Opening Remarks/ Introductions

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Stephen A. Mahin: October 16, 1946 – February 10, 2018

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Mahin: A Pioneer of Pseudodynamic Testing & Hybrid Simulation

PSEUDODYNAMIC TEST METHOD—CURRENT STATUS AND FUTURE DIRECTIONS

By Stephen A. Mahin,[1] Member, ASCE, Pui-Shum B. Shing,[2] Associate Member, ASCE, Christopher R. Thewalt,[3] Associate Member, ASCE, and Robert D. Hanson,[4] Member, ASCE

ABSTRACT: A major concern in seismic performance testing is whether the loading conditions imposed on a test specimen are representative of those that might occur during an actual earthquake. An on-line computer-controlled experimental procedure has been recently developed that appears to combine the simplicity of quasistatic testing with the realism of shaking table tests. The basis of this so called pseudodynamic test method is summarized in this paper. Recent research results are examined to identify the method's capabilities and limitations. Efforts to extend the applicability of the method are highlighted.

INTRODUCTION

The inelastic cyclic behavior of structures is generally quite sensitive to the imposed histories of displacement. Thus, selection of loading techniques and histories is a key part of the planning for any seismic performance test (Scholl 1984). Shaking tables provide possibly the most realistic means of simulating seismic effects in the laboratory but the capabilities of available tables are limited. Alternative quasistatic test methods, while facilitating studies of large specimens and components, introduce problems in relating observed response to expected seismic performance. One-line computer control procedures have been recently suggested as a means for overcoming many of these difficulties (Takanashi et al. 1975).

These so-called pseudodynamic test methods reproduce seismic effects by combining quasistatic experimental techniques with numerical simulation procedures. Nonlinear dynamic analysis software is used during a test to determine the loading histories to be imposed on the test specimen. To insure realism in these analyses, computations are based on the currently measured state of damage in the actual test specimen. Since this software directly accounts for dynamic effects, tests are performed slowly using electro-hydraulic actuators of the type commonly used in quasistatic tests. As a result, study of specimens too large, massive, or strong to be tested on available shaking tables is possible. The analytical basis of the method permits a particular earthquake excitation to be considered and by using appropriate numerical formulations pseudodynamic tests can account for geometric nonlinearities, three-dimensional and multiple support excitations, and soil-structure interaction. Similarly, the use of analytical substructuring concepts with pseudodynamic methods permits seismic response simulation to be extended to tests of structural subassemblages.

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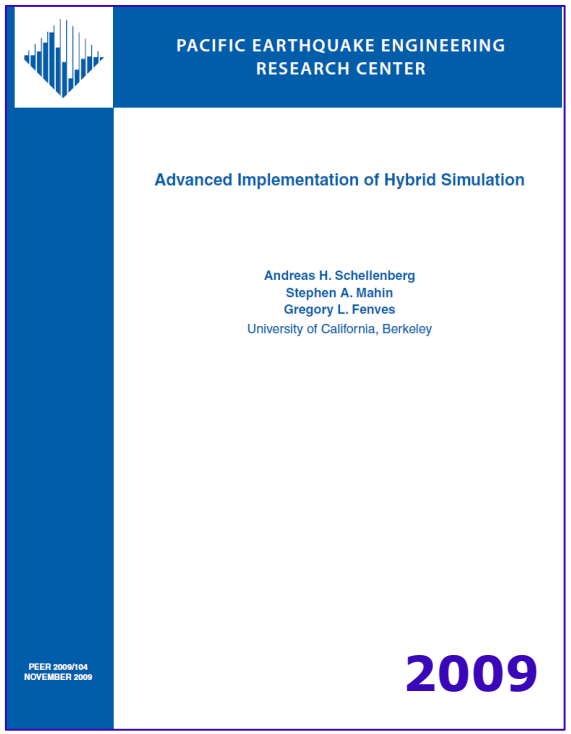

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Agenda (1/2)

