Catalog of FEMA Building Science Resources

FEMA P-787 / Sixth Edition / January 2022

FEMA

These publications have been developed by the Building Science Branch and Earthquake and Wind Programs Branch of the Federal Emergency Management Agency's (FEMA's) Federal Insurance and Mitigation Administration (FIMA).

Please visit https://www.fema.gov/emergency-managers/risk-management/building-science to view or download publications.

ORDERING INFORMATION

To order publications from this catalog, please call 1-800-480-2520 or fax 240-699-0525 (Monday – Friday 8:00 a.m. – 5:00 p.m., ET) or send an email to FEMAPubs@gpo.gov. Please provide the title, item number, and quantity of each publication, along with your name, address, zip code, and daytime telephone number.

Catalog of FEMA Building Science Resources

FEMA P-736 / January 2022

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Contents

ABOUT THIS CATALOG

FEMA's Building Science and Earthquake and Wind Programs Branches have compiled this catalog of available FEMA publications for natural hazards. The publication descriptions are first organized by primary hazard – earthquake, flood, high wind, hurricane, multi-hazard, other hazards, Mitigation Assessment Team (MAT) program, and building codes resources – and then by stakeholder groups – individuals and homeowners, teachers and kids, private sector and small business, community planning and policy, building professionals and engineers (contractors, builders, engineers, and architects), and private sector and small business – and are further arranged by subject areas and ordered alphabetically.

See the inside cover of this document for ordering information.

FEMA BUILDING SCIENCE BRANCH AND EARTHQUAKE AND WIND PROGRAMS BRANCH

The Building Science and Earthquake and Wind Programs Branches lead FEMA's efforts to provide communities across the United States with technical guidance to reduce loss of life and property damage from earthquakes, floods, hurricanes, tornadoes, and other natural hazards. The branches reside in the Risk Management Directorate of FEMA's Federal Insurance Mitigation Administration (FIMA) and are staffed by highly skilled national experts on building codes, disaster-resistant construction techniques, and post-disaster rebuilding strategies. The Branches' activities include deploying MATs to conduct post-disaster engineering investigations for both man-made and natural hazard events. They take a lead role in developing publications, guidance materials, tools, technical bulletins, and recovery advisories that incorporate the most up-to-date building codes, seismic design standards, floodproofing requirements, and wind design requirements for new construction and the repair and retrofitting of existing buildings.

In addition to providing technical support for the development and adoption of model building codes and standards, the Building Science Branch and Earthquake and Wind Programs Branch provide technical support for the National Earthquake Hazards Reduction Program (NEHRP), the National Flood Insurance Program (NFIP) for public and private sector stakeholders, and the National Windstorm Impact Reduction Program (NWIRP), and pursues outreach strategies for communicating Building Science issues.

Visit FEMA Building Science at: https://www.fema.gov/emergency-managers/risk-management/building-science.

To subscribe to FEMA Building Science e-mail updates, visit https://service.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic_id=USDHSFEMA_193.

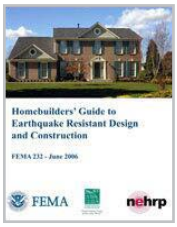
Visit FEMA Earthquake and Wind Programs at: https://www.fema.gov/earthquake.

For more information about FEMA Building Science and Earthquake and Wind Programs Branch publications, please contact the FEMA Building Science Helpline by email at https://www.fema.gov/emergency-managers/risk-management/earthquake or by phone at (866) 927-2104 (toll free).

EARTHQUAKE PUBLICATIONS

INDIVIDUALS AND HOMEOWNERS

PROTECTING PROPERTY

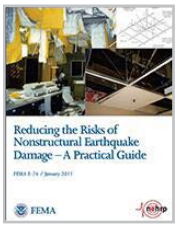


FEMA 232 – *Homebuilders' Guide to Earthquake Resistant Design and Construction* (June 2006)

This illustrated guide presents seismic design and construction guidance for one- and two- family light frame residential structures and provides information supplemental to the 2003 edition of the "International Residential Code." The guide presents background information on the principles of seismic resistance and how earthquake forces impact conventional residential construction and more detailed information on architectural considerations (site selection, foundations and foundation details, floors, shear walls, and roofs). Also included are discussions of masonry and stone elements, examples of typical floor plans for earthquake-resistant one- and two-story homes, excerpts of seismic requirements from building codes, and checklists for homebuilders. The guide also presents a series of "above-code recommendations" that provide low-cost measures to increase the performance of the building and help keep it functional after an earthquake.

FEMA B-526 – *Earthquake Safety Checklist* (November 2017)

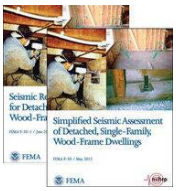
This quick reference guide helps individuals and families prepare for an earthquake and prevent earthquake related damage to their homes. The easy to read brochure features instructions on conducting earthquake drills and "hazard hunts." Also included are a checklist of disaster supplies, tips on what to do during and after an earthquake, and additional resources. Available in English and Spanish in print and multiple languages online.



FEMA E-74 – *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide* (Fourth Edition, December 2012)

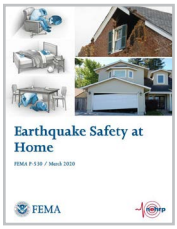
This fourth edition of FEMA 74 describes the sources of nonstructural earthquake damage and effective methods of reducing potential risks associated with such damage. It assists in identifying potential hazards and provides specific guidance on upgrades.

EARTHQUAKE PUBLICATIONS



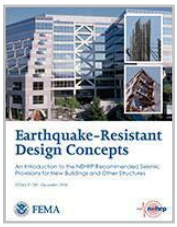
FEMA P-50 and FEMA P-50-1 – *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings and Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame* (May-June 2012)

FEMA P-50 explains how to use the Simplified Seismic Assessment Form to calculate a Seismic Performance Grade for a detached, single-family, wood- frame home. The grade is based on a Structural Score and Seismic Hazard Score, which are derived using location- specific data available through online websites. The companion publication FEMA P-50-1 describes low-cost seismic retrofitting techniques that can be used to address deficiencies identified on the Simplified Seismic Assessment Form and shows how implementing those techniques could improve a home's grade. These publications provide a tool that communities can use to encourage the seismic retrofitting of residential structures to reduce future earthquake losses.



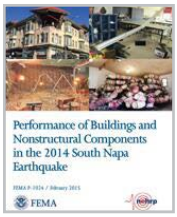
FEMA P-530 – *Earthquake Safety at Home* (March 2020)

This Guide will show you why you should care about earthquakes wherever you live, and how you can Prepare, Protect, Survive, Respond, Recover and Repair. It will familiarize you with familiar why and where earthquakes might occur and discuss steps to take to adequately prepare and protect ourselves, our families, and our belongings. These steps are wide ranging and include: developing family response plans, assembling earthquake disaster supplies, securing heavy objects and furniture, retrofitting your home, and more. During and immediately after an earthquake, guidelines for survival will help keep your family safe.



FEMA P-749 – *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (December 2010)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750) in particular. The NEHRP Recommended Seismic Provisions and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community.



FEMA P-1024 – *Performance of Buildings and Nonstructural Components in the 2014 South Napa Earthquake* (February 2015)

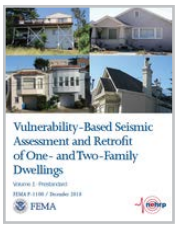
On August 24, 2014, a magnitude-6.0 earthquake occurred in Napa, California. In response to this earthquake, the Special Projects Task of the National Earthquake Technical Assistance Program (NETAP) was used to fund an investigation. The work described in P-1024 was focused on documenting the observed performance of buildings and nonstructural components in order to lead into future improvements in future building codes, and to do so within six months.

FEMA P-1024-RA1 – *Repair of Earthquake-Damaged Masonry Fireplace Chimneys* (January 2015)

Recovery Advisory 1 (RA1) is Appendix A of the FEMA P-1024 report. RA1 recommends best practices for reconstruction of earthquake-damaged masonry chimneys in one-and two-family dwellings to minimize risk of damage in future earthquakes.

FEMA P-1024-RA2 – *Earthquake Strengthening of Cripple Walls in Wood-Frame Dwelling* (April 2015)

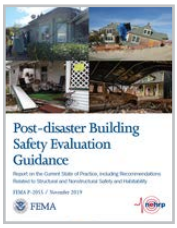
Recovery Advisory 2 (RA2) is Appendix B of the FEMA P-1024 report. RA2 addresses measures to mitigate cripple wall vulnerabilities before an earthquake occurs and provides information on how and when to use the accompanying FEMA Plan Set.



FEMA P-1100 – *Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings* (December 2018)

Improved seismic design and seismic retrofitting of vulnerable configurations will increase the probability that homes are available to provide shelter immediately following moderate to large seismic events. The purpose of this prestandard is to provide a methodology to identify and retrofit specific known vulnerabilities in wood light-frame dwellings. Development of the assessment and retrofit provisions has included use of the best available seismic numerical modeling tools and engineering practices to assist in development of assessment methods and to identify retrofit criteria to best achieve targeted performance objectives. Use of the provisions is anticipated to improve earthquake performance but it is not intended to prevent earthquake damage.

EARTHQUAKE PUBLICATIONS



FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

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FEMA V-528 – *Earthquake Home Hazard Hunt Poster* (September 2014)

This poster provides visuals and descriptions so that homeowners can identify and fix at-risk areas of their homes to reduce future earthquake damage and disruption.

What to Do Before, During, and After an Earthquake Fact Sheet (July 2017)

This fact sheet provides an overview of many important things we can do before, during, and after an earthquake to protect ourselves, our homes, and our families.

EMERGENCY PREPAREDNESS

FEMA B-526 – *Earthquake Safety Checklist* (November 2017)

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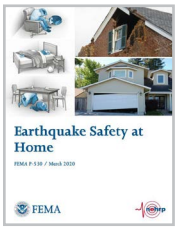

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FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (August 2017)

This guide provides up-to-date, authoritative information, and guidance that schools can use to develop a comprehensive strategy for addressing natural hazards. It is intended to be used by administrators, facilities managers, emergency managers, emergency planning committees, and teachers and staff at K through 12 schools. It can also be valuable for state officials, district administrators, school boards, teacher union leaders, and others that play a role in providing safe and disaster-resistant schools for all. Parents, caregivers, and students can also use this Guide to learn about ways to advocate for safe schools in their communities.

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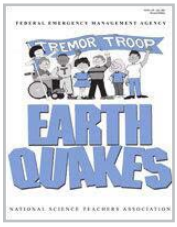
EARTHQUAKE PUBLICATIONS

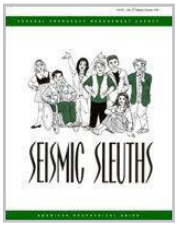
TEACHERS AND KIDS

CURRICULA AND ACTIVITIES



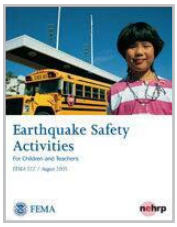
FEMA 159 – *Tremor Troop: Earthquakes— A Teacher's Package for K–6* (July 2002)

This teacher's package for grades K-6 provides ready-to-use, hands-on activities for students and teachers on the science of earthquakes and earthquake safety. This edition contains assessments throughout the units, matrices linking activities to the National Science Education Standards, and a new glossary. Four of the five units are divided into levels by grades: Level 1, for grades K-2; Level 2, for grades 3-4; and Level 3, for grades 5-6. The lessons introduce how earthquakes are defined, why and where earthquakes occur, the physical results of earthquakes, and how earthquakes are measured. The final unit addresses earthquake safety and survival and includes activities for students in all grades K-6. At the end of each unit, ready-to-reproduce masters are provided for classroom use.



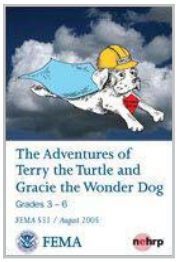
FEMA 253 – *Seismic Sleuths: A Teacher's Package for Grades 7–12* (October 1995)

This package provides middle-school and high-school teachers with information about the causes and effects of earthquakes. Activity sheets for students and background materials for teachers are provided in each of the volume's six units. The units assess students' knowledge of earthquakes; provide information on preparedness and emergency management; discuss the causes of earthquakes and their effects; present information on seismic waves and the development of seismology and instruments used to measure an earthquake's magnitude; explain the effects of earthquakes on buildings and earthquake-resistant design techniques; and discuss earthquake preparedness and the reactions of different populations to historical earthquakes. The last unit provides a variety of summary and assessment activities and a list of additional resources.



FEMA 527 – *Earthquake Safety Activities for Children and Teachers* (August 2005)

This publication provides elementary-school teachers with ready-to-use, hands-on activities that explain what happens during an earthquake, how to prepare for earthquake shaking, and how to stay safe during and after an earthquake. Included are a variety of handouts for students, including maps, songs, "hazard hunt" worksheets, and earthquake safety checklists.



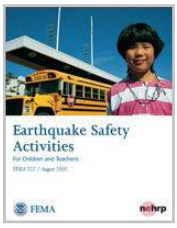
FEMA 531 – *The Adventures of Terry the Turtle and Gracie the Wonder Dog, Grades 3–6* (August 2005)

This storybook for children in grades 3-6 relates the adventures of the safety-conscious mayor of Shakeyville (Terry the Turtle) and a team of safety volunteers who meet with students at the local elementary school to teach them about earthquake safety. The students discover the importance of earthquake safety and preparedness. Included are suggestions for creating a disaster kit, illustrations of what to do if an earthquake happens (Drop, Cover, and Hold), and a list of resources.

FEMA Earthquake School Hazard Hunt - Video Game (September 2013)

The game engages young children to learn about earthquake hazard mitigation. Presented in the form of a school hazard hunt, players will be transported into an animated school in which they will be asked to choose a character, pick their desired room, and identify hazard within the room for tickets. Due to the target audience's age group, the players will be asked to identify the hazard and then identify which tools can be used to mitigate the hazard. By being shown how to mitigate hazards visually, it is believed that they are more likely to retain the information and understand complicated concepts. If engaged properly, students will learn tips and tricks about how to prepare for an earthquake while at school. The goal is to show children that if properly prepared, damages caused by earthquakes can be lessened or avoided.

SCHOOL EMERGENCY PREPAREDNESS



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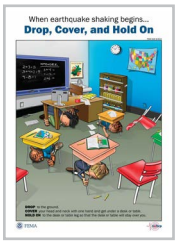

FEMA 529 – *Drop, Cover, and Hold On Poster* (September 2014)

This poster is intended for classroom use and updates a previous edition. The poster depicts a teacher and students in a classroom responding appropriately to the first sign of an earthquake (Drop, Cover, and Hold On).

EARTHQUAKE PUBLICATIONS

FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (August 2017)

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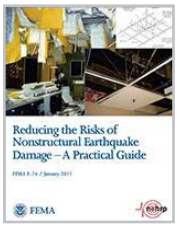
PRIVATE SECTOR AND SMALL BUSINESS



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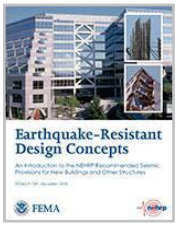

FEMA P-749 – *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (December 2010)

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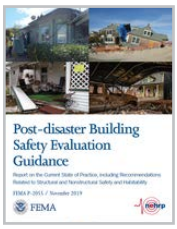
FEMA P-811 – *Earthquake Publications for Businesses* (QuakeSmart Toolkit) (September 2011)

Developed by FEMA for NEHRP, QuakeSmart is an initiative to help businesses in seismically at-risk communities start and maintain earthquake mitigation efforts. The QuakeSmart Toolkit provides actionable and scalable basic guidance and tools to the private sector about the importance of earthquake mitigation and the simple things that businesses can do to reduce the potential for earthquake damages, injuries, and financial losses. The toolkit walks you through a three-step process: 1) identify your risk, 2) make a plan, and 3) take action. This information was specifically developed to encourage businesses to incorporate earthquake mitigation into their decision making and planning processes to enhance their all-hazards resilience.



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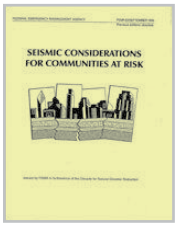
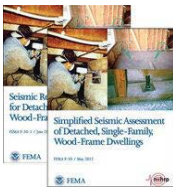
COMMUNITY PLANNING AND POLICY



FEMA 83 – *Seismic Considerations for Communities at Risk* (September 1995)

This publication provides individuals and community decision-makers with information they can use to assess seismic risk, make informed decisions about seismic safety in their communities, and determine what can be done to mitigate risk. The publication includes information on the scope of earthquake risk in the United States, the effects of earthquakes on buildings, how design can reduce earthquake effects, and the importance of seismic codes and the *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (FEMA P-750). Also included are factors to consider when deciding whether and how to take action to reduce earthquake risk and suggestions for stimulating community action.

EARTHQUAKE PUBLICATIONS



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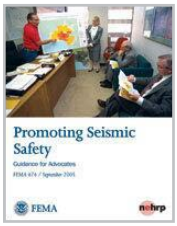
FEMA P-366 – *Hazus® Estimated Annualized Earthquake Losses for the United States* (April 2017)

Policies and practices associated with minimization of earthquake impacts in the United States have been shaped by knowledge of the earthquake hazard, which focuses on the location and type of faulting and ground failure, and the distribution of strong ground motion or shaking.

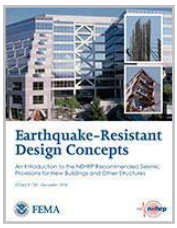
While hazard maps contribute to understanding earthquakes, there is increasing recognition among policy makers, researchers and practitioners of the need to analyze and map the earthquake risk in the United States. As urban development continues in earthquake-prone regions there is growing concern about the exposure of buildings, lifelines (e.g., utilities and transportation systems), and people to the potential effects of destructive earthquakes.

Earthquake risk analysis begins with hazard identification, but goes beyond that to investigate the potential consequences to people and property, including buildings, lifelines, and the environment.



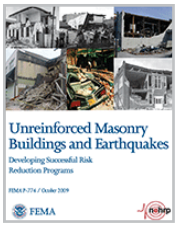
FEMA P-474 – *Promoting Seismic Safety: Guidance for Advocates* (September 2005)

This booklet offers research-based advice to assist seismic safety advocates in presenting risk reduction information and ideas. Part One is a guidance document for advocates. Part Two is a set of background papers developed by the authors as part of the project.



FEMA P-749 – *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (December 2010)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750) in particular. The NEHRP Recommended Seismic Provisions and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community.



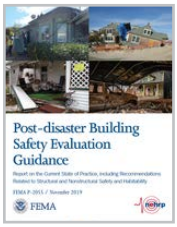
FEMA P-774 – *Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs* (October 2009)

This publication provides guidance on reducing the risks faced by those who own, occupy, or use unreinforced masonry (URM) buildings in seismically active areas. Among structures currently in use in U.S. communities, URM buildings are typically the most vulnerable to earthquake damage and the type of construction that is most commonly singled out for voluntary and mandatory seismic risk reduction programs. The publication includes illustrations and photographs of URM buildings and describes their seismic vulnerabilities. It discusses policy and regulatory issues that often must be considered in efforts to reduce URM risks, such as retrofit costs, the economic viability of older buildings, numbers of occupants and types of use, and historic or architectural values. Rather than prescribing a rigid sequence of steps for URM risk reduction, FEMA P-774 documents a wide variety of successful approaches that have been developed across the United States.

FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (August 2017)

This guide provides up-to-date, authoritative information, and guidance that schools can use to develop a comprehensive strategy for addressing natural hazards. It is intended to be used by administrators, facilities managers, emergency managers, emergency planning committees, and teachers and staff at K through 12 schools. It can also be valuable for state officials, district administrators, school boards, teacher union leaders, and others that play a role in providing safe and disaster-resistant schools for all. Parents, caregivers, and students can also use this Guide to learn about ways to advocate for safe schools in their communities.

EARTHQUAKE PUBLICATIONS



FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

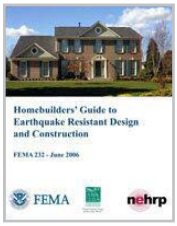
This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

Seismic Building Code Provisions for New Buildings to Create Safer Communities (October 2020)

Earthquakes are some of the most destructive and unpredictable natural phenomena, causing deaths, injuries, and extensive property damage in populated areas. As of 2015, roughly half of all Americans in the conterminous United States are exposed to potentially damaging ground shaking from earthquakes (USGS, 2015). The population exposed to seismic hazard has been steadily growing, leading to a higher potential for losses from seismic events. The estimated earthquake losses per year, known as Annualized Earthquake Losses (AEL), are calculated by FEMA to be $6.1 billion per year in the United States, and 55 metropolitan areas account for 85 percent of the AEL (FEMA, 2017).

BUILDING PROFESSIONALS AND ENGINEERS

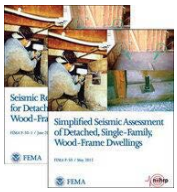
RESIDENTIAL BUILDINGS



FEMA 232 – *Homebuilders' Guide to Earthquake Resistant Design and Construction* (June 2006)

This illustrated guide presents seismic design and construction guidance for one- and two- family light frame residential structures and provides information supplemental to the 2003 edition of the "International Residential Code." The guide presents background information on the principles of seismic resistance and how earthquake forces impact conventional residential construction and more detailed information on architectural considerations (site selection, foundations and foundation details, floors, shear walls, and roofs). Also included are discussions of masonry and stone elements, examples of typical floor plans for earthquake-resistant one- and two-story homes, excerpts of seismic requirements from building codes, and checklists for homebuilders. The guide also presents a series

of "above-code recommendations" that provide low-cost measures to increase the performance of the building and help keep it functional after an earthquake.

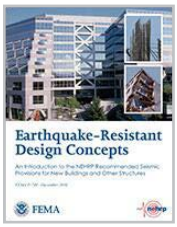


FEMA P-50 and FEMA P-50-1 – *Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings and Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings* (May-June 2012)

FEMA P-50 explains how to use the Simplified Seismic Assessment Form to calculate a Seismic Performance Grade for a detached, single-family, wood- frame home. The grade is based on a Structural Score and Seismic Hazard Score, which are derived using location- specific data available through online websites. The companion publication FEMA P-50-1 describes low-cost seismic retrofitting techniques that can be used to address deficiencies identified on the Simplified Seismic Assessment Form and shows how implementing those techniques could improve a home's grade. These publications provide a tool that communities can use to encourage the seismic retrofitting of residential structures to reduce future earthquake losses.

FEMA P-593 – *Seismic Rehabilitation Training for One- and Two-Family Dwellings: Program and Slide Presentations* (January 2010)

This product contains PowerPoint slide presentations, an instructional guide, and speaker's notes for training contractors, code officials, and other parties interested in the seismic retrofitting of existing light frame dwellings. It has been used by the International Code Council as the basis for a series of webinars that have been presented to its membership.



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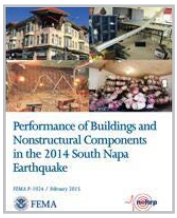
EARTHQUAKE PUBLICATIONS



FEMA P-1024 – *Performance of Buildings and Nonstructural Components in the 2014 South Napa Earthquake* (February 2015)

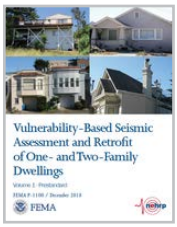
On August 24, 2014, a magnitude-6.0 earthquake occurred in Napa, California. In response to this earthquake, the Special Projects Task of the National Earthquake Technical Assistance Program (NETAP) was used to fund an investigation. The work described in P-1024 was focused on documenting the observed performance of buildings and nonstructural components in order to lead into future improvements in future building codes, and to do so within six months.

FEMA P-1024-RA1 – *Repair of Earthquake-Damaged Masonry Fireplace Chimneys* (January 2015)

Recovery Advisory 1 (RA1) is Appendix A of the FEMA P-1024 report. RA1 recommends best practices for reconstruction of earthquake-damaged masonry chimneys in one-and two-family dwellings to minimize risk of damage in future earthquakes.

FEMA P-1024-RA2 – *Earthquake Strengthening of Cripple Walls in Wood-Frame Dwelling* (April 2015)

Recovery Advisory 2 (RA2) is Appendix B of the FEMA P-1024 report. RA2 addresses measures to mitigate cripple wall vulnerabilities before an earthquake occurs and provides information on how and when to use the accompanying FEMA Plan Set.



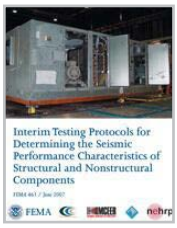
FEMA P-1100 – *Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings* (December 2018)

Improved seismic design and seismic retrofitting of vulnerable configurations will increase the probability that homes are available to provide shelter immediately following moderate to large seismic events. The purpose of this prestandard is to provide a methodology to identify and retrofit specific known vulnerabilities in wood light-frame dwellings. Development of the assessment and retrofit provisions has included use of the best available seismic numerical modeling tools and engineering practices to assist in development of assessment methods and to identify retrofit criteria to best achieve targeted performance objectives. Use of the provisions is anticipated to improve earthquake performance but it is not intended to prevent earthquake damage.

PERFORMANCE BASED SEISMIC DESIGN

FEMA 445 – *Next-Generation Performance-Based Seismic Design Guidelines: Program Plan for New and Existing Buildings* (August 2006)

This publication is a step-by-step program plan for the FEMA project with the Applied Technology Council to develop next-generation performance-based seismic design procedures and guidelines for structural and nonstructural components in new and existing buildings. The plan provides background information on current code design procedures, introduces performance-based seismic design concepts, identifies improvements needed in current seismic design practice, and outlines the tasks and projected costs for a two-phase program to develop next-generation performance-based seismic design procedures and guidelines.

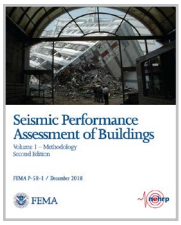


FEMA 461 – *Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components* (June 2007)

This publication was developed under FEMA's next-generation performance-based seismic design (PBSD) project with the ATC, and is one of the first major accomplishments achieved under the program plan described in FEMA 445. FEMA 461 provides methodologies that can be used to measure the seismic performance of buildings' structural or nonstructural components in a consistent and comparable manner. It describes in detail two laboratory testing protocols that determine fragility functions for various building systems and components. The first protocol, Quasi-Static Cyclic Testing of Structural and Nonstructural Components and Systems, can be used to test shear walls, beam-column assemblies, drywall partitions, cladding panels, pipes, ducts, and other elements whose behavior is sensitive to the relative motion of several floors or vertical connections within a building. The second protocol, Shake Table Testing of Structural and Nonstructural

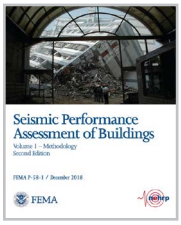
Components and Systems, is designed for testing mechanical and electrical equipment and other elements that are sensitive to the dynamic effects of motion imparted at a single point of attachment. Although these protocols are intended as interim methods that will be finalized over time as they are used and evaluated by researchers nationwide, they are nevertheless a significant step forward in the development of PBSD.

EARTHQUAKE PUBLICATIONS



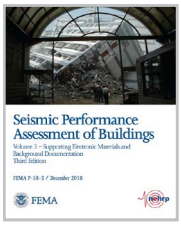
FEMA P-58-1 – *Seismic Performance Assessment of Buildings, Volume 1 – Methodology, Second Edition* (May 2018)

This report describes a general methodology and recommended procedures to assess the probable seismic performance of individual buildings based on their unique site, structural, nonstructural, and occupancy characteristics. Performance is measured in terms of the probability of incurring casualties, repair and replacement costs, repair time, selected environmental impacts, and unsafe placarding.



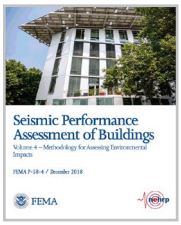
FEMA P-58-2 – *Seismic Performance Assessment of Buildings, Volume 2 – Implementation Guide, Second Edition* (May 2018)

This *Second Edition Implementation Guide* provides guidance on implementation and use of the methodology set forth in FEMA P-58,Volume 1 to assess the seismic performance of individual buildings based on their unique site, structural, nonstructural, and occupancy characteristics, expressed in terms of the probability of incurring casualties, repair and replacement costs, repair time, environmental impacts, and unsafe placarding.



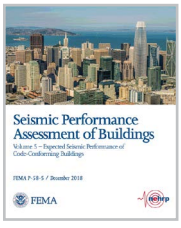
FEMA P-58-3 – *Seismic Performance Assessment of Buildings, Volume 3 – Supporting Electronic Materials, Third Edition* (May 2018)

This volume consists of a series of electronic products assembled to assist engineers in conducting seismic performance assessments and in understanding the technical basis of the methodology.



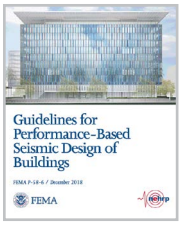
FEMA P-58-4 – *Seismic Performance Assessment of Buildings, Volume 4 – Methodology for Assessing Environmental Impacts* (May 2018)

This report describes a recommended methodology for incorporating assessment of environmental impacts, along with other consequences, that are associated with the repair of damage caused by earthquake shaking. The findings were used to update the methodology and PACT to incorporate environmental impact consequences.



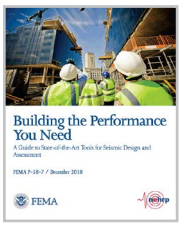
FEMA P-58-5 – *Seismic Performance Assessment of Buildings, Volume 5 – Expected Seismic Performance of Code-Conforming Buildings* (May 2018)

Volume 5 describes the application of the FEMA P-58 assessment methodology to a group of archetypical buildings representative of structures conforming to the seismic design requirements of the current building code.



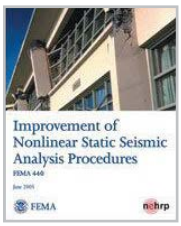
FEMA P-58-6 – *Guidelines for Performance-Based Seismic Design of Buildings* (May 2018)

This volume provides guidelines and recommendations for specifying seismic performance objectives in terms of FEMA P-58 performance metrics, and for selecting appropriate structural and nonstructural systems, configurations, and characteristics necessary to achieve the desired performance in varying regions of seismicity.



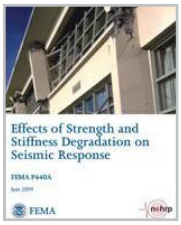
FEMA P-58-7 – *Building the Performance You Need, A Guide to State-of-the Art Tools for Seismic Design and Assessment* (May 2018)

This short document is intended for project managers and decision-makers, and presents a non-technical basis for using a performance-based approach for seismic design and assessment. This document is also supported by an online quiz.



FEMA P-440 – *Improvement of Nonlinear Static Seismic Analysis Procedures* (June 2005)

This state-of-the-art resource captures the latest advances in nonlinear static analysis. It evaluates FEMA and Applied Technology Council (ATC) procedures for estimating the response of structures to ground shaking and attempts to address the significantly different results in estimates of maximum displacement that these procedures generate. This report sets the stage for future improvements to FEMA 356 or the ATC report, Seismic Evaluation and Retrofit of Concrete Buildings (ATC-40).



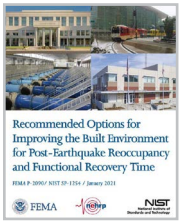
FEMA P-440A – *Effects of Strength and Stiffness Degradation on Seismic Response* (June 2009)

This document is a follow-on publication to Improvement of Nonlinear Static Seismic Analysis Procedures, FEMA 440. It provides information that will improve nonlinear analysis for cyclic response, considering cyclic and in-cycle degradation of strength and stiffness. Recent work has demonstrated that it is important to be able to differentiate between cyclic and in-cycle degradation in order to more accurately model degrading behavior, while current practice only recognizes cyclic degradation, or does not distinguish between the two. The material contained within this publication is expected to improve nonlinear modeling of structural systems, and ultimately make the seismic retrofit of existing hazardous buildings more cost-effective.

EARTHQUAKE PUBLICATIONS

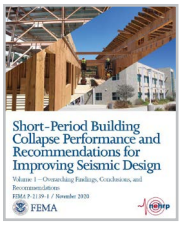
FEMA P-2078 – *Procedures for Developing Multi-Period Response Spectra at Non-Conterminous United States Sites* (August 2020)

This study develops methods for constructing multi-period response spectra (MPRS) at all periods and site classes of interest, assuming that only deterministic and probabilistic values of SS and S1, and approximated values of TL from ASCE 7-16, are available for the site of interest. A comparison between derived MPRS and calculated MPRS at sites in the conterminous United States was used to validate the proposed methods and models. With this validation, these method and models can be used to derive multi-period response spectra using only the three currently available ground motion parameters SS, S1, and TL for all non-conterminous United States regions of interest.



FEMA P-2090 / NIST SP-1254 – *Recommended Options for Improving the Built Environment for Post-Earthquake Reoccupancy and Functional Recovery Time* (January 2021)

This report provides a set of options in the form of recommendations, tasks, and alternatives for improving the built environment, which have been developed and assessed by the Committee of Experts. It describes community resilience, defines the concepts of reoccupancy and functional recovery, and explains the relationship among these three ideas. It explains why reoccupancy and functional recovery concepts are needed, describes a target performance state, and identifies potential cost and benefits associated with implementing enhanced seismic design.

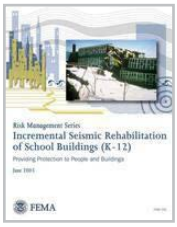


FEMA P-2139 – *Short-Period Building Collapse Performance and Recommendations for Improving Seismic Design* (December 2020)

Recent analytical studies investigating a wide range of modern seismic-force-resisting systems have predicted collapse rates for short-period buildings that are significantly larger than those observed in earthquakes during the past 50 years. This gap between analytically predicted and historically observed collapse rates in known as the short-period building seismic performance paradox. Additionally, analytically predicted collapse rates for short-period buildings are generally larger than maximum collapse rates used in national model codes and standards to establish seismic design requirements. The FEMA P-2139 series of reports documents a multi-year investigation of the response behavior and collapse performance of different structural systems to identify causes and develop solutions for the short-period building seismic performance paradox. Studies investigated three structural systems: wood light-frame, special reinforced masonry shear wall, and steel special concentrically braced frame systems. Volume 1 summarizes results, conclusions, and recommendations from the three-system specific studies and presents a common understanding of the seismic response and collapse performance of short-period buildings. Volume 2 summarizes results, conclusions, and recommendations from the study of wood light-frame systems. Volume 3 summarizes results, conclusions, and recommendations from the study of special reinforced masonry shear wall systems. Volume 4 summarizes results, conclusions,

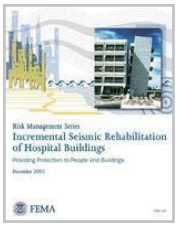
and recommendations from the study of steel special concentrically braced frame systems.

EXISTING CONSTRUCTION



FEMA 395 – *Incremental Seismic Rehabilitation of School Buildings (K-12): Providing Protection to People and Buildings* (June 2003)

This publication was developed to provide school administrators with the information necessary to assess the seismic vulnerability of their buildings, and to implement a program of incremental seismic retrofitting for those buildings.

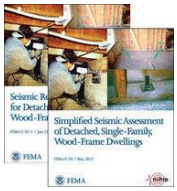


FEMA 396 – *Incremental Seismic Rehabilitation of Hospital Buildings : Providing Protection to People and Buildings* (December 2003)

This manual provides healthcare organizations with the information necessary to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic retrofitting for those buildings.

FEMA 547 – *Techniques for the Seismic Rehabilitation of Existing Buildings* (February 2007)

This seismic rehabilitation techniques document is part of the NEHRP family of publications addressing seismic rehabilitation of existing buildings. It describes common seismic rehabilitation techniques used for buildings represented in the set of standard building types in FEMA seismic publications.



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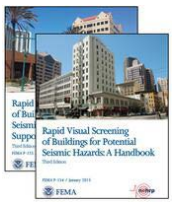
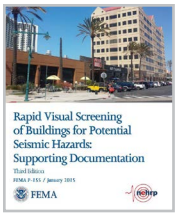
EARTHQUAKE PUBLICATIONS



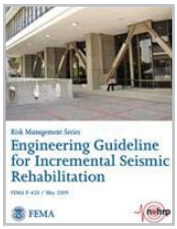
FEMA P-154 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards* (Second Edition, January 2015)

The Rapid Visual Screening (RVS) handbook can be used by trained personnel to identify, inventory, and screen buildings that are potentially seismically vulnerable. The RVS procedure comprises a method and several forms that help users to quickly identify, inventory, and score buildings according to their risk of collapse if hit by major earthquakes. The RVS handbook describes how to identify the structural type and key weakness characteristics, how to complete the screening forms, and how to manage a successful RVS program.



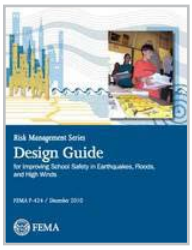
FEMA P-155 – *Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation* (Third Edition, January 2015)

The third edition companion to FEMA P-154 describes the technical background and process used to update the Handbook and the revisions considered and conclusions reached. Extensive detail is also provided in FEMA P-155 on the third edition scoring and associated risk.



FEMA P-420 – *Engineering Guideline for Incremental Seismic Rehabilitation* (May 2009)

This publication serves as a technical resource for design professionals on the topic of incremental seismic rehabilitation and strategies for implementing this approach in practice. The publication includes discussions on several topics including building maintenance, capital improvement and decision-making processes as a basis for communicating with decision-makers on seismic rehabilitation opportunities. In addition, other resource documents for seismic rehabilitation are reviewed. FEMA P-420 is a companion manual to the Incremental Seismic Rehabilitation Publications (FEMA 395 and 396) targeted to engineers and design professionals.

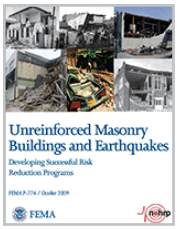


FEMA P-424 – *Design Guide for School Safety in Earthquakes, Floods, and High Winds* (December 2010)

This manual is the updated version of the original FEMA 424 published in January 2004. It is intended to provide guidance for the protection of school buildings from natural disasters. This volume concentrates on grade schools, K-12. FEMA P-424 covers earthquakes, floods, and high winds. Its intended audience is design professionals and school officials involved in the technical and financial decisions of school construction, repair, and renovations.

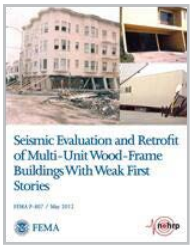
FEMA P-593 – *Seismic Rehabilitation Training for One- and Two-Family Dwellings: Program and Slide Presentations* (January 2010)

This product contains PowerPoint slide presentations, an instructional guide, and speaker's notes for training contractors, code officials, and other parties interested in the seismic retrofitting of existing light frame dwellings. It has been used by the International Code Council as the basis for a series of webinars that have been presented to its membership.



