Earthquake Hazard Mitigation for Libraries

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Introduction

Librarians within the Charleston, South Carolina region expressed concern that library faculty, and staff of the colleges, universities and local libraries, were not aware of what they could do to reduce the risk of being hurt during an earthquake. The question of what measures could be taken to mitigate earthquake damage within libraries and at home prompted the Staff Development Committee of the Charleston Academic Library Consortium to request a workshop outlining earthquake preparedness strategies.

The material presented here was designed to assist librarians in the development and modification of an earthquake safety program for their individual institutions and homes. However, it can only be useful if each reader implements an earthquake preparedness plan in his/her institution.

As a personal reflection, I have found that the most important factor in the ultimate success of undertaking an earthquake preparedness plan is not the amount of money spent, but rather, the amount of interest and enthusiasm for achieving a well developed program. Experts in emergency management advocate spending wisely and purchasing the items that serve the greatest need. Travel the road of least resistance, and learn from the mistakes that others have made.

We Live In South Carolina - Why Should We Be Concerned?

On August 31, 1886, South Carolina was shaken by an earthquake of intensity X that heavily damaged the low country (Bollinger, 1972, 1977, 1983; Dutton, 1987; Talwani, 1982, Tarr, 1977; Shedlock, 1987, 1988). The aftershocks of this damaging earthquake continued for a period of years (Seeber & Armbruster, 1987). From 1754 to 1970, 438 earthquakes occurred in South Carolina. Of those, 402 occurred in lower South Carolina (Bollinger, 1977). Since 1973, there have been over 150 earthquakes in South Carolina, with more than half of these being felt in the low country. On November 22, 1974, an earthquake of magnitude 3.8 (first estimated to be 4.5) shook the Charleston-Summerville area and was felt as far away as Columbia and Aiken, South Carolina (Benson, Stanford, & Fogle, 1975; Talwani, 1977). Residents were frightened and reported some damage, i.e., cracked chimneys, plaster, steps, etc. In April 1975, a tremor of 2.5 occurred in Summerville. There was no damage, but the earthquake was felt by many (Talwani, 1977).

In 1976, the U.S. Geological Survey (USGS) set up a seismic monitoring network at the Baptist College at Charleston (renamed Charleston Southern University (CSU), November 13, 1990). The institution is located within the meizoseismal zone of the Charleston 1886 earthquake. The seismic stations were placed in an eight mile radius around the Middleton Place area. The area had the highest intensity during the 1886 Charleston and November 22, 1974 events. Presently, in Lower South Carolina, a seven station network of 15 channels is monitored at Charleston Southern University. Since the 1976 installations, the public has become aware of the seismic network, particularly because of the felt earthquakes of magnitude 2.0 to 3.3 in the South Carolina low country (Shedlock, 1988). Area residents call the news media and the Earthquake Center at CSU to confirm that the shaking they felt was indeed an earthquake, and if so, what size, or was this shaking the result of a sonic boom or chemical explosion?

Section 4 - Preparedness in Environments Outside the Traditional Classroom

Every year since 1977, the South Carolina Low Country Seismic Network has recorded local earthquakes as well as earthquakes from all over the globe. The seismic network at Charleston Southern University has recorded 35 earthquakes located between Middleton Place and Summerville from January 7, 1990, to November 23, 1991. Thirteen of these events were felt. CSU is responsible for monitoring the seismic equipment, collecting data, conducting intensity surveys, and supplying the USGS with accurate daily records of recorded earthquakes on the master helicorder at CSU.

The Earthquake Education Center began in 1983 as a pilot program funded by the Federal Emergency Management Agency (FEMA) to develop an earthquake education program on how to prepare for an earthquake for the public and specific target audiences, thus reducing the loss of life should a damaging earthquake occur. The threat of earthquakes in South Carolina and the southeastern U.S. is realistic, the preparedness level for such an event is not. The CSU Earthquake Education Center responds to this threat however, by working with the South Carolina Emergency Preparedness Division (SCEPD) to maintain earthquake education programs to help an area that is prone to earthquakes become a better prepared populace.

A logical question that the public might raise is, "Where is the fault?" No one knows where the fault in Lower South Carolina lies; therefore, the hazard is spread over a large area (Hays & Gori, 1983; Stewart & Rhea, 1986). Current research is focused on determining where the fault is located. The purpose of establishing the Earthquake Education Center is to enhance the public's knowledge of what to do in case of an earthquake and aid target audiences in mitigating earthquake preparedness plans.

