COSMOS Newsletter

No. 5, August 2001

Consortium of Organizations for Strong-Motion Observation Systems

Contents

Calendar

COSMOS Annual Meeting: 2 October 2001, at the Pacific Earthquake Engineering Research Center, Richmond, California. Please check website for details.

COSMOS Geotechnical Database Workshop, 4-5 October 2001,at the Pacific Earthquake Engineering Research Center, Richmond, California. Please check website for details.

COSMOS Instrumentation of Structures Workshop, 14-15 November 2001, at the Courtyard Marriott, Emeryville, California. Please check website for details.

Editor: Claire M. Johnson

Highlights

B.A. Bolt, President

On 2 October 2001 our Consortium will hold its Second Annual Meeting—the first meeting of the membership since the stimulating gathering and Board of Director's Meeting on 8 February 2001 at the EERI Annual Meeting at Monterey (see Newsletter No. 4). The program outlined at that time has continued successfully. First, at the suggestion of Dr. John Filson of the U.S. Geological Survey (USGS), I prepared a "White Paper" (now circulated) on the cost-effective and open role COSMOS could play as a virtual archive and distribution center for strong-motion recordings obtained by the Advanced National Seismic System (ANSS) (see article by C.B. Crouse). Secondly, strong progress has been made in the compilation of critical strong-motion recordings available on the COSMOS Virtual Data Center (VDC) (db.cosmos-eq.org) (see article by M. Squibb). In particular, we were delighted by special support by the California Strong Motion Instrumentation Program (CSMIP), a core member of COSMOS, enabling Mr. C.-P. Lee, a graduate student of Professor Y.-B. Tsai of the Central National University of Taiwan, to visit and work with CSMIP in Sacramento to process over 400 recordings from the 20 September 1999 Chi-Chi, Taiwan, earthquake and three major aftershocks as compiled by Dr. W. H.K. Lee and others. Full processing is being carried out to velocity, displacement, and response spectra according to CSMIP standards. These recordings will be shortly available from the COSMOS VDC or directly from the CSMIP server (see pg. 2 for an accelerogram obtained from strong-motion recording by the Taiwan Central Weather Bureau).

Additional recordings from Turkey and Guatemala have been added during the year, as well as recordings from the Nisqually, Washington, earthquake (see article by H. Benz). We are also in contact with Russian, European, New Zealand, and Indian sources to secure ground motion recordings from those countries. I will hold discussions on data access with colleagues in India and China (Harbin) on a special trip in early September.

Funding for strong-ground motion systems has received some increases from various sources in 1999-2000. There has been important growth in strong-motion systems in the USGS, including the launching of the ANSS (see article by R. Page), and from a portion of the $3.9 million appropriated in the State of California's 2001-2002 budget for the California Integrated Seismic Network (CISN) (see Newsletter No. 4). We stand ready to assist further in the development of strong-motion recording and distribution sources in the U.S. for use by earthquake engineers, seismologists, and other interested parties as expressed in the COSMOS Charter.

I would like to congratulate Dr. William "Woody" Savage on his appointment at the USGS as the National Strong-Motion Program Coordinator. Woody Savage has been a

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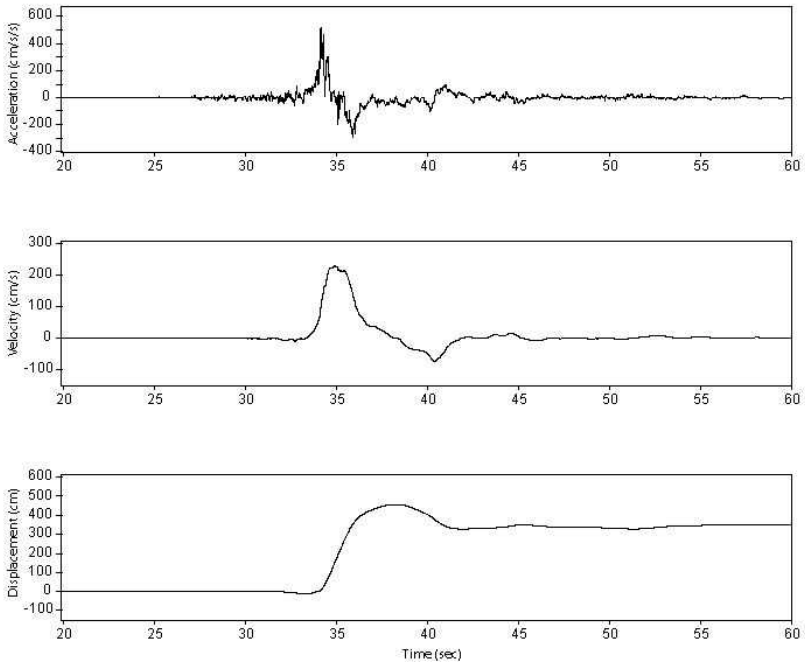

