# Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings

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Prepared by

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## Notice

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Cover Photos: Source: FEMA G225-CD, *Seismic Retrofit Training for Building Contractors & Inspectors*, 2006.

# Foreword

The Federal Emergency Management Agency (FEMA) has the goal of reducing the ever-increasing cost that disasters inflict on our country. Preventing losses before they happen by designing and building to withstand anticipated forces from these hazards is one of the key components of mitigation, and is the only truly effective way of reducing the cost of disasters. As part of its responsibilities under the National Earthquake Hazards Reduction Program (NEHRP), and in accordance with the National Earthquake Hazards Reduction Act of 1977 (PL 94-125) as amended, FEMA is charged with supporting activities necessary to improve technical quality in the field of earthquake engineering. The primary method of addressing this charge has been supporting the investigation of seismic technical issues as they are identified by FEMA, the development and publication of technical design and construction guidance products, the dissemination of these products, and support of training and related outreach efforts.

In recent earthquake events, typical wood-frame residential structures were observed to have suffered more damage than had traditionally been thought, damage due primarily to their flexibility. This risk is magnified by the sheer numbers of these buildings that exist in moderate and high seismic regions in our country.

This residential seismic rating system was originally developed by the Applied Technology Council (ATC) for the City of Los Angeles using FEMA disaster funds following the 1994 Northridge earthquake. At a recent workshop on seismic rating systems, one of the recommendations was to update and expand that original ATC-50 assessment system for national use. FEMA supported the development of this expanded residential rating system (FEMA P-50) and its accompanying retrofit guidelines (FEMA P-50-1) to be applicable in all high seismic areas of the country. FEMA supported this work not to promote the use of a residential rating system, but to provide a tool that communities or other entities could then use to encourage the seismic retrofitting of residential structures, thereby reducing future earthquake losses.

FEMA wishes to express its gratitude to the Project Management Committee of Ronald T. Eguchi (Project Technical Director), Kelly E. Cobeen, Douglas C. Hohbach, Nicolas Luco, Charles Real, and Jonathan P. Stewart for their efforts in preparing this document. We also wish to thank the Project

Review Panel of Barry Welliver (Chair), Susan Dowty, Gary J. Ehrlich, Mark Legg, Philip Line, and James E. Russell, who provided expert review and guidance throughout the developmental effort. Thanks are also due to Surya Gunturi, Kate Stillwell, and Kamban Parasuraman, who conducted an independent analysis to develop damage ranges for each Seismic Performance Grade.

Federal Emergency Management Agency

# Preface

In September 2011 the Applied Technology Council (ATC), with funding from the Federal Emergency Management Agency (FEMA) under Task Order Contract HSFEHQ-08-D-0726, commenced the updating of the ATC-50 report, *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings* (ATC, 2002a), which had been written for use in Los Angeles, California. The project's purpose was to make the ATC-50 document nationally applicable and, at the same time, take advantage of web-based information and other technological developments that have occurred since 2002. The update effort was one of several projects in a task order series to develop written guidance for FEMA on the creation, update, and maintenance of seismic evaluation and rehabilitation documents for existing buildings.

The ATC-50 report was originally developed in 2002 (first printing) and expanded in 2007 (second printing) to include additional supporting documentation. The original project was prompted by high economic losses resulting from damage to single-family, wood-frame dwellings during the 1994 Northridge earthquake, and focused on the development and testing of standardized procedures for voluntary seismic evaluation and retrofit. In addition to the ATC-50 report, two additional documents were also prepared in the original project: (1) the ATC-50-1 report, *Seismic Rehabilitation Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (ATC, 2002b); and (2) the ATC-50-2 report, *Safer at Home in Earthquakes: A Proposed Earthquake Safety Program* (ATC, 2002c).

The current work involved a review and update of:

1. Information on the Simplified Seismic Assessment Form pertaining to the dwelling's structural and nonstructural systems and the site conditions, including the organization and completeness of all assessment items on the form, and the numerical scores for all penalties related to such assessment items.
2. Information on the Simplified Seismic Assessment Form pertaining to the dwelling's seismic hazard exposure, including the organization and completeness of all conditions on the form, and the numerical scores for all penalties related to such conditions. Furthermore, significant effort was made to replace the original paper-based, zip code hazard data with location-specific data available through online websites.

3. The procedures and data for calculating a Seismic Performance Grade in the Simplified Seismic Assessment Form, including the matrix of Performance Grades as a function of Structural Score and Seismic Hazard Score, and the ranges of expected damage for each grade.

In a separate related FEMA-funded project, ATC also updated the ATC-50-1 report for consistency with this FEMA P-50 document and the updated Simplified Seismic Assessment Form. That document is now available as FEMA P-50-1, *Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (FEMA, 2012).

ATC is indebted to the ATC Project Management Committee, which consisted of Ronald T. Eguchi (Project Technical Director), Kelly E. Cobeen, Douglas C. Hohbach, Nicolas Luco, Charles Real, and Jonathan P. Stewart, for their efforts in researching and preparing this report, and to the Project Review Panel, which consisted of Barry Welliver (Chair), Susan Dowty, Gary J. Ehrlich, Mark Legg, Philip Line, and James E. Russell, who provided expert review and guidance throughout the developmental effort. Surya Gunturi, Kate Stillwell, and Kamban Parasuraman served on the Stochastic Analysis Team, who conducted an independent analysis to develop damage ranges for each Seismic Performance Grade. Thomas R. McLane served as Project Manager, and Peter Mork provided report production services. The affiliations of these individuals are provided in the list of Project Participants.

Special recognition is given to the California Earthquake Authority (CEA), who provided funding for (1) the independent development of damage ranges for each Seismic Performance Grade, and (2) the incorporation of that information in this document. The input and guidance of CEA's Janiele Maffei and Shawna Ackerman are also highly appreciated.

ATC also gratefully acknowledges the input, support, and guidance provided by Michael Mahoney (FEMA Project Officer), Jennifer Lynette (FEMA Region IX), and John Gillengerten (FEMA Subject Matter Expert).

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