Earthquake Safety Planning Strategies

In preparing earthquake safety plans, the first step is to examine the emergency plan in place for other hazards, then determine the need required to integrate safety procedures specifically for earthquakes. This should be an appendix of the facility's overall comprehensive emergency plan. In many communities, emergency response plans are prepared on the assumption that institutions will look after themselves (FEMA, 1990). In planning, develop a support network among the members of your facility, then utilize the following personnel to provide you with input. The resources listed below can be vital to your own support network. Don't hesitate to call on them for information and advice (FEMA, 1990).

In many communities, emergency response plans are prepared on the assumption that schools will look after themselves. In these same communities, school plans are generally developed on the assumption that essential services and emergency assistance will be provided by community agencies (FEMA, 1990).

Planning strategies should assume that water, gas, electricity, food supplies, communication systems, and transportation systems will not remain available and operative (FEMA, 1990). From the recent experiences of Hurricane Hugo, one hospital in Charleston, South Carolina had planned on the availability of back up generators. Unfortunately, these generators were dependent upon the City of Charleston water supply for the coolant. When the City's water supply failed, the generators ran hot without the water coolant and became inoperable (Dr. James B. Edwards, President of the Medical University of South Carolina, personal communication, January 23, 1992).

Little effective attention has been given to the necessity for self-sufficiency and the state of isolation that could realistically confront any facility after a major earthquake. Good communication procedures among the various buildings on a campus and communication among the lifelines within the community are important.

Don't hesitate to call on some experts for more information and advice. Eventually, you'll have your own support network, which might include:

- Local emergency services officials (e.g., fire, police, city emergency managers),
- Community American Red Cross chapter representatives;
- Experts on geology, structural engineering, and architecture at your local college or university or in private practice,
- School district and/or city building inspectors;
- Members of local environmental groups, civic organizations, and retirement associations;
- Community/neighborhood representatives with special skills (e.g., ham radio operators, building engineers, doctors, nurses, and medical paraprofessionals); and
- Safety experts in business and industry.

Making Your Plan: Hazard Identification

The first step in making earthquake safety plans would be to designate an earthquake safety committee, secure information from the proper authorities within your facility, and carry the following checklist with you to the first committee meeting. The checklist should stimulate ideas of which issues should be addressed first and who will be responsible for carrying out the task. Have available planning guideline resources that organizations such as the Federal Emergency Management Agency (FEMA), American Red Cross, Southern California Earthquake Preparedness Project (SCEPP), Bay Area Regional Earthquake Preparedness Project (BAREPP), and National Center for Earthquake Engineering Research (NCEER) can provide for you. The Earthquake Education Center at Charleston Southern University can also provide you with information. The resources will only give you a guide. The members of your committee should modify the outline to meet the specific needs of your institution. The following pages provide a step by step checklist. Take one step at a time.

Conclusion

The damage to California libraries during earthquakes in the 1970's and 1980's and the necessity of a raised level of awareness about emergency plans concerned the members of the Charleston Library Consortium. They wanted an earthquake preparedness plan to be more than a book that takes up shelf space in libraries. In the workshop for the Charleston Library Consortium the participants became involved in working on checklists of actions that could be taken to reduce the risks for librarians, students, and others being hurt during an earthquake. The hands-on activities which explained the cause and effects of earthquakes enhanced their interest in earthquake preparedness not only for the library, but for their homes and families as well.

Should you decide to have a workshop for librarians, the sample agenda could be used a guide. Historical and recent earthquake information for your specific area could be substituted for South Carolina information.

References

Benson, A. F., Stanford, C.F., & Fogle, G. H. (1975). Intensity survey of Charleston, South Carolina earthquake November 22, 1974, Earthquake Notes, 46, 15-26.

Bollinger, G. A. (1972). Historical and recent seismic activity in South Carolina. Bulletin of the Seismological Society of America, 62, 851-854.

Bollinger, G A. (1977). Reinterpretation of the intensity data for the 1886 Charleston, South Carolina earthquake, In Rankin, D.W (Ed). Studies related to the Charleston, South Carolina earthquake of 1886 - A preliminary report. (U.S Geological Survey Professional Paper 1028, 17-32). Washington, D.C.: U.S. Government Printing Office.

