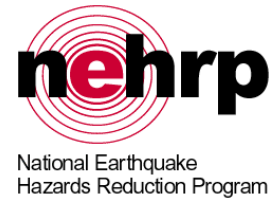


FEMA* REPORTS ON SEISMIC SAFETY OF BUILDINGS AND OTHER SEISMIC ISSUES



*Federal Emergency Management Agency

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FEMA REPORTS BY NUMBER:

[FEMA-74] Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. Third Edition. Prepared for FEMA by Wiss, Janney, Elstner Associates, Inc. Washington, DC, 1994. 131 pages.

This well-illustrated publication describes the sources of nonstructural earthquake damage and provides information on effective methods of reducing potential risks from such damage. Meant primarily for building owners, facilities managers, maintenance personnel, homeowners, store or office managers, business proprietors, organizational department heads, and others concerned with building safety and the continuation of business, this book assists in identifying potential hazards, and provides specific guidance with upgrade details that readers can do themselves. The publication contains diagrams and photographs, a glossary, and references, as well as an annotated bibliography for those who wish additional information. A nonstructural inventory form, a checklist of nonstructural earthquake hazards, and an explanation of nonstructural risk ratings are included as appendices.

[FEMA-83] Seismic Considerations for Communities at Risk. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1995. 114 pages. [Supersedes previous editions of **FEMA-83**].

This publication is a companion volume to the 1994 edition of **NEHRP Recommended Provisions for Seismic Regulations for New Buildings**. It is designed to provide interested individuals and community decision-makers with information for assessing seismic risk and making informed decisions about seismic safety in their communities and in determining what might be done to mitigate that risk. Included is information on the scope of earthquake risk in the U.S., the effects of earthquakes on buildings, how design can reduce earthquake effects, as well as the importance of seismic codes and the **NEHRP Provisions**. Also included are factors to consider when deciding whether and how to take action to reduce earthquake risk and suggestions for stimulating community action.

[FEMA-84] Societal Implications: Selected Readings. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1985. Approximately 160 pages.

This book of readings is meant to provide participants in the building process at the local, state, and regional levels with information on the most significant societal implications of adopting new or improved seismic regulations for new buildings. Included are papers on such topics as estimated impact of the **NEHRP Recommended Provisions** on design and construction costs, seismic hazards in various areas of the U.S., seismic safety codes, current seismic hazard mitigation practices and programs, and recent seismic safety policy research. Also contains an extensive bibliography, a list of information sources, and a glossary of terms.

[FEMA-88] Guidebook for Developing a School Earthquake Safety Program. Revised Edition. FEMA. Washington, DC, 1990. 52 pages.

This **Guidebook** is designed to assist the school community of principal, teachers, staff, parents, and students in developing an earthquake safety program for their school. Topics addressed include hazard identification, earthquake drills, immediate response and care requirements, communication, and post-earthquake shelter planning. Examples of planning forms are included.

[FEMA-99] Non-Technical Explanation of the 1994 NEHRP Recommended Provisions. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1995. 82 pages. [Supersedes previous editions of **FEMA-99**].

This publication serves as an introduction to the 1994 edition of the **NEHRP Recommended Provisions for Seismic Regulations for New Buildings**. It includes an explanation of the nature of ground motion generated by earthquakes, how such ground motion affects buildings, what techniques are used to design against earthquake forces, and how the **Provisions** translate this information into simple, uniform criteria and requirements to be followed by designers and builders.

[FEMA-140] Guide to Application of the 1991 NEHRP Recommended Provisions in Earthquake-Resistant Building Design. Prepared for FEMA by J.R. Harris and Company under agreements with the Building Seismic Safety Council. Washington, DC, 1995. Approximately 467 pages. [Supersedes previous editions of **FEMA-140**].

This publication is a companion publication and guide to the application of the **1991 NEHRP Recommended Provisions**. Applications are illustrated with examples that cover various building materials and systems, including structural steel, reinforced concrete, timber, and masonry, as well as nonstructural elements. The **Guide** also contains flow charts, which provide overviews of the processes for satisfying the **NEHRP Recommended Provisions**.

[FEMA-149] Seismic Considerations: Elementary and Secondary Schools. Revised edition. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1990. 102 pages.

This publication is a companion publication and guide to the application of the **NEHRP Recommended Provisions**.

[FEMA-150] Seismic Considerations: Health Care Facilities. Revised edition. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1990. 102 pages.

This publication is a companion publication and guide to the application of the **NEHRP Recommended Provisions**.

[FEMA-151] Seismic Considerations: Hotels and Motels. Revised edition. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1990. 106 pages.

This publication is a companion publication and guide to the application of the **NEHRP Recommended Provisions**.

[FEMA-152] Seismic Considerations: Apartment Buildings. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1988. 112 pages.

This publication is a companion publication and guide to the application of the **NEHRP Recommended Provisions**.

[FEMA-153] Seismic Considerations: Office Buildings. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1988. 110 pages.

This series of publications is devoted to the seismic safety of particular types of buildings with special occupancy and functional characteristics. These publications are intended to encourage owners, developers, designers, and regulatory officials to become aware of the particular seismic vulnerabilities of these buildings through the selective use of the **NEHRP Recommended Provisions**. References are included.

[FEMA-154] Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook. Second Edition. Prepared for FEMA by the Applied Technology Council. Redwood City, CA, 2002. Approximately 162 pages. [Supersedes **FEMA-154**, 1988].