Record from CWB station TCU068, close to the fault trace on the upthrown block, near the northern end of the fault that ruptured in the Chi Chi, Taiwan, earthquake, of 20 September 1999 (vertical component). Because of low instrument noise, a permanent displacement of about 3.5 m can be calculated by directly integrating the acceleration record.

great help and supporter of COSMOS since its inception. We look forward to his continued involvement as all systems in the U.S. move in a cooperative way to an optimum recording network.

Roger Borcherdt, after consultation with Dr. Haresh Shah of the World Seismic Safety Initiative, has constructed a model scheme for extended loans of redundant but older types of strong-motion accelerometers to selected groups in developing countries. Please contact him if you know of groups who would be suitable candidates for this program. (borcherdt@usgs.gov).

I might mention also that I have been consulting with the University of Dakar in the program to instrument the extensive Jamuna Bridge across the Jamuna River in Bangladesh. After submission of bids, Kinemetrics, Inc., is to provide the instrumentation system.

We remain indebted to PEER (and Director Jack P. Moehle) for continued program contributions and use of office space for our Editor, C.M. Johnson.

COSMOS Workshop on Archiving and Web Dissemination of Geothnical Data

J. Carl Stepp, COSMOS
J. Swift, University of Southern California

COSMOS, with support from the PEER Center Lifelines Program, will hold an important Workshop on 4-5 October 2001 to disucss issues related to archiving and web dissemination of geotechnical data. The invited Workshop will address the recognized need to make valuable geotechnical data available in the most cost-efficient way to the extensive user community. Geotechnical investigations are routinely required for design and to obtain approval to construct significant structures and buildings, as well as for a wide range of specific research purposes. Consequently, large quantities of data are generated, many of them of significant value to geotechnical engineering, construction activities, and university research. While the collected data usually follow current professional practices, consistent standards and quality assurance are not generally adopted. Large volumes of potentially valuable geotechnical data collected over the years often reside in the archives of local, state,

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and federal agencies and private sector organizations. These include Caltrans, the Federal Highway Administration, and transportation agencies of other states; the California Division of Mines and Geology, the geological surveys of other states, the U.S. Geological Survey, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and other federal agencies; private sector companies such as Pacific Gas and Electric; national research-focused activities such as the National Geotechnical Experimental Sites; and university-government-private sector cooperative projects such as GEOINFO-ROSRINE, and the PEER Center Lifelines Program. Efforts aimed at developing databases for archiving and web dissemination of geotechnical data are now in progress in the U.S. Such programs require large resources, however, and significant barriers for exhaustive access to data exist because of the lack of common data format standards and optimally compatible data archiving and distribution methods.

The objective of the Workshop is to develop consensus recommendations for classifying, archiving, and web dissemination of the various types of geotechnical data. The final product is intended to provide a road map of developmental and infrastructure needs. A Workshop Agenda, which can be viewed on the COSMOS web site (www.cosmos-eq.org), has been structured to identify common features and issues of various ongoing database development efforts and to address long-term infrastructure and funding requirements. The key central deliverables of the Workshop will be consensus recommendations that describe a clear path forward meet user needs. Workshop presentations and consensus recommendations will be published in an archival-quality Proceedings.

COSMOS VIRTUAL DATA CENTER NEWS

M. Squibb, University of California, Santa Barbara

The COSMOS Virtual Data Center (VDC) (db.cosmos-eq.org) has been busy incorporating new data and making plans for future enhancements. We have recently added uncorrected data from free-field stations for the 20 September 1999 main shock of the Chi-Chi, Taiwan, earthquake. Early this fall we will have available corrected data and data products for this dataset. Through the generous assistance of Mustafa Erdik and Erdal Safak, we now have uncorrected data for 16 earthquakes in Turkey with magnitude greater than or equal to magnitudes 5.0. Data are from the August 1999 Kocaeli earthquake and aftershocks through August 2000. This first dataset is from the Kandilli Observatory and Earthquake Research Institute (KOERI); we are in the process of adding data from additional agencies in Turkey.