Bollinger, G. A. (1983). Speculations on the nature of seismicity at Charleston, South Carolina. In G. S. Gohn (Ed.), Studies Related to the Charleston, South Carolina Earthquake of 1886 - Tectonics and Seismicity. (U.S. Geological Survey Professional Paper 1313, T1-T11). Washington, D.C.. U.S. Government Printing Office.

Dutton, C.E. (1889). The Charleston earthquake of August 31, 1886. U.S. Geological Survey Ninth Annual Report, 1887-88, 203-528.

FEMA, (1990). Guidebook for developing a school earthquake safety program Washington, D.C : Federal Emergency Management Agency.

Hays, W., & Gori, P. (Eds.). (1983). The 1886 Charleston, South Carolina earthquake and its implications for today. Proceedings of Conference XX. Reston, VA: U.S. Geological Survey.

Seeber, L., & Armbruster, J. G. (1987). The 1886-1889 aftershocks of the Charleston, South Carolina, earthquake: A widespread burst of seismicity. Journal of Geophysical Research, 92, (B3), 2663-2696.

Shedlock, K. M. (1987). South Carolina earthquakes. U.S. Geological Survey Open-file Report 87-437, 1-17 Reston, VA.

Shedlock, K M. (1988). Seismicity in South Carolina. Seismological Research Letters. 59(4), 165-171.

Stewart, R., & Rhea, S. (1983). Scientific contributions and future uses of seismic networks in the Charleston, South Carolina area. In W. W. Hays & P L. Gori (Eds), Proceedings of Conference XX: A Workshop on "The 1886 Charleston, South Carolina Earthquake and its Implications for Today." U.S. Geological Survey Open-File Report 221-23.

Talwani, P (1977). An intensity of the April 28, 1975 Summerville, South Carolina earthquake. Bulletin of the Seismological Society of America, 67 (2), 547-549.

Talwani, P. (1982) Internally consistent pattern of seismicity near Charleston, South Carolina. Geology, 10, 654-65.

Tarr, A. C. (1977). Recent seismcity near Charleston South Carolina, and it relationship to the August 31, 1886 earthquake. U S Geological Survey Professional Paper 1028, 43-57. Washington, D.C.: U.S. Government Printing Office.

Step-by-Step Checklist[10]

HAZARD IDENTIFICATION

WHAT	WHO	WHEN
• STEP ONE: Obtain or draw a map of the library and surrounding environment.	_____	_____
• STEP TWO: Identify potential earthquake hazards in_____.	_____	_____
• STEP THREE: Identify earthquake and other hazards throughout _____ the library.	_____	_____
• STEP FOUR: Identify potential hazards along building evacuation routes.	_____	_____
• STEP FIVE: Identify potential hazards in the area surrounding the library.	_____	_____

[10] Resource: Guidebook for Developing a School Earthquake Safety Program (FEMA, 1990).

EARTHQUAKE DRILLS

WHAT	WHO	WHEN
• **STEP ONE:** Hold a staff meeting to discuss earthquake dangers and response actions.	_____	_____
• **STEP TWO:** Hold a special meeting or workshop with _____ to discuss preparation activities.	_____	_____
• **STEP THREE:** Develop procedures for holding library earthquake drills.	_____	_____
• **STEP FOUR:** Determine and discuss procedures for evacuating the library.	_____	_____
• **STEP FIVE:** Plan for the unexpected.	_____	_____
• **STEP SIX:** Designate an outdoor evacuation assembly area.	_____	_____
• **STEP SEVEN:** Practice and evaluate the effectiveness of your earthquake drills.	_____	_____

IMMEDIATE RESPONSE AND CARE REQUIREMENTS

WHAT	WHO	WHEN
• **STEP ONE:** Anticipate first-hour priorities.	_____	_____
• **STEP TWO:** Assess staff skills and identify training requirements.	_____	_____
• **STEP THREE:** Develop procedures and assign roles and responsibilities.	_____	_____
• **STEP FOUR:** Prepare simple response checklists for each staff member.	_____	_____
• **STEP FIVE:** Discuss and coordinate your plan with _____.	_____	_____
• **STEP SIX:** Inform staff of your earthquake response plan and their role in an emergency.	_____	_____
• **STEP SEVEN:** Discuss your earthquake response plan with library and school administrators.	_____	_____
• **STEP EIGHT:** Exercise your response plan.	_____	_____