This **Handbook** presents a method to quickly identify, inventory, and rank buildings posing risk of death, injury, or severe curtailment in use following an earthquake. The Rapid Visual Screening (RVS) procedure can be used by trained personnel to identify potentially hazardous buildings on the basis of a 15 to 30-minute exterior inspection, using a data collection form included in the **Handbook**. A significant difference in the second edition is the need for a higher level of technical engineering expertise on the part of the users. The structural scoring system has been revised, based on new information, and the **Handbook** has been shortened and focused to facilitate implementation. Building inspectors are the most likely group to implement an RVS, although this report is also intended for building officials, engineers, architects, building owners, emergency managers, and interested citizens.

[FEMA-155] Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation. Second Edition. Prepared for FEMA by the Applied Technology Council. Redwood City, CA, 2002. Approximately 118 pages. [Supersedes **FEMA-155**, 1988].

A companion document to **FEMA-154**, this **Supporting Documentation** contains the technical basis for the updated Rapid Visual Screening procedure, including a summary of results from the efforts to solicit user feedback, and a detailed description of the Basic Structural Hazard Score and the Score Modifier developmental effort.

[FEMA-156] Typical Costs for Seismic Rehabilitation of Existing Buildings: Volume 1: Summary. Second Edition. Prepared for FEMA by the Hart Consultant Group, Inc. Santa Monica, CA, 1994. Approximately 70 pages. [Supersedes **FEMA-156**, 1988].

This publication provides a methodology that enables users to estimate the costs of seismic rehabilitation projects at various locations in the United States. This edition is based on a sample of almost 2100 projects. The data were collected by use of a standard protocol, given a stringent quality control verification and a reliability rating, and then entered into a database that is available to practitioners. A sophisticated statistical methodology applied to this database yields cost estimates of increasing quality and reliability as more and more detailed information on the building inventory is used in the estimation process. Guidance is also provided to calculate a range of uncertainty associated with this process.

[FEMA-157] Typical Costs for Seismic Rehabilitation of Existing Buildings: Volume 2: Supporting Documentation. Second Edition. Prepared for FEMA by the Hart Consultant Group, Inc. Santa Monica, CA, 1995. Approximately 102 pages. [Supersedes **FEMA-157**, 1988].

A companion volume to **FEMA-156**, this **Supporting Documentation** contains an in-depth discussion of the approaches and methodology that were used in developing the second edition of **FEMA-156**.

[FEMA-159] Tremor Troop: Earthquakes: A Teacher's Packet for K-6. Revised Edition. Developed jointly by FEMA and the National Science Teachers Association (NSTA) under contract with FEMA. Washington, DC, 2000. Approximately 200 pages. Available online at <http://www.fema.gov/pdf/library/tremortroop.pdf>.

A revised edition of the 1988 version, this teacher's package for grades K-6 produced by the Federal Emergency Management Agency (FEMA) and the National Science Teachers Association (NSTA) provides ready-to-use hands-on activities for students and teachers explaining the science of earthquakes. This edition contains assessments throughout the units, matrices linking activities to the National Science Education Standards, and a new glossary. Divided into five units, the lessons covered include defining an earthquake, why and where earthquakes occur, physical results of earthquakes, measuring earthquakes, and earthquake safety and survival. Each of the first five units is divided into three levels: Level 1, for grades K-2; Level 2, for grades 3-4; and Level 3, for grades 5-6. At the end of each unit, masters ready to reproduce are provided for use in the classroom.

[FEMA-172] NEHRP Handbook of Techniques for the Seismic Rehabilitation of Existing Buildings. Prepared for FEMA by the Building Seismic Safety Council. Washington, DC, 1992. 197 pages.

Intended for engineers, this **Handbook** presents techniques for solving a variety of seismic rehabilitation problems for existing buildings. The **Handbook** identifies and describes seismic rehabilitation techniques for a broad spectrum of building types and building components (both structural and nonstructural). Techniques are illustrated with sketches, and the relative merits of the techniques are discussed. This publication is based on a preliminary version prepared by URS/John A. Blume and Associates, **Techniques for Seismically Rehabilitating Existing Buildings (FEMA-172, 1989)**.

[FEMA-173] Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Supporting Report. Prepared for FEMA by Building Systems Development, Inc. with Integrated Design Services and Claire B. Rubin. Washington, DC, 1989. 190 pages.

This **Supporting Report** includes additional information and commentary such as supporting documentation, annotated bibliographies, and reproductions of selected laws and ordinances that are presented in summary form in establishing programs and priorities for the **Seismic Rehabilitation of Buildings: Handbook (FEMA-174)**.

[FEMA-174] Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Handbook. Prepared for FEMA by Building Systems Development, Inc. with Integrated Design Services and Claire B. Rubin. Washington, DC, 1989. 122 pages.

This **Handbook**, together with **FEMA-173, Supporting Report**, provide the information needed to develop a seismic rehabilitation program, with particular reference to establishing priorities. The **Handbook** is intended to assist local jurisdictions in making informed decisions on rehabilitating seismically hazardous existing buildings by providing nationally applicable guidelines. It discusses the

pertinent issues that merit consideration, both technical and societal, and suggests a procedure whereby these issues can be resolved.

[FEMA-198] Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 1: Findings, Conclusions, and Recommendations. Prepared by Building Technology, Inc. Silver Spring, MD, 1990. 104 pages.

