

The **6**th Caltrans

Seismic

Research Workshop Program

Sponsored by the

California Transportation Foundation

(A non-profit, public benefit corporation dedicated to the promotion
and recognition of excellence in California Transportation)

and the

**California Department of Transportation
Division of Engineering Services**

**Radisson Hotel
Sacramento, California**

June 12th - 13th, 2001

The 6th Caltrans *Seismic* Research Workshop

Foreword

Established in 1991 by the former Caltrans' Division of Structures, the **Caltrans Seismic Research Workshop** continues as a function of the Division of Engineering Services. The purpose of these Workshops is to accelerate the dissemination of results from the Seismic Research and Development Program funded by the Division of Engineering Services. The Loma Prieta Earthquake pointed out the need for extensively expanding the program to support the seismic retrofit of California bridges already in-service and improve the design and construction of new bridges to resist seismic events.

The objective of this Workshop is to provide researchers the opportunity to present a succinct summary of their research projects to Caltrans as well as other interested professionals. This summary includes the objective of the work and results, as well as the need for this research and its benefit to Caltrans and other state and local transportation agencies. The Workshop is not organized specifically for Caltrans' technical staff, but to disseminate information to fellow researchers, the technical staffs at other government transportation agencies, the Seismic Advisory Board, as well as consulting engineers interested in the application of earthquake engineering principles to bridge design and retrofit. This Workshop also presents a unique opportunity for interaction between researchers and design professionals interested in these fields of study.

Research performed under these programs has resulted in the advancement of seismic design and analysis techniques for bridges, and the development of new techniques to evaluate seismic response and soil-structure interaction. In addition, this research program has supported the investigation and integration of developing technologies for bridge applications. One example is the Seismic Response Modification Device (SRMD) Facility located at the University of California – San Diego. This facility will provide Caltrans, as well as other transportation agencies the ability to validate the actual response characteristics of full-scale response modification devices, such as isolation bearings and viscous dampers. Another example of a developing technology is the implementation of advanced composite materials in the design and rehabilitation of bridges. Originally introduced to the bridge engineering profession as a seismic retrofit solution, this technology has evolved to other applications, such as strengthening of bridges for live load traffic (i.e., Byron Road Bridge) and new construction (i.e., Kings Stormwater Channel Bridge).

The Workshop opens on Tuesday with a session summarizing on-going research supporting the Toll Bridge Retrofit Program with emphasis on the replacement San Francisco-Oakland Bay Bridge. Subsequent sessions that day present new techniques for moment-curvature analysis of reinforced concrete columns, as well as results from intensive laboratory tests of columns and piles. The afternoon sessions present

additional test results related to the design of abutments, columns, CIDH Piles and bridge superstructures, as well as work quantifying ground motion for design purposes.

On Wednesday the Workshop continues with a summary of work related to Soil-Structure Interaction. More specifically, this first session focuses on efforts to develop P-Y curves and quantify the interaction of drilled CIDH piles and the soil. Additional test results pertaining to seismic retrofit is presented in the second morning session. The workshop concludes Wednesday afternoon with two sessions taking a more forward-looking approach toward the design and construction of bridges. The third session of the day is devoted to the implementation of advanced composite materials in bridge construction. This session reviews on-going work related to incorporating advanced composite materials in new bridge construction. The final session discusses directions for emerging technologies. Specifically, this session will discuss areas for improvement related to testing and evaluating the performance of seismic response modification devices; estimating the realistic increase in service life of bridge structures rehabilitated with advanced composites; modeling soil-structure interaction in a production environment; and incorporating non-destructive damage evaluation methods in structural health monitoring.

Due to the large number of abstracts submitted, a Poster Session will be held concurrently on Wednesday to accommodate papers that could not be scheduled in the General Sessions. Also, a trade show is scheduled for Wednesday to allow vendors the opportunity to demonstrate products of interest to bridge designers.

Lastly, the Organizing Committee gratefully acknowledges the assistance of the California Transportation Foundation, in particular Heinz Heckerroth and George Amaro.