COMMUNICATION

WHAT	WHO	WHEN
• **STEP ONE:** Determine on-site communication needs.	_____	_____
• **STEP TWO:** Determine off-site communication resources and develop reporting procedures.	_____	_____
• **STEP THREE:** Submit a copy of your communication plan to school and library officials	_____	_____
• **STEP FOUR:** Develop procedures for conveying emergency information to library and school officials.	_____	_____

POST-EARTHQUAKE SHELTER PLANNING

WHAT	WHO	WHEN
• **STEP ONE:** Develop a list of care and shelter planning assumptions.	_____	_____
• **STEP TWO:** Estimate the number of persons requiring care and shelter.	_____	_____
• **STEP THREE:** Determine short-term care and shelter requirements.	_____	_____
• **STEP FOUR:** Identify additional requirements for long-term care and shelter.	_____	_____

Checklist for Head Librarian

1. Be knowledgeable of responsibilities for emergency preparedness, including elements of your plan.
2. Appoint an assistant and alternate.
3. Order a site and building hazard survey by a qualified structural and civil engineer.
4. Order removal or correction of hazards, as feasible.
5. Appoint a chairperson for an Emergency Preparedness Committee (to serve more than one year to allow for continuity).
6. Cooperate with chairperson of Emergency Preparedness Committee (to see that terms of the Plan are carried out).
7. Become informed of school policies and plans relating to emergency preparedness.
8. Require all staff to periodically review emergency plans and procedures.
9. Require all staff to periodically check preparations for their own areas.
10. Recommend that all staff hold current first aid certification. Recommend that a number of staff hold current CPR certification
11. Develop procedures for protection of vital records.
12. Develop a procedure for releasing staff members.
13. Encourage all staff to prepare family emergency plans. Test regularly.
14. Near the end of the school year, require the Emergency Preparedness Committee to prepare a list of supplies needed for the following school year.

General Earthquake Information

The following earthquake information can be found in a brochure written by FEMA - Earthquake Checklist.

1. During an earthquake, remain calm and quickly follow the steps outlined below.

2. IF INDOORS, seek refuge in a doorway or under a desk or table. Stay away from glass windows, shelves, and heavy equipment.

3. IF OUTDOORS, move quickly away from buildings, utility poles, and other structures. Caution: Always avoid power or utility lines as they may be energized Know your assembly points.

4. If in an automobile, stop in the safest place available, preferably away from power lines and trees. Stop as quickly as safety permits, but stay in the vehicle for the shelter it offers.

5 After the initial shock, evaluate the situation and if emergency help is necessary, call Campus Public Safety, if on campus, or _____ if off campus. Protect yourself at all times and be prepared for aftershocks

6. Damaged facilities should be reported to Campus Public Safety and Maintenance. NOTE: Gas leaks and power failures create special hazards Please refer to the section on Utility Failures

7. If an emergency exists, activate the building alarm. CAUTION: THE BUILDING ALARM ONLY RINGS IN SOME BUILDINGS - you must report the emergency by phone.

8. When the building evacuation alarm is sounded, walk to the nearest marked exit and ask others to do the same.

9 ASSIST THE HANDICAPPED IN EXITING THE BUILDING! Remember that elevators are reserved for handicapped use. DO NOT USE ELEVATORS IN CASE OF FIRE. DO NOT PANIC.

10. Once outside, move to a clear area at least 500 feet away from the affected building(s). Keep streets, fire lanes, hydrants and walkways clear for emergency vehicles and crews

11 If requested, assist emergency crews as necessary.

12 A Campus Emergency Command Post may be set up near the emergency site. Keep clear of the Command Post unless you have official business.

13. DO NOT RETURN TO AN EVACUATED BUILDING unless told to do so by a College official.

IMPORTANT: After an evacuation, report to your designated area assembly point. Stay there until an accurate HEADCOUNT has been taken. The Senior Building Coordinator will take attendance and assist in the accounting of all building occupants.