FEMA P-774 – *Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs* (October 2009)

This publication provides guidance on reducing the risks faced by those who own, occupy, or use unreinforced masonry (URM) buildings in seismically active areas. Among structures currently in use in U.S. communities, URM buildings are typically the most vulnerable to earthquake damage and the type of construction that is most commonly singled out for voluntary and mandatory seismic risk reduction programs. The publication includes illustrations and photographs of URM buildings and describes their seismic vulnerabilities. It discusses policy and regulatory issues that often must be considered in efforts to reduce URM risks, such as retrofit costs, the economic viability of older buildings, numbers of occupants and types of use, and historic or architectural values. Rather than prescribing a rigid sequence of steps for URM risk reduction, FEMA P-774 documents a wide variety of successful approaches that have been developed across the United States.



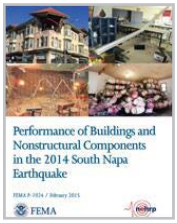
FEMA P-807 – *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings With Weak First Stories* (May 2012)

Multi-unit wood-frame buildings with a weak first story represent a significant risk in highly seismic regions of the United States because of their high potential for collapse. This collapse potential is due primarily to their soft or weak first-story walls, which have often been weakened by large numbers of openings such as garages or store front windows. FEMA P-807 addresses seismic retrofitting of weak-story woodframe buildings in seismically active regions of the United States, with a focus on multi-family, multi-story buildings with weak first stories, and apartment buildings with tuck-under parking. These seismic retrofitting guidelines are the first to focus solely on the weak first story and to provide just enough additional strength to protect the first floor from collapse but not so much as to drive earthquake forces into the upper stories, placing them at risk of collapse. They are also the first to take into account the strength provided by existing non-structural walls, making seismic retrofitting more affordable. An electronic tool was developed as part of the project to help apply the rules and perform the calculations described in the report. The Weak Story Tool (WST) is available for download as a zip file. Note that the report contains all the data, formulas, and procedural background needed to apply the method without using the WST.

EARTHQUAKE PUBLICATIONS

FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (August 2017)

This guide provides up-to-date, authoritative information, and guidance that schools can use to develop a comprehensive strategy for addressing natural hazards. It is intended to be used by administrators, facilities managers, emergency managers, emergency planning committees, and teachers and staff at K through 12 schools. It can also be valuable for state officials, district administrators, school boards, teacher union leaders, and others that play a role in providing safe and disaster-resistant schools for all. Parents, caregivers, and students can also use this Guide to learn about ways to advocate for safe schools in their communities.

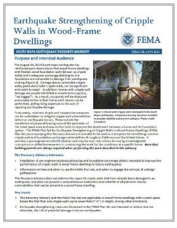


FEMA P-1024 – *Performance of Buildings and Nonstructural Components in the 2014 South Napa Earthquake* (February 2015)

On August 24, 2014, a magnitude-6.0 earthquake occurred in Napa, California. In response to this earthquake, the Special Projects Task of the National Earthquake Technical Assistance Program (NETAP) was used to fund an investigation. The work described in P-1024 was focused on documenting the observed performance of buildings and nonstructural components in order to lead into future improvements in future building codes, and to do so within six months.

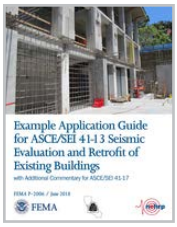
FEMA P-1024-RA1 – *Repair of Earthquake-Damaged Masonry Fireplace Chimneys* (January 2015)

Recovery Advisory 1 (RA1) is Appendix A of the FEMA P-1024 report. RA1 recommends best practices for reconstruction of earthquake-damaged masonry chimneys in one-and two-family dwellings to minimize risk of damage in future earthquakes.



FEMA P-1024-RA2 – *Earthquake Strengthening of Cripple Walls in Wood-Frame Dwelling* (April 2015)

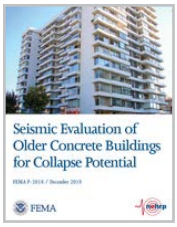
Recovery Advisory 2 (RA2) is Appendix B of the FEMA P-1024 report. RA2 addresses measures to mitigate cripple wall vulnerabilities before an earthquake occurs and provides information on how and when to use the accompanying FEMA Plan Set.



FEMA P-2006 – *Example Application Guide for ASCE/SEI 41-13 Seismic Evaluation and Retrofit of Existing Buildings; with Additional Commentary for ASCE/SEI 41-17* (June 2018)

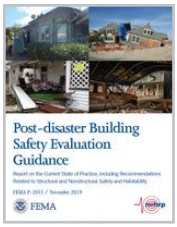
This *Example Application Guide* provides helpful guidance on the interpretation and the use of ASCE/SEI 41-13 through a set of examples that address key selected topics. The Guide covers topics that commonly occur where guidance is believed to be beneficial, with topics effectively organized and presented such that information is easy to find. Commentary accompanies the examples to provide context, rationale, and advice, including discussion of revisions to the standard made in ASCE/SEI 41-17.

The intended audience for this Guide is both practicing engineers and building officials who have limited or no experience with ASCE/SEI 41 and those engineers and building officials who have used these documents in the past, but have specific questions. It is assumed that the user has seismic design experience and a working knowledge of seismic design concepts.



FEMA P-2018 – *Seismic Evaluation of Older Concrete Buildings for Collapse Potential* (May 2018)

This report, *Seismic Evaluation of Older Concrete Buildings for Collapse Potential* provides a simplified methodology for evaluating collapse resistance using simplified estimates of drift demand. The calculations have been intentionally simplified; however, the underlying criteria are based on probabilistic concepts and structural reliability theory. Development of the procedures included testing of the methodology by practicing engineers in several rounds of trial evaluations, and vetting of the methodology in a series of annual workshops. All of this was used to adjust and improve the methodology throughout the development process.

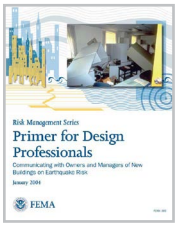


FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

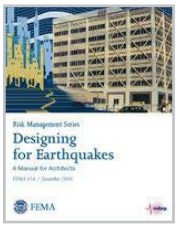
EARTHQUAKE PUBLICATIONS

NEW CONSTRUCTION



FEMA 389 – *Primer for Design Professionals: Communicating with Owners and Managers of New Buildings on Earthquake Risk* (January 2004)

This publication educates building owners and managers on seismic risk management tools that can be effectively and economically employed during the building development phase. The document, which is intended primarily for design professionals, introduces and discusses (1) seismic risk management and the development of a risk management plan; (2) emerging concepts in performance-based seismic design; and (3) seismic design and performance issues related to six specific building occupancies: commercial office facilities, retail commercial facilities, light manufacturing facilities, health care facilities, local schools (K-12), and higher education (university) facilities. The document also provides guidance for identifying and assessing earthquake-related hazards during the site selection process.

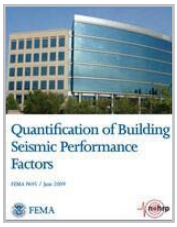


FEMA 454 – *Designing for Earthquakes: A Manual for Architects* (December 2006)

The present publication consists of a series of chapters that provide the foundation for an understanding of seismic design, each authored by an expert in the field. The authors were given freedom to decide the scope of their chapters; and thus this publication represents expert opinion rather than consensus. Designing for Earthquakes: a Manual for Architects is intended to explain the principles of seismic design for those without a technical background in engineering and seismology. The primary intended audience is that of architects and includes practicing architects, architectural students, and faculty in architectural schools who teach structures and seismic design.

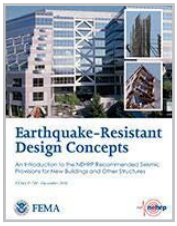
FEMA 577 – *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds* (June 2007)

This publication provides design information for the construction of new hospitals and rehabilitation of existing ones with the purpose of improving their performance during the immediate aftermath of various hazard events. This manual is concerned with factors such as performance-based design and continuity of operations for this type of building. It provides a multi-hazard approach highlighting conflicts and benefits to consider when designing.



FEMA P-695 – *Quantification of Building Seismic Performance Factors* (June 2009)

This publication presents a recommended methodology for reliably quantifying building system performance and response parameters for use in seismic design. The parameters or "seismic performance factors" addressed include the response modification coefficient (R factor), system overstrength factor, and deflection amplification factor. The methodology is a refinement of an earlier preliminary methodology, and is based on a review of relevant research on nonlinear response and collapse simulation, benchmarking studies of selected structural systems, feedback from an expanded group of experts and potential users, and evaluations of additional structural systems conducted to verify the technical soundness and applicability of the approach.



FEMA P-749 – *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (December 2010)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures" (FEMA P-750) in particular. The NEHRP Recommended Seismic Provisions and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community.

FEMA P-795 – *Quantification of Building Seismic Performance Factors: Component Equivalency Methodology* (June 2011)

Published in 2011, this document builds upon an earlier FEMA publication, FEMA P-695. Although the methodology contained in FEMA P-695 provides a means to evaluate complete seismic-force-resisting systems proposed for adoption into building codes, a component-based methodology was needed to reliably evaluate structural elements, connections, or subassemblies proposed as substitutes for equivalent components in established seismic-force-resisting systems. The Component Equivalency Methodology presented in this document fills this need by maintaining consistency with the probabilistic, system-based collapse assessment concepts of FEMA P-695 while providing simple procedures for comparing the tested performance of different components. It is intended to be of assistance to organizations, such as the International Code Council Evaluation Service, that need to compare the seismic performance of alternate components to that of components in established seismic-force-resisting systems.

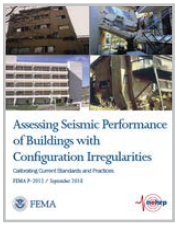
EARTHQUAKE PUBLICATIONS

FEMA P-1026 – *Seismic Design of Rigid Wall-Flexible Diaphragm Buildings: An Alternate Design Procedure* (March 2015)

Warehouse or retail store buildings in the U.S. are commonly built as single-story "big-boxes." These buildings typically have stiff walls constructed of reinforced concrete or masonry, or braced frames of structural steel, and relatively flexible roofs of metal deck or wood structural panels. This type of structure is often referred to as Rigid-Wall and Flexible-Diaphragm (RWFD) buildings. The seismic response of these buildings is dominated by deflection of the diaphragm rather than the vertical seismic resisting system, as assumed by building code procedures. This publication presents an alternate design procedure to consider this characteristic response and improve seismic performance related to large diaphragm deflections. The procedure has yet to be vetted by a standards body for future adoption into building codes and standards.

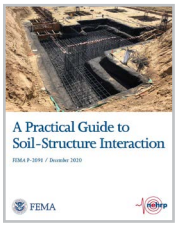
FEMA P-1091 – *Recommended Simplified Provisions for Seismic Design Category B Buildings* (September 2017)

Simplification of seismic design provisions for buildings is desirable for anyone who uses the seismic provisions of the building code, including structural engineers and local building officials. This goal has been explored in various ways over decades through efforts supported by FEMA as part of its responsibilities under NEHRP through the FEMA-funded NEHRP Provisions Update Committee as well as through other code development organizations such as the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 7 Seismic Subcommittee, as summarized in the Appendix of this document.



FEMA P-2012 – *Assessing Seismic Performance of Buildings with Configuration Irregularities* (September 2018)

This guidance evaluates current building code triggers, the influence of structural irregularities on seismic building performance (in terms of collapse probability), and the effectiveness of relevant code provisions. The objective of the studies conducted under this project was to inform and improve U.S. codes and standards so that structures with configuration irregularities have a level of safety against collapse in an earthquake that is comparable to that for regular structures. The publication focuses primarily on design requirements for new buildings, with limited consideration of the treatment of irregularities for existing buildings.



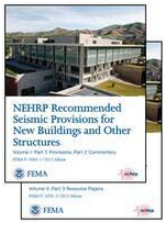
FEMA P-2091 – *A Practical Guide to Soil-Structure Interaction* (December 2020)

Soil-Structure Interaction (SSI) can make a substantial difference in how buildings behave during an earthquake FEMA P-2091 describes how to better construct buildings with consideration for SSI. This Guide is for engineers to help them determine when SSI effects are of importance and to show them examples of how to implement SSI in design.

Seismic Building Code Provisions for New Buildings to Create Safer Communities (October 2020)

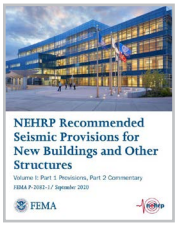
Earthquakes are some of the most destructive and unpredictable natural phenomena, causing deaths, injuries, and extensive property damage in populated areas. As of 2015, roughly half of all Americans in the conterminous United States are exposed to potentially damaging ground shaking from earthquakes (USGS, 2015). The population exposed to seismic hazard has been steadily growing, leading to a higher potential for losses from seismic events. The estimated earthquake losses per year, known as Annualized Earthquake Losses (AEL), are calculated by FEMA to be $6.1 billion per year in the United States, and 55 metropolitan areas account for 85 percent of the AEL (FEMA, 2017).

NEHRP PROVISIONS



FEMA P-1050, FEMA P-1051, FEMA P-1052 – *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (2015 Edition)

The 2015 NEHRP Provisions marks the ninth edition of this technical resource document since its first publication in 1985. FEMA is proud to sponsor this cycle of the NEHRP Provisions update, and to publish the new edition for use by national codes and standards organizations and the general public. The 2015 NEHRP Provisions are a new knowledge-based resource document intended to translate research results into engineering design practice. The new changes in the 2015 NEHRP Provisions have incorporated extensive results and findings from recent research projects, problem-focused studies, and post-earthquake investigation reports conducted by various professional organizations, research institutes, universities, material industries, and the NEHRP agencies. Similar to the previous edition, the 2015 NEHRP Provisions have adopted by reference the American Structural Engineers Association (ASCE) / Structural Engineering Institute (SEI) standard ASCE/SEI 7-10: Minimum Design Loads for New Buildings and Other Structures as the baseline.

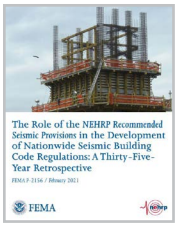


FEMA P-2082-1 and FEMA P-2082-2 – *2020 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (September 2020)

The 2020 NEHRP Provisions continues to apply the current state-of-knowledge in earthquake engineering for improving the seismic design of buildings and other structures. It presents a set of recommended improvements to the ASCE/SEI 7-16 Standard: Minimum Design Loads and Associated Criteria for Buildings and Other Structures, and nine resource papers on new concepts, suggested future development, and technical information in support of the recommended improvements.

Part 1 of the Provisions provides recommended changes to the seismic requirements of ASCE 7-16, Chapters 11 to 22. Part 2 of the Provisions provides a complete commentary for each chapter.

EARTHQUAKE PUBLICATIONS

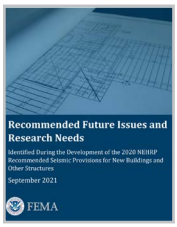


FEMA P-2156 – *The Role of the NEHRP Recommended Seismic Provisions in the Development of Nationwide Seismic Building Code Regulations: A Thirty-Five-Year Retrospective* (February 2021)

In retrospect, the NEHRP Recommended Provisions not only provided many critical stepping stones to form the foundation of modern U.S. seismic-resistant codes and standards, but also helped to explore new ways to advance earthquake science and risk reduction technologies. Over the past thirty-five years, many scientists, researchers, engineers, code and standard experts, material industry experts, and professionals from the NEHRP agencies contributed to the success of the NEHRP Provisions. This report captures the history of the NEHRP Provisions and many great benefits it has introduced.

Seismic Building Codes in the U.S.: A Thirty-Five Year Retrospective of NEHRP Provisions (February 2021)

This brochure is a companion piece to FEMA P-2156.



Recommended Future Issues and Research Needs Identified During the Development of the 2020 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures (November 2021)

As part of its efforts to regularly update the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, the Building Seismic Safety Council is charged by FEMA to identify and recommend issues to be addressed and research needed to advance the state of the art of earthquake-resistant design and to serve as the basis for future refinement of the Provisions.

NON-STRUCTURAL COMPONENTS

FEMA 412 – *Installing Seismic Restraints for Mechanical Equipment* (December 2002)

This illustrated guide shows 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 list of various types of equipment and includes a chart that identifies the equipment, the recommended configuration for restraint, and the type of attachment needed. The second section provides examples of attachment types with instructions for installing equipment in different configurations. The third section provides examples of anchors. The fourth section presents special cases. Step-by-step instructions and special precautions are given for each type of equipment, the method for installing the equipment, and the attachment type needed. The guide does not cover non-building structural framing required to elevate equipment above the floor.

FEMA 413 – *Installing Seismic Restraints for Electrical Equipment* (January 2004)

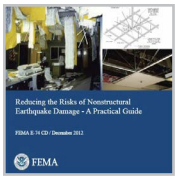
This guide provides equipment installers with information on how to attach electrical equipment to buildings to minimize earthquake damage. Many examples of attachments are presented, including anchors and seismic restraints. An electrical danger instruction chart and safety requirements and codes are included.

FEMA P-414 – *Installing Seismic Restraints for Duct and Pipe* (January 2004)

This is one of three fully illustrated guides that show equipment installers how to attach mechanical equipment (FEMA 412), electrical equipment (FEMA 413), and duct and pipe (FEMA 414) to buildings to minimize earthquake damage. The guides describe various types of equipment and include a chart that identifies the types of recommended equipment, the configuration for restraint, and the type of attachment needed. Step-by-step instructions and precautions for each type of equipment and methods for installing the equipment are included. Examples of anchoring and seismic restraint devices; attachment types and instructions for installing equipment in different configurations; and special cases for housekeeping pads, cable assemblies, supports for control panels, and residential equipment are included. The publication does not cover non-building structural framing required to elevate equipment above the floor.

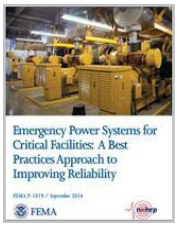
FEMA 460 – *Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public* (September 2005)

This report highlights issues for consideration in the seismic design, installation, ongoing inspection, maintenance, and use of steel single selective pallet storage racks located in areas of retail warehouse stores and other facilities accessible to the general public.



FEMA E-74 – *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide* (Fourth Edition, December 2012)

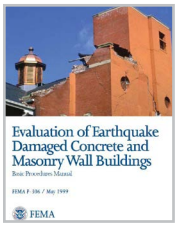
This fourth edition of FEMA 74 describes the sources of nonstructural earthquake damage and effective methods of reducing potential risks associated with such damage. It assists in identifying potential hazards and provides specific guidance on upgrades.



FEMA P-1019 – *Emergency Power Systems for Critical Facilities: A Best Practices Approach to Improving Reliability* (September 2014)

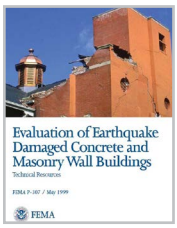
There is a significant likelihood that utility power will not be available for an extended period of time during severe natural hazard events. Thus, it is necessary for critical facilities to have reliable sources of sustained electrical power to achieve continued operation. This document provides guidance on the design and operation of emergency power systems in critical facilities so that they will be able to remain operational for extended periods, as needed.

