Operational and Long-Range Investment Strategies; Dr. Harris Gold; Water Purification Associates, 238 Main Street, Cambridge, MA 02142; **Award #77-25966**

Develop and evaluate an integrated method for optimizing operational and long-range investment strategies for water management in New England. This integrated method will be tested in New England at the city, sub-region, and river basin levels. Research will center on technological and institutional mechanisms for matching supply with demand; formulation and testing of an optimization method for demand reduction and supply increase; and tests of developed methods on specific cases. Transfer of the developed water management tools is expected through the specific cases studied, workshop/seminars, and a manual of practice.

9. Application of Sequencing Batch Reactors for Treatment of Municipal and Industrial Wastewaters; Robert L. Irvine; University of Notre Dame, Department of Civil Engineering, Notre Dame, IN 46556; **Award #76-10381 A02**

Investigate controlled, periodic treatment of wastewater for obtainment of better control and reliability than is presently possible using conventional continuous steady-state methods of processing. By using draw-and-fill treatment processes, the unreliability and inconsistency characteristic of continuous-flow systems can be diminished. Cost comparisons between controlled fill-and-draw methods and conventional continuous-flow methods will be made.

10. Wetland Utilization for Management of Community Wastewater; Robert H. Kadlec; University of Michigan, Department of Chemical Engineering, Ann Arbor, MI 48109; **Award #77-23868**

The objective of this research is to evaluate the use of a peat-marsh wetland in the Houghton Lake Wildlife Area for advanced treatment of domestic wastewater. Observations include those necessary to determine the effects of wastewater effluent application on hydrologic, nutrient, soil, microbial, algal, vegetation and animal compartments of the ecosystem. Cooperating agencies include the State of Michigan Department of Natural Resources, U.S. EPA, Houghton Lake Sewer

Authority, and the small business consulting engineering firm of Williams and Works, Inc.

11. Evaluation of Coliform Bacteria and Bacteriophage Relationships in Assessment of Water Quality; Judith F. Kitchens; Atlantic Research Corporation, 5390 Cherokee Avenue, Alexandria, VA 22314; **Award #78-19196**

This research will develop a method for rapid and reliable determination of coliform bacteriophage in water as an essential step toward an improved, more accurate, more reliable, and reproducible procedure for the enumeration of total and fecal coliform organisms in water as an indicator of water quality.

12. Public Health and Nuisance Aspects of Community Wastewater Sludge Management; Steven J. Marcus; Energy Resources Company, Inc., 185 Alewife Brook Parkway, Cambridge, MA 02138; **Award #78-15878**

Assess the public health and nuisance aspects of managing community wastewater treatment plant sludges, specifically, composted sludges. Topics to be reviewed in a project workshop including survival characteristics of pathogenic organisms subjected to composting procedures, health risks posed by application of viable sludge pathogens to land and the legal and institutional constraints that arise from or are associated with the production, distribution, and use of composted sludges.

13. Utilization of Cypress Wetlands for Management of Municipal Wastewater Treatment Plant Effluents; Howard T. Odum; University of Florida, Center for Wetlands, Gainesville, FL 32611; **Award #77-06013 A01**

Three years' research indicates that cypress dome-wetlands have the capability of conserving water by returning treated wastewater to subsurface formations after removing nutrients, heavy metals, bacteria, and viruses. This continuation research is directed toward final observations to determine the growth responses of trees and understory vegetation to the application of wastewater.

14. Prediction and Control of Heavy Metals and Toxic Organic Materials in Sludges; Leon W. Weinberger; Environmental Quality Systems, Inc., 1160 Rockville Pike, Suite 202, Rockville, MD 20852; **Award #78-15874**

This research will project the future composition of community wastewater treatment plants sludges with regard to their content of heavy metals and toxic organic substances based upon the implementation of current and projected future pollution abatement regulations. The results of these projects will provide a basis for the formulation, development, and evaluation of control strategies for toxic and hazardous substances and sludges.