James E. Roberts
Chair

Tom Post
Co-Chair

Charles Sikorsky
Technical Coordinator

Cynthia MacLeay
Program Coordinator

WORKSHOP PROGRAM

TUESDAY - JUNE 12, 2001 Morning

6:45 a.m. - 3:00 p.m.
7:45 a.m. - 8:00 a.m.

**REGISTRATION
 INTRODUCTION**

Introductory Remarks

Overview of Caltrans Seismic Research Program

Tom Post,
*California Department of
 Transportation*
 Jim Roberts,
*California Department of
 Transportation*

8:00 a.m. - 9:40 a.m.

SESSION 1 - Toll Bridge Retrofit Program -- Update

CHAIR: Brian Maroney, *Caltrans*

PAPER NUMBER

TITLE

AUTHOR(S), AFFILIATION

01-101 San Francisco-Oakland Bay Bridge, Task E1: Full-Scale Shear Link Test
 01-102 Cyclic Behavior of Shear Link Connections of the New East Span of San Francisco-Oakland Bay Bridge Tower
 01-103 Analysis of Component Tests of the New San Francisco-Oakland Bay Bridge
 01-104 Structural Testing of the San Francisco-Oakland Bay Bridge East Span Skyway Structures: Longitudinal Pier Test
 01-105 On-Line Structural Test Monitoring and Data Archiving

C. McDaniel, C-M. Uang,
 F. Seible, *UCSD*
 P. Dusicka, A.M.Itani,
 I.G. Buckle, *UNR*
 R. K. Dowell, D.R. Parker,
 F. Seible, *UCSD*
 E.M. Hines,
 F. Seible, *UCSD*
 A. Elgamal, F. Seible
 F.Vernon, M. Fraser, *UCSD*

9:40 a.m. - 10:00 a.m.

Morning Break

10:00 a.m. - 12 Noon

SESSION 2 - Advances in Bridge Design and Analysis

CHAIR: Mark Yashinsky, *Caltrans*

PAPER NUMBER

TITLE

AUTHOR(S), AFFILIATION

02-101 Effect of Configuration on Seismically Protected Bridges
 02-102 Incremental Confinement Effects in a Moment-Curvature Analysis
 02-103 Experimental and Analytical Study of Circular Flexural Retrofitted Columns Subjected to Shake Table Loading
 02-104 Experimental Testing of Unbonded Post-Tensioned Precast Concrete Segmental Bridge Columns
 02-105 Soil-Foundation-Structure Interaction In a 1-G Shaking Table
 02-106 Behavior of Piles in Laterally Spreading Ground During Earthquakes

E. Anderson, S. Mahin,
 G. Fenves A. Whittaker, *UCB*
 R. K. Dowell, Y.D. Hose,
 D. Brestel,
 F. Seible, *UCSD*
 P. N. LaPlace, D. H. Sanders,
 M. "Saiid" Saiidi, *UNR*
 Joshua Hewes,
 M.J.N. Priestley, *UCSD*
 W. Jakrapiyanum,
 S.A. Ashford, *UCSD*
 S. J. Brandenberg, P. Singh,
 R. W. Boulanger,
 B. L. Kutter, *UCD*

12 Noon - 1:00 p.m.

Lunch (Box Lunch Provided)

AFFILIATIONS

CALTRANS

California Department of Transportation

SCEC

Southern California Earthquake Center

UCB

University of California, Santa Barbara

UCD

University of California, Davis

UCSD

University of California, San Diego

UNR

University of Nevada, Reno

WORKSHOP PROGRAM

TUESDAY - JUNE 12, 2001 Afternoon

1:00 p.m. - 2:40 p.m. SESSION 3 - Advances in Seismic Design Practice

CHAIR: Robert Tanaka, *Caltrans*

PAPER NUMBER	TITLE	AUTHOR(S), AFFILIATION
03-101	Seismic Performance of Precast Segmental Bridge Superstructures	M. Garg, S. Megally, F. Seible, R. K. Dowell, <i>UCSD</i>
03-102	Seismic Performance of Sacrificial Shear Keys	P. Silva, <i>UMR</i> ; S. Megally, F. Seible, <i>UCSD</i>
03-103	Seismic Performance of CIDH Pile Supported Footings	In Ho Ha, M.J.N. Priestley, <i>UCSD</i>
03-104	Longitudinal Seismic Response of Concrete Substructure to Steel Superstructure Integral Bridge Connections	J. Patty, F. Seible, C. Uang, <i>UCSD</i>
03-105	The Application of Design Requirements in the AASHTO Guide Specification for Isolated Design	G. Fenves, <i>UCB</i>