SPECIAL CONSTRUCTION TYPES – CONCRETE



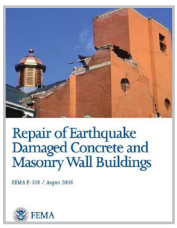
FEMA 306 – *Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Basic Procedures Manual* (May 1999)

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* (January 1998)

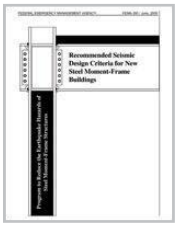
This document provides background and theoretical information to be used in conjunction with FEMA 306. Analytical and experimental findings are included, as well as information on the Component Damage Classification Guides.



FEMA 308 – *Repair of Earthquake Damaged Concrete and Masonry Wall Buildings* (May 1999)

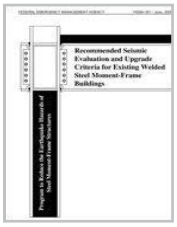
This document provides practical guidance for the repair and upgrade of earthquake-damaged concrete and masonry wall buildings. Target audiences include design engineers, building owners and officials, insurance adjusters, and government agencies. The publication contains sections on performance-based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

SPECIAL CONSTRUCTION TYPES – STEEL



FEMA 350 – *Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings* (June 2000)

This resource document (FEMA 350) for organizations engaged in the development of building codes and standards 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* (June 2000)

This publication provides recommended methods for evaluating the probable performance of existing steel moment-frame buildings in future earthquakes. It presents guidelines on how to retrofit these buildings for improved performance, 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.

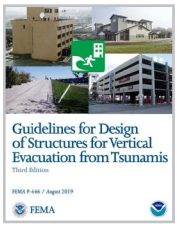
FEMA 352 – *Recommended Post-earthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings* (June 2000)

This report provides recommendations for performing inspections to detect damage in steel moment-frame buildings following an earthquake; evaluating the damaged buildings' safety in a post-earthquake environment; and repairing damaged buildings. Chapters cover inspection and classification of damage; preliminary post-earthquake assessment; detailed post-earthquake evaluations; and post-earthquake repair. The appendices include procedures for performance evaluation; sample placards that may be used to post buildings following preliminary post-earthquake evaluations; and sample inspection forms that may be used to record damage detected in beam-column connections as part of a detailed post-earthquake inspection program.

FEMA 353 – *Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications* (June 2000)

This two-part publication provides recommended specifications for the fabrication and erection of steel moment-frames for seismic applications. Part One covers recommended specifications, including information on products; execution; welded joint and fabrication details; and quality control and 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.

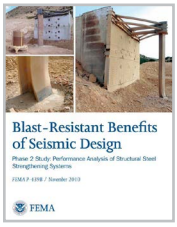
SPECIAL CONSTRUCTION TYPES – TSUNAMI RESISTANT



FEMA P-646 – *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis, Third Edition* (August 2019)

This guidance document includes the following information to assist in the planning and design of tsunami vertical evacuation structures: general information on the tsunami hazard and its history; guidance on determining the tsunami hazard, including tsunami depth and velocity; different options for tsunami vertical evacuation structures; guidance on siting, spacing, sizing, and elevation considerations; determining tsunami and earthquake loads and related structural design criteria; and structural design concepts and other considerations.

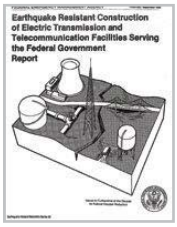
SPECIAL CONSTRUCTION TYPES – BLAST RESISTANT BENEFITS OF SEISMIC DESIGN



FEMA 439B – *Blast-Resistant Benefits of Seismic Design, Phase 2 Study: Performance Analysis of Structural Steel Strengthening Systems* (November 2012)

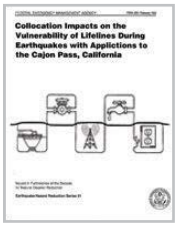
This is one in a series of publications that was developed in response to the September 11, 2001 terrorist attacks on the New York World Trade Center and the subsequent events that led to the formation of DHS and an increased emphasis on preparedness and mitigation of terrorism-related hazards. One issue that FEMA began shortly after that was to examine whether lessons learned in response to natural hazards could be effectively applied to protect building occupants from human threats. Important similarities between seismic and blast loadings lend themselves to such examination.

LIFELINES



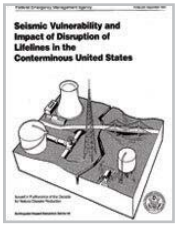
FEMA 202 – *Earthquake Resistant Construction of Electric Transmission and Telecommunication Facilities Serving the Federal Government* (September 1990)

This report summarizes a National Institute of Standards and Technology study that reviewed measures implemented by Federal agencies to protect electric power transmission and telecommunication lifelines against seismic hazards. The report examines the seismic vulnerability of these lifelines and discusses current standards and design criteria. Seismic retrofitting techniques for components and systems are reviewed, including the benefits of retrofitting versus gradual replacement. A summary of federal practices in the design of new facilities and the retrofit of existing facilities is included.



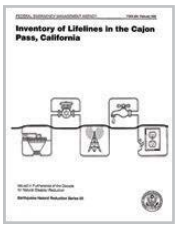
FEMA 221 – *Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California: Study Overview* (February 1992)

This report summarizes a study of lifeline systems located along the Cajon Pass in southern California. The study included analysis of communication, electric power, fuel pipeline, and transportation lifelines. This study overview describes how collocation may influence each lifeline's seismic vulnerability. A brief description of the screening tool developed during the study is provided.



FEMA 224 – *Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States* (September 1991)

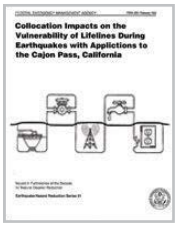
This report provides a national overview of lifeline seismic vulnerability and the impacts of lifeline disruptions. Both site-specific lifelines and extended lifeline networks are examined. Included is a review of electrical, water, transportation, and emergency-service systems. The vulnerability estimates and impacts are presented in terms of estimated direct damage losses and indirect economic losses. The report also presents hazard mitigation measures and their expected benefits as well as recommendations for future work.



FEMA 225 – *Inventory of Lifelines in the Cajon Pass, California* (February 1992)

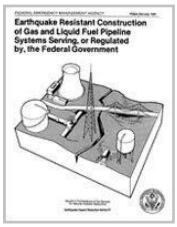
This publication provides an inventory of the major lifeline systems in the Cajon Pass, and describes the earthquake and geologic analysis tools available to identify and define the level of seismic risk to those lifelines. It evaluates the vulnerabilities resulting from the siting of multiple lifeline systems in confined and at-risk areas and from potential interactions among these systems in natural and man-made disasters. Potential mitigation techniques for communication, electric power, fuel pipeline, and transportation lifelines are identified. Detailed maps indicate lifeline locations. The report also discusses seismic hazards and predictive models for evaluating the damage potentials associated with these hazards.

EARTHQUAKE PUBLICATIONS



FEMA 226 – *Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California* (February 1992)

This report presents a new analytical method for identifying the increase in the seismic vulnerability of individual lifeline systems (communication systems, electric power systems, fuel pipelines, and transportation lifelines) due to their proximity to other lifelines in the Cajon Pass. The method calculates a parameter that can be used to adjust the damage-state values for shaking as determined by the Applied Technology Council's ATC–13 damage probability matrices. The primary objective of the study was to determine how the time to restore full service would be affected by the collocation of several types of lifelines in the same congested corridor. The new method is applied to the Cajon Pass lifelines. The design program AutoCAD is used to develop overlays of the lifeline routes with seismic and geologic information presented in the inventory report (FEMA 225).



FEMA 233 – *Earthquake Resistant Construction of Gas and Liquid Fuel Pipeline Systems Serving or Regulated by the Federal Government* (July 1992)

This document summarizes the vulnerability of gas and liquid-fuel pipeline systems to damage in past earthquakes. It lists the available standards and technologies that can protect such facilities against earthquake damage. An overview of measures taken by various Federal agencies to protect pipeline systems is presented. The appendix presents summaries of statements made by representatives of Federal agencies and other organizations contacted during the study.

FLOOD PUBLICATIONS

INDIVIDUALS AND HOMEOWNERS

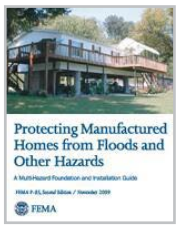
PROTECTING PROPERTY

ABC's of Returning to Flooded Buildings (November 2012)

Returning to flood damaged buildings requires careful planning. The tips contained in this flyer are designed to assist impacted individuals when they are able to reach their flooded property.

L-235 – *Homeowner's Guide to Retrofitting* (2009)

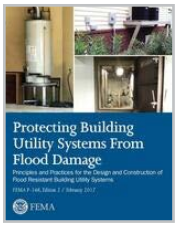
This brochure presents a brief overview of the information in FEMA P-312, Homeowner's Guide to Retrofitting using photographs and illustrations.



FEMA P-85 – *Protecting Manufactured Homes from Floods and Other Hazards* (Second Edition, November 2009)

This publication provides guidance for prospective homeowners, contractors, and local officials for the installation of manufactured homes in Special Flood Hazard Areas (SFHAs). Manufactured homes have unique challenges related to water intrusion into the structure. This publication addresses recommendations for foundation construction for this popular style of home.

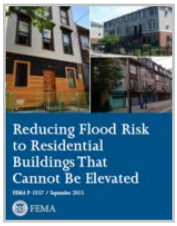
FLOOD PUBLICATIONS



FEMA P-348 – *Protecting Building Utility Systems From Flood Damage* (February 2017)

The overall objective of this publication is to assist in the construction of buildings with building utility systems that are designed and built so that the buildings can be re-occupied and fully operational as soon as electricity and sewer and water are restored to the neighborhood.

This publication illustrates the design and construction of utility systems that comply with the National Flood Insurance Program (NFIP) requirements for construction of new residential and non-residential structures in flood-prone areas. It is also useful when evaluating structures that will undergo Substantial Improvement, guiding users to meet floodplain management regulations and building code requirements. Even if compliance is not required, many building owners may find that applying mitigation measures described in this publication will not only reduce future flood damage, but also facilitate recovery after flooding.

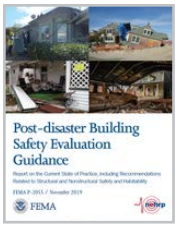


FEMA P-1037 – *Reducing Flood Risk to Residential Buildings That Cannot be Elevated* (September 2015)

This publication presents a range of flood protection measures available as alternatives to traditional structural elevation for homeowners whose residences meet both of the following conditions:

1. The residences are existing buildings. This publication is not intended to address construction of new buildings in floodprone areas as these structures should be sufficiently elevated and built in conformance with NFIP and local floodplain management regulations.

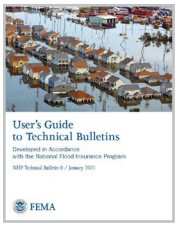
2. The residences are not Substantially Damaged or Substantially Improved, meaning that the buildings have not sustained damage or undergone improvement (i.e., reconstruction, rehabilitation, addition) where the cost of the damage or improvement exceeds 50 percent of the market value of the building before the damage occurred or improvement began. As with new construction, Substantially Damaged or Substantially Improved structures must be re-built in conformance with NFIP and local floodplain management regulations.



FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

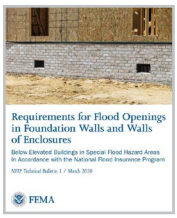
This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) TECHNICAL BULLETINS



TB-0 – *User's Guide to Technical Bulletins* (January 2021)

This Technical Bulletin provides a list of available technical bulletins, a key word/subject reference index for all of the bulletins, and information about how to obtain copies of the bulletins.

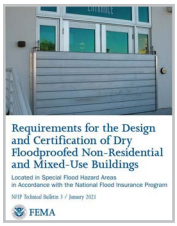


TB-1 – *Openings in Foundation Walls of Enclosures* (March 2020)

This Technical Bulletin provides guidance on the NFIP regulations concerning the requirements for openings in foundation walls for buildings with enclosures below the base flood elevation (BFE) and located in SFHAs shown on Flood Insurance Rate Maps (FIRMs) as Zones A, AE, A1-A30, AR, AO, and AH.

TB-2 – *Flood Damage-Resistant Materials Requirements* (August 2008)

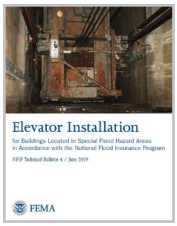
This Technical Bulletin provides guidance on the NFIP regulations concerning the required use of flood damage-resistant construction materials for building components located below the BFE in SFHAs in both A and V zones.



TB-3 – *Non-Residential Floodproofing – Requirements and Certification* (January 2021)

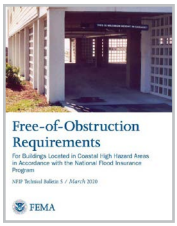
This Technical Bulletin provides guidance on the NFIP floodplain management requirements for the design and certification of dry floodproofing. This guidance applies to new and substantially improved non-residential buildings and mixed-use buildings in Special Flood Hazard Areas identified as Zone A, AE, A1-30, AH and AO on Flood Insurance Rate Maps.

FLOOD PUBLICATIONS



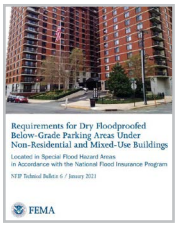
TB-4 – *NFIP Technical Bulletin 4 – Elevator Installation* (August 2019)

This Technical Bulletin provides guidance on the NFIP regulations concerning the installation of elevators below the BFE in Special Flood Hazard Areas (both A and V zones).



TB-5 – *Free-of-Obstruction Requirements* (March 2020)

This Technical Bulletin provides guidance on the NFIP regulations concerning obstructions to floodwaters below elevated buildings and on building sites in Coastal High Hazard Areas (Zones V, VE, and V1-V30).

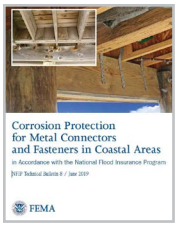


TB-6 – *Below-Grade Parking Requirements* (January 2021)

This Technical Bulletin provides guidance on NFIP floodplain management requirements for the design and certification of dry floodproofed below-grade parking areas. This guidance applies to new and substantially improved non-residential buildings and mixed-use buildings in SFHA identified as Zone A, AE, A1-30, AH, and AO on FIRMs.

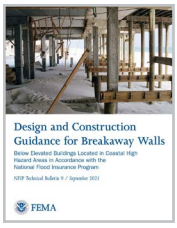
TB-7 – *NFIP Wet Floodproofing Requirements* (December 1993)

This Technical Bulletin provides guidance on the NFIP regulations concerning wet floodproofing of certain types of structures located in Zones A, AE, A1-A30, AR, AO, and AH.



TB-8 – *Corrosion Protection for Metal Connectors in Coastal Areas* (August 2019)

This Technical Bulletin provides guidance on the need for, selection of, and use of corrosion-resistant metal connectors for the construction of buildings in coastal areas.

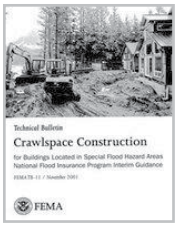


TB-9 – *Design and Construction Guidance for Breakaway Walls* (September 2021)

This Technical Bulletin provides prescriptive criteria for the design and construction of wood-frame and masonry breakaway walls beneath elevated buildings in Coastal High Hazard Areas compliant with NFIP regulatory requirements.

TB-10 – *Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding* (May 2001)

This Technical Bulletin discusses building techniques, including the use of fill that can be used to ensure structures are reasonably safe from flooding.



TB-11 – *Crawlspace Construction for Buildings Located in Special Flood Hazard Areas* (November 2001)

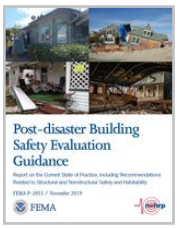
This Technical Bulletin provides interim guidance on minimum NFIP requirements as well as best practices for crawlspace construction in Special Flood Hazard Areas.

Updates to the NFIP Technical Bulletins Fact Sheet (September 2021)

The Bulletins are changing to modernize and streamline their content and presentation, incorporate relevant information from the latest I-Codes and ASCE Standards, provide updated guidance and best practices observed from post-disaster assessments and address known issues identified by a wide range of stakeholders. These changes intended to improve the TBs' usability, credibility, and content while presenting them in a streamlined format.

COMMUNITY PLANNING AND POLICY

GENERAL

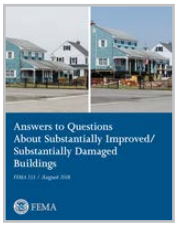


FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

FLOOD PUBLICATIONS

DAMAGE ASSESSMENT TOOLS (SUBSTANTIAL DAMAGE ESTIMATOR (SDE) MATERIALS)



FEMA 213 – *Answers to Questions about Substantially Improved/Substantially Damaged Buildings* (2018)

The questions and answers in the 2018 update to FEMA 213 provide guidance for many concerns regarding Substantial Improvement (SI) and Substantial Damage (SD) of buildings in Special Flood Hazard Areas. The publication answers questions about pertinent definitions and regulations and some general questions about SI/SD and determining when buildings are Substantially Improved or have incurred Substantial Damage. Revised FEMA 213 also addresses common questions that arise about SI/SD in the post-disaster period. Each question refers readers to specific sections and more complete guidance in FEMA P-758, Substantial Improvement/Substantial Damage Desk Reference.

FEMA P-758 – *Substantial Improvement/Substantial Damage Desk Reference* (2010)

To participate in the National Flood Insurance Program (NFIP), communities must adopt and enforce regulations and codes that apply to new development in Special Flood Hazard Areas (SFHAs). Local floodplain management regulations and codes contain minimum NFIP requirements that apply not only to new structures, but also to existing structures which are "substantially improved (SI)" or "substantially damaged (SD)." This Desk Reference provides practical guidance and suggested procedures to implement the NFIP requirements for SI/SD

FEMA P-784 – *Substantial Damage Estimator (SDE) Tool* (2017)

FEMA developed the SDE tool to assist State and local officials in estimating Substantial Damage for residential and non-residential structures. This tool can be used to assess flood, wind, wildfire, seismic, and other forms of damage. Although the SDE data collection and reporting process remains relatively unchanged from previous versions of the tool, the SDE 3.0 release focuses on enhancing the three key areas of performance, data accessibility, and usability. Users can now access the underlying database to run queries, perform bulk updates of data, or generate custom reports using their own databases and reporting tools.

Understanding Substantial Damage in the International Building Code, International Existing Building Code, or International Residential Code (2017)

This document will help you understand the concept of Substantial Damage (SD) and how to determine if a building meets this criterion. FEMA's Public Assistance Required Minimum Standards Policy found in the Public Assistance Program and Policy Guide, Chapter 2 – Section VII.B.2, requires that projects receiving FEMA assistance for repair or replacement incorporate the natural hazards-related provisions of the most recent edition of the International Code Council's® (ICC®) International Building Code (IBC®), International Existing Building Code® (IEBC®), and/or International Residential Code® (IRC®), known collectively as the I-Codes. The Policy applies to buildings that have received designations of Substantial Structural Damage, Substantial Damage, or are eligible for replacement in accordance with 44 CFR Part 206.226(f).