Earthquake Hazards Mitigation

The objectives of the Earthquake Hazards Mitigation program are to develop methods and techniques that can provide effective protection for man, his works and institu-

tions from life loss, personal injury, property damage, social dislocations, and economic and ecological disruption associated with potential or realized earthquake hazards. Three major aspects of the problem are considered: Siting, Design and Policy. SITING focuses on the relationship between soil and geologic conditions at a given site, the potential earthquake hazard of the region, and the architectural, land use and engineering practices and policies necessary to make buildings at that site earthquake-resistant. DESIGN investigates the elastic and inelastic behavior of building materials used on the behavior of structures during seismic and wind excitation, ways to minimize the risk of older buildings not built to meet earthquake code standards, and the behavior of nonengineered structures and secondary components of buildings. POLICY deals with social, economic, legal, institutional and other factors which facilitate or hinder the adoption of social and technological solutions, including prediction and warning, to earthquake hazards, and also seeks effective dissemination of earthquake information to the public and to government decision-makers.

1. Prediction of Conditional Expected Tsunami Inundation on Hawaiian Shorelines; William Mansfield Adams; University of Hawaii, Hawaii Institute of Geophysics, Honolulu, HI 96822; **Award #77-27102**

Apply a hybrid finite-element numerical model developed by Chin and Mei for harbor oscillation and wave scattering to the prediction of tsunami inundation on Hawaiian shorelines. The methodology developed will be applicable to other areas including Alaska, Oregon and California.

2. Seminars on Earthquake Criteria and Design; M. S. Agabian; Earthquake Engineering Research Institute, 2620 Telegraph Avenue, Berkeley, CA 94704; **Award #78-16745**

Conduct three seminars on topics of interest to structural engineers engaged in seismic design. Topics will include seismicity and ground motions, structural behavior, design criteria and procedures, soil behavior, soil-structure interaction, and damage inspection. Videotapes of the seminars will be made available by the Earthquake Engineering Research Institute to interested groups.

3. Estimation of Strong Ground Motion from Small Seismic Events in Garm, USSR; Keiiti Aki; Massachusetts Institute of Technology, Department of Geology and Geophysics; Cambridge, MA 02139; **Award #76-23279 A01**

This award is for a cooperative field experiment program with Russian seismologists to apply U.S. techniques and experience for studying seismic wave propagation, phenomena, source mechanisms, and observations of earthquakes to a tectonic region in Garm, USSR, and to learn related Russian techniques and experience. The primary objective is to study small seismic events and estimate strong ground motions.

4. Reliability Analysis of Slopes During Earthquakes; Prof. Dimitri S. Athanasiou-Grivas; Rensselaer Polytechnic Institute, Department of Civil Engineering, Troy, NY 12181; **Award #77-16185**