Earthquake Hazard Mitigation for Libraries Workshop

Agenda

1:00 p.m. - 1:10 p.m.	Welcome Introductions
1:00 p m. - 1:30 p m.	Historical and Recent South Carolina Earthquakes Definitions of Terms: Earthquake Fact Sheet
1:30 p m. - 2:00 p m.	Causes and Effects of Earthquakes Demonstrations/Slide Show/Overhead Projector/Hands on Models
2:00 p.m. - 2:20 p.m.	How To Plan at School and Home: Make Assignments
2:20 p.m. - 2:30 p.m.	Break
2:30 p.m. - 3:15 p.m	Group Assignments/Discussions Fill Out Checklists/Plans
3:15 p.m. - 3:30 p.m	Summary Groups Reports on Plans
3:30 p.m - 3:46 p.m.	Earthquake Preparedness Film: i.e Earthquake Don'ts and Do's
3:46 p.m. - 4:00 p.m.	Visit Seismic Lab

Section 5

Last Word

This publication just begins to touch on some of the issues that need to be considered when developing a comprehensive earthquake education program for schools. But education has to be a continuing process. As certain issues are addressed, others will be revealed. The following list, by no means all-inclusive, provides additional issues for schools to consider in this on-going process:

- Generating Concern When There Is None; how to get the school community to accept the concept of preparedness
- Training of School Substitutes
- Back-up Disaster Plans
- Activating the PTA
- School Resumption Plans
- Psychological Plan to Deal With Mass Fatalities
- Earthquake Education for Developmentally Delayed Parents
- Planning and Training for Structural Collapse Rescue Situations
- Effectively Using High School Students After the Earthquake
- Post-Earthquake Security Issues
- Dealing With Post-Earthquake Stress
- Effectively Using Technology in Earthquake Education Programs

NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH
LIST OF TECHNICAL REPORTS

The National Center for Earthquake Engineering Research (NCEER) publishes technical reports on a variety of subjects related to earthquake engineering written by authors funded through NCEER. These reports are available from both NCEER's Publications Department and the National Technical Information Service (NTIS). Requests for reports should be directed to the Publications Department, National Center for Earthquake Engineering Research, State University of New York at Buffalo, Red Jacket Quadrangle, Buffalo, New York 14261. Reports can also be requested through NTIS, 5285 Port Royal Road, Springfield, Virginia 22161. NTIS accession numbers are shown in parenthesis, if available.

NCEER-87-0001 "First-Year Program in Research, Education and Technology Transfer," 3/5/87, (PB88-134275/AS).

NCEER-87-0002 "Experimental Evaluation of Instantaneous Optimal Algorithms for Structural Control," by R.C. Lin, T.T. Soong and A.M. Reinhorn, 4/20/87, (PB88-134341/AS).

NCEER-87-0003 "Experimentation Using the Earthquake Simulation Facilities at University at Buffalo," by A.M. Reinhorn and R.L. Ketter, to be published.

NCEER-87-0004 "The System Characteristics and Performance of a Shaking Table," by J.S. Hwang, K.C. Chang and G.C. Lee, 6/1/87, (PB88-134259/AS). This report is available only through NTIS (see address given above).

NCEER-87-0005 "A Finite Element Formulation for Nonlinear Viscoplastic Material Using a Q Model," by O. Gyebi and G. Dasgupta, 11/2/87, (PB88-213764/AS).

NCEER-87-0006 "Symbolic Manipulation Program (SMP) - Algebraic Codes for Two and Three Dimensional Finite Element Formulations," by X. Lee and G. Dasgupta, 11/9/87, (PB88-219522/AS).

NCEER-87-0007 "Instantaneous Optimal Control Laws for Tall Buildings Under Seismic Excitations," by J.N. Yang, A. Akbarpour and P. Ghaemmaghami, 6/10/87, (PB88-134333/AS).

NCEER-87-0008 "IDARC: Inelastic Damage Analysis of Reinforced Concrete Frame - Shear-Wall Structures," by Y.J. Park, A.M. Reinhorn and S.K. Kunnath, 7/20/87, (PB88-134325/AS).

NCEER-87-0009 "Liquefaction Potential for New York State: A Preliminary Report on Sites in Manhattan and Buffalo," by M. Budhu, V. Vijayakumar, R.F. Giese and L. Baumgras, 8/31/87, (PB88-163704/AS). This report is available only through NTIS (see address given above).