Understanding Substantial Structural Damage in the International Existing Building Code (2017)

This document will help you understand how the concept of Substantial Structural Damage (SSD) is used within the International Existing Building Code® (IEBC®). FEMA's Public Assistance Required Minimum Standards Policy found in the Public Assistance Program and Policy Guide, Chapter 2 – Section VII.B.2, requires that projects receiving FEMA assistance for repair or replacement incorporate the natural hazards-related provisions of the most recent edition of the International Code Council's® (ICC®) International Building Code® (IBC®), International Residential Code® (IRC®), and/or the IEBC. The policy applies to buildings that have sustained any level of damage (including, possibly, SSD or Substantial Damage), as well as projects involving new construction, such as improved projects, alternate projects, or projects eligible for replacement in accordance with 44 CFR, Part 206.226(f). The relevant code provisions include not only the design criteria for repair or replacement construction, but also those provisions that determine whether repair to the pre-damage condition is sufficient, or whether repair must be supplemented by improvement. One of those scope-determining provisions involves the concept of SSD.

DESIGN & CONSTRUCTION GUIDANCE

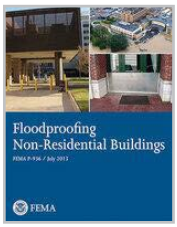
2012 IAPMO Flood Excerpts (2015)

This document contains Flood Resistant Provisions of the 2012 editions of codes published by the International Association of Plumbing and Mechanical Officers (IAPMO): the Uniform Mechanical Code; Uniform Plumbing Code, Uniform Swimming Pool, Spa and Hot Tub Code; and Uniform Solar Energy Code.

FLOOD PUBLICATIONS

Best Practices for Incorporating Building Science Guidance into Community Risk MAP Implementation (2012)

The Building Science Branch provides communities with guidance on reducing flood risk through publications, education, and tools that can be used with the Risk MAP program to help communities implement hazard-resistant construction. Building Science resources can be used in conjunction with Risk MAP products to strengthen the community's ability to reduce risk by increasing design standards for new construction and by implementing mitigation measures for existing construction.

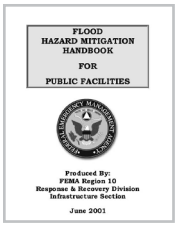


FEMA P-936 – *Floodproofing Non-Residential Buildings* (2013)

The primary focus of the guidance document is on dry floodproofing technologies for non-residential buildings, but it also includes an overview of other techniques including wet floodproofing and the use of levees and floodwalls. The publication provides information about regulatory requirements, design considerations, and descriptions of floodproofing methods and equipment. Key document features include: 1) Tools to assist the designer or building owner in determining the best floodproofing option for a particular building including a vulnerability checklist, 2) Case studies providing examples of applied floodproofing techniques, 3) Equations for determining flood forces and loads, 4) A summary of results from recent dry floodproofing research and testing for new construction.

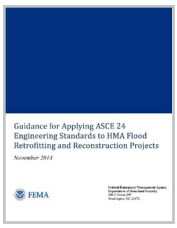
FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (2017)

This Guide provides up-to-date, authoritative information and guidance that schools can use to develop a comprehensive strategy for addressing natural hazards. It is intended to be used by administrators, facilities managers, emergency managers, emergency planning committees, and teachers and staff at K through 12 schools. It can also be valuable for state officials, district administrators, school boards, teacher union leaders, and others that play a role in providing safe and disaster-resistant schools for all. Parents, caregivers, and students can also use this Guide to learn about ways to advocate for safe schools in their communities.



Flood Hazard Mitigation Handbook for Public Facilities (2001)

The Flood Hazard Mitigation Handbook for Public Facilities (Handbook) is intended to aid local jurisdictions in identifying a variety of feasible mitigation ideas that can be implemented during the rebuilding process.



Guidance for Applying ASCE 24 Engineering Standards to HMA Flood Retrofitting and Reconstruction Projects (2013)

FEMA's Hazard Mitigation Assistance (HMA) program provides funding for mitigation activities that reduce disaster losses and protect life and property from future disaster damages including the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). An important part of funding mitigation projects involves ensuring that each project meets FEMA's requirements, which includes adhering to project-related design standards. Specifically for flood-related HMA projects, FEMA requires projects to incorporate the American Society of Civil Engineers Flood-Resistant Design and Construction Standard (ASCE 24). In order to integrate ASCE 24 as the minimum standard for flood-related HMA projects, FEMA Building Science Branch has developed a guidance document, methodology and checklists, and a training to compliment FEMA Policy-203-074-1, "Minimum Design Standards for Hazard Mitigation Assistance Projects in Flood Hazard Areas". Appendix C and Appendix D are spreadsheet tools and must be download separately.

Highlights of ASCE 24-05 Flood Resistant Design and Construction (2010)

The American Society of Civil Engineers (ASCE) 24-05 is a referenced standard in the International Building Code® and International Residential Code® (editions published 2012, 2009 and 2006). Building and structures within the scope of the IBC proposed to be constructed in a flood hazard area must designed in accordance with ASCE 24. The IRC requires that dwellings in floodways to be designed in accordance with ASCE 24, and the 2012 and 2009 editions include an alternative that allows communities to require homes in Zones V to be designed in accordance with ASCE 24. Highlights of ASCE 24 that complement the NFIP minimum requirements include: Building Performance; Flood-Damage Resistant Materials; Utilities and Service Equipment; and Siting Considerations.

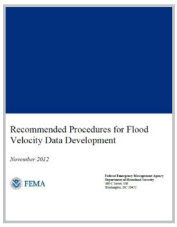
Highlights of ASCE 24-14 Flood Resistant Design and Construction (2015)

The American Society of Civil Engineers (ASCE) 24-14 is a referenced standard in the 2015 International Building Code® (IBC) and the 2015 International Residential Code® (IRC). Building and structures within the scope of the IBC proposed to be constructed in flood hazard areas must be designed in accordance with ASCE 24-14. The IRC requires dwellings in floodways to be designed in accordance with ASCE 24-14 and includes an alternative that allows communities to require homes in any flood zone to be designed in accordance with ASCE 24-15. Highlights of ASCE 24-14 that complement the NFIP minimum requirements include: Building Performance; Flood-Damage Resistant Materials; Utilities and Service Equipment and Siting Considerations.

FLOOD PUBLICATIONS

Significant Building Code Requirements That Exceed or Are More Specific Than the National Flood Insurance Program (2021)

This fact sheet summarizes the more significant flood-resistant provisions of the 2021 International Codes (I-Codes) and American Society of Civil Engineers (ASCE) 24-14, Flood Resistant Design and Construction, that are "higher standards" and that are more specific than the National Flood Insurance Program (NFIP) requirements.



Recommended Procedures for Flood Velocity Data Development (2012)

This report highlights recommended procedures for developing flood velocity data within the context of FEMA efforts related to the Risk Mapping, Assessment, and Planning (Risk MAP) Program and FEMA's Building Science Branch. Report sections provide detailed descriptions of velocity grid development and considerations for one-dimensional (1D), two-dimensional (2D), and three-dimensional (3D) models.

See " Damage Assessment Tools (Substantial Damage Estimator (SDE) Materials)" on page 46

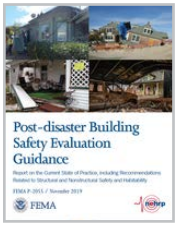
NFIP TECHNICAL BULLETINS

See "NFIP Technical Bulletins (0-11)" on page 43

See "Updates to the NFIP Technical Bulletins" on page 45

BUILDING PROFESSIONALS AND ENGINEERS

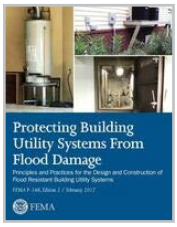
EXISTING CONSTRUCTION



FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

NONSTRUCTURAL COMPONENTS



FEMA P-348, Protecting Building Utility Systems From Flood Damage (2017)

The overall objective of this publication is to assist in the construction of buildings with building utility systems that are designed and built so that the buildings can be re-occupied and fully operational as soon as electricity and sewer and water are restored to the neighborhood.

This publication illustrates the design and construction of utility systems that comply with the National Flood Insurance Program (NFIP) requirements for construction of new residential and non-residential structures in flood-prone areas. It is also useful when evaluating structures that will undergo Substantial Improvement, guiding users to meet floodplain management regulations and building code requirements. Even if compliance is not required, many building owners may find that applying mitigation measures described in this publication will not only reduce future flood damage, but also facilitate recovery after flooding.

NFIP TECHNICAL BULLETINS

See "NFIP Technical Bulletins (0-11)" on page 43

See "Updates to the NFIP Technical Bulletins" on page 45

PRIVATE SECTOR AND SMALL BUSINESS

NFIP TECHNICAL BULLETINS

See "NFIP Technical Bulletins (0-11)" on page 43

See "Updates to the NFIP Technical Bulletins" on page 45

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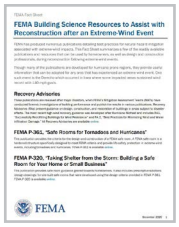
HIGH WIND PUBLICATIONS

INDIVIDUALS AND HOMEOWNERS

GENERAL



FEMA Building Science Resources to Assist with Reconstruction after an Extreme-Wind Event (December 2020)

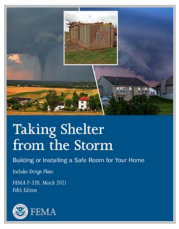
FEMA has produced numerous publications detailing best practices for natural hazard mitigation associated with extreme-wind impacts. This Fact Sheet summarizes a few of the readily available publications and resources that can be used by homeowners, as well as design and construction professionals, during reconstruction following extreme-wind events.

FEMA L-233 – *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business* (2014)

This brochure is about FEMA P-320, Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business, which is now in its fifth edition. It describes briefly how having a safe room built for your home or small business can help provide near-absolute protection for you and your family or employees from injury or death caused by the dangerous forces of extreme-winds such as tornadoes and hurricanes.

FEMA L-780 – *Building Science for Disaster-Resistant Communities: Wind Hazard Publications* (2015)

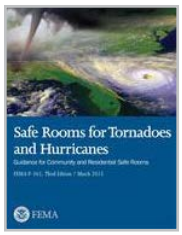
This brochure provides readers with a quick summary of publications that will help them prepare for and mitigate against wind hazards. The Building Science Branch develops and produces technical guidance and tools focused on fostering a disaster-resistant built environment. Located within FEMA's Federal Insurance and Mitigation Administration's (FIMA's) Risk Reduction Division, the Building Science Branch supports FIMA's mission to reduce risk to life and property by providing state-of-the-art technical hazard mitigation solutions for buildings



FEMA P-320 – *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business* (2021)

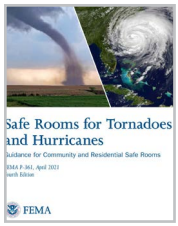
FEMA P-320 presents updated and refined criteria for residential safe rooms through reference to the newly updated fourth edition of FEMA P-361 (FEMA, 2021a), Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms. FEMA P-320 draws on these updated criteria to address how to design and construct a safe room for a one- or two-family dwelling that provides near-absolute protection from wind and wind-borne debris for occupants.

HIGH WIND PUBLICATIONS



FEMA P-361 – *History and Relevant FEMA Building Science Activities* (2015)

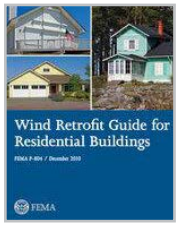
This document will contain the background and history of FEMA P-361 as well as the tornado and hurricane events that were researched to inform the necessary criteria for safe room design.



FEMA P-361 – *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, Fourth Edition* (April 2021)

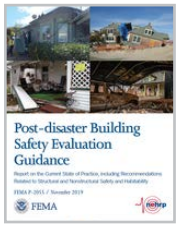
This publication provides guidance from FEMA about the planning, design, construction, and operation of safe rooms. It presents important information about the design and construction of residential and community safe rooms that will protect people during extreme-wind events such as tornadoes and hurricanes. The guidance in FEMA P-361 is intended for architects, engineers, building officials, local officials and emergency managers, and prospective safe room owners and operators.

FEMA P-361 presents updated and refined criteria for safe rooms compared to the third edition's 2015 criteria. The criteria presented in this publication address how to design and construct a safe room that provides near-absolute protection from wind and wind-borne debris for occupants.



FEMA P-804 – *Wind Retrofit Guide for Residential Buildings* (2010)

The purpose of this Guide is to provide guidance on how to improve the wind resistance of existing residential buildings in Mississippi and across the Gulf Coast. Although this Guide was developed to support initiatives in the Gulf Coast region, the content of this document should serve as guidance on retrofitting existing buildings for improved performance during high-wind events in all coastal regions.

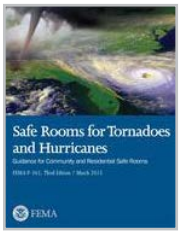


FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

BUILDING PROFESSIONALS AND ENGINEERS

GENERAL



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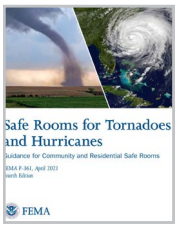

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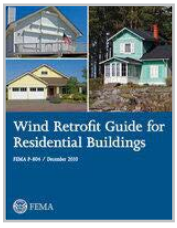
FEMA P-361 presents updated and refined criteria for safe rooms compared to the third edition's 2015 criteria. The criteria presented in this publication address how to design and construct a safe room that provides near-absolute protection from wind and wind-borne debris for occupants.

FEMA P-431 – *Tornado Protection: Selecting Refuge Area in Buildings, Second Edition* (2009)

This booklet presents information that will aid qualified architects and engineers in the identification of the best available refuge areas in existing buildings. The Best Available Refuge Area (BARA) Checklist may also be downloaded from the link on this page.



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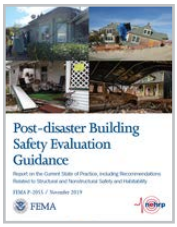
HIGH WIND PUBLICATIONS



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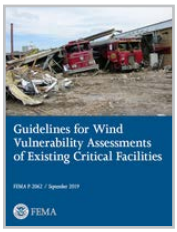


FEMA P-2062 - *Guidelines for Wind Vulnerability Assessments of Existing Critical Facilities* (2019)

Hurricanes Irma and Maria in 2017 as well as other recent storms, including Hurricane Michael in 2018, resulted in extensive wind damage to critical facilities in Puerto Rico, the U.S. Virgin Islands, and Florida. This manual provides design professionals with guidelines for assessing the vulnerability of critical facilities to wind pressure, wind-borne debris, and wind-driven rain. The manual incorporates observations and lessons learned from recent hurricanes, current building code requirements, past hurricanes, and other historic high wind events. The guidelines apply to critical facilities both within and outside hurricane-prone regions and to critical facilities in tornado-prone regions.

Mitigation Assessment Teams: Building Stronger and Safer (2021)

FEMA's MATs conduct engineering analyses after major natural disasters to assess damage to government facilities, homes, businesses, and other structures, and to determine the causes of structural failures and successes. Based on a comprehensive analysis of data, the teams prepare recommendations regarding construction codes and standards, building design issues, and best practices that communities and the construction industry can use to reduce damages in future disasters. The program works in collaboration with State and local government, and draws on a wide range of technical expertise from the private sector.

HURRICANE SANDY FACT SHEETS

Cleaning Flooded Buildings Fact Sheet, Hurricane Sandy Fact Sheet No. 1 (2013)

This Fact Sheet builds on information provided in FEMA's Recovery Advisory, Initial Restoration for Flooded Buildings (2005), prepared after Hurricane Katrina. It offers information on correctly cleaning and drying buildings that were not adequately cleaned and dried shortly after the Hurricane Sandy flooding. The advisory describes the selection and application of appropriate cleaners as well as the equipment and process needed to properly dry the building prior to any restoration efforts.

Foundation Requirements and Recommendations for Elevated Homes, Hurricane Sandy Recovery Fact Sheet No. 2 (2013)

This Fact Sheet includes foundation requirements and recommendations for elevated homes. The Fact sheet summarizes key concepts of the National Flood Insurance Program (NFIP), describes the typical damaged foundation types observed after Hurricane Sandy, and offers design guidance for elevating homes by retrofitting with deep foundations.

Building Science Support and Code Changes Aiding, Sandy Recovery Fact Sheet No. 3 (2014)

In 2012, Hurricane Sandy made landfall, devastating New Jersey and New York with tens of billions of dollars in damages. Since then, recovery activities have focused on increasing resilience of buildings and the lifeline infrastructure. Significant progress on this front, described in this fact sheet, includes:

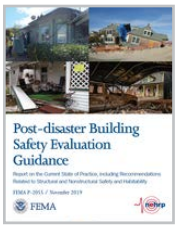
1. Deployment of the Hurricane Sandy MAT to assess damage and make recommendations
2. Updated building codes at the local, State, and national levels
3. Recovery projects across New Jersey, New York, and New York City to restore critical facilities and infrastructure
4. Developing a culture of resilient recovery in building mitigation and risk reduction actions

COMMUNITY PLANNING AND POLICY

GENERAL

FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (2017)

This Guide provides up-to-date, authoritative information and guidance that schools can use to develop a comprehensive strategy for addressing natural hazards. It is intended to be used by administrators, facilities managers, emergency managers, emergency planning committees, and teachers and staff at K through 12 schools. It can also be valuable for state officials, district administrators, school boards, teacher union leaders, and others that play a role in providing safe and disaster-resistant schools for all. Parents, caregivers, and students can also use this Guide to learn about ways to advocate for safe schools in their communities.



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SAFE ROOM RESOURCES

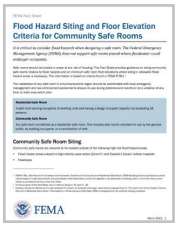
GENERAL

Community Safe Room Fact Sheet (2015)

This fact sheet provides information about safe rooms and explains that a safe room is a room or structure specifically designed and constructed to resist wind pressures and wind-borne debris impacts during an extreme-wind event, like tornadoes and hurricanes, for the purpose of providing life-safety protection.

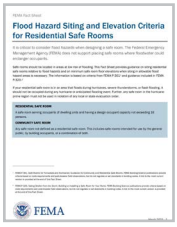
Community Tornado Safe Room Doors Installation and Maintenance Fact Sheet (2021)

Safe room door assemblies are one of the most important components of a safe room because they must provide the same level of protection as the walls and roof, yet also remain functional for quick access. This fact sheet provides information about the selection, installation, and maintenance of safe room door assemblies for community safe rooms. It is recommended that safe room door assembles are regularly maintained to protect their functionality and maximize their life span. The fact sheet covers what should be checked and how often, as well as several solutions related to the maintenance of safe room door assemblies. While the fact sheet discusses community safe room door assemblies, some of the information in the fact sheet is pertinent to owners of residential safe rooms.



Flood Hazard Elevation and Siting Criteria for Community Safe Rooms (2021)

It is critical to consider flood hazards when designing a safe room. FEMA cannot fund and does not support placing safe rooms where floodwaters could endanger occupants. This quick guide includes flood elevation and siting criteria for community safe rooms to be complaint with FEMA P-361 guidance.



Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms (February 2021)

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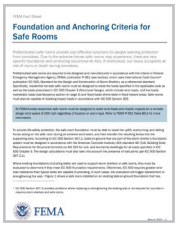
HIGH WIND PUBLICATIONS



Foundation and Anchoring Criteria for Safe Rooms Fact Sheet (2021)

Prefabricated safe rooms are becoming more popular as people seek protection from tornadoes. Due to the extreme forces safe rooms may experience, there are very specific foundation and anchoring requirements that, if overlooked, can leave occupants at risk of injury or death during tornadoes. This fact sheet provides graphics and useful information about the foundation and anchoring criteria in FEMA P-361, Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, Third Edition, which uses ICC 500, Standard for the Design and Construction of Storm Shelters, as a referenced standard.