We continue to monitor both U.S. and international networks from which we have received strong-motion data in the past. We have also added uncorrected data from the El Salvador earthquakes of 13 January, 13 February, and 17 February 2001 (through the Centro de Investigaciones Geotecnicas and the Structural Mechanics Department at the Universidad Centroamericana, San Salvador), 10 new earthquakes from the Kik-Net network in Japan since the beginning of the year, and U.S. quakes at Big Bear Lake, California (2/10/2001), Satsop, Washington (6/10/2001), and Central Alaska (11/29/2000) through the Advanced National Seismic System, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, California Strong-Motion Instrumentation Program, and the Washington Department of Natural Resources.

Recently added datasets from KOERI and Taiwan have been converted to the new COSMOS data format, which can be viewed through our website at www.cosmos-eq.org/cosmos_format_01.pdf. For these trial cases we've left the data in a single column so that it's easier to import into applications like Excel or Matlab, but we will soon be adding programs for users to convert these files to familiar formats.

Although it has been true for some time that users could download earthquake parameters from the COSMOS VDC into an ASCII file, there are now improved instructions on the VDC home page (db.cosmos-eq.org) to facilitate downloading parameters as TAB-delimited data and importing them into a spreadsheet program.

Later this summer we plan to deploy two mirror sites at U.S. Geological Survey's Menlo Park office and the California Division of Mines and Geology to improve performance and ensure uninterrupted access. Although the University of California, Santa Barbara, where the COSMOS VDC is housed, has been ex-

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empted from California's rolling blackouts this summer, we have recently purchased a UPS for additional protection.

We are currently in the process of adding additional data fields, pgv, and earthquake mechanism to the database, and before the end of the year plan to display additional data products and change the look of the COSMOS home page.

COSMOS Strong-Motion Data Format is Finalized and Available.

A.F. Shakal, California Strong-Motion Instrumentation Program

The COSMOS Strong-Motion Data Format described in Newsletter No. 4 is finalized and ready for use. Several reviews and suggestions led to key revisions, which though minor, are important for future applications. The Strong-Motion Programs Board would like to thank anyone who contacted us with suggestions, especially those individuals with detailed experience with formats used in seismological networks; they provided invaluable perspective and experience to the revision process. Version 1.20 includes more reference tables to handle the variety of station, network, and instrument details. It also describes the process that will be used for additions to these tables as new networks, instruments, etc., are introduced. The basic similarity to the traditional formats continues to be preserved, however. The format is available at cosmos-eq.org/cosmos_format_01.pdf. With the format established, the next step involves programs and converters that use the format; these will begin appearing at the COSMOS website within the next month and more will be added as they become available. If you have further comments about the format or suggestion for application tools, please email tshakal@consrv.ca.gov.

USGS Selects National Strong-Motion Program Coordinator

Dr. Mary Lou Zoback, Chief Scientist of the U.S. Geological Survey's (USGS) Western Earthquake Hazards Team in Menlo Park, California, has announced that Dr. William "Woody" Savage has accepted a position within the USGS as the National Strong-Motion Program (NSMP) Coordinator beginning 1 September. Woody was Senior Seismologist at the Pacific Gas and Electric Company (PG&E), where he had worked since 1986. Prior to that he was a member of the staff of Woodward-Clyde Consultants in San Francisco and Pasadena. He currently serves as Secretary of COSMOS.

Woody is well known as an internationally respected member of the seismological community. Woody was instrumental in setting up and administering the PG&E-USGS Cooperative Research and Development Agreement (CRADA), which accelerated earthquake hazard research on critical topics in the USGS Earthquake Program. He has been coordinating PG&E's involvement in the PEER Lifelines research program and is Project Director for the Electric System Seismic Safety and Reliability contract with the California Energy Commission, which helps fund the PEER Lifelines program.