The intent of this document, together with **Volume 2 (FEMA-199)** and **Volume 3 (FEMA-216)**, is to identify and describe the existing and potential regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings in an earthquake. **Volume 1** includes a discussion of the methodology used for these documents, background information on financial incentives, as well as findings, conclusions and recommendations for use by decision makers at local, state, and national levels.

[FEMA-199] Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 2: State and Local Case Studies and Recommendations. Prepared for FEMA by Building Technology, Inc. Silver Spring, MD, 1990. 130 pages.

The intent of this document, together with **Volume 1 (FEMA-198)** and **Volume 3 (FEMA-216)**, is to identify and describe the existing and potential regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings in an earthquake. **Volume 2** includes detailed descriptions of the twenty case studies that were examined as part of the project.

[FEMA-216] Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 3: Applications Workshops, Prepared for FEMA by Building Technology, Inc. Silver Spring, MD, 1990. Approximately 200 pages.

The intent of this document, together with **Volume 1 (FEMA-198)** and **Volume 2 (FEMA-199)**, is to identify and describe the existing and potential regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings in an earthquake. **Volume 3** reports on workshops for the development of local agendas for action in seismic rehabilitation. It includes directions for convening additional workshops and teaching materials, which can be used in such workshops. This information is directed primarily to groups that are interested in planning for local seismic mitigation in existing buildings who wish to convene a workshop to initiate the process.

[FEMA-232] Home Builder's Guide to Seismic Resistant Construction. Prepared for FEMA by SOHA Engineers. Washington, DC, 1998. Approximately 80 pages. [Supersedes previous editions of **FEMA-232**].

The purpose of this **Guide** is to encourage homeowners and builders of one- and two-family residences to employ construction practices intended to provide resistance to damage from earthquakes. Well-illustrated with numerous diagrams and photographs, the **Guide** presents background information on how earthquake forces impact conventional residential construction and the principles of seismic resistance, as well as more detailed information on

architectural considerations; site selection; foundation and foundation details; floors; shear walls; and roofs. Also included are discussions of masonry and stone elements, such as chimneys and veneers. Tables present excerpts from the seismic requirements of the **Uniform Building Code (UBC)**, **Standard Building Code (SBC)**, the **National Building Code (NBC)** and the **Council of American Building Officials (CABO) One and Two Family Dwelling Code**. Also included are examples of typical floor plans for earthquake resistant one- and two-story homes and a home builders checklist.

[FEMA-237] Development of Guidelines for Seismic Rehabilitation of Buildings – Phase 1: Issues Identification and Resolution. Prepared for FEMA by the Applied Technology Council. Redwood City, CA, 1992. 150 pages.

This report was intended to assist in the preparation of **Guidelines for the Seismic Rehabilitation of Existing Buildings**. The report identifies and analyzes issues that might impact the preparation of the **Guidelines** and offers alternative as well as recommended solutions to facilitate their development and implementation. Also discussed are issues concerned with the scope, implementation, and format of the **Guidelines**, as well as coordination efforts, and legal, political, social, and economic aspects. In addition to issues concerning historic buildings, research and new technology, seismicity and mapping, engineering philosophy and goals are discussed. The report concludes with a presentation of issues concerned with the development of specific provisions for major structural and nonstructural elements.

[FEMA-241] Identification and Reduction of Nonstructural Earthquake Hazards in Schools. Prepared for FEMA by the Bay Area Regional Earthquake Preparedness Project (BAREPP) and the California Office of the State Architect, Structural Safety Section. [Washington, DC], 1993. 18 pages.

Adapted from **FEMA-74, Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide**, this publication is intended to help school administrators and engineers identify nonstructural hazards found in schools and to show how these hazards can be reduced. The report contains a checklist to assist in identifying nonstructural hazards, such as suspended ceilings, lights, windows, office equipment, computers, files, electrical and mechanical equipment, furnishings, partitions, and anything stored on shelves or hung on walls; that is, everything **but** columns, beams, floors, load bearing walls, and foundations. Following each nonstructural hazard, the publication lists either a brief solution or a numbered reference to a solution that follows the checklist. The solutions provide line drawings and specifications that illustrate how to restrain or anchor nonstructural elements to reduce their hazardousness. For more complicated hazards, notations indicate that an architect or engineer should be consulted (**A/E**) or if the item is a life safety hazard (**LS**).

[FEMA-253] Seismic Sleuths: Earthquakes: A Teacher's Package on Earthquakes for Grades 7-12. Developed jointly by FEMA and the American Geophysical Union (AGU) under contract with FEMA. Washington, DC, 1994. Approximately 375 pages. Available online at <http://www.fema.gov/pdf/library/seismic.pdf>.

This volume was prepared to provide middle and high school teachers with information about the causes and effects of earthquakes. Activity sheets for students and background material for teachers are provided in each of the volume's six units. The first unit is designed to assess students' knowledge about earthquakes and provides information about preparedness and emergency management. The second unit concentrates on the causes of earthquakes, including crustal stresses and the earth's structure. Lessons on geologic time and paleoseismology are featured. The unit also includes information about the effects of earthquakes, tsunamis, liquefaction, and landslides. The third unit focuses on seismic waves and the development of seismology and instruments used to measure an earthquake's magnitude. Worldwide seismicity is also discussed. The fourth unit is designed to explain the effects of earthquakes on buildings and earthquake resistant design techniques. The fifth unit discusses earthquake preparedness and various population's reactions to historical earthquakes. The final unit provides a variety of summing-up and assessment activities (essay topics, a quiz, and a disaster simulation), as well as an extensive list of additional resources.

