



# Seismic Retrofit Guidelines for 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.

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# 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. 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 retrofit guidelines document and a companion seismic assessment procedure were 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 seismic assessment system for national use. FEMA supported the development of the expanded residential rating system (FEMA P-50) and this accompanying retrofit guidelines document (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 Robert Bruce, the principal developer of this report, and the Project Review Panel of Kelly E. Cobeen, Susan Dowty, Ronald T. Eguchi, and Douglas C. Hohbach.

Federal Emergency Management Agency



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# 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-50-1 report, *Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (ATC, 2002), which had been written for use in Los Angeles, California. The project's purpose was to make the ATC-50-1 document nationally applicable and, at the same time, take advantage of technological developments, including code 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 retrofit documents for existing buildings.

The ATC-50-1 report was originally developed in 2002 (first printing) and modified in 2007 (second printing) to include updated contact information for important related resources. 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-50-1 report, two additional documents were also prepared in the original project: (1) the ATC-50 report, *Simplified Seismic of Detached Detached, Single-Family, Wood-Frame Dwellings*; and (2) the ATC-50-2 report, *Safer at Home in Earthquakes: A Proposed Earthquake Safety Program*.

In a separate recent related FEMA-funded project, ATC also updated the ATC-50 report to incorporate an expanded Simplified Seismic Assessment Form for national application. Evaluation of a dwelling using the Simplified Seismic Assessment Form enables an inspector to assign a Seismic Performance Grade for the dwelling and identify portions of the dwelling in need of retrofit. The updated document is now available as FEMA P-50, *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings* (FEMA, 2012).

This FEMA P-50-1 *Guidelines* document includes specific guidance for retrofitting a dwelling's seismic deficiencies (identified using the FEMA P-50 Simplified Seismic Assessment Form) and potentially improving its

Seismic Performance Grade. The updated *Guidelines* incorporate methods that utilize:

- the Cripple Wall and Anchorage Provisions of the *International Existing Building Code*;
- the *International Residential Code* Provisions
- prescriptive or engineered methods for the retrofit of nonstructural building elements; and
- engineered structural retrofit procedures.

ATC is indebted to Robert Bruce, who was the principal developer of these updated *Guidelines*, and to the Project Review Panel, which consisted of Kelly E. Cobeen, Susan Dowty, Ronald T. Eguchi, and Douglas C. Hohbach. Thomas R. McLane served as Project Manager, and Peter N. Mork and Bernadette Hadnagy provided report production services. The affiliations of these individuals are provided in the list of Project Participants.

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

Christopher Rojahn  
ATC Executive Director



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