This newly created position within the USGS will be responsible for four major initiatives:

1) Manage the NSMP, whose instruments are split in number nearly equally between USGS instruments and instruments serviced by the USGS for other agencies. Initially, Woody will develop a business plan for this operation with Ron Porcella, head of NSMP field operations.

2) Provide national leadership for strong-motion recording issues within the Advanced National Seismic System (ANSS) and help establish priorities particularly for structural sites (roughly 6/7 of ANSS funds will be spent on strong-motion recording). This role will involve substantial interaction—at both regional and national levels—with the earthquake and structural engineering communities. Woody will also coordinate earthquake-related issues regarding utility and transportation systems on behalf of the USGS and will continue his involvement in the American Lifelines Alliance Project with the Federal Emergency Management Agency (FEMA) and the American Society of Civil Engineers (ASCE).

3) Guide the evolution of the NSMP into the ANSS. As the ANSS receives increased funding as authorized (tens of $M/year rather than the current

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level of about 4 $M/year), much of station operation is expected to require more regional administration. Woody will coordinate the USGS national identity and leadership in strong-motion recording and data applications with the ANSS regions, public agency strong-motion programs, and related engineering and facility interests in the private sector.

4) Build support for corporate participation in strong-motion monitoring and develop a "Corporate Partners" program within ANSS. The goal is to create mutually beneficial partnerships whereby owners instrument critical structures and facilities and then contribute their data streams to ANSS, thereby allowing them to take advantage of the ANSS infrastructure to provide rapid information and data products for their decision making. At PG&E, Woody established a prototype of this program, which now supplies strong-motion data to the Bay Area ShakeMap from more than 30 instruments at substations and service centers.

The appointment of Dr. Savage to the important position of National Strong Motion Program Coordinator, with the expanded leadership responsibilities of the position, is welcomed by the strong-motion seismology and earthquake engineering communities. COSMOS looks forward to his continued crucial participation to advance the dissemination and application of strong-motion data for earthquake hazard and engineering practice, thus improving public safety in earthquakes.

Strong-Motion Recordings of the M6.8 Nisqually Earthquake

H. Benz, U.S. Geological Survey

Strong-motion recordings of the M6.8 Nisqually, Washington, earthquake of 28 February 2001 provide an invaluable dataset for earthquake engineers and seismologists to help mitigate the impact of future large earthquakes. Moderate and large earthquakes that occur deep within a subducting plate, such as the Nisqually earthquake (depth of 55 km), pose substantial risk to many urban centers of the world located adjacent to subduction zones. In North America, urban centers like Anchorage, Alaska, and Vancouver, British Columbia, are vulnerable to large, intraplate earthquakes. An increasing awareness of the hazard posed by these types of earthquakes has resulted in a modest increase in the number of modern strong-motion seismographs operating in the Puget Sound region. Consequently, recordings of the Nisqually earthquake increased the number of peak ground motion and spectral response values available from such intraplate earthquakes. These new data will be useful in developing improved attenuation relations for such events, thereby increasing the accuracy of probabilistic and deterministic seismic hazard estimates for areas situated above subducting plates. Data obtained from instrumented structures will be critical for assessing structural performance. In addition, the strong-motion recordings of the Nisqually event are important for site response studies that can be used to zone seismic hazard for urban areas. The waveform data will also be applied to determine the source process of the earthquake and further our understanding of the mechanism of such deep earthquakes.

One reason for the quantity and quality of strong-motion records obtained from the Nisqually earthquake was the recent installation of 20 new digital strong-motion instruments funded by the Advanced National Seismic System (ANSS). These recordings validate the dual strategy of the ANSS whereby strong-motion instruments are installed resulting in (a) a mix of regional and urban seismic stations for improved earthquake notification and response activities; and (b) structural arrays to collect data of the dynamic response of structures for improving design of earthquake-resistant structures.