[FEMA-254] Seismic Retrofit Incentive Programs: A Handbook for Local Governments. Prepared for FEMA by the Bay Area Regional Earthquake Preparedness Project (BAREPP) and the California Seismic Safety Commission. [Washington, DC], 1994. 133 pages. [Supersedes previous editions of **FEMA-254**].

Intended to assist local government officials in developing their own seismic retrofit incentive programs, this book summarizes several case studies which describe the steps that seven California cities have taken to promote and implement retrofitting in their own communities. The **Handbook** also includes sections on using zoning as an incentive to retrofit; local government finance options; a description of the Unreinforced Masonry Buildings (URM) law and of recent legislation; liability implications and considerations in the event of an earthquake; and a list of contacts whose names appear in the **Handbook**.

[FEMA-255] Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 1: A User's Manual. Prepared for FEMA by VSP Associates, Inc. Sacramento, CA, 1994. Approximately 158 pages.

This **User's Manual** and accompanying software present a second-generation cost-benefit model for the seismic rehabilitation of federal and other government buildings. Intended for facility managers, design professionals, and others involved in decision making, the cost/benefit methodology provides estimates of the benefits (avoided damages, avoided losses, and avoided casualties) of seismic rehabilitation, as well as estimates of the costs necessary to implement the rehabilitation. The methodology also generates detailed scenario estimates of damages, losses, and casualties. The **Manual** describes the computer hardware and software required to run the program. It also explains how to install the program, how to use Quattro Pro for Windows, and how to enter necessary data. A tutorial provides a fully worked example. Benefit/Cost analyses of eight federal buildings are included. (**Note:** Computer software to run the benefit/cost model is available on 3½" diskettes and can be used on IBM compatible personal computers with at least 386 CPU. The computer must also have Windows and Quattro Pro.)

[FEMA-256] Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 2: Supporting Documentation. Prepared for FEMA by VSP Associates, Inc. Sacramento, CA, 1994. Approximately 71 pages.

This **Supporting Documentation** contains background information for the **User's Manual**, including information on valuing public sector services, discount rates and multipliers, the dollar value of human life, and technical issues that affect benefit/cost analysis, such as seismic risk assessment and sensitivity analysis. (**Note:** Computer software to run the benefit/cost model is available on 3½" diskettes and can be used on IBM compatible personal computers with at least 386 CPU. The computer must also have Windows and Quattro Pro.)

[FEMA-266] Creating a Seismic Safety Advisory Board: A Guide to Earthquake Risk Management. Prepared for FEMA by the Seismic Safety Commission of California. Washington, DC, 1995. Approximately 84 pages.

The purpose of this **Guide** is to assist interested states, coalitions of states or confederations of local governments in creating, developing, and nurturing seismic safety advisory boards. The first part includes such chapters as *Why Create a Board?*; *Creating a Board*; *Selecting Advisory Board Members*; and *Operations: Getting to Work*. Chapters are also devoted to staffing and funding a board. Other chapters provide guidelines for strategic planning and developing a model seismic risk management program by which to measure progress. Appendices include: a model executive order; a model enabling legislation; an example of an interstate compact; an example of articles of incorporation; an example of corporate bylaws; model staff duty descriptions; model workshop design and roster; a list of existing seismic safety advisory boards, and a lexicon of terms.

[FEMA-274] NEHRP Commentary on the NEHRP Guidelines for the Seismic Rehabilitation of Buildings. Prepared with FEMA funding by the Applied Technology Council and the American Society for Civil Engineers for the Building Seismic Safety Council. Washington, DC, 1997. Approximately 400 pages. Available online at http://www.degenkolb.com/0_0_Misc/0_1_FEMADocuments/fema356/fema274pdf.html.

This publication is intended to provide commentary on the NEHRP guidelines for the seismic rehabilitation of buildings. It should be used in connection with **FEMA-356, Prestandard and Commentary for the Seismic Rehabilitation of Buildings**.

[FEMA-275] Planning for Seismic Rehabilitation: Societal Issues. Developed for the Building Seismic Safety Council by ROA (Robert Olson Associates, Inc.) with support of FEMA. Washington, DC, 1998. 102 pages.

This publication is intended to provide users of the NEHRP materials for the seismic rehabilitation of buildings with an understanding of the social and public policy issues that may accompany seismic rehabilitation, such as demographic, social and economic impacts; historic property restrictions; resident dislocations; and business interruptions. It also highlights the difficulties that may arise in implementing seismic rehabilitation recommendations. Designed primarily for local officials, private owners, and design professionals,

this guide presents a four-step decision process to assist in determining the necessity for rehabilitation. It includes an "escalation ladder" to assist in understanding the degree of conflict that might be generated and the implications when choosing particular strategies.

[FEMA-306] Evaluation of Earthquake-Damaged Concrete and Masonry Wall Buildings, Basic Procedures Manual. Prepared for the Partnership for Response and Recovery by the Applied Technology Council (ATC). Redwood City, CA, 1999. 270 pages. Available online at <http://www.conservatiotech.com/FEMA-Publications/FEMA-306-8.htm>.