NCEER-87-0010 "Vertical and Torsional Vibration of Foundations in Inhomogeneous Media," by A.S. Veletsos and K.W. Dotson, 6/1/87, (PB88-134291/AS).

NCEER-87-0011 "Seismic Probabilistic Risk Assessment and Seismic Margins Studies for Nuclear Power Plants," by Howard H.M. Hwang, 6/15/87, (PB88-134267/AS).

NCEER-87-0012 "Parametric Studies of Frequency Response of Secondary Systems Under Ground-Acceleration Excitations," by Y. Yong and Y.K. Lin, 6/10/87, (PB88-134309/AS).

NCEER-87-0013 "Frequency Response of Secondary Systems Under Seismic Excitation," by J.A. HoLung, J. Cai and Y.K. Lin, 7/31/87, (PB88-134317/AS).

NCEER-87-0014 "Modelling Earthquake Ground Motions in Seismically Active Regions Using Parametric Time Series Methods," by G.W. Ellis and A.S. Cakmak, 8/25/87, (PB88-134283/AS).

NCEER-87-0015 "Detection and Assessment of Seismic Structural Damage," by E. DiPasquale and A.S. Cakmak, 8/25/87, (PB88-163712/AS).

NCEER-87-0016 "Pipeline Experiment at Parkfield, California," by J. Isenberg and E. Richardson, 9/15/87, (PB88-163720/AS) This report is available only through NTIS (see address given above).

NCEER-87-0017 "Digital Simulation of Seismic Ground Motion," by M. Shinozuka, G. Deodatis and T. Harada, 8/31/87, (PB88-155197/AS). This report is available only through NTIS (see address given above).

NCEER-87-0018 'Practical Considerations for Structural Control: System Uncertainty, System Time Delay and Truncation of Small Control Forces,' J.N. Yang and A. Akbarpour, 8/10/87, (PB88-163738/AS).

NCEER-87-0019 "Modal Analysis of Nonclassically Damped Structural Systems Using Canonical Transformation," by J.N. Yang, S. Sarkani and F.X. Long, 9/27/87, (PB88-187851/AS).

NCEER-87-0020 "A Nonstationary Solution in Random Vibration Theory," by J.R. Red-Horse and P.D. Spanos, 11/3/87, (PB88-163746/AS)

NCEER-87-0021 'Horizontal Impedances for Radially Inhomogeneous Viscoelastic Soil Layers," by A.S. Veletsos and K.W. Dotson, 10/15/87, (PB88-150859/AS).

NCEER-87-0022 "Seismic Damage Assessment of Reinforced Concrete Members," by Y.S. Chung, C. Meyer and M. Shinozuka, 10/9/87, (PB88-150867/AS). This report is available only through NTIS (see address given above)

NCEER-87-0023 "Active Structural Control in Civil Engineering," by T.T. Soong, 11/11/87, (PB88-187778/AS)

NCEER-87-0024 "Vertical and Torsional Impedances for Radially Inhomogeneous Viscoelastic Soil Layers," by K.W. Dotson and A.S. Veletsos, 12/87, (PB88-187786/AS).

NCEER-87-0025 "Proceedings from the Symposium on Seismic Hazards, Ground Motions, Soil-Liquefaction and Engineering Practice in Eastern North America," October 20-22, 1987, edited by K.H. Jacob, 12/87, (PB88-188115/AS).

NCEER-87-0026 "Report on the Whittier-Narrows, California, Earthquake of October 1, 1987," by J. Pantelic and A. Reinhorn, 11/87, (PB88-187752/AS). This report is available only through NTIS (see address given above).

NCEER-87-0027 "Design of a Modular Program for Transient Nonlinear Analysis of Large 3-D Building Structures," by S. Srivastav and J.F. Abel, 12/30/87, (PB88-187950/AS).

NCEER-87-0028 "Second-Year Program in Research, Education and Technology Transfer," 3/8/88, (PB88-219480/AS).

NCEER-88-0001 "Workshop on Seismic Computer Analysis and Design of Buildings With Interactive Graphics," by W. McGuire, J.F. Abel and C.H. Conley, 1/18/88, (PB88-187760/AS).