Residential Safe Room Fact Sheet (2015)

This fact sheet provide information about residential safe rooms and explains that a safe room is a room or structure specifically designed and constructed to resist wind pressures and wind-borne debris impacts during an extreme-wind event, like tornadoes and hurricanes, for the purpose of providing life-safety protection.

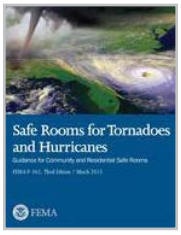
Residential Tornado Safe Room Doors Fact Sheet (2021)

Residential safe rooms are becoming more popular as families seek protection from violent tornadoes. Like any other room, safe rooms must be accessed through an opening or door. Just as the walls and roof of a safe room are designed and built to protect against extreme winds and wind-borne debris, so must the safe room door. When careful selection and installation of the safe room door assembly is overlooked, the safe room door opening can leave occupants at great risk of injury or death during tornadoes. This fact sheet provides graphics and useful information about selecting adequate door assemblies for residential safe rooms.

see "Safe Room Recovery Advisories" on page 81

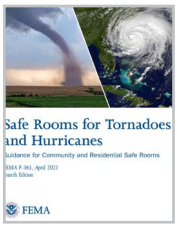
PRIVATE SECTOR AND SMALL BUSINESS

GENERAL



FEMA P-361 – *History and Relevant FEMA Building Science Activities* (2015)

This document will contain the background and history of FEMA P-361 as well as the tornado and hurricane events that were researched to inform the necessary criteria for safe room design.



FEMA P-361 – *Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms, Fourth Edition* (April 2021)

This publication provides guidance from FEMA about the planning, design, construction, and operation of safe rooms. It presents important information about the design and construction of residential and community safe rooms that will protect people during extreme-wind events such as tornadoes and hurricanes. The guidance in FEMA P-361 is intended for architects, engineers, building officials, local officials and emergency managers, and prospective safe room owners and operators.

FEMA P-361 presents updated and refined criteria for safe rooms compared to the third edition's 2015 criteria. The criteria presented in this publication address how to design and construct a safe room that provides near-absolute protection from wind and wind-borne debris for occupants.

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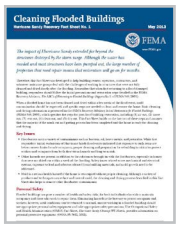
HURRICANE PUBLICATIONS

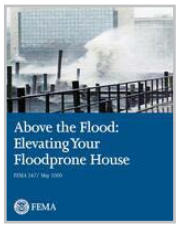
INDIVIDUALS AND HOMEOWNERS

PROTECTING PROPERTY



Cleaning Flooded Buildings Fact Sheet, Hurricane Sandy Recovery Fact Sheet No. 1 (2013)

This Fact Sheet builds on information provided in FEMA's Recovery Advisory, Initial Restoration for Flooded Buildings (2005), prepared after Hurricane Katrina. It offers information on correctly cleaning and drying buildings that were not adequately cleaned and dried shortly after the Hurricane Sandy flooding. The advisory describes the selection and application of appropriate cleaners as well as the equipment and process needed to properly dry the building prior to any restoration efforts.



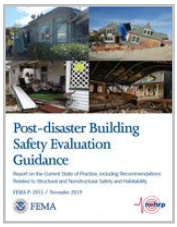
FEMA 347 – *Above the Flood: Elevating Your Floodprone House* (2000)

This publication shows how floodprone houses in south Florida were elevated above the 100-year flood level following Hurricane Andrew. Alternative elevation techniques are also demonstrated.

FEMA P-312 – *Homeowner's Guide to Retrofitting 3rd Edition* (2014)

FEMA has prepared this guide specifically for homeowners who want to know how to protect their homes from flooding. As a homeowner, you need clear information about the options available to you and straightforward guidance that will help you make decisions. This guide gives you both, in a form designed for readers who have little or no experience with flood protection methods or building construction techniques.

HURRICANE PUBLICATIONS



FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

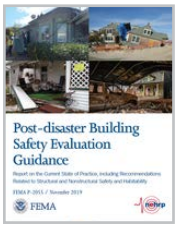
This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

Hurricane Recovery Issue Paper Guidance for Turning the Power Back On (English and Spanish) (2017)

This document contains guidance on the steps that should be taken during and after a power outage. IT is also available in Spanish.

COMMUNITY PLANNING AND POLICY

GENERAL



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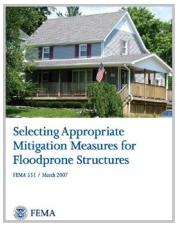
DESIGN AND CONSTRUCTION GUIDANCE

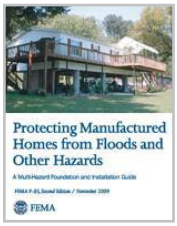


FEMA 551 – *Selecting Appropriate Mitigation Measures for Floodprone Structures* (2007)

FEMA 551, Selecting Appropriate Mitigation Measures for Floodprone Structures (2007)

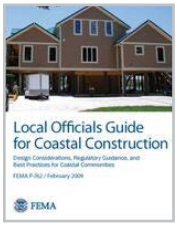
FEMA L-782 – *Building Science for Disaster-Resistant Communities: Flood Hazard Publications* (2011)

This brochure provides readers with a quick summary of publications that will help them prepare for and mitigate against flood hazards. The Building Science Branch develops and produces technical guidance and tools focused on fostering a disaster-resistant built environment. Located within FEMA's Federal Insurance and Mitigation Administration's (FIMA's) Risk Reduction Division, the Building Science Branch supports the directorate's mission to reduce risk to life and property by providing state-of-the-art technical hazard mitigation solutions for buildings.



FEMA P-85 – *Protecting Manufactured Homes from Floods and Other Hazards* (2009)

FEMA P-85 has been updated to reflect the requirements of the most current codes and standards and to provide a best practices approach in reducing damages from natural hazards. While the original version of FEMA 85 concentrated on flood and wind events, this version also addresses seismic hazards and recommends several multi-hazard resistant foundation designs. Designs are included for wood-framed foundations, conventional concrete and masonry pier foundations, and ground anchors. The ground anchor foundations are based on results from a series of first-of-its-kind saturated and dry soil anchor tests.



FEMA P-762 – *Local Officials Guide for Coastal Construction* (2009)

This document was developed to assist building officials in understanding the connection between National Flood Insurance Program (NFIP) guidelines, the International Building Code, and the International Residential Code. Additionally, flood and wind provisions of both ASCE 7-05 and ASCE 24-05 are presented and discussed. The guide also explores building performance and real-life success and failures following recent storm events and recommends design and construction "best practices" where appropriate.

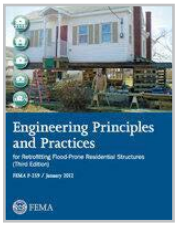
HURRICANE PUBLICATIONS

BUILDING PROFESSIONALS AND ENGINEERS

EXISTING CONSTRUCTION

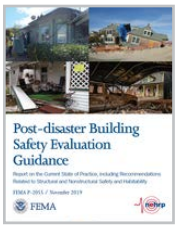
FEMA L-781 – *Building Science for Disaster-Resistant Communities: Hurricane Hazard Publications* (2011)

This brochure provides readers with a quick summary of publications that will help them prepare for and mitigate against hurricane hazards. The Building Science Branch develops and produces technical guidance and tools focused on fostering a disaster-resistant built environment. Located within FEMA's Federal Insurance and Mitigation Administration's (FIMA's) Risk Reduction Division, the Building Science Branch supports the directorate's mission to reduce risk to life and property by providing state-of-the-art technical hazard mitigation solutions for buildings.



FEMA P-259 – *Engineering Principles and Practices of Retrofitting Floodprone Residential Structures, Third Edition* (2012)

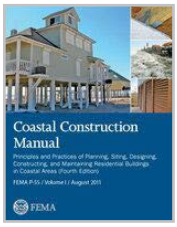
The third edition of this document is intended to further aid homeowners in selecting and successfully executing a flood retrofit on their home. Engineering design and economic guidance on what constitutes feasible and cost-effective retrofitting measures for flood-prone residential and non-residential structures are presented. Elevation, relocation, dry floodproofing, wet floodproofing, and the use of levees and floodwalls to mitigate flood hazards are discussed. This edition was updated to be more user-friendly and concise, the overall length of the publication has been shortened.



FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

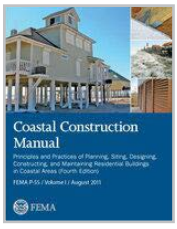
This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

NEW CONSTRUCTION



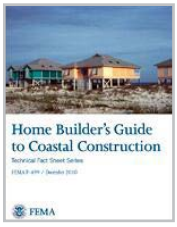
FEMA P-55 VOL I – *Coastal Construction Manual, Fourth Edition* (2011)

The 2011 CCM, 4th Ed. (FEMA P-55), is a 2-volume publication that provides a comprehensive approach to planning, siting, designing, constructing, and maintaining homes in the coastal environment. Volume I provides information about hazard identification, siting decisions, regulatory requirements, economic implications, and risk management. The primary audience for Volume I is design professionals, officials, and those involved in the decision-making process.



FEMA P-55 VOL II – *Coastal Construction Manual, Fourth Edition* (2011)

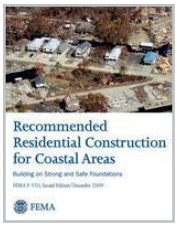
The 2011 CCM, 4th Ed. (FEMA P-55), is a 2-volume publication that provides a comprehensive approach to planning, siting, designing, constructing, and maintaining homes in the coastal environment. Volume II contains in-depth descriptions of design, construction, and maintenance practices that, when followed, will increase the durability of residential buildings in the harsh coastal environment and reduce economic losses associated with coastal natural disasters. The primary audience for Volume II is the design professional who is familiar with building codes and standards and; has a basic understanding of engineering principles.



FEMA P-499 – *Home Builder's Guide to Coastal Construction* (2010)

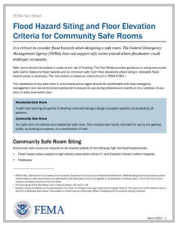
FEMA produced this series of 37 fact sheets to provide technical guidance and recommendations concerning the construction of coastal residential buildings. The fact sheets present information aimed at improving the performance of buildings subject to flood and wind forces in coastal environments. Photographs and drawings illustrate National Flood Insurance Program (NFIP) regulatory requirements, the proper siting of coastal buildings, and recommended design and construction practices for building components, including structural connections, the building envelope, and utilities.

HURRICANE PUBLICATIONS



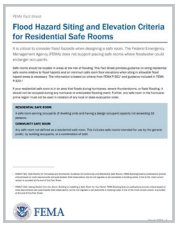
FEMA P-550 – *Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations* (2009)

Every storm has shown that, while good design and construction cannot completely eliminate risk, they can significantly reduce the risk to life and damage to property. This design manual provides recommended designs and guidance for rebuilding homes destroyed by hurricanes in the Gulf Coast. The manual also provides guidance in designing and building less vulnerable new homes that reduce the risk to life and property. To keep pace with developing codes and standards and to improve its guidance, FEMA is issuing this Second Edition of FEMA 550. The Second Edition of FEMA 550 contains a new foundation style Case H, which incorporates an elevated concrete beam for improved structural efficiency. The Second Edition of FEMA 550 has also been updated for consistency with the 2006 and 2009 editions of the IRC and IBC, and the 2005 Edition of ASCE 7 Minimum Design Loads for Buildings and Other Structures.



Flood Hazard Elevation and Siting Criteria for Community Safe Rooms (2021)

It is critical to consider flood hazards when designing a safe room. FEMA cannot fund and does not support placing safe rooms where floodwaters could endanger occupants. This quick guide includes flood elevation and siting criteria for community safe rooms to be complaint with FEMA P-361 guidance.



Flood Hazard Elevation and Siting Criteria for Residential Safe Rooms (February 2021)

It is critical to consider flood hazards when designing a safe room. FEMA cannot fund and does not support placing safe rooms where floodwaters could endanger occupants. This quick guide includes flood elevation and siting criteria for residential safe rooms to be compliant with FEMA P-361 guidance.

PRIVATE SECTOR AND SMALL BUSINESS

NFIP TECHNICAL BULLETINS

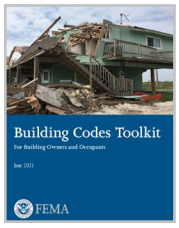
See "NFIP Technical Bulletins (0-11)" on page 43

See "Updates to the NFIP Technical Bulletins" on page 45

MULTI-HAZARD PUBLICATIONS

INDIVIDUALS AND HOMEOWNERS

PROTECTING PROPERTY



Building Codes Toolkit (2021)

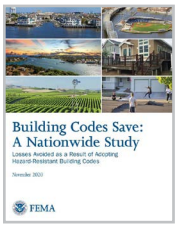
This toolkit contains guidance and tools on building codes for property owners, engineers and design professionals, building codes officials, and the general public. Materials referenced here are based on local best practices, input from local, regional, and federal subject matter experts, industry partners, and existing FEMA standards and guidance.

FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

COMMUNITY PLANNING AND POLICY

GENERAL



Building Codes Save: A Nationwide Study - Losses Avoided as a Result of Adopting Hazard-Resistant Building Codes (November 2020)

FEMA's landmark study, "Building Codes Save: A Nationwide Study," shows that modern building codes lead to major reduction in property losses from natural disasters. The FEMA report calculates losses from three types of natural hazard (earthquakes, flooding, and hurricane winds) for each state and Washington, D.C.

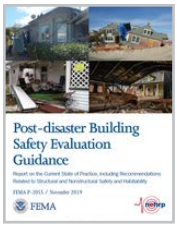
Protecting Communities and Saving Money - The Case for Adopting Building Codes (November 2020)

This brochure is a companion piece to *Building Codes Save: A Nationwide Study.*

MULTI-HAZARD PUBLICATIONS

FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (2017)

This Guide provides up-to-date, authoritative information and guidance that schools can use to develop a comprehensive strategy for addressing natural hazards. It is intended to be used by administrators, facilities managers, emergency managers, emergency planning committees, and teachers and staff at K through 12 schools. It can also be valuable for state officials, district administrators, school boards, teacher union leaders, and others that play a role in providing safe and disaster-resistant schools for all. Parents, caregivers, and students can also use this Guide to learn about ways to advocate for safe schools in their communities.



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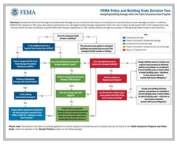
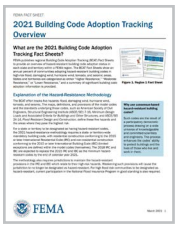


FEMA Policy and Building Code Decision Tree

Substantial Structural Damage and Substantial Damage are two conditions that require a building to improve beyond its pre-damage state. In addition, FEMA Public Assistance (PA) policy also allows the improvement of a damaged building through replacement when the cost of repair would exceed 50% of the replacement cost. This document guides FEMA staff, PA grant applicants or their representatives, state hazard mitigation officers, and others through the process of making these determinations and decisions.



Building Code Adoption Tracking (BCAT) Fact Sheets (2021)

The annual BCAT fact sheets provide an overview of the building code adoption status within each state and territory, organized by FEMA region. The fact sheets:

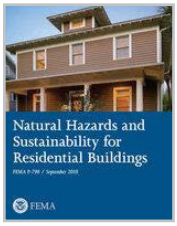
- Describe weakening amendments the state or territory introduced into the building or residential code for any of the five tracked hazards (damaging wind, hurricane wind, tornado, seismic, and flood)
- Assess the building and residential codes for mandatory or limited statewide or territory-wide applicability
- Show the percentage of hazard-resistant jurisdictions within each state or territory

Mutual Aid for Building Department (MABD) Fact Sheets (2021)

The annual MABD regional fact sheets provide an overview of mutual aid laws and regulations in each state or territory, for response teams to assist with building code safety and enforcement after disasters. The fact sheets:

- Describe the intrastate mutual aid system (IMAC) in each state or territory
- Describe how each state or territory has incorporated private sector into its mutual aid response system
- Describe legal protections for private personnel conducting disaster response efforts in coordination with state, territory or local government officials
- Highlight provisions related to architects, engineers or design professionals

DESIGN AND CONSTRUCTION



FEMA P-798 – *Natural Hazards and Sustainability for Residential Buildings* (2010)

FEMA P-798 examines current green building rating systems in a broader context. It identifies green building practices—the tools of today's green building rating systems—that are different from historical residential building practices and that, unless implemented with an understanding of their interactions with the rest of the structure, have the potential to compromise a building's resistance to natural hazard events. This document discusses how to retain or improve natural hazard resistance while incorporating these green building practices. While most common green building practices provide sustainability advantages with little or no effect on structural performance or durability, others require reevaluation of the building's structural design or detailing to retain its integrity during natural hazard events. Often, only minimal design modifications are required to maintain natural hazard resistance.

MULTI-HAZARD PUBLICATIONS

FEMA P-1019 – *Emergency Power Systems for Critical Facilities: A Best Practices Approach* (2014)

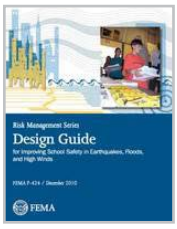
There is a significant likelihood that utility power will not be available for an extended period of time during severe natural hazard events. Thus, it is necessary for critical facilities to have reliable sources of sustained electrical power to achieve continued operation. This document provides guidance on the design and operation of emergency power systems in critical facilities so that they will be able to remain operational for extended periods, as needed.

SUBSTANTIAL DAMAGE ESTIMATOR TOOLS

See " Damage Assessment Tools (Substantial Damage Estimator (SDE) Materials)" on page 46

BUILDING PROFESSIONALS AND ENGINEERS

GENERAL



FEMA 424 – *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds* (2010)

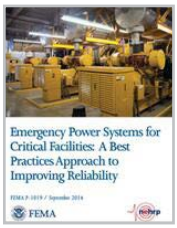
This manual is intended to provide guidance for the protection of school buildings from natural disasters. This volume concentrates on grade schools, K-12. FEMA P-424 covers earthquakes, floods, and high winds. Its intended audience is design professionals and school officials involved in the technical and financial decisions of school construction, repair, and renovations. NOTE: This publication is available free to Local and State government staff. All other interested parties can obtain this publication via online download only.

FEMA 543 – *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings* (2007)

This manual concentrates on critical facilities (hospitals, schools, fire and police stations, and emergency operation centers). It is based on the behavior of critical facilities during Hurricane Katrina and makes recommendations on the performance of these types of buildings. It provides building professionals and decision-makers with information and guidelines for implementing a variety of mitigation measures to reduce the vulnerability to damage and disruption of operations during severe flooding and high-wind events. It includes extensive information on the impact of storm surges to the Gulf Area.

FEMA 577 – *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings* (2007)

The intent of the Design Guide is to provide its audience with state-of-the-art knowledge on the variety of vulnerabilities faced by hospitals exposed to earthquakes, flooding, and high-winds risks, as well as the best ways to mitigate the risk of damage and disruption of hospital operations caused by these events. The information presented in this publication provides an exhaustive review of mitigation measures and design solutions that can improve the safety of hospitals in natural hazard events. However, this publication is not intended to be a comprehensive mitigation design manual that the reader can use to develop actual plans and specifications. It is intended as an introduction to the fundamental principles of natural hazard risk reduction, with an emphasis on mitigation planning and the design of hospital buildings.