2:40 p.m. - 3:00 p.m. Afternoon Break

3:00 p.m. - 4:40 p.m. SESSION 4 – Evaluating Seismic Response

CHAIR: Fadel Alamaddine, *Caltrans*

PAPER NUMBER	TITLE	AUTHOR(S), AFFILIATION
04-101	Parametric Performance Evaluation of Circular Columns	M.H. Hachem, S. Mahin, <i>UCB</i>
04-102	Simulation Issues with a Real-Time Seismic Testing System	J. Shortreed, <i>UCSD</i>
04-103	Effects of Local Deformations on the Seismic Response of Bridge Structures	S. Mazzoni, J.B. Smith, G. Fenves, <i>UCB</i>
04-104	Data from Downhole Arrays Instrumented by the Caltrans / CDMG Project	P. Hipley, (<i>Caltrans</i>); A. Shakal, A.V. Grazier, (<i>CSMIP</i>)
04-105	Accounting for Site Effects in Probabilistic Seismic Hazard Analysis	N. Field, <i>SCEC</i>

4:40 p.m.

CLOSURE

AFFILIATIONS

CALTRANS

California Department of Transportation

CDMG

California Division of Mines and Geology

CSMIP

California Seismic Monitoring Instrumentation Program, California Department of Conservation, Division of Mines and Geology

SCEC

Southern California Earthquake Center

UCB

University of California, Santa Barbara

UCD

University of California, Davis

UCI

University of California, Irvine

UCSD

University of California, San Diego

UNR

University of Nevada, Reno

UMR

University of Missouri-Rolla

WORKSHOP PROGRAM

WEDNESDAY - JUNE 13, 2001 Morning

6:45 a.m. – 12 Noon **REGISTRATION**
7:00 a.m. **TRADE SHOW OPENS**

8:00 a.m. - 10:00 a.m. **SESSION 5 - Soil-Structure Interaction**
 CHAIR: Craig Whitten, *Caltrans*

PAPER NUMBER	TITLE	AUTHOR(S), <i>AFFILIATION</i>
05-101	Flexural Strength and Ductility of Reinforced Concrete Extended Pile-Shafts	Y.H. Chai, <i>UCD</i>
05-102	Pile Group Response Under Lateral Load	M. Ashour, G. Norris <i>UNR</i>
05-103	Effect of Pile Diameter on p-y Curves	T. Juirnarongrit, S.A. Ashford, <i>UCSD</i>
05-104	Development of P-Y Curves for Liquefied Sands	T. J. Weaver, S. A. Ashford, K. M. Rollins, <i>UCSD</i>
05-105	Interaction Between Soil and Drilled Shaft Under Lateral Load	K. Janoyan, <i>UCLA</i>

10:00 a.m -10:40 a.m. **Morning Break in Exhibit Hall**

10:40 a.m. - 12 Noon **SESSION 6 - Advances in Seismic Design**
 CHAIR: Saad El-Azazy, *Caltrans*