NCEER-88-0002 "Optimal Control of Nonlinear Flexible Structures," by J.N. Yang, F.X. Long and D. Wong, 1/22/88, (PB88-213772/AS)

NCEER-88-0003 'Substructuring Techniques in the Time Domain for Primary-Secondary Structural Systems," by G.D. Manolis and G. Juhn, 2/10/88, (PB88-213780/AS).

NCEER-88-0004 "Iterative Seismic Analysis of Primary-Secondary Systems," by A. Singhal, L.D. Lutes and P.D. Spanos, 2/23/88, (PB88-213798/AS).

NCEER-88-0005 "Stochastic Finite Element Expansion for Random Media," by P.D. Spanos and R. Ghanem, 3/14/88, (PB88-213806/AS).

NCEER-88-0006 "Combining Structural Optimization and Structural Control," by F Y. Cheng and C.P. Pantelides, 1/10/88, (PB88-213814/AS)

NCEER-88-0007 "Seismic Performance Assessment of Code-Designed Structures," by H.H-M Hwang, J-W. Jaw and H-J. Shau, 3/20/88, (PB88-219423/AS).

NCEER-88-0008 "Reliability Analysis of Code-Designed Structures Under Natural Hazards," by H.H-M Hwang, H. Ushiba and M Shinozuka, 2/29/88, (PB88-229471/AS).

NCEER-88-0009 "Seismic Fragility Analysis of Shear Wall Structures," by J-W Jaw and H.H-M. Hwang, 4/30/88, (PB89-102867/AS).

NCEER-88-0010 "Base Isolation of a Multi-Story Building Under a Harmonic Ground Motion - A Comparison of Performances of Various Systems," by F-G Fan, G. Ahmadi and I.G. Tadjbakhsh, 5/18/88, (PB89-122238/AS).

NCEER-88-0011 "Seismic Floor Response Spectra for a Combined System by Green's Functions," by F.M. Lavelle, L A. Bergman and P D Spanos, 5/1/88, (PB89-102875/AS).

NCEER-88-0012 "A New Solution Technique for Randomly Excited Hysteretic Structures," by G.Q. Cai and Y.K. Lin, 5/16/88, (PB89-102883/AS).

NCEER-88-0013 "A Study of Radiation Damping and Soil-Structure Interaction Effects in the Centrifuge," by K Weissman, supervised by J.H. Prevost, 5/24/88, (PB89-144703/AS).

NCEER-88-0014 "Parameter Identification and Implementation of a Kinematic Plasticity Model for Frictional Soils," by J H. Prevost and D V Griffiths, to be published

NCEER-88-0015 "Two- and Three- Dimensional Dynamic Finite Element Analyses of the Long Valley Dam," by D.V Griffiths and J.H. Prevost, 6/17/88, (PB89-144711/AS).

NCEER-88-0016 "Damage Assessment of Reinforced Concrete Structures in Eastern United States," by A.M Reinhorn, M J Seidel, S.K. Kunnath and Y.J. Park, 6/15/88, (PB89-122220/AS).

NCEER-88-0017 "Dynamic Compliance of Vertically Loaded Strip Foundations in Multilayered Viscoelastic Soils," by S. Ahmad and A S M. Israil, 6/17/88, (PB89-102891/AS).

NCEER-88-0018 "An Experimental Study of Seismic Structural Response With Added Viscoelastic Dampers," by R.C Lin, Z Liang, T T Soong and R.H. Zhang, 6/30/88, (PB89-122212/AS). This report is available only through NTIS (see address given above).

NCEER-88-0019 "Experimental Investigation of Primary - Secondary System Interaction," by G.D. Manolis, G. Juhn and A M. Reinhorn, 5/27/88, (PB89-122204/AS).

NCEER-88-0020 "A Response Spectrum Approach For Analysis of Nonclassically Damped Structures," by J.N. Yang, S. Sarkani and F X Long, 4/22/88, (PB89-102909/AS).

NCEER-88-0021 "Seismic Interaction of Structures and Soils: Stochastic Approach," by A S Veletsos and A.M. Prasad, 7/21/88, (PB89-122196/AS).

NCEER-88-0022 "Identification of the Serviceability Limit State and Detection of Seismic Structural Damage," by E. DiPasquale and A.S. Cakmak, 6/15/88, (PB89-122188/AS) This report is available only through NTIS (see address given above).

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