This document provides practical criteria and guidance for evaluating earthquake damage to concrete and masonry wall buildings. Component Damage Classification Guides and Test and Investigation Guides are included. Detailed drawings accompany the text.

[FEMA-307] Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings, Technical Resources. Prepared for the Partnership for Response and Recovery by the Applied Technology Council (ATC). Redwood City, CA, 1999. 271 pages. Available online at <http://www.conservatiotech.com/FEMA-publications/FEMA-306-8.htm>.

This document provides background and theoretical information to be used in conjunction with the guidelines given in **FEMA-306**. Relevant analytical and experimental findings are included, as well as additional background information on the Component Damage Classification Guides.

[FEMA-308] The Repair of Earthquake-Damaged Concrete and Masonry Wall Buildings. Prepared for the Partnership for Response and Recovery by the Applied Technology Council (ATC). Redwood City, CA, 1999. 81 pages. Available online at <http://www.conservatiotech.com/FEMA-publications/FEMA-306-8.htm>.

Intended for design engineers, building owners, building officials, insurance adjusters, and government agencies, this document provides practical guidance for the repair and upgrading of earthquake-damaged concrete and masonry wall buildings. The publication contains sections on performance-based repair design, repair technologies, categories of repair, and nonstructural considerations. The last section includes repair guides, which provide outline specifications for typical repair procedures.

[FEMA-313] Promoting the Adoption and Enforcement of Seismic Building Codes: A Guidebook for State Earthquake and Mitigation Managers. Prepared for FEMA by the Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign under the direction of Robert Olshansky. Washington, DC, 1998. Approximately 200 pages.

This publication provides background information and education materials to help state officials promote the adoption and enforcement of state and local model building codes that contain the latest seismic provisions. Intended for state officials, especially earthquake program managers and hazard mitigation officers in the emergency management agencies of states and territories prone to earthquakes, this **Guidebook** includes the purpose, function, and effectiveness of building codes in general and seismic codes

in particular. It presents a step-by-step process for adopting state or local codes and for administering codes. Appendices provide information regarding: the history and principles of seismic design; a state-by-state listing of state codes and their code influences; seismic design practices in the United States; examples of state building codes; examples of state legislation; examples of local codes; services of three model code organizations in the United States; sources of further information; recommended readings; educational materials for making local presentations; sample press releases for the media; sample brochures aimed at local audiences; and a glossary of relevant terms.

[FEMA-315] Seismic Rehabilitation of Buildings: Strategic Plan 2005. Prepared for FEMA by the Earthquake Engineering Research Institute (EERI). Washington, DC, 1998. Approximately 115 pages. [Supersedes **FEMA-90**, 1998].

In addition to providing a discussion of the mission, history, and previous results of FEMA's Existing Building Program (EBP), this publication provides four objectives and 25 tasks to be carried out through the EBP in the years to come. The four objectives are to: 1) promote seismic rehabilitation and advance the implementation of previously developed materials; 2) monitor the use of and refine existing materials; 3) develop new seismic rehabilitation tools; and 4) consider new program directions for the EBP. Estimated costs for the next 10-15 years and guidelines for plan implementation are also included. The **Plan** broadens the EBP's original goal by emphasizing the protection of the nation's economy by limiting fatalities, life-threatening injuries, as well as property and economic losses from earthquakes by increasing the number of seismically resistant buildings in all areas of identified earthquake risk. This publication is expected to provide FEMA managers with guidance on the conduct of the EBP program in the years to come and takes the EBP to a new threshold: implementation through support of commitments to seismic rehabilitation in the United States.

[FEMA-318] Existing School Buildings: Incremental Seismic Retrofit Opportunities. Prepared for FEMA by Building Technology Inc. Silver Spring, MD, 1994. Approximately 60 pages.

This document provides technical guidance to school district facility managers for linking specific incremental seismic retrofit opportunities to specific maintenance and capital improvement projects. The linkages are based on logical affinities including technical fit, location of the work within the building, cost saving opportunities, and scheduling benefits. Five categories of maintenance/capital improvement projects are discussed including: 1) roofing maintenance and repair/re-roofing; 2) exterior walls maintenance and repair/window replacement; 3) fire and life safety improvements; 4) modernization/remodeling/new technology; and 5) underfloor and basement maintenance and repair. Tables relate 24 retrofit measures to building type in each of the five categories. Building types included are: 1) wood frame; 2) unreinforced masonry; 3) reinforced masonry; 4) steel frame; and 5) concrete frame. Each of the retrofit measures is discussed in detail. This report is based on the research project: *Seismic Mitigation Strategies for Existing School Buildings Which are Subject to Earthquake Risk throughout the United States*.

[FEMA-349] Action Plan for Performance Based Seismic Design. Prepared for the FEMA by the Earthquake Engineering Research Institute (EERI). Washington, DC, 2000. 66 pages.

This document, published as a "final draft" for informational purposes only, explores the steps required to successfully implement performance-based seismic design (PBSD). Topics discussed include the need for changes in current seismic design practice, the definition of performance-based design, and the products necessary for its effective adoption. Products include: 1) A Planning and Management Program; 2) Structural Performance Products (SPP); 3) Nonstructural Performance Products (NPP); 4) Risk Management Products (RMP); 5) PBSD Guidelines; 6) A Stakeholders' Guide. The costs involved in obtaining both a basic framework and full implementation for PBSD are outlined.