- Develop improved methods to determine the seismic loads imposed on slopes having randomness in material properties, and develop probabilistically based design methods and safety criteria.
5. Optimal Design of Earthquake Strong-Motion Networks; Jack R. Benjamin; Engineering Decision Analysis Company, Inc., 480 California Avenue, Suite 301, Palo Alto, CA 94306; **Award #77-18644**
Because of the possibility of a greatly expanded United States Geological Survey (USGS) strong motion network, it is important that a systematic methodology for locating instruments be established. This research will develop a practical decision-making methodology including consideration of network configuration, number and type of instruments, network pattern with respect to tectonic, geologic, seismologic, and structural engineering requirements as well as various cost factors and derived benefits; apply this methodology for central and eastern United States; and recommend necessary coordination between USGS national network programs, State and local government agencies, and university projects.
 6. Reliability Assessment of Linear Lifelines for Natural Hazards; Jack R. Benjamin; Engineering Decision Analysis Company, Inc., 480 California Avenue, Suite 301, Palo Alto, CA 94306; **Award #77-24727**
Develop a practical methodology for reliability assessment of linear lifelines for energy supply, water supply, transportation or communications; verify this methodology using case studies.
 7. Dynamic Response Analysis of Offshore Platforms; J. G. Bouwkamp; J. G. Bouwkamp, Inc., 1930 Shattuck Avenue, Berkeley, CA 94704; **Award #76-82385**
Develop a computer program for the three-dimensional dynamic analysis of tubular framed offshore platforms subjected to the combined loads of earthquakes and wave forces, taking into account the flexibility of tubular joints; analyze the dynamic response of typical structures in both shallow and deep waters; develop simplified analytical procedures and investigate the effect of non-linear joint deformation.
 8. Objective and Subjective Seismic Safety Considerations; Colin C. Brown; University of Washington, Department of Civil Engineering, Seattle, WA 98195; **Award #77-01095**
This study addresses the problem of rationally including both objective and subjective considerations in seismic safety evaluations. The project will obtain quantitative estimates of the objective and subjective seismic safety of structures and will combine these estimates to provide a seismic safety value which properly accounts for both.
 9. Committee on Scholarly Communication with the People's Republic of China: Earthquake Hazards Mitigation; Mary Brown Bullock; National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418; **Award #6300057**
Send a delegation to China in August 1978, to visit technical institutes involved with earthquake hazards mitigation, explore the work being done, investigate the records on the destructive Tangshan earthquake of 1976, and expand the contacts made between Chinese and American earthquake engineers and seismologists.
 10. Earthquake Waves in Soil Deposits; Ahmet Cakmak; Princeton University, Department of Civil Engineering, Princeton, NJ 08540; **Award #76-20027 A01**
The geological configuration and the material properties of local soil deposits are rarely determined with sufficient accuracy to justify a deterministic analysis. This project will conduct analytical studies of seismic wave propagation in random soil media to develop a stochastic representation and modeling of soil deposits, taking into account the uncertainties of local geology and seismic ground motions.
 11. Seismic Resistance of Buildings with Reinforced Concrete Structural Walls; W. G. Corley; Portland Cement Association, Research and Development Division, 5420 Old Orchard Road, Skokie, IL 60077; **Award #77-15333**
Develop reliable and practical design procedures for earthquake-resistant reinforced concrete structural wall (shear wall) systems including isolated walls, coupled walls and frame-wall systems. Establish realistic estimates of the strength and deformation requirements in critical regions of structural wall systems through laboratory tests on large-size specimens. Correlate the results of these tests with theory to develop methods to predict the available strength and deformation capacities of properly proportioned and detailed structural walls and to simplify methods of design and analysis.
 12. Invitational Workshop on Comprehensive Emergency Preparedness; A. Berry Crawford; Institute for Policy Research, Western Governors' Policy Office, Suite 3100, 3333 Quebec Street, Denver, CO 80207; **Award #78-01003**
Representatives from the National Governors' Conference, the Council of State Planning Agencies, the Western Governors' Policy Office, State and local emergency preparedness officials, and Federal officials will examine comprehensive emergency preparedness, define local, State and Federal emergency preparedness roles and responsibilities, and will develop recommendations on the basis of selected case studies at this invitational workshop.
 13. Modeling of Foundations for Embedded Structures; Gautama Dasgupta; Columbia University, 620 SW NUDD, New York, NY 10027; **Award #77-22524**
Develop two different methods for foundation modeling taking into account for radiation damping according to continuum solutions. Investigate the substructure deletion and sub-domain solution procedures.
 14. Nondestructive Dynamic Testing of Three Highway Bridges; Bruce M. Douglas; University of Nevada, Department of Civil Engineering, Reno, NV 89557; **Award #77-27596**
Subject a five-span reinforced concrete box girder bridge and a six-span composite girder bridge to dynamic testing for both lateral and vertical motions;