FEMA P-1019 – *Emergency Power Systems for Critical Facilities: A Best Practices Approach to Improving Reliability* (2014)

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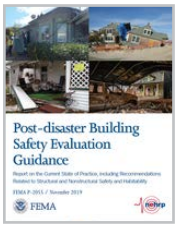


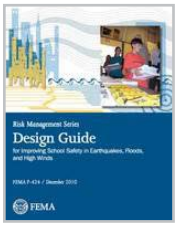
FEMA P-2055 – *Post-disaster Building Safety Evaluation Guidance* (November 2019)

This report is on the current state of practice for post-disaster building safety evaluation, including recommendations related to structural and nonstructural safety and habitability. FEMA P-2055 summarizes and references best practice guideline documents, identifies recommended improvements and needs, and provides interim recommendations for issues without best practice guidance. It also offers considerations for program planning prior to an incident and program management and implementation after an incident, including a primer for state, local, tribal, and territorial governments that have the authority to set standards or policy related to the implementation of post-disaster evaluations. The following incident types are covered: earthquakes; hurricanes; floods; tornadoes; tsunamis; landslides and other land instabilities; volcanoes; snow, hail, and ice storms; fire; and explosions.

MULTI-HAZARD PUBLICATIONS

PRIVATE SECTOR AND SMALL BUSINESS

GENERAL



FEMA 424 – *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds* (2010)

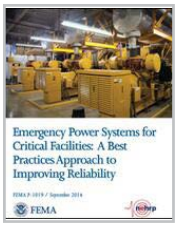
This manual is intended to provide guidance for the protection of school buildings from natural disasters. This volume concentrates on grade schools, K-12. FEMA P-424 covers earthquakes, floods, and high winds. Its intended audience is design professionals and school officials involved in the technical and financial decisions of school construction, repair, and renovations. NOTE: This publication is available free to Local and State government staff. All other interested parties can obtain this publication via online download only.

FEMA 543 – *Design Guide for Improving Critical Facility Safety from Flooding and High Winds: Providing Protection to People and Buildings* (2007)

This manual concentrates on critical facilities (hospitals, schools, fire and police stations, and emergency operation centers). It is based on the behavior of critical facilities during Hurricane Katrina and makes recommendations on the performance of these types of buildings. It provides building professionals and decision-makers with information and guidelines for implementing a variety of mitigation measures to reduce the vulnerability to damage and disruption of operations during severe flooding and high-wind events. It includes extensive information on the impact of storm surges to the Gulf Area.

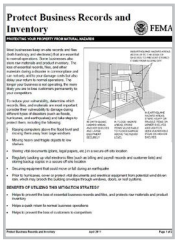
FEMA 577 – *Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings* (2007)

The intent of the Design Guide is to provide its audience with state-of-the-art knowledge on the variety of vulnerabilities faced by hospitals exposed to earthquakes, flooding, and high-winds risks, as well as the best ways to mitigate the risk of damage and disruption of hospital operations caused by these events. The information presented in this publication provides an exhaustive review of mitigation measures and design solutions that can improve the safety of hospitals in natural hazard events. However, this publication is not intended to be a comprehensive mitigation design manual that the reader can use to develop actual plans and specifications. It is intended as an introduction to the fundamental principles of natural hazard risk reductions.



FEMA P-1019 – *Emergency Power Systems for Critical Facilities: A Best Practices Approach to Improving Reliability* (2014)

There is a significant likelihood that utility power will not be available for an extended period of time during severe natural hazard events. Thus, it is necessary for critical facilities to have reliable sources of sustained electrical power to achieve continued operation. This document provides guidance on the design and operation of emergency power systems in critical facilities so that they will be able to remain operational for extended periods, as needed.



Protect Your Business from All Natural Hazards (2011)

Protecting your business from disasters caused by natural hazards can involve a variety of actions, from inspecting and maintaining your buildings to installing protective devices. Most of these actions, especially those that affect the structure of your buildings or their utility systems, should be carried out by qualified maintenance staff or professional contractors licensed to work in your state, county, or city. One example of disaster protection is safely storing the important documents, electronic files, raw materials, and inventory required for the operation of your business.

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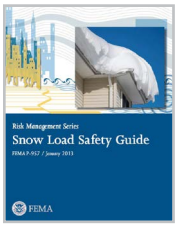
OTHER HAZARDS: SNOW PUBLICATIONS

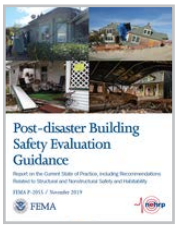
COMMUNITY PLANNING AND POLICY

GENERAL



FEMA P-957 – *Snow Load Safety Guide* (2013)

The objective of the Risk Management Series Snow Load Safety Guide is to inform building stakeholders about the risks a snow event poses to their buildings, provide them with information about preventative measures to take before the snow season, and inform them of actions that should be taken before, during, and after a snow event. This document is not intended to provide a comprehensive discussion of the underlying issues or forensics of snow-induced structural failure. The purpose is instead to: 1. Inform building stakeholders of susceptible snow loading conditions 2. Identify potentially vulnerable roof framing systems 3. Outline a general methodology to monitor buildings for signs of potential failure so that steps can be taken to reduce the potential risk of snow-load-induced structural failure



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FEMA Roof Snowdrift Design Guide (September 2019)

Following a series of heavy snow and wind events in February of 2015, a FEMA team assessed four partial school building collapses in the Greater Boston area. In all four cases, the partial collapses were due to roof snowdrift loading. In two of the four cases, the FEMA team observed and documented 3-D drifts that cannot be determined when following the current ASCE 7 minimum load requirements.

This new design guide provides guidance, in the form of three design examples, for three-dimensional (3-D) roof snowdrifts. The procedures identified are consistent with the intersecting drift provisions expected in the 2022 edition of ASCE 7 and are intended to serve as best practice guidance for design professionals in the interim.

FEMA Snow Load Safety Guidance Fact Sheet (2014)

This flyer summarizes warning signs of overstress conditions during a snow event, key safety issues and risks a snow event poses to buildings, and what to do after a snow event.

SNOW STUDY SUMMARY REPORT

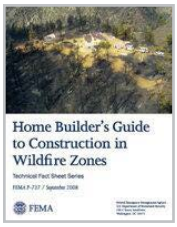
Snow Study Summary Report: Observations of Snow Load Effects on Four School Buildings in New England (2016)

The conclusions and recommendations of this report are intended to provide decision-makers and design professionals with information and technical guidance that can be used to reduce future damage from snow loads.

OTHER HAZARDS: WILDFIRE PUBLICATIONS

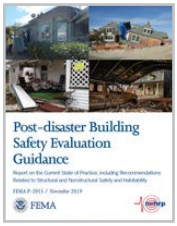
INDIVIDUALS AND HOMEOWNERS

GENERAL



FEMA P-737 – *Home Builder's Guide to Construction in Wildfire Zones* (2008)

The purpose of these Technical Fact Sheets is to provide information about wildfire behavior and recommendations for building design and construction methods in the wildland/urban interface. Implementation of the recommended design and construction methods can greatly increase the chances of a building's survival in a wildfire.



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***Rebuilding After a Wildfire Fact Sheet* (2016)**

Returning to your fire-damaged home will undoubtedly be an emotional experience. But as you go about the task of rebuilding, there are many ways to rebuild safer, stronger, smarter and more resilient to wildfires. FEMA has teamed with Firewise Communities, the Federal Alliance for Safe Housing, and the Institute for Business and Home Safety to provide this resource for rebuilding after a fire.

PRIVATE SECTOR AND SMALL BUSINESS

GENERAL

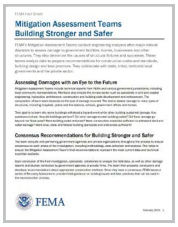
FEMA P-754 – *Wildfire Hazard Mitigation Handbook for Public Facilities* (2008)

FEMA 551, Selecting Appropriate Mitigation Measures for Floodprone Structures (2007)

MAT ACTIVITIES PUBLICATIONS

MAT ACTIVITIES

MAT PROGRAM

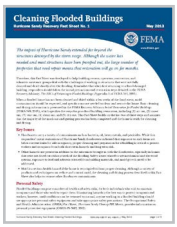


FEMA Mitigation Assessment Team Program Fact Sheet (2021)

FEMA's Mitigation Assessment Teams (MATs) conduct engineering analyses after major natural disasters to assess damage to government facilities, homes, businesses, and other structures. They also determine the causes of structural failures and successes. These teams analyze data to prepare recommendations for construction codes and standards, building design and best practices. They collaborate with state, tribal, territorial, local governments and the private sector.

FEMA P-2054 – *Mitigation Assessment Team Compendium Report* (2019)

The 2017 Atlantic hurricane season was extremely active, producing 17 named storms. Six of these storms became major hurricanes (Category 3, 4, or 5), and three ranked in the National Hurricane Center's (NHC's) top five hurricanes with the greatest cumulative damage.



Cleaning Flooded Buildings Fact Sheet, Hurricane Sandy Fact Sheet No. 1 (2013)

This Fact Sheet builds on information provided in FEMA's Recovery Advisory, Initial Restoration for Flooded Buildings (2005), prepared after Hurricane Katrina. It offers information on correctly cleaning and drying buildings that were not adequately cleaned and dried shortly after the Hurricane Sandy flooding. The advisory describes the selection and application of appropriate cleaners as well as the equipment and process needed to properly dry the building prior to any restoration efforts.

Foundation Requirements and Recommendations for Elevated Homes Hurricane Sandy Recovery Fact Sheet No. 2 (2013)

This Fact Sheet includes foundation requirements and recommendations for elevated homes. The Fact sheet summarizes key concepts of the National Flood Insurance Program (NFIP), describes the typical damaged foundation types observed after Hurricane Sandy, and offers design guidance for elevating homes by retrofitting with deep foundations.

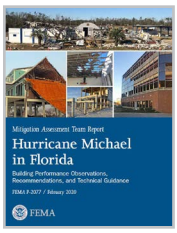
MAT ACTIVITIES PUBLICATIONS

Building Science Support and Code Changes Aiding Sandy Recovery Fact Sheet No. 3 (2014)

In 2012, Hurricane Sandy made landfall, devastating New Jersey and New York with tens of billions of dollars in damages. Since then, recovery activities have focused on increasing resilience of buildings and the lifeline infrastructure. Significant progress on this front, described in this fact sheet, includes:

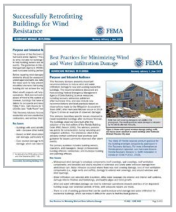
1. Deployment of the Hurricane Sandy MAT to assess damage and make recommendations
2. Updated building codes at the local, State, and national levels
3. Recovery projects across New Jersey, New York, and New York City to restore critical facilities and infrastructure
4. Developing a culture of resilient recovery in building mitigation and risk reduction actions

HURRICANE MICHAEL IN FLORIDA



FEMA P-2077 – *Mitigation Assessment Team Report: Hurricane Michael in Florida* (2020)

Approximately 2 weeks after Hurricane Michael struck the Florida coast, FEMA deployed a pre-Mitigation Assessment Team (pre-MAT) (October 22 to 25, 2018) consisting of a small team of subject matter experts (SMEs) to perform a preliminary field assessment of building damage in limited areas in Bay, Calhoun, Franklin, Gulf, Jackson, and Wakulla Counties.



Hurricane Michael Recovery Advisories (2019)

Following Hurricane Michael, a FEMA Building Science MAT studied the damages from Hurricane Michael and prepared two Recovery Advisories (RAs). These RAs are applicable to other hurricane-affected areas.

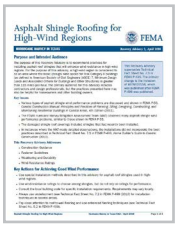
HURRICANE HARVEY IN TEXAS

FEMA P-2022 – *Mitigation Assessment Team Report: Hurricane Harvey in Texas* (2019)

In response to Hurricane Harvey FEMA's Federal Insurance and Mitigation Administration's (FIMA) Building Science Branch deployed a MAT to affected areas in Texas in November and December 2017. The MAT was deployed to Harris County to assess flood performance issues, and to Aransas, Nueces, Refugio, and San Patricio Counties to assess wind performance issues. MAT members evaluated building systems to determine the effectiveness of various design and construction practices and ascertain the effect of code adoption and enforcement on reducing flood and wind damage. To improve resiliency in future events, the lessons learned can either be incorporated into best practices for future retrofits or new hazard-resistant building design.

RA 1, *Dry Floodproofing Planning and Design Considerations* (2018)

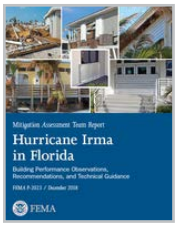
The purpose of this Recovery Advisory is to provide guidance on the design of dry floodproofing measures to reduce flood damage and limit interruption of building services. The audience for this advisory includes building owners, operators, and managers; architects; engineers; building officials; contractors; and local government officials responsible for public building planning, design, and maintenance.



RA 2, *Asphalt Shingle Roofing for High-Wind Regions* (2018)

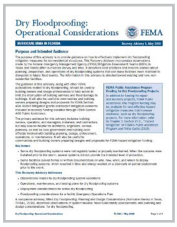
The purpose of this Recovery Advisory is to recommend practices for installing asphalt roof shingles that will enhance wind resistance in high-wind regions. The primary audience for this advisory includes contractors and design professionals, but the practices presented here may also be helpful for homeowners and other building owners.

HURRICANE IRMA IN FLORIDA



FEMA P-2023 – *Mitigation Assessment Team Report: Hurricane Irma in Florida* (2018)

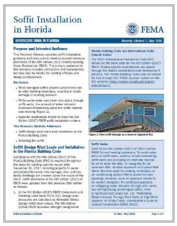
FEMA's Federal Insurance and Mitigation Administration's (FIMA) Building Science Branch deployed a MAT composed of national and regional subject matter experts to affected areas in Florida in December 2017. The MAT assessed the performance of municipal buildings, coastal residential properties, and public facilities to make recommendations for actions that Federal, State, and local governments; the design and construction industry; and building code and standards organizations can take to mitigate damage from future natural hazard events.



RA 1, *Dry Floodproofing: Operational Considerations* (2018)

The purpose of this advisory is to provide guidance on how to effectively implement dry floodproofing mitigation measures for non-residential structures. The primary audience for this advisory includes building owners, operators, and managers; installers; and contractors, but may also be helpful for architects, engineers, various planners, as well as local government and building code officials involved with building planning, design, enforcement, operations, or maintenance. It will also be useful to communities and building owners preparing designs and proposals for FEMA hazard mitigation funding.

MAT ACTIVITIES PUBLICATIONS



RA 2, *Soffit Installation in Florida* (2018)

This Recovery Advisory provides soffit installation guidance and resources to meet or exceed minimum provisions of the 6th Edition (2017) Florida Building Code, Residential (FBCR). The primary audience for this advisory includes contractors and homeowners, but may also be helpful for building officials and design professionals.

RA 3, *Mitigation Triggers for Flood Repair and Replacement* (2018)

This Recovery Advisory provides guidance on wind mitigation triggers for roof repairs and replacement in the 6th Edition (2017) Florida Building Code (FBC). The information in this advisory is particularly pertinent to repairs and rebuilding in areas of Florida recovering from Hurricane Irma. However, this information applies generally throughout Florida. The primary audience for this advisory includes building owners, operators, and managers; design professionals; building officials; contractors; and municipal building and planning officials. The guidance in this advisory should be incorporated or referenced to help in the development of repair scopes of work and/or hazard mitigation proposals for FEMA Section 406 Public Assistance grants or used by designers and various stakeholders for other projects.

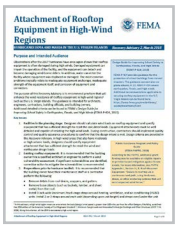
HURRICANES IRMA AND MARIA IN THE U.S. VIRGIN ISLANDS

FEMA P-2021 – *Mitigation Assessment Team Report: Hurricanes Irma and Maria in the U.S. Virgin Islands* (2018)

FEMA's Federal Insurance and Mitigation Administration's (FIMA) Building Science Branch deployed a MAT to affected areas in St. Thomas, St. John, and St. Croix, in October and November, 2017. The MAT was charged with evaluating damage from Hurricanes Irma and Maria, especially for buildings constructed or reconstructed after Hurricane Marilyn (1995), to identify both successful and unsuccessful mitigation techniques. This work involved: assessing the performance of residential, nonresidential, and critical facilities affected by the storms; evaluating the performance of photovoltaic (PV) facilities; investigating the effects of wind speed-up due to the islands' topography on building performance; and meeting with residents and local officials to better understand what transpired during and after the storms.

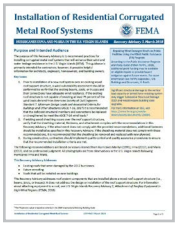
RA 1, *Rebuilding Your Flood-Damaged House (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to provide information to assist with rebuilding decisions in the aftermath of Hurricanes Irma and Maria in 2017 as well as future flooding events. The intended audience for this advisory is primarily homeowners, residential contractors, and designers.



RA 2, *Attachment of Rooftop Equipment in High-Wind Regions (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to recommend practices that will enhance the wind resistance of rooftop equipment in high-wind regions such as the U.S. Virgin Islands. This guidance is intended for architects, engineers, contractors, building officials, and building owners.



RA 3, *Installation of Residential Corrugated Metal Roof Systems (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to recommend practices for installing corrugated metal roof systems that will enhance their wind and water leakage resistance in the U.S. Virgin Islands (USVI). This guidance is primarily intended for contractors; however, it provides helpful information for architects, engineers, homeowners, and building owners.

RA 4, *Design, Installation and Retrofit of Doors, Windows and Shutters (English and Spanish)* (2018)

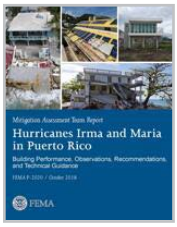
The purpose of this Recovery Advisory is to recommend practices for selecting, detailing, and installing doors, windows, and storm shutters that will enhance their wind and water leakage resistance in the U.S. Virgin Islands. This guidance is intended for building owners, architects, engineers, and contractors; however, it provides helpful information for other stakeholders as well.

RA 5, *Rooftop Solar Panel Attachment (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to provide guidance on existing code requirements as well as recommend best practices for attachment design, installation, and maintenance of rooftop solar panels, also known as photovoltaic (PV) panels, to increase panel wind resistance in the U.S. Virgin Islands. This guidance is primarily intended for architects, engineers, and contractors. However, it also provides helpful information for facility operators, building and home owners as well as for manufacturers of PV panels and attachment devices.

MAT ACTIVITIES PUBLICATIONS

HURRICANES IRMA AND MARIA IN PUERTO RICO

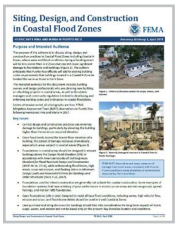


FEMA P-2020 – *Mitigation Assessment Team Report: Hurricanes Irma and Maria in Puerto Rico* (2018)

In response to Hurricanes Irma and Maria, FEMA deployed a MAT to evaluate damage, document observations, and, based on these, offer conclusions and recommendations on the performance of buildings and other structures affected by wind forces, flooding, and other hazards due to the hurricanes. The conclusions and recommendations in this report are intended to provide decision makers, designers, contractors, planners, code officials, industry groups, government officials, academia, homeowners, and business owners and operators with information and technical guidance that can be used to reduce future hurricane damage.