[FEMA-350] Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings. Prepared for SAC Joint Venture Partnership by Guidelines Development Committee. Washington, DC, 2000. Approximately 220 pages. Available online at <http://www.fema.gov/hazards/earthquakes/fema350.shtm>. Errata list online at <http://www.aisc.org/ContentManagement/ContentDisplay.cfm?ContentID=4216>

Intended primarily as a resource document for organizations engaged in the development of building codes and standards, this publication provides recommended guidelines for the design and construction of steel moment-frame buildings and alternative performance-based design criteria. It supplements the **NEHRP Recommended Provisions for Seismic Regulations for New Buildings and other Structures**. A series of pre-qualified connection details, as well as a detailed procedure for performance evaluation, is included.

[FEMA-351] Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings. Prepared for SAC Joint Venture Partnership by Guidelines Development Committee. Washington, DC, 2000. Approximately 255 pages. Available online at <http://www.fema.gov/hazards/earthquakes/fema351.shtm>.

This publication provides recommended methods for evaluation of the probable performance of existing steel moment-frame buildings in future earthquakes. It presents guidelines on how to retrofit these buildings for improved performance. Also included are a simplified procedure for estimating the probable post-earthquake repair costs and methods for developing building-specific vulnerability and loss functions for steel moment-frame buildings.

[FEMA-352] Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings. Prepared for SAC Joint Venture Partnership by Guidelines Development Committee. Washington, DC, 2000. Approximately 200 pages. Available online at <http://www.fema.gov/hazards/earthquakes/fema352.shtm>.

This report provides recommendations for performing postearthquake inspections to detect damage in steel moment-frame buildings following an earthquake, evaluating the damaged buildings' safety in a postearthquake environment, and repairing damaged buildings. Chapters cover inspection and classification of damage; preliminary postearthquake assessment; detailed postearthquake

evaluations; and postearthquake repair. The appendices include procedures for performance evaluation; sample placards that may be used to post buildings following preliminary postearthquake evaluations; and sample inspection forms that may be used to record damage detected in beam-column connections as part of a detailed postearthquake inspection program.

[FEMA-353] Recommended Specifications and Quality Assurance Guidelines for Steel-Moment Frame Construction for Seismic Applications. Prepared for SAC Joint Venture Partnership by Guidelines Development Committee. Washington, DC, 2000. Approximately 200 pages. Available online at <http://www.fema.gov/hazards/earthquakes/fema353.shtm>. Errata list online at <http://www.aisc.org/ContentManagement/ContentDisplay.cfm?ContentID=4215>.

This publication provides recommended specifications for the fabrication and erection of steel moment frames for seismic applications. The recommended design criteria contained in the three companion reports (**FEMA-350**, **FEMA-351**, and **FEMA-352**) are based on the material and workmanship standards contained in this document. The report has been prepared in two parts. Part one covers recommended specifications, including information on products; execution; welded joint details; fabrication details; quality control; and quality assurance. Part two outlines quality assurance guidelines; contractor qualifications and quality tasks; quality assurance agency qualifications and quality assurance tasks; and recommended methods for determining whether structural steel materials, welded joints, and bolted joints meet the applicable standards.

[FEMA-354] A Policy Guide to Steel Moment-Frame Construction. Prepared for SAC Joint Venture Partnership by Guidelines Development Committee. Washington, DC, 2000. Approximately 27 pages. Available online at <http://www.fema.gov/hazards/earthquakes/fema354.shtm>.

Written for building owners, local community officials, and other non-technical audiences, this document addresses the social, economic, and political issues related to the earthquake performance of steel moment-frame buildings. Also included is a discussion of the relative costs and benefits of implementing the design criteria recommended in **FEMA-350-FEMA-353**.

[FEMA-355] Seismic Design Criteria for Steel Moment-Frame Structures. CD-ROM. Prepared for FEMA by the SAC Joint Venture. Washington, DC, 2001.

This CD-ROM contains a library of technical reports on the seismic design criteria, evaluation, repair, and specifications of steel moment-frame buildings. The reports are in PDF format. Produced by the SAC Joint Venture and FEMA as part of the *Program to Reduce the Earthquake Hazards of Steel Moment-Frame Structures*, the first four reports are primarily intended as resource documents for organizations engaged in the development of building codes and standards for regulation of the design, construction, repair and upgrading of steel moment-frame structures that may be subject to the effects of earthquakes: **Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings (FEMA-350)**; **Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel**

Moment-Frame Buildings (FEMA-351); **Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings (FEMA-352)**; and **Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications (FEMA-353)**. Additionally, the CD-ROM contains six state of the art reports prepared in parallel with these resource documents (**FEMA-355 A-F**). The state of the art reports provide detailed explanations of the basis for the design criteria and evaluation recommendations for base metals, welding, systems performance, connection performance, and past and predicted performance included in the resource reports. Also included is **A Policy Guide to Steel Moment Frame Construction (FEMA-354)**, prepared for building owners, local community officials and other non-technical audiences who need to understand this issue. This guide discusses the social, economic, and political issues related to the earthquake performance of steel moment-frame buildings, as well as the relative costs and benefits of implementing the recommended criteria.

[FEMA-356] Prestandard and Commentary for the Seismic Rehabilitation of Buildings. Prepared by the American Society of Civil Engineers (ASCE). Reston, VA, 2000. Approximately 481 pages. [Supersedes **NEHRP Guidelines for the Seismic Rehabilitation of Buildings (FEMA-273)**]. Available online at http://www.degenkolb.com/0_0_Misc/0_1_FEMADocuments/fema356/ps-fema356.html.