TUESDAY, 20 MARCH WEDNESDAY, 21 MARCH

TIME	PRESENTATION	PRESENTER	BUILDING
8:00	Welcome / Registration		Building Map
8:30	Opening Remarks / Introductions	Zak Gens, MTS Prof. Khalid Mosalam, UC-Berkeley	445
8:45	Hybrid Simulation: Past and Future	Prof. Khalid Mosalam, UC-Berkeley	445
9:15	Introduction to Mechanical Hybrid Simulation	Dr. Shawn You, MTS	445
10:00	Substructuring, Integration Methods and Simulation Errors	Dr. Selim Günay, UC-Berkeley	445
10:30	Break		
11:00	Hybrid Simulation Techniques	Dr. Shawn You, MTS	445
11:30	Implementation Frameworks: OpenFresco and OpenFresco Express	Dr. Andreas Schellenberg, UC-Berkeley	445
12:00	Lunch / PEER at 21	Prof. Khalid Mosalam, UC-Berkeley	445
13:00	Application I: Small Component Hybrid Simulation	Dr. Selim Günay, UC-Berkeley Dr. Andreas Schellenberg, UC-Berkeley	445
13:30	Application II: Hybrid Simulation of a Bridge Bent with Innovative Column Design	Mr. Yingjie Wu, UC-Berkeley Dr. Selim Günay, UC-Berkeley	445
14:00	Richmond Field Station Lab Tours		420 & 484
14:30	Hybrid Simulation Demos 1: » Control Room Overview » Small Component HS	Dr. Selim Günay, UC-Berkeley Dr. Andreas Schellenberg, UC-Berkeley	484
15:00	Break		
15:15	Application III: Hybrid Simulation of Environmentally Damaged Bridges	Mr. Ian Williams, UC-Berkeley Mr. Jacob Duncan, UC-Berkeley	445
15:40	Application IV: Multi Directional Hybrid Testing System at Polytechnique Montreal – System, Challenges and Applications	Mr. Martin LeClerc, Polytechnique Montreal	445
16:10	Hybrid Simulation Demos 2: » Free Vibration HS » Geographically Distributed HS with Davis Hall	Dr. Selim Günay, UC-Berkeley Dr. Andreas Schellenberg, UC-Berkeley	484
17:00	Day 1 Conclusion	Zak Gens, MTS Prof. Khalid Mosalam, UC-Berkeley	445

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Agenda (2/2)

TUESDAY, 20 MARCH | WEDNESDAY, 21 MARCH

TIME	PRESENTATION	PRESENTER	BUILDING
8:00	Welcome		Building Map
8:30	Day 2 Introduction	Prof. Khalid Mosalam, UC-Berkeley	445
8:45	Overview of Real-Time Hybrid Simulation	Dr. Shawn Gao, MTS	445
9:20	Real-Time Hybrid Shake Table Testing: Overview, Theory, and Applications	Dr. Andreas Schellenberg, UC-Berkeley	445
10:10	Break		
10:40	Real-Time Hybrid Shake Table Testing: Development & Applications	Dr. Selim Günay, UC-Berkeley	445
11:20	Seismic Testing System Modeling and Control Techniques	Dr. Shawn Gao, MTS	445
12:00	Lunch / Remembering Prof. Stephen A. Mahin		445
13:00	Real-Time Hybrid Shake Table Demos: » PEER 6-DOF Hybrid Shake Table Tests	Dr. Andreas Schellenberg, UC-Berkeley Dr. Selim Gunay, UC-Berkeley Dr. Amarnath Kasalanati, UC-Berkeley	420
14:00	New Hybrid Simulation Tools / Hybrid Simulation in Other Industries	Dr. Shawn You, MTS	445
14:30	Hybrid Simulation of Energy Generation from Ocean Waves	Mr. Thomas Boerner, CalWave Mr. Nigel Kojimoto, CalWave Dr. Selim Günay, UC-Berkeley	445
15:00	Break		
15:15	Hybrid Simulation of Daylighting Systems	Dr. Alex Mead, UC Berkeley	445
15:40	Hybrid Fire Simulation	Dr. Martin Neuenschwander, UC-Berkeley	445
16:00	Interactive Panel + Q&A	All Presenters	445
17:00	Workshop Conclusion	Zak Gens, MTS Prof. Khalid Mosalam, UC-Berkeley	445

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