This earthquake was recorded by more than 90 digital and analog accelerographs at epicentral distances between 12 and 100 km. Three major sets of strong-motion data are available through the Internet. The first is from the University of Washington 40-station, strong-motion network, which is part of the ANSS (www.geophys.washington.edu). Data from most of these sensors were telemetered in real-time and used to produce ShakeMaps, which were then released rapidly on the Internet showing intensity, peak acceleration, and other values. Peak accelerations and velocities from about 40 sites, obtained from digital instruments of the National Strong-Motion Program (NSMP) of the U.S. Geological Survey (USGS), were released shortly after the event; these records are also available (www.nsmp.wr.usgs.gov). The NSMP operates two

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structural arrays of sensors in Olympia and Seattle. These data have been submitted to the COSMOS VDC (db.cosmos-eq.org). The third dataset is from an array of 25 digital recorders in Seattle operated by the USGS office in Golden, Colorado, consisting of soft-soil sites south of downtown and closely spaced sites in downtown, Queen Anne Hill, and other locations (groundmotion.cr.usgs.gov).

Peak ground accelerations for the Nisqually earthquake ranged from about 5%g to 30%g within a hypocentral distance of 100 km. The peak accelerations and spectral response values will be compared to attenuation relations currently used for intraslab earthquakes. An initial analysis of the data from Seattle indicates substantial amplification at 1 Hz and lower frequencies for soft-soil sites, consistent with the pattern of damage reported for the earthquake.

Advanced National Seismic System Improves Strong-Motion Monitoring

R. Page, U.S. Geological Survey

The fledgling Advanced National Seismic System (ANSS) (www.anss.org) is materially enhancing strong-motion monitoring and rapid reporting of seismic shaking in targeted earthquake-prone urban areas of the U.S. The ANSS is envisioned to be a linked network of more than 7000 modern national, regional and urban seismic stations, deployed and operated to improve the nation's ability to respond effectively to damaging earthquakes, volcanic unrest, and tsunamis (www.greenwood.cr.usgs.gov/pub/circulars/c1188/). In its first two years, the ANSS has focused on developing and enhancing urban monitoring and rapid reporting in several high-risk urban areas.

The management and implementation structure of the ANSS is outlined in a U.S. Geological Survey (USGS) fact sheet (geology.cr.usgs.gov/pub/fact-sheets/fs-0045-01/). A National Steering Committee with earth science, engineering, and emergency management representation sets priorities and provides overall direction for the ANSS. Members include Jonathan Bray, James Davis, Art Frankel, Arch Johnston, Eduardo Miranda, Farzad Naiem, David Simpson, Carl Stepp, Craig Weaver, and Glen Woodbury. A National Implementation Committee, chaired by ANSS Manager, Harley Benz, develops implementation plans with advice from several national and regional advisory committees, including a Technical Integration Committee. Regional and national coordinators are responsible for implementing the various components of the ANSS.

The major new thrust envisioned for the ANSS is enhanced monitoring of ground shaking and the response of structures in high-risk urban areas. Responsibility for implementing this intensified strong-motion monitoring lies with the National Strong Motion Program Coordinator and seven Regional Coordinators, who are assisted by advisory committees and regional working groups of network operators. The coordinators of the ANSS regions and chairpersons of the regional advisory committees are listed in the following table.

ANSS Region	Coordinator	Adv. Comm. Chair
Alaska	Tom Murray	John Aho
California	David Oppenheimer	Chris Poland
Hawaii	Paul Okubo	undecided
Intermtn. West	Walter Arabasz	undecided
Mid-America	Mitch Withers	Robert Herrmann
Northeast	John Ebel/ Art Lerner-Lam	undecided
Pacific NW	Steve Malone	C.B. Crouse

With ANSS funding, modern digital strong-motion stations have been deployed or old analog stations upgraded with digital instrumentation at more than 160 sites in targeted high-risk urban areas in the western and central U.S. (see table). The ANSS stations have onboard recording as well as communication links to a regional data center where ShakeMaps (geopubs.wr.usgs.gov/fact-sheet/fs103-00/)—"instant" maps of earthquake shaking—are produced to guide emergency response. Better monitoring of ground shaking has been the initial priority in the targeted urban areas. As the ShakeMap capability within a region is realized, monitoring the response of structures will become a priority. In 2001, two structures in the San Francisco Bay region are being instrumented with ANSS support.