- subject a three-span composite girder structure to vertical motion analysis; identify structural dynamic properties such as natural frequencies, mode shapes and modal damping to confirm the validity of experimental results and the methodologies used in the theoretical modeling processes.
15. **Methodology for Mitigation of Seismic Hazards in Existing Unreinforced Masonry Buildings**; Robert D. Ewing; ABK, A Joint Venture, 250 North Nash Street, El Segundo, CA 90245; **Award #78-19200**
Unreinforced masonry buildings pose a potential hazard to life when subjected to seismic forces. This project will evaluate the current state-of-the-art for mitigating the hazard of unreinforced masonry buildings; develop a methodology for the mitigation of these hazards; evaluate the methodology; and design a nationwide utilization plan for disseminating the methodology.
 16. **Study of the Role of the Mass Media in Disaster Reporting**; Charles E. Fritz; National Academy of Sciences—National Research Council, 2101 Constitution Avenue, Washington, DC 20418; **Award #63-00057**
An interdisciplinary committee including communications specialists, scientists, and disaster researchers will review existing knowledge on the role of the mass media of communication in disaster reporting, organize a workshop, construct a model on the structure and policies of news organizations in different media, and identify research priorities and relevant methodologies.
 17. **Design of Splices in Reinforced Concrete Frames for Earthquake Effects**; Peter Gergely; Cornell University, Department of Structural Engineering, Hollister Hall, Ithaca, NY 14853; **Award #78-02399**
Evaluate strength, deformation, and ductility of lapped splices in beams and columns in reinforced concrete subjected to reverse cyclic loadings; examine current code design provisions and new design recommendations in the light of experimental results.
 18. **Influence of Nonstructural Cladding on Dynamic Properties and Response of Highrise Buildings**; Barry J. Goodno; Georgia Institute of Technology, School of Civil Engineering, Atlanta, GA 30332; **Award #77-04269**
This project will assess the role of cladding systems in the structural performance of modern highrise buildings subject to earthquake forces. Exterior cladding in multi-story buildings may provide considerable resistance to low level excitation and help control interstory drift and building motion. Analytical and experimental studies will determine whether the stiffness and energy absorption capacity of these elements can be used to advantage in modern building design.
 19. **Urban Environmental Factors and Personal Well-Being**; Robert M. Griffin, S-126 Human Development Building, Pennsylvania State University, University Park, PA 16802; **Award #77-21295 A01**
Develop and validate measurement procedures to test the hypothesis that reactions to the urban environment are governed by two psychological predispositions: individuals predisposed to conforming behavior seek support from their environments, while individuals predisposed to self-directed behavior seek control over their environments. This research will lead to the identification of attributes that can be modified or created by urban planning and design. This project will give urban planners new ways to conceptualize the environment at a level relevant to personal well-being.
 20. **Collaborative Research: Processing and Analysis of Oroville Earthquake Aftershock Ground Motion Records**; Thomas C. Hanks; U.S. Geological Survey, Department of the Interior, Reston, VA 22092; **Award #76-81816 A01**
Develop an improved model to predict local ground motion of earthquakes based on the analysis of Oroville aftershock records (see also Helmbarger, Don).
 21. **Collaborative Research: Processing and Analysis of Oroville Earthquake Aftershock Ground Motion Records, Part II**; Donald V. Helmbarger; California Institute of Technology, Department of Geology and Planetary Science, Pasadena, CA 91104; **Award #76-21652 A01**
Provide continuing support for a joint program between the USGS and California Institute of Technology to assess continuously recorded seismograms taken in the aftershock sequence of the Oroville earthquake of 1975; develop an improved model to predict local ground motion time histories that occur due to earthquakes.
 22. **Contribution of Floor Systems to Earthquake Resistance of Steel and Concrete Building Frames**; Ti Huang; Lehigh University, Fritz Engineering Lab Bldg., Bethlehem, PA 18015; **Award #76-00715 A01**
This study will investigate and evaluate the contribution of floor systems frequently used in steel and concrete buildings to the earthquake resistance of building structural frames and will develop design guidelines which will consider the floor system contribution under repeated loadings. A computerized parametric study will be used for the generation and development of design guidelines for incorporation into design codes.
 23. **Workshop on Tsunamis Research**; Li-San Hwang; Tetra Tech, Inc., 630 North Rosemead Blvd., Pasadena, CA 91107; **Award #78-05646**
Conduct a workshop on tsunami behavior, including tsunamigenic earthquake ground motions, near-field problems, run-up, trans-oceanic propagation, resonances, and wave forces on structures. Proceedings will guide current researches and will be made available to the public.
 24. **Operation of the Universities Council for Earthquake Engineering Research**; Wilfred D. Iwan; California Institute of Technology, Mail Code 104-44, Pasadena, CA 91125; **Award #77-20044**
This project is for support of the activity of the Universities Council for Earthquake Engineering Research (UCEER). UCEER provides a vehicle for the free exchange of information on earthquake engineering related university research plans, priorities, and programs; and assists in the coordination of university