PAPER NUMBER	TITLE	AUTHOR(S), <i>AFFILIATION</i>
06-101	Cyclic Testing of Column Bents Strengthened by Infill Walls	M. A. Haroun, A. Abdel-Kareem, H. Elsanadedy, M. Elbahar, <i>UCI</i> , A.S. Mosallam, <i>UCF</i> , M. Yashinsky, C. Whitten, <i>Caltrans</i>
06-102	Dynamic Assessment and Retrofitting of Reinforced Concrete Bridge Bents	C. Pulido, M. "Saiid" Saiidi, D. Sanders, A. Itani, <i>UNR</i>
06-103	Experimental and Analytical Study of Shear Dominated Circular Bridge Columns Subjected to Shake-Table Loading	P.N. LaPlace, D. H. Sanders, M. "Saiid" Saiidi, <i>UNR</i>
06-104	Shake Table Testing of a Substandard Two Column Bent with Round Hinged Columns	J. Moore, D. Sanders, M. "Saiid" Saiidi, <i>UNR</i>
06-105	Cyclic Response of Steel Plate Girder Bridges in the Tranverse Direction	L. Carden, F. Garcia-Alvarez, A. Itani, I. Buckle, <i>UNR</i>

12 Noon -1:00 p.m. **Lunch (Box Lunch Provided) in Exhibit Hall**

AFFILIATIONS

<i>UCSD</i>	<i>University of California, San Diego</i>
<i>UCD</i>	<i>University of California, Davis</i>
<i>UNR</i>	<i>University of Nevada, Reno</i>
<i>UCB</i>	<i>University of California, Santa Barbara</i>
<i>CALTRANS</i>	<i>California Department of Transportation</i>
<i>UCI</i>	<i>University of California, Irvine</i>
<i>UCLA</i>	<i>University of California, Los Angeles</i>
<i>UCF</i>	<i>University of California, Fullerton</i>

WEDNESDAY ONLY

POSTER SESSION 8:00 a.m. - 4:00 p.m.

POSTER NUMBER	TITLE	AUTHOR(S), <i>AFFILIATION</i>
101	Geotechnical Earthquake Analysis for the 21 st Century	K. Arulanandan, <i>UCD</i>
102	Seismic Performance of Bridge Restrainers at Intermediate Hinges	F. Sanchez-Camargo, E. M. Maragakis, M. Saiid Saiidi, <i>UNR</i>
103	Cyclic Testing of Retrofitted and Repaired Bridge Columns by Composite Jackets	M. A.Haroun, M. Q. Feng, Carla Yland, A. Hassan, H.Elsanadedy, M.Elbahar, <i>UCI</i> , A.A. Mosallam, <i>UCF</i>
104	The Field Measurement of Glass Transition Temperatures in Fiber Reinforced Composites	J. Nokes, G. Hawkins. <i>The Aerospace Corporation, Los Angeles</i>
106	Modeling of Composite-Jacketed Reinforced Concrete Bridge Columns	M. A.Haroun, H. M. Elsanadedy, <i>UCI</i>
107	Caltrans/CDMG Bridge Strong Motion Instrumentation Program	P. Hipley, <i>Caltrans</i> ; A. Shakal, M. Huang, <i>CSMIP</i>
108	The SCEC Borehole Instrumentation Program	Steidl, <i>SCEC</i>
109	Bridge Performance Assessment and Database	Y.D. Hose, F. Seible, <i>UCSD</i>
110	Plastic Hinge Length of Reinforced Concrete Bridge Column	R.H. Dowell, E.M. Hines, <i>UCSD</i>
111	Seismic Performance of Hollow Rectangular Reinforced Concrete Piers with Highly-Confined Corner Elements	E.M. Hines, F. Seible, <i>UCSD</i>
112	Development and Experimental Calibration of Models for Elastomeric Isolation Bearings of Bridges	W. Huang, G. Fenves, A.S. Whittaker, S.A. Mahin, <i>UCB</i>
113	Long-period Amplification and Attenuation in the Los Angeles Basin	K. Olsen, <i>UCSB</i>
114	Lateral Behavior of Piles in Liquefied Soil	M. Ashour, G. Norris, <i>UNR</i>
115	Lateral Load Tests on Piles in Liquefied Sand to Develop P-Y Curves	K.M. Rollins, J.D. Lane, <i>BYU</i> , T.M. Gerber, <i>URS Greiner, Inc</i> , S.A. Ashford, <i>UCD</i>