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ANSS Strong-Motion Station Deployment		
Urban Area	FY 2000	FY 2001
San Francisco Bay	40	10*
Seattle	20	20
Salt Lake City	20	20
Memphis	--	12
Las Vegas	--	12
Anchorage	--	12

*plus two arrays in buildings

The seed funding for the ANSS has been less than $4 million in 2000 and 2001. The costs to fully implement the ANSS are projected to be $170 million for equipment and $47 million per annum for operation and maintenance. The modest seed funding for the ANSS is already yielding dividends:

- Helping guide response to the Mw 6.8 Nisqually, Washington, earthquake on 28 February 2001 and to the Mw 5.0 Yountville, California, temblor on 3 September 3 2000; and
- Providing the first well-documented picture of ground shaking from a subcrustal shock comparable in size to the 1949 and 1965 shocks that caused damage in the Puget Sound region.

Proposal for a National Strong-Motion Database System

C.B. Crouse, URS Corporation

The need for a national strong-motion database system has existed for 20 years. A variety of reasons have kept the system from being established, but none of them should be a roadblock today. The creation of this database should be one of the top priorities (if not the highest priority) of our national strong-motion program. The database would contain:

- Processed accelerograms, response, and Fourier spectra:
- Information on causative earthquakes, such as magnitudes, moments, stress drops, slip distributions, rupture dimensions, and rupture velocities;
- Information on the recording stations and local geology; and
- 3-D sub-regional geology including velocity structures, faults, and basins.

All accelerograms worldwide should eventually be admitted to the database provided references for all included data are listed. This database must be carefully designed, and an initial intensive effort lasting two to three years and costing on the order of $1 million must be spent to create it. The most logical candidate organization to supply this level of funding is the Advanced National Seismic Network (ANSS). The Consortium of Organizations for Strong-Motion Observation Systems (COSMOS) has the organizational structure in place to carry out this mission and is now posting U.S. and international accelerogram data on its Virtual Data Center for web access. After the database management system has been established and the bulk of existing accelerogram, earthquake, station and geologic data have been incorporated, then funding could be reduced to a level required for system maintenance and addition of new strong-motion data.

All current strong-motion databases (e.g., California Division of Mines and Geology, U.S. Geological Survey, Southern California Earthquake Center, private consulting firms, and universities) would contribute relevant data to the effort. Strong-motion networks in other countries should also be encouraged to participate. In addition to a national center, regional centers, linked to the national center, could also be established. These centers would have the same database as the national center but might offer easier access and better service to regional users who may want to consult with regional center personnel about data in their region.

With a national strong-motion database system and organization that is easily accessible to seismologists and engineers, many aspects of research on ground motion and structural engineering will become more efficient, thus justifying the expenditure for the database system. Furthermore, the database, complete with search and visual display options, may offer new insights in these topic areas.

Invited Workshop on Instrumentation of Buildings

A.F. Shakal, California Strong-Motion Instrumentation Program
J. Carl Stepp, COSMOS
R.L. Nigbor, University of Southern California

COSMOS, in cooperation with the Advanced National Seismic System (ANSS), is sponsoring an Invited Workshop entitled "Strong-Motion Instrumentation of Buildings" to be held 14-15 November 2001. The Workshop, an activity of the COSMOS Strong-Motion Programs Board (SMPB), will obtain broad input from earthquake engineering professionals to define strategic needs for development of guidelines for strong-motion instrumentation of buildings as part of the ANSS (see Newsletter No. 2).

The main objective of the Workshop is to examine and advance strategies for strong-motion instrumentation of buildings, document current practice for instrumentation of buildings, and define the types of building response measurements needed to respond to expanding uses of strong-motion data in earthquake engineering research and practice, emergency response practice, and building health evaluation. Another important objective is to document developing instrumentation technologies, communication technologies, and monitoring systems. The Workshop is being organized around four principal topics: strategies for selecting buildings for strong-motion instrumentation, current building instrumentation programs and guidelines, future needs for strong-motion measurements in buildings, and instrumentation technologies. The first of these topics will address national and regional priorities, priorities for selection of buildings, and mechanisms to encourage expansion of private participation in a coordinated national building instrumentation program.

Invited discussion papers will be distributed to participants prior to the Workshop. The discussion papers together with consensus recommendations of the Workshop will be published as archival quality Proceedings. The Proceedings will serve as a technical information base for separate development of guidelines for strong-motion instrumentation of buildings.

Supporting organizations include the National Science Foundation, the U.S. Committee for Advancement of Strong-Motion Programs, the ANSS, COSMOS, and PEER.