ATC-40

Seismic Evaluation and Retrofit of Concrete Buildings
Volume 1

by

APPLIED TECHNOLOGY COUNCIL
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SEISMIC SAFETY COMMISSION
State of California
Products 1.2 and 1.3 of the Proposition 122
Seismic Retrofit Practices Improvement Program

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Preface

Proposition 122 passed by California's voters in 1990, created the Earthquake Safety and Public Buildings Rehabilitation Fund of 1990, supported by a $300 million general obligation bond program for the seismic retrofit of state and local government buildings. As a part of the program, Proposition 122 authorizes the California Seismic Safety Commission (CSSC) to use up to 1% of the proceeds of the bonds, or approximately $3 million, to carry out a range of activities that will capitalize on the seismic retrofit experience in the private sector to improve seismic retrofit practices for government buildings. The purpose of California's Proposition 122 research and development program is to develop state-of-the-practice recommendations to address current needs for seismic retrofit provisions and seismic risk decision tools. It is focused specifically on vulnerable concrete structures consistent with the types of concrete buildings that make up a significant portion of California's state and local government inventories.

In 1994, as part of the Proposition 122 Seismic Retrofit Practices Improvement Program, the Commission awarded the Applied Technology Council (ATC) a contract to develop a recommended methodology and commentary for the seismic evaluation and retrofit of existing concrete buildings (Product 1.2). In 1995 the Commission awarded a second, related contract to ATC to expand the Product 1.2 effort to include effects of foundations on the seismic performance of existing concrete buildings (Product 1.3). The results of the two projects have been combined and are presented in this ATC-40 Report (also known as SSC-96-01).

Two other reports recently published by the California Seismic Safety Commission, the *Provisional Commentary for Seismic Retrofit* (1994) and the *Review of Seismic Research Results on Existing Buildings* (1994), are Products 1.1 and 3.1 of the Proposition 122 Program, respectively. These two previous reports provide the primary basis for the development of the recommended methodology and commentary contained in this document.

This document is organized into two volumes. Volume One contains the main body of the evaluation and retrofit methodology, presented in 13 chapters, with a glossary and a list of references. This volume contains all of the parts of the document required for the evaluation and retrofit of buildings. Volume Two consists of Appendices containing supporting materials related to the methodology: four example building case study reports, a cost effectiveness study related to the four building studies, and a review of research on the effects of foundation conditions on the seismic performance of concrete buildings.

This report was prepared under the direction of ATC Senior Consultant Craig Comartin, who served as Principal Investigator, and Richard W. Niewiarowski, who served as Co-Principal Investigator and Project Director. Fred Turner served as CSSC Project Manager. Overview and guidance were provided by the Proposition 122 Oversight Panel consisting of Frederick M. Herman (Chair), Richard Conrad, Ross Cranmer, Wilfred Iwan, Roy Johnston, Frank McClure, Gary McGavin, Joel McRonald, Joseph P. Nicoletti, Stanley Scott, and Lowell Shields. The Product 1.2 methodology and commentary were prepared by Sigmund A. Freeman, Ronald O. Hamburger, William T. Holmes, Charles Kircher, Jack P. Moehle, Thomas A. Sabol, and Nabih Youssef (Product 1.2 Senior Advisory Panel). The Product 1.3 Geotechnical/Structural Working Group consisted of Sunil Gupta, Geoffrey Martin, Marshall Lew, and Lelio Mejia. William T. Holmes, Yoshi Moriwaki, Maurice Power and Nabih Youssef served on the Product 1.3 Senior Advisory Panel. Gregory P. Luth and Tom H. Hale, respectively, served as the Quality Assurance Consultant and the Cost Effectiveness Study Consultant. Wendy Rule served as Technical Editor, and Gail Hynes Shea served as Publications Consultant.

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