AFFILIATIONS

<i>CALTRANS</i>	<i>California Department of Transportation</i>
<i>SCEC</i>	<i>Southern California Earthquake Center</i>
<i>TAMU</i>	<i>Texas A & M University</i>
<i>UCB</i>	<i>University of California, Santa Barbara</i>
<i>UCD</i>	<i>University of California, Davis</i>
<i>UCI</i>	<i>University of California, Irvine</i>
<i>UCSD</i>	<i>University of California, San Diego</i>
<i>UNR</i>	<i>University of Nevada, Reno</i>
<i>UCSB</i>	<i>University of California, Santa Barbara</i>
<i>UCF</i>	<i>University of California, Fullerton</i>
<i>BYU</i>	<i>Brigham Young University, Salt Lake City, Utah</i>

TRADE SHOW VENDORS

Vendor Name, Address, Website	Vendor Phone	Product
COMPUTER & STRUCTURES INC 1995 University Ave., Suite 540, Berkeley, CA 94704 INTERNET: www.csiberkeley.com	510-845-2177 Fax 510-845-4096	Software for Bridge Engineering
DYNAMIC ISOLATION SYSTEMS INC. 2080 Brierly Way #101, Sparks, NV 89434 INTERNET: www.dis-inc.com	775-359-3333 (866-376-8006) Fax 775-359-3985	Seismic Isolation Bearings
EARTHQUAKE PROTECTION SYSTEMS INC. 2801 Giant Hwy, Bldg A, Richmond, CA 94805 INTERNET: www.earthquakeprotection.com	510-232-5996 Fax 510-232-6577	Friction Pendulum Isolation Bearings
ENDEVCO CORP P.O. Box 2817 San Francisco, CA 94126 INTERNET: www.endevco.com	415-558-9815 Fax 401-735-5290	Seismic Sensors
HEADED REINFORCEMENT CORP. (HRC) 11200 Condor Ave, Fountain Valley, CA 92708 INTERNET: www.hrc-usa.com	714-557-1455 Fax 714-557-4460	High Performance Reinforcement Products
INDEPENDENT WITNESS INC 1515 W. 2200 South, Suite E, Salt Lake City, UT 84119 INTERNET: www.iniwitness.com	801-886-2255 Fax 801-886-2849	Strong Motion Seismic Sensors
LARSA, INC. 3500 Sunrise Highway, Great River, NY 11739 INTERNET: www.larsausa.com	631-206-3606 Fax 631-206-3610	LARSA 2000 Time Dependent Construction Analysis
SC SOLUTIONS 3211 Scott Blvd, # 202, Santa Clara, CA 95054 INTERNET: www.scsolutions.com	408-486-6060 x20 Fax 408-486-6083	Seismic Analysis
SEISMIC ENERGY PRODUCTS, L.P. 518 Progress Way, Athens, TX 75751	903-675-8571 Fax 903-677-4980	Seismic Isolation Bearings
STRUCTURAL COMPOSITE CONSTRUCTION INCORPORATED (SCCI) 5577 Arrow Hwy, Montclair, CA 91763 INTERNET: www.SCCIUSA.com	800-350-8751 Fax 909-949-2431	FRP Composite Strengthening Products
SUMIDEN WIRE PRODUCTS CORP P.O. Box 8719, Stockton, CA 95208 INTERNET: www.sumidenwire.com	209-466-8924 Fax 209-941-2990	PC Strand & Epoxy Coated PC Strand
THE REINFORCED EARTH COMPANY/ MENARD INC. 8614 Westwood Ctr Dr. Suite S-1100, Vienna, VA 22181 INTERNET: www.reinforcedearth.com	800-446-5700 Fax 703-821-1815	MSE Walls and Ground Improvement
WATSON BOWMAN ACME CORP. 95 Pineview Drive, Amherst, NY 14228 INTERNET: www.wbacorp.com	716-691-7566 Fax 716-564-0361	Bridge Maintenance, Expansion Control
WILLIAMS FORM ENGINEERING 7601 N. Columbia Blvd, Portland, Oregon 97203 INTERNET: www.williamsform.com	503-285-4548 Fax 503-285-6858	Post Tension Bar -1-2½" Concrete Anchors