- research efforts. All University research investigators with an active interest in Earthquake Engineering are welcome to participate.
25. Strong Motion Seminar—Workshop, California Institute of Technology, January 1978; Paul C. Jennings and Donald V. Helmberger; California Institute of Technology, Thomas Laboratory 104-44, Pasadena, CA 91125; **Award #78-05355**
This award provide support for a seminar-workshop on strong motions produced by earthquakes to provide a technical exchange between the engineering and seismological communities and to promote discussion of future research directions. Main areas to be discussed are characterization and parameterization of strong ground motions, simulation and modeling of strong motions, and source mechanisms and estimation of strong motion for great earthquakes.
 26. Comprehensive Building Analysis Computer Program for Earthquake Response; Lindsay R. Jones; Computech, 2150 Shattuck Avenue, Berkeley, CA 94704; **Award #78-07599**
Develop, document and distribute a comprehensive computer program in standard fortran for the analysis of highrise buildings subject to seismic forces. A user panel consisting of engineers having an interest in the analysis field will insure relevancy. This program is intended for general use.
 27. Summer Seismic Institutes for Architectural Faculty; Earle W. Kennett; AIA Research Corporation, 1735 New York Ave., N.W., Washington, DC 20006; **Award #77-28413**
The AIA Research Corporation will conduct two one-week summer seismic institutes to educate faculty from architectural schools in design elements which impact the seismic safety of buildings.
 28. Response of Submerged Structures to Seismic Excitation; Denny R. Ko; Dynamic Technology, Inc., 3838 Carson Street, Suite 110, Torrance, CA 90503; **Award #78-09866**
Formulate a general finite element solution procedure and develop a computer program for calculating the response of submerged underwater tanks (rigid and flexible) to seismic actions.
 29. Earthquakes Stability of Reinforced Earth Structures; Kenneth L. Lee; University of California, Los Angeles, 3173 Engineer, Los Angeles, CA 90024; **Award #73-07845 A03**
Provide seismic design guidance to engineers and designers for reinforced earth structures such as retaining walls, dykes, and dams. Research will include small and large scale model tests, forced vibration tests, soil-tie friction studies, and analytical and semi-empirical studies to refine the stress distribution analysis and to study the problems of wall deformations which develop during sustained strong shaking.
 30. Sequential Optimization of Structural Geometry; Ovadia E. Lev; Merritt Cases, Inc., 710 Brookside Avenue, P. O. Box 1206, Redlands, CA 92373; **Award #78-04313**
This project will determine the validity of the basic procedure in design for optimum geometry of structures, that of sequential optimization with fixed and variable node coordinates. Conclusions from this study will clarify the nature of geometry interaction with other design variables and will lead to a unified approach to other aspects of optimum design. A theoretical analysis and optimality conditions will be developed.
 31. Earthquake Risk and Damage Functions—An Integrated Preparedness and Planning Study for Central USA; Benchieh Liu; Midwest Research Institute, 425 Volker Boulevard, Kansas City, MO 64110; **Award #77-15669**
Specify the earthquake hazard at four sites in the Central United States; develop a body of information on major earthquakes in the central U.S. particularly for the sites selected; develop intensity maps; construct a simulation model so various fiscal damage functions can be estimated; and evaluate existing preparedness policy and programs.
 32. U.S./Republic of China Cooperative Research in Earthquake Engineering, Part II; Le-Wu Lu; Lehigh University, Department of Civil Engineering, Bethlehem, PA 18015; **Award #77-07470 A01**
Provide continuing support for a cooperative U.S.-Republic of China Earthquake Engineering Project on "Earthquake Resistance and Strengthening of Concrete Building with Differential Foundation Settlement and Partial Structural Damage". (see also Penzien, Joseph)
 33. Liabilities of Local Governments for Earthquake Hazard Reduction; Terry R. Margerum; Association of Bay Area Governments, Hotel Claremont, Berkeley, CA 94705; **Award #77-07496**
This project will determine the impact of governmental tort liability on the choice of alternative earthquake-related hazard mitigation strategies by local governments, and will define legislative and administrative approaches which can help local governments better handle their potential liabilities in a manner supportive of their responsibilities.
 34. Seismic Engineering Program; R. B. Matthiesen; U. S. Geological Survey, 345 Middlefield Road, Mail Code 87, Menlo Park, CA; **Award #73-07125 A05**
Continue support for the seismic engineering program of strong-motion instrumentation and data management, which records strong ground motions and the response of representative types of structures during earthquakes and disseminates this data and information about the sites and structures to external users in earthquake engineering research and design practice.
 35. Workshop on Wood Diaphragms and Development of a Wood Manual; Ronald L. Mayes; Applied Technology Council, 408 California Avenue, Suite 205, Palo Alto, CA 94306; **Award #77-06490**
Develop a single, comprehensive, nationally applicable standard reference guide summarizing current technology and practices for the design of wood floor and roof diaphragms; identify and outline additional

research needed to improve horizontal wood diaphragm design and performance.

36. Wind Load Provisions for Safe Design of Structures; Kishor C. Mehta; Texas Tech University, Department of Civil Engineering, P.O. Box 4089, Lubbock, TX 79409; **Award #78-17244**

Develop design guidelines for severe dynamic lateral loads to buildings from winds and possibly earthquakes; provide concise examples showing how to apply American National Standards Institute A58.1-1972 standards to the design of different types of structures.

