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Proceedings from the Fifth U.S.-Japan Workshop on Earthquake Resistant Design of Lifeline Facilities and Countermeasures Against Soil Liquefaction

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PREFACE

The Fifth U.S.-Japan Workshop was held near Salt Lake City, Utah, several kilometers from the Wasatch fault zone. This fault zone is the longest and most active normal-slip fault in North America. Workshop participants were taken on a field trip by the Utah Geological Survey to several trenches crossing the Wasatch fault zone, where evidence of previous surface faulting was preserved in the form of rupture planes and colluvial wedges in the walls of the trenches. This evidence is a striking reminder that the Salt Lake Valley is an active seismic area. Over 80 percent of Utah's 2.3 million residents live and work in the vicinity of the fault zone.

The Fifth U.S.-Japan Workshop was not only an international event, but a forum for engineers and utility personnel in the Salt Lake City area to learn about state-of-the-art developments and to participate in the presentations and discussions as experienced members of a community which must implement seismic resistant design of lifeline facilities and countermeasures for soil liquefaction. It is our hope that research results presented in these proceedings will be applied in engineering decisions and planning, and that the workshop has acted as a catalyst in promoting the transfer of technology from theory to practice.

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U.S.-JAPAN COOPERATIVE RESEARCH PROGRAM AND WORKSHOPS

The U.S.-Japan Research Program on Earthquake Resistant Design of Lifeline Facilities and Countermeasures Against Soil Liquefaction focuses on the earthquake performance of lifelines, with emphasis on liquefaction-induced large ground deformations. Large ground deformations are the principal cause of subsurface structural damage during earthquakes. Currently, there is a growing recognition in the civil and earthquake engineering communities of the importance of large ground deformations. Our understanding of the mechanisms of large ground deformations and their effects on lifeline facilities, and our ability to predict the magnitude and distribution of ground displacements have improved substantially in recent years to provide a rational framework for siting, design, and protective measures. Both Japanese and U.S. researchers have been working on this topic, and it was recognized that considerable benefits will result from their cooperative effort to collect case history data and their recommendations about the most appropriate analytical methods and design procedures.

The program was initiated formally in November, 1988 with the signing of a Memorandum of Understanding between the Japanese and U.S. sides. The document was signed at a ceremony during a workshop in Tokyo, Japan by K. Kubo, Professor Emeritus of Tokyo University, and M. Shinozuka, Sollenberger Professor of Civil Engineering of Princeton University Professor Kubo signed on behalf of the Association for the Development of Earthquake Prediction (ADEP), the Japanese sponsoring agency. Professor Shinozuka signed on behalf of Robert L. Ketter, the Director of the National Center for Earthquake Engineering Research (NCEER), the U.S. sponsoring agency. A second Memorandum of Understanding was signed in December, 1990 to continue the cooperative program of research. The signatures were K. Kubo, representing ADEP, and M. Shinozuka, the Director of NCEER

The research program has concentrated on case histories of ground deformations and their effects on lifeline facilities. The case histories were collected in two volumes and published in May, 1992 as a joint Japan-U.S. effort by NCEER. The earthquakes included in the Japanese case histories are: 1923 Kanto, 1948 Fukui, 1964 Niigata, 1983 Nihonkai-Chubu, and 1990 Luzon, Philippines earthquakes. The earthquakes included in the U.S. case histories are: 1906 San Francisco, 1964 Alaska, 1971 San Fernando, 1979 Imperial Valley, and 1989 Loma Prieta earthquakes. The Japanese and U.S. case history studies were coordinated by Professor T.D. O'Rourke of Cornell University and Professor M. Hamada of Waseda University. Case studies are in progress for the 1993 Kushiro, 1993 Hokaido Nansei-oki, and 1994 Northridge earthquakes.

In addition to the publication of the case history volumes, the products of the cooperative research include U.S.-Japan workshops and associated publications of the proceedings covering case history data, analytical modeling, experimental studies and recommendations for improved practices.

ACKNOWLEDGMENTS

The organizers of the workshop thank the Association for the Development of Earthquake Prediction (ADEP) and the National Center for Earthquake Engineering Research (NCEER) for sponsoring the research program and workshop activities. In particular, we express our gratitude to M. Shinozuka, Sollenberger Professor of Civil Engineering, Princeton University, and to K. Kubo, Vice President of ADEP and Professor Emeritus of the University of Tokyo, who provided oversight on the cooperative research work and support for the workshop. Our thanks also are extended to G. Lee, Director of NCEER and Dean of the College of Engineering at the State University of New York at Buffalo, for his encouragement and support.

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We extend our sincere thanks to the members of NCEER and Cornell University, who helped organize the workshop and assisted in the exchange of information and execution of the program. In particular, we thank Andrea Dargush, Assistant Director of NCEER, and Debbie O'Rourke and Laurie McCall, of NCEER and Cornell University, respectively, for their dedication and outstanding service. We also thank members of the Utah engineering and scientific communities for their active participation. Special recognition in this regard is extended to Professor T.L. Youd of Brigham Young University, S. Musser of the Utah Department of Transportation, and Gary Christianson and Bill Black of the Utah Geological Survey.

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OBSERVATIONS DURING PAST EARTHQUAKES