This publication supersedes **NEHRP Guidelines for the Seismic Rehabilitation of Buildings (FEMA-273)** and related **NEHRP Commentary (FEMA-274)**, and converts these publications into mandatory prestandard language. This prestandard is intended to serve as a nationally applicable tool for design professionals, code officials, and building owners undertaking the seismic rehabilitation of existing buildings. The publication contains two parts: **Provisions**, which include technical requirements for seismic rehabilitation; and **Commentary**, which explains the **Provisions**. Commentary for a given section immediately follows the pertinent section. Chapters include: requirements; analysis procedures; foundations and geologic site hazards; steel; concrete; masonry; wood and light metal framing; seismic isolation and energy dissipation; simplified rehabilitation; architectural, mechanical, and electrical components; and use of this **Standard** for risk mitigation programs.

[FEMA-357] Global Topics Report on the Prestandard and Commentary for the Seismic Rehabilitation of Buildings. Prepared by the American Society of Civil Engineers (ASCE). Reston, VA, 2000. Approximately 443 pages. Available online at http://www.degenkolb.com/0_0_Misc/0_1_FEMADocuments/fema356/gtfema357.html.

This report chronicles the development process as the **NEHRP Guidelines for the Seismic Rehabilitation of Buildings (FEMA-273)** evolved into **Prestandard and Commentary for the Seismic Rehabilitation of Buildings (FEMA-356)** by providing a narrative discussion and permanent record of the technical changes made to the original **Guidelines (FEMA-273)**. Also included is a brief discussion of new concepts introduced to the engineering profession in the original **Guidelines** and **Commentary (FEMA-274)**.

[FEMA-366] HAZUS 99: Estimated Annualized Earthquake Losses for the United States. Prepared for FEMA by the National Institute of Building Sciences (NIBS) with Durham Technologies, Inc. Washington, DC, 2001. 33 pages. Available online at http://www.fema.gov/hausus/dl_eqpub.shtm.

Intended for policy makers, practitioners, and researchers in the public and private sectors who have roles in assessing risk and responding to natural disasters, this study is based on loss estimates generated by Hazards U.S. (HAZUS). HAZUS is a Geographic Information System (GIS)-based earthquake loss estimation tool, developed by the Federal Emergency Management Agency (FEMA) in cooperation with the National Institute of Building Sciences (NIBS). The report summarizes ways to identify earthquake risk and describes the procedures used to develop the economic loss estimates. Through a series of maps and tables, the actual loss estimates are presented at the county, metropolitan, and state levels. The appendices include a glossary, an overview of HAZUS, and probabilistic hazard data.

[FEMA-368] NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, 2000 Edition. Part 1: Provisions. Prepared for FEMA by the Building Seismic Safety Council (BSSC). Washington, DC, 2001. 392 pages. Available online at <http://www.bssconline.org/pubs/downloads.html>. Seismic design maps from the 1997 edition can be ordered separately from FEMA and used with the 2000 edition. These maps are also available on CD-ROM (Seismic Design Parameters) and can be purchased from the BSSC at <http://www.bssconline.org/pubs/seismic.html>.

The 2000 edition of the NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures is the sixth edition of this document, and like the 1985, 1988, 1991, 1994, and 1997 editions that preceded it, has the consensus approval of the Building Seismic Safety Council membership. These Provisions present criteria for the design and construction of new buildings, additions and alterations to existing buildings, and nonbuilding structures, such as vessels, silos, piers, hydraulic structures, chimneys, and towers to enable them to resist the effects of earthquake ground motions. The purpose of the Provisions is to: 1) provide minimum seismic design criteria for structures, appropriate to their function and use, to protect the health, safety, and welfare of the general public by minimizing the earthquake-related risk to life; and 2) to improve the capability of essential facilities and structures containing substantial quantities of hazardous materials to function during and after design earthquakes.

In contrast with the 1997 **Provisions**, this update does not make significant changes to the hazard maps or design procedures. Rather, the nearly 170 changes consist mostly of new material in select areas intended to keep the document at the cutting edge of seismic design practices, such as new material on: anchorage to concrete; pushover design; glass in glazed curtain walls, glazed storefronts, and glazed partitions; simplified design procedures; a comprehensive procedure for the design of structures with energy dissipating devices; and a comprehensive treatment of design of steel moment frame structures based on the

research results of a FEMA-funded project started after the 1994 Northridge earthquake. Since no changes have been made to the 1997 hazard maps, they can be used with the 2000 edition. Please note that the previous (1997) editions of the **NEHRP Provisions and Commentary** are available as **FEMA-302** and **303**, respectively.

[FEMA-369] NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, 2000 Edition. Part 2: Commentary. Prepared for FEMA by the Building Seismic Safety Council (BSSC). Washington, DC, 2001. 458 pages. Available online at <http://www.bssconline.org/pubs/downloads.html>.

The **Commentary** provides general requirements, background information, and explanations for applying the analysis and design criteria in the **Provisions (FEMA-368)**, similar to what might be incorporated in a code as administrative regulations. Please note that the previous (1997) editions of the **NEHRP Provisions and Commentary** are available as **FEMA-302** and **303**, respectively.

[FEMA-412] Installing Seismic Restraints for Mechanical Equipment. Developed by the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) under a cooperative agreement between FEMA and the American Society of Civil Engineers (ASCE). [Washington, DC], 2002. 161 pages.