37. A Symposium on the Structural Use of Wood in Adverse Environments—May 15-18, 1978; Robert W. Meyer; Washington State University, Department of Engineering, Pullman, WA 99163; **Award #77-20087**

This award will support a symposium to bring together available information on the effects of extreme environments on the structural use of wood, design considerations for using wood in extreme conditions, and methods for analyzing residual strength of wood members following severe loadings or environmental stress that have caused or are suspected to have caused reduced strength. A symposium volume will be prepared for use by designers of wood structures, particularly for natural hazard considerations such as wind, earthquake, flood, and snow loads.

38. Geophysical Fluid Dynamics; John W. Miles; University of California, San Diego, Applied Mechanics and Geophysics, La Jolla, CA 92093; **Award #77-24005**

This project involved theoretical studies and laboratory experiments in geophysical fluid dynamics including theoretical studies of non-linear wave motion, experimental studies of the propagation, diffusion and damping of solitary waves, and studies of wave breaking and momentum transfer.

39. Seismic Effects in Liquid Storage Tanks; William A. Nash; University of Massachusetts, Department of Civil Engineering, Amherst, MA 01002; **Award #76-14833 A01**

Develop rational, seismic-resistant design criteria for slab-supported liquid storage tanks; study the uplift effect of the supporting base slab, the effect of sloshing liquid and tank prestressing, and develop computer programs for design.

40. Real Estate Agents and the Dissemination of Information on Natural Hazards in the Urban Area; Risa I. Palm; University of Colorado, The Regents of the University of Colorado, Boulder, CO 80309; **Award #78-04775**

Study the effect of the California legislation which requires disclosure of seismic information to buyers by realtors; evaluate the impact of disclosure on both sellers and buyers; study alternative disclosure methods and test the effectiveness of various presentations strategies.

41. National Information Service in Earthquake Engineering; Joseph Penzien, University of California; Earthquake Engineering Research Center, 1301 S. 46 Street, Berkeley, CA 94720; **Award #77-20667**

The National Information Service in Earthquake Engineering (NISEE) is a national focus for information

on earthquake engineering data, projects and research reports. This project provides for the transfer of earthquake and other hazard information generated through research to the public, academic researchers, design engineers, and government officials. A computer program distribution service of NISEE offers 33 computer programs for use in professional engineering. The Earthquake Engineering Research Library maintains reports, records, and data, and offers an abstracting service and a technical journal directed to the needs of earthquake engineers.

42. Seismic Behavior of Structural Systems—Analysis and Design of structures; Joseph Penzien; University of California, Earthquake Engineering Research Center, 1301 S. 46 Street, Berkeley, CA 94720; **Award #76-04264 A03**

Develop improved seismic analysis capabilities and apply them in structural design to achieve increased reliability in controlling seismic damage and costs. Specific research tasks will include analytical studies of building response; soil-structure interaction; development of non-linear structural analysis techniques; probabilistic studies of seismic response; and analytical methods for design.

43. United States—Republic of China Cooperative Research in Earthquake Engineering Part I; Dr. Joseph Penzien; University of California, Earthquake Engineering Research Center, 1301 S. 46 Street, Richmond, CA 94804; **Award #77-06006 A01**

Support a cooperative program between the University of California, Berkeley and the National Taiwan University to compare available data from both countries in two subject areas: "Attenuation, Intensity, and Characteristics of Strong Ground Motions", and "Seismic Response of Embedded Structures", which includes development of a mathematical model for soil-structure interaction of both rigid and flexible structures during earthquakes. (see also Lu, Le-Wu)

44. Social-Behavioral Responses to Chemical Hazards; Enrico L. Quarantelli; The Ohio State University, Disaster Research Center, Derby Hall, Columbus, OH 43210; **Award #77-14445 A01**

Study the socioeconomic and political factors associated with the adjustment of communities to chemical disaster, including preparation, analysis of emergency responses, and examination of long-term impacts.

45. An Experimental Study of Tsunamis: Their Generation, Propagation, and Coastal Effects; Frederick Raichlen; California Institute of Technology, Engineering and Applied Science 138-78, Pasadena, CA 91104; **Award #77-20499**

This research is directed toward a better understanding of tsunamis including wave propagation over shelves, harbor response to linear and non-linear transient waves, shore run-up and onshore structures, and three-dimensional generation, spreading, and transformation of waves through deep ocean onto the continental shelf.

46. The Dynamic Response of Anisotropic Clay Soils with Application to Soil-Structure Analysis; Adel S. Saada;

- Case Western Reserve University, School of Engineering, Cleveland, OH 44106; **Award #76-12332 A01**
- Study the dynamic response of clays under cyclic loading at various inclinations of the various stresses by experiments to study the influence of material properties by finite element techniques; apply the results to the analysis of embankments, earthdams, and other structures subjected to earthquake and dynamic loadings.
47. Influence of Site Characteristics on the Damage During the October 1974 Lima Earthquake; H. Bolton Seed; University of California—Berkeley, 441 Davis Hall, Berkeley, CA 94720; **Award #77-03687**
 This project will study the soil conditions in the heavy damage areas during the 1974 Lima, Peru earthquake and will compare them to soil conditions in areas with light damage to determine if site conditions could account for the major differences in damage, or whether such differences might have been anticipated on the basis of previous studies of such effects. The project will include the damage survey, survey of sub-surface conditions, boring geophysical tests of selected sites, analysis of data, and cross-comparison with results from previous earthquakes.
 48. A Generalized Study of Seismic Risk Analysis; Haresh C. Shah; Stanford University, Dept. of Civil Engineering, Stanford, CA 94305; **Award #77-17834**
 The objective of this project is to establish an improved seismic risk analysis procedure to aid design engineers and to provide a solid basis for code modification. The project is intended to improve procedures for estimating ground motion input duration and defining response duration; to improve parameters to represent input amplitude and frequency; and to develop a better understanding of the needs of structural designers, the objectives of building codes and the relationship of codes to probabilistic information on the seismic environment.
 49. Distribution of ATC-3 Report, Tentative Seismic Design Recommendations for Buildings; Roland L. Sharpe; Applied Technology Council, 480 California Avenue, Suite 205, San Francisco, CA 94105; **Award #78-00664**
 This project consists of printing and distributing copies of the report, "Tentative Recommendations for Use in Development of Seismic Regulations," which was prepared by the Applied Technology Council. The document represents a consensus of current knowledge in the aseismic design of buildings and introduces many new concepts of analysis, design, and construction.
 50. Testing of Tentative Provisions for Seismic Regulations for Buildings; Roland L. Sharpe; Applied Technology Council, 480 California Avenue, Suite 205, Palo Alto, CA 94306; **Award #78-02806**
 The Applied Technology Council has completed a project to develop nationally applicable seismic provisions for buildings. The project report, entitled "Tentative Provisions for Development of Seismic Regulations for Buildings", embodies a number of new or modified concepts which are significant departures from existing seismic building codes. This project will undertake a study to develop a plan to test the viability, applicability, enforceability, and potential economic impact of the proposed provisions.
 51. Workshop on Seismic Resistance of Highway Bridges; Roland L. Sharpe; Applied Technology Council, 480 California Avenue, Suite 205, Palo Alto, CA 94306; **Award #78-11802**
 Conduct a workshop for researchers and practitioners to evaluate current knowledge and practices re seismic resistance of various types of highway bridges, and to determine research needs.
 52. Second International Conference on Earthquake Microzonation for Safer Construction—Research and Application, November 1978—San Francisco; Dr. M. A. Sherif; Applied Engineering Resources, Inc., 114 East De La Guerra Street, P. O. Box 345, Santa Barbara, CA 93102; **Award #77-23228**
 This project provides support for a second "International Conference on Microzonation—Research and Application" to be held November, 1978. This conference will bring together persons of diverse backgrounds, including geophysics, seismology, engineering, and government, to summarize the state-of-the-art concerning earthquake microzonation techniques; to contribute papers on current basic research; to promote discussion of various theories and concepts; and to identify future research needs. A comprehensive conference proceedings which will serve to promote utilization and which can be used as a future reference document will be produced.
 53. State Government Policy Options for the Utilization of Earthquake Prediction Technology; Hirst Sutton; Council of State Governments, 1225 Connecticut Avenue, N.W., Suite 300, Washington, DC 20036; **Award #76-81112 A03**
 The Council of State Governments will examine public, legal, legislative, program, and administrative issues associated with earthquake prediction technology and will recommend program and policy options for state and local jurisdictions and the general public. A general conference of state and other government officials will be convened and a final report will be prepared summarizing findings, conclusions, and recommendations applicable to state government actions and programs.
 54. Seismic Behavior Of Irregularly Shaped Low-Rise Buildings; David T. Tang; State University of New York—Buffalo, Dept. of Civil Engineering, Buffalo, NY 12201; **Award #77-06014**
 This project will conduct a comprehensive investigation of the inelastic, coupled torsional and translational motion of low-rise unsymmetric buildings subjected to earthquake excitations. Finite element computer programs will be developed based on mathematical models characterizing the behavior of building members, and dynamic analysis will be performed to identify governing seismic design parameters and to establish design and analysis guidelines for low-rise unsymmetric structures.