This guide is intended to show equipment installers how to attach mechanical equipment to a building to minimize earthquake damage. Many examples using anchoring and seismic restraint devices are included. The guide begins with a section that lists various types of equipment and includes a chart that identifies types of equipment, the recommended configuration for restraint, and the type of attachment needed. Equipment that is covered includes: air compressors, air conditioning units and heat pumps; air handling units; air separators; boilers, furnaces, humidifiers, and water heaters; chillers; coils and heat exchangers; condensers and condensing units; cooling towers, evaporative coolers, and fluid coolers; fans; heaters; pumps; tanks and gas cylinders; VAV boxes, duct silencers, and fan-coil units. The second section provides examples of attachment types with instructions for installing equipment in different configurations (rigid floor-mounted attachment/pad-mounted attachment; roof-mounted attachment; suspended attachment; vibration-isolated/floor-mounted attachment; and wall-mounted attachment). The third section provides examples of anchors, showing various types of anchors used to connect equipment to a building (general; cast-in-place anchors; lag bolts; masonry and drywall anchors; steel bolt connections; welding; and anchor sizes for equipment less than 400 pounds). The fourth section presents special cases, including housekeeping pads, cable assemblies, supports for control panels, and residential equipment. Step-by-step instructions are given for each type of equipment, the method for installing the equipment, and the attachment type needed. Special precautions are indicated. The guide does not cover non-building structural framing required to elevate equipment above the floor. This publication is well illustrated with diagrams and photographs. A glossary and index are also included.

ALPHABETICAL LIST OF PUBLICATIONS

TITLES	FEMA REPORT NUMBER
Action Plan for Performance Based Seismic Design	FEMA 349
Creating a Seismic Safety Advisory Board: A Guide to Earthquake Risk Management	FEMA 266
Development of Guidelines for Seismic Rehabilitation of Buildings – Phase 1: Issues Identification and Resolution	FEMA 237
Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Handbook	FEMA 174
Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Supporting Report	FEMA 173
Evaluation of Earthquake-Damaged Concrete and Masonry Wall Buildings, Basic Procedures Manual	FEMA 306
Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings, Technical Resources	FEMA 307
Existing School Buildings: Incremental Seismic Retrofit Opportunities	FEMA 318
Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 1: Findings, Conclusions, and Recommendations	FEMA 198
Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 2: State and Local Case Studies and Recommendations	FEMA 199
Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 3: Applications Workshops	FEMA 216
Global Topics Report on the Prestandard and Commentary for the Seismic Rehabilitation of Buildings	FEMA 357
Guide to Application of the 1991 NEHRP Recommended Provisions in Earthquake-Resistant Building Design	FEMA 140
Guidebook for Developing a School Earthquake Safety Program	FEMA 88
HAZUS 99: Estimated Annualized Earthquake Losses for the United States	FEMA 366
Home Builder's Guide to Seismic Resistant Construction	FEMA 232
Identification and Reduction of Nonstructural Earthquake Hazards in Schools	FEMA 241
Installing Seismic Restraints for Mechanical Equipment	FEMA 412
NEHRP Commentary on the NEHRP Guidelines for the Seismic Rehabilitation of Buildings	FEMA 274
NEHRP Handbook of Techniques for the Seismic Rehabilitation of Existing Buildings	FEMA 172
NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, 2000 Edition. Part 1: Provisions	FEMA 368
NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, 2000 Edition. Part 2: Commentary	FEMA 369
Non-Technical Explanation of the 1994 NEHRP Recommended Provisions	FEMA 99
Planning for Seismic Rehabilitation: Societal Issues	FEMA 275
Policy Guide to Steel Moment-Frame Construction	FEMA 354
Prestandard and Commentary for the Seismic Rehabilitation of Buildings	FEMA 356
Promoting the Adoption and Enforcement of Seismic Building codes: A Guidebook for State Earthquake and Mitigation Managers	FEMA 313
Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook, 2nd Edition	FEMA 154
Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation, 2nd Edition	FEMA 155
Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings	FEMA 352
Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings	FEMA 350
Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings	FEMA 351
Recommended Specifications and Quality Assurance Guidelines for Steel-Moment Frame Construction for Seismic Applications	FEMA 353
Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide, 3rd Edition	FEMA 74
Repair of Earthquake-Damaged Concrete and Masonry Wall Buildings	FEMA 308
Seismic Considerations: Apartment Buildings	FEMA 152
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Seismic Considerations: Office Buildings	FEMA 153
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Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 1: A User's Manual	FEMA 255
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Typical Costs for Seismic Rehabilitation of Existing Buildings: Volume 1: Summary, Second Edition	FEMA 156
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These FEMA publications concerning Seismic Safety of Buildings and other Seismic Issues can be obtained free from the FEMA Distribution Center, P.O. Box 2012, 8241-A Sandy Court, Jessup, MD 20794-2012. To order, call 1-800-480-2520; or fax: 301-362-5335.

Multidisciplinary Center for Earthquake Engineering Research (MCEER) Information Service, State University of New York at Buffalo, 304 Capen Hall, c/o Science and Engineering Library, Buffalo, NY 14260-2200. Telephone: 716-645-3377; Fax: 716-645-3379; E-Mail: mceeris@buffalo.edu; MCEER Web site: <http://mceer.buffalo.edu>.

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