55. Automatic Digitization of Accelerograph Records; Mihailo D. Trifunac; University of Southern California, Department of Civil Engineering, Los Angeles, CA 90007; **Award #76-14902 A03**

Through this project an automatic digitization system consisting of a rotating drum scanner and a complete computer interactive system will be built at USC. This capability will provide an accurate, convenient, and fast way to digitize accelerograph film records. Implementation of a such a system will significantly extend the life of mechanical-optical type accelerograph systems and permit continued exploitation of the simplicity and reliability of this accelerograph type. The project contributes to a more complete and expedient data collection and exchange system.

56. Community Response to Earthquake Threat in Southern California; Ralph H. Turner; University of California, Los Angeles, 405 Hilgard Avenue, Los Angeles, CA 90024; **Award #76-24154 A01**

In anticipation of the development of a capability to predict earthquakes, there is a need to understand how people will respond to predictions so that effective public policy can be developed. This research will survey residents of Los Angeles County to determine people's reception and understanding of earthquake danger reports, extent of altruistic concern, disposition to cooperate with hazard reduction programs, and patterns of community response.

57. Evaluation of Seismic Safety of Buildings; Erik H. Vanmarcke; Massachusetts Institute of Technology, Department of Civil Engineering, Cambridge, MA 02139; **Award #76-19021 A01**

Evaluate and compare ways of representing the predicted ground motion and the associated methods of seismic analysis: time-integration analysis, response spectrum analysis, or random vibration analysis. This project will fill in gaps of knowledge to establish procedures to determine the overall safety provided by seismic design, considering the variability in both the prediction of ground motion and in structural analysis and design.

58. A Clearinghouse on Natural Hazards Research and Applications; Gilbert F. White; University of Colorado, Institute of Behavioral Science, Boulder, CO 80302; **Award #76-05682 A01**

A clearinghouse on natural hazards research and ap-

plications will be established to accelerate the exchange and use of information on natural hazards research publications, findings, continuing and emerging research needs, and the interests of disaster agencies and organizations in both the public and private sectors. Information on natural hazards will be disseminated through a free quarterly newsletter and in response to public inquiry. Conferences and symposia will be initiated when need is established. An annual workshop on natural hazards for public and private disaster agency officials and the research community will be conducted.

59. Development of Earthquake and Other Natural Hazard Damage Assessment Procedures for Existing Structures; John H. Wiggins; John H. Wiggins Co., 1650 South Pacific Coast Highway, Redondo Beach, CA 90277; **Award #77-19342**

This project will develop a computerized three-dimensional program for evaluating the relative damageability and hazard of existing structures under earthquake, wind, and tornado loads. The program will model the regional seismicity, soil conditions, the framing and non-structural portions of the building, shape, height, and structural resistance capacity. The program and associated manuals and documentation will be made available to interested parties.

60. Strong-Motion Instrument Development and Array Design; Francis T. Wu; State University of New York, Binghamton, Department of Geological Survey, Binghamton, NY 13901; **Award #76-23897 A01**

Optimum design of local and regional instrument arrays will be investigated to develop more efficient strong-motion instruments with wider dynamic range and versatility, develop criteria for reliable and cost-effective network design including portable systems, and study the dynamic seismic source mechanisms by using near-field data. This project will provide strong-motion instrument coverage to the eastern United States and will increase the efficiency of ground motion data recordings.

61. Response of Nonlinear Saturated Soils to Seismic Disturbances; E. Benjamin Wylie; University of Michigan, Department of Engineering, Ann Arbor, MI 48104; **Award #77-22219**

Develop a procedure for predicting liquefaction of soil masses using the method of characteristics.

Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.