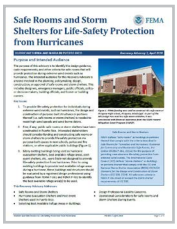
RA 1, *Rooftop Equipment Maintenance and Attachment In High-Wind Regions (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to recommend practices that will increase the wind resistance of rooftop equipment in high-wind regions such as Puerto Rico. This guidance is intended for architects, engineers, contractors, building officials, and building owners. Additional detailed criteria can be found in FEMA's Design Guide for Improving School Safety in Earthquakes, Floods and High Winds.



RA 2, *Siting, Design, and Construction in Coastal Flood Zones (English and Spanish)* (2018)

The purpose of this advisory is to discuss siting, design, and construction practices in Coastal Flood Zones including Coastal A Zones, where wave and flood conditions during a flooding event will be less severe than in V Zones but can still cause significant damage to foundations and buildings (Figure 1). The authors anticipate that Puerto Rico officials will add to existing building codes requirements that buildings located in a Coastal A Zone be treated the same as those in the V Zone. The intended audience for this document includes building owners and design professionals who are planning new building or rebuilding projects in coastal areas, as well as floodplain managers and community regulators involved in developing and enforcing building codes and ordinances in coastal floodplains.



RA 3, *Safe Rooms and Storm Shelters for Life-Safety Protection from Hurricanes (English and Spanish)* (2018)

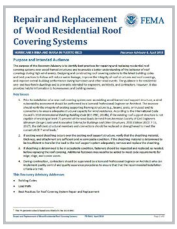
The purpose of this advisory is to identify the design guidance, code requirements, and other criteria for safe rooms that will provide protection during extreme-wind events such as hurricanes. The intended audience for this Recovery Advisory is anyone involved in the planning, policymaking, design, construction, or approval of safe rooms and storm shelters.

RA 4, *Best Practices for Minimizing Flood Damage to Existing Structures (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to identify best practices for using wet flood proofing techniques to reduce flood damage to new or existing residential and non-residential concrete buildings that are not substantially improved or substantially damaged as defined by the National Flood Insurance Program (NFIP) and local codes. An overview of methods to achieve NFIP compliance for new or existing buildings that are substantially improved or substantially damaged is also provided. The intended audience for this advisory is anyone involved in the repair of existing residential or non-residential structures.

RA 5, *Protecting Windows and Openings in Buildings (English and Spanish)* (2018)

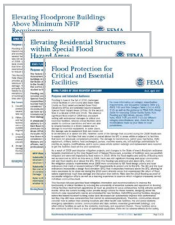
The purpose of this Recovery Advisory is to identify best practices for repairing and replacing residential roof covering systems over wood framed structures and to provide a better understanding of the behavior of roof coverings during high wind events. The guidance is for residential one and two-family dwellings and is primarily intended for engineers, architects, and contractors. However, it also provides helpful information to homeowners and building owners.



RA 6, *Repair and Replacement of Wood Residential Roof Covering Systems (English and Spanish)* (2018)

The purpose of this Recovery Advisory is to identify best practices for repairing and replacing residential roof covering systems over wood framed structures and to provide a better understanding of the behavior of roof coverings during high wind events. Designing and constructing roof covering systems to the latest building codes and best practices to follow will reduce water leakage, improve the integrity of roof structures and roof coverings, and improve overall building performance during hurricanes and other wind events. The guidance is for residential one- and two-family dwellings and is primarily intended for engineers, architects, and contractors. However, it also provides helpful information to homeowners and building owners.

2016 FALL FLOODING IN IOWA RECOVERY ADVISORIES

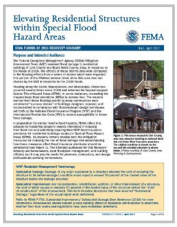


The following five Recovery Advisories were developed by the FEMA MAT that responded to and studied damage from the 2016 Flooding in Iowa. They present mitigative measures that can and have implemented to minimize damage to residential buildings and critical facilities subject to riverine flooding. A list of the RAs is provided below:

MAT ACTIVITIES PUBLICATIONS

RA 1, *Elevating Floodprone Buildings Above Minimum NFIP Requirements* (2017)

This Recovery Advisory reviews how Flood Insurance Rate Maps (FIRMs) and BFEs are established and provides guidance on elevating buildings above minimum NFIP requirements to minimize flood damage. The intended audience for this advisory is primarily homeowners and designers, but it may be helpful to anyone involved in selecting lowest floor elevations for new construction and reconstruction of buildings in areas with riverine flooding across Iowa and other Midwest states.

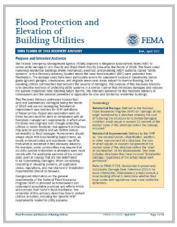


RA 2, *Elevating Residential Structures within Special Flood Hazard Areas* (2017)

FEMA offers this recovery advisory to residential property owners interested in reducing their flood risk and potentially lowering their NFIP flood insurance premiums for residential buildings located in Special Flood Hazard Areas (SFHA). As property owners rebuild, both the mitigation measures for reducing the risk of flood damage and understanding how these measures affect flood insurance premiums should be considered. The intended audiences for this Recovery Advisory are homeowners, local floodplain management, and building officials, but it may also be useful for planners, contractors, and design professionals advising homeowners.

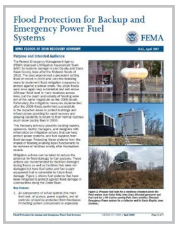
RA 3, *Flood Protection for Critical and Essential Facilities* (2017)

This Recovery Advisory provides flood mitigation information and recommendations to improve the functionality of critical facilities by reducing the vulnerability of essential systems and equipment to flooding.



RA 4, *Flood Protection and Elevation of Building Utilities* (2017)

This Recovery Advisory addresses houses that were not Substantially Damaged during the floods of 2016 and are not undergoing Substantial Improvement. Repair and restoration work on these houses must be done in compliance with all floodplain management requirements in effect when the home was originally built (though protecting utilities to newer floodplain management ordinances may also be acceptable and will further reduce vulnerability to flood damage). Homeowners should always check with local building departments, as locally enforced codes and standards may differ from what is described in this Recovery Advisory.



RA 5, *Flood Protection for Backup and Emergency Power Fuel Systems* (2017)

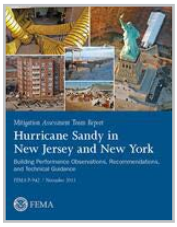
This Recovery Advisory provides building owners, operators, facility managers, and designers with information on mitigation actions that can help protect power systems, and fuel supplies from flood damage.

TORNADO IN MOORE, OKLAHOMA

FEMA P-1020 – *Tornado: Moore, Oklahoma, May 20, 2013* (2014)

This formal observation report presents the observations, conclusions, and recommendations in response to field investigations conducted after the EF-5 tornado that impacted Moore, Oklahoma, on May 20, 2013. The post-storm investigation team focused its efforts on safe rooms and storm shelters in the path of the tornado in order to analyze their performance, functionality, and use.

HURRICANE SANDY IN NEW JERSEY AND NEW YORK



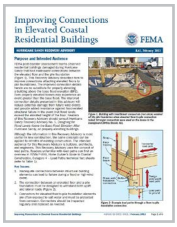
FEMA P-942 – *Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York, Combined* (2013)

FEMA P-942 documents observations made during field visits conducted by the MAT following Hurricane Sandy. FEMA P-942 presents the conclusions and recommendations derived from the field observations with regards to key engineering concepts, codes and standards, mitigation measures and considerations that can be used in the planning and recovery process to help minimize future damage to structures and their related utility systems. The recommendations for disaster-resistant practices in hurricane-prone regions presented are applicable to planners; decision makers; designers; contractors; building officials; Federal, State, and local government officials; building owners and operators; emergency managers; and homeowners.

Hurricane Sandy in New Jersey and New York Recovery Advisories

Following Hurricane Sandy, FEMA Building Science MATs studied the damages from Hurricane Sandy and prepared seven Recovery Advisories (RAs). These RAs are applicable to other hurricane-affected areas.

MAT ACTIVITIES PUBLICATIONS



RA 1, *Improving Connections in Elevated Coastal Residential Buildings* (2013)

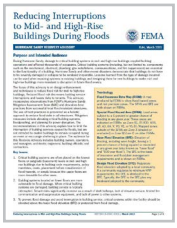
FEMA post-disaster assessment teams observed residential buildings damaged during Hurricane Sandy that had inadequate connections between the elevated floor and the pile foundation. This Recovery Advisory describes how to improve connections attaching elevated floors to pile foundations. The improved connection details presented in this advisory will reduce potential damage from future wind events and provide added resistance against flood-related structural failure in the event that flood levels exceed the elevated height of the floor. Readers of this Recovery Advisory should consult Hurricane Sandy Recovery Advisory No. 5, Designing for Flood Levels Above the Base Flood Elevation After Hurricane Sandy, on properly elevating buildings. The intended audience for this Recovery Advisory is builders, architects, and engineers.

RA 2, *Reducing Flood Effects in Critical Facilities* (2013)

This Recovery Advisory provides information and recommendations to improve the functionality of critical facilities by reducing the vulnerability of essential systems and equipment to flooding. Critical facilities include hospitals and other health care facilities; fire and police stations; emergency operations centers; communication and data centers; essential government buildings; and other critical facilities and their contents, machinery, and equipment therein, that serve the community or affect the safety, health, or welfare of the surrounding population. This Recovery Advisory describes how essential equipment must be protected from flooding to allow a critical facility to perform its primary function during and after a flood event. The intended audience for this Recovery Advisory includes facility owners and operators and other individuals involved in making decisions for critical facilities.

RA 3, *Restoring Mechanical, Electrical, and Plumbing Systems* (2013)

The purpose of this Recovery Advisory is to describe methods to restore utility systems in a manner that minimizes damage from future flood events and reduces the system restoration time following future storms. This Recovery Advisory addresses houses that were not Substantially Damaged during Hurricane Sandy and are not undergoing Substantial Improvement. The intended audience for this Recovery Advisory is homeowners and the information is solely for residential buildings.



RA 4, *Reducing Interruptions to Mid- and High-Rise Buildings During Floods* (2013)

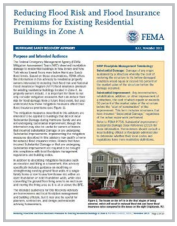
The focus of this advisory is on design enhancement and techniques to reduce flood risk for mid- to high-rise buildings. This advisory incorporates observations from FEMA's Hurricane Sandy MAT and describes best practices from successful local flood-resistant structures. The intended audience includes building owners, operators, and managers; architects; engineers; building officials; and contractors.

RA 5, *Designing for Flood Levels Above the BFE After Hurricane Sandy* (2013)

This Recovery Advisory reviews how coastal Flood Insurance Rate Maps (FIRMs) and BFEs are established and provides guidance on elevating buildings to minimize flood damage in cases where flood levels exceed the BFE. The intended audience for this advisory is primarily homeowners and designers, but it may be helpful to anyone involved in selecting lowest floor elevations for new construction and reconstruction of buildings in areas affected by Sandy.

RA 6, *Protecting Building Fuel Systems from Flood Damage* (2013)

This Recovery Advisory provides building owners, operators, facility managers, and designers with information on mitigation actions that can help protect fuel supplies from flood damage, enabling basic functionality to be restored at facilities shortly after floodwaters recede. Mitigation actions can be taken to reduce the potential for flood damage to fuel systems. These actions are recommended for facilities damaged during Hurricane Sandy as well as facilities that were not damaged but have fuel tanks and fuel supply equipment that is vulnerable to future flood damage.



RA 7, *Reducing Flood Risk and Flood Insurance Premiums for Existing Residential Buildings in Zone A* (2013)

The mitigation measures described in this advisory are intended to be applied to buildings that did not incur Substantial Damage during Hurricane Sandy and are not undergoing Substantial Improvement, though the information may also be useful for owners of homes that incurred Substantial Damage or are undergoing Substantial Improvements. Implementing the mitigation measures described in this advisory may qualify a home for reduced flood insurance rates. In addition to describing mitigation measures such as elevation and filling in a basement, this advisory specifically includes guidance on modifying or strengthening existing ground floor walls of a single family home or row house/townhouse into either an open foundation or solid foundation walls, while also converting the ground floor living area to an enclosure and moving the living area so it is at or above the BFE. The intended audiences for this Recovery Advisory are homeowners and local floodplain management and building officials, but it may also be useful for planners, contractors, and design professionals advising homeowners.

MAT ACTIVITIES PUBLICATIONS

HURRICANE ISAAC IN LOUISIANA

FEMA P-938 – *Hurricane Isaac in Louisiana: Mitigation Assessment Team Report, Building Performance Observations Recommendations, and Technical Guidance* (2013)

In response to Hurricane Isaac, FEMA deployed a MAT to evaluate and assess damage from the hurricane and provide observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The MAT included representatives from FEMA Headquarters and other Federal agencies, local government officials, academia, and experts from the design and construction industry. The conclusions and recommendations of this report are intended to provide decision-makers with information and technical guidance that can be used to reduce future hurricane damage.

Hurricane Isaac in Louisiana Recovery Advisories

These Recovery Advisories are developed by the MAT studying the damages of Hurricane Isaac. They offer mitigative measures that could be taken to minimize damage to buildings.

RA 1, Minimizing Wind and Water Intrusion by Covering the Underside of Elevated Buildings (2012)

The purpose of this Hurricane Recovery Advisory is to describe practices for minimizing damage to the underside of elevated buildings resulting from high-wind events. The undersides of elevated coastal buildings are typically covered with paneling (vinyl or aluminum soffit sheeting) or sheathing (plywood) to protect the insulation and metal connectors used for the floor system. These undersides are often damaged by high winds during hurricanes, allowing water to be driven into the building.

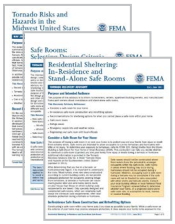
RA 2, Minimizing Flood Damage to Electrical Service Components (2012)

The purpose of this Hurricane Recovery Advisory is to describe practices for minimizing damage to electrical service components during coastal and riverine flood events. Its primary focus is on services of less than 300 volts, which are typical of residential homes. Considering flood risks when designing and constructing electrical services can ensure that outage durations resulting from flooding are minimized and that utility and code requirements are met.

ALABAMA, MISSISSIPPI, TENNESSEE, GEORGIA, AND MONTANA TORNADOES

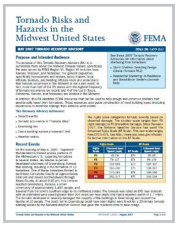
FEMA P-908 – *Mitigation Assessment Team Report – Spring 2011 Tornadoes: April 25-28 and May 22* (2012)

This report presents the MATs observations, conclusions, and recommendations in response to those field investigations. The mission of the MATs was to assess the performance of structures affected by the tornadoes, investigate safe room and shelter performance in the affected areas, and describe the lessons learned to help future efforts to more successfully mitigate tornado events. The objective of the report is to provide information to communities, businesses, and individuals so that they can rebuild safer, more robust structures and minimize loss of life, injuries, and property damage in future tornadoes and high-wind events.



Recovery Advisories from the Tornado MATs for Alabama, Mississippi, TN, GA, and MO

Eight (8) new Recovery Advisories (RAs) from the Tornado MATs for Alabama, Mississippi, Tennessee, Georgia, and Missouri are now available. RA1 – Tornado Risks and Hazards in the Southeastern United States. RA2 – Safe Rooms: Selecting Design Criteria. RA3 – Residential Sheltering: In-Residence and Stand-Alone Safe Rooms. RA4 – Safe Rooms and Refuge Areas in the Home. RA5 – Critical Facilities Located in Tornado-Prone Regions: Recommendations for Facility Owners. RA6 - Critical Facilities Located in Tornado-Prone Regions: Recommendations for Architects and Engineers. RA7 - Rebuilding and Repairing Your Home After a Tornado. RA8 - Reconstructing Non-Residential Buildings after a Tornado.



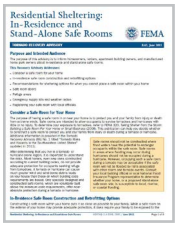
RA 1, *Tornado Risks and Hazards in the Southeastern United States* (2011)

The purpose of this Tornado Recovery Advisory is to provide background on the tornado hazard in the Southeast. This advisory also identifies FEMA resources that can be used to help design and construct portions of almost any building type (including residences) to provide safe refuge from tornadoes, or to help minimize damage caused by these wind events.

RA 2, *Safe Rooms, Selecting Design Criteria* (2011)

The purpose of this advisory is to identify the design guidance, code requirements, and other criteria that pertain to the design and construction of safe rooms for tornadoes and hurricanes. The intended audience for this Tornado Recovery Advisory is anyone involved in the planning, policy-making, design, construction, or approval of safe rooms, including designers, emergency managers, public officials, policy or decision-makers, building code officials, and home or building owners. Homeowners and renters should also refer to the Tornado Recovery Advisory No. 3 titled “Residential Sheltering: In-Residence and Stand-Alone Safe Rooms” (updated in 2011).

MAT ACTIVITIES PUBLICATIONS

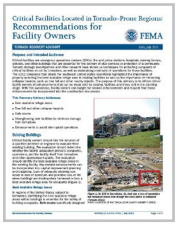


RA 3, *Residential Sheltering: In-Residence and Stand-Alone Safe Rooms* (2011)

The purpose of this advisory is to inform homeowners, renters, apartment building owners, and manufactured home park owners about in-residence and stand-alone safe rooms.

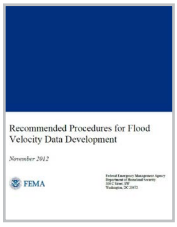
RA 4, *Safe Rooms and Refuge Areas in the Home* (2011)

The intended audience for this Tornado Recovery Advisory is homeowners or home builders. Homeowners and renters should also refer to the Tornado Recovery Advisory No. 3 titled "Residential Sheltering: In-Residence and Stand-Alone Safe Rooms" (updated in 2011). The purpose of this advisory is to identify the different types of safe rooms and provide a brief overview of areas of refuge.



RA 5, *Critical Facilities Located in Tornado-Prone Regions: Recommendations for Facility Owners* (2011)

The purpose of this advisory is to inform critical facility owners of enhancements that can be made both to existing facilities and those still in the planning stage. With this awareness, facility owners can budget for desired enhancements and request that these enhancements be incorporated into the construction documents.

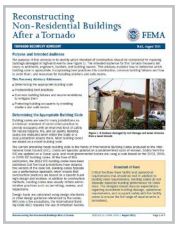


RA 6, *Critical Facilities Located in Tornado-Prone Regions: Recommendations for Architects and Engineers* (2011)

The purpose of this advisory is to inform architects and engineers of design enhancements that can be made to both existing facilities and facilities in the planning stage. With this awareness, desired enhancements can be incorporated into construction documents. The interim information in this Recovery Advisory is intended to assist during the recovery and redevelopment of tornado-damaged areas and to minimize future tornado damage and interruption of operations. This information was developed because of the lack of design guidance on this topic.

RA 7, *Rebuilding and Repairing Your Home After a Tornado* (2011)

The purpose of this advisory is to identify which standard of construction should be used when repairing houses damaged in high-wind events (see Figure 1). The intended audience for this Tornado Recovery Advisory is homeowners or home builders. The advisory explains how to determine which building code is appropriate, describes how to incorporate best practices into construction, and lists resources for installing residential safe rooms. Homeowners and renters should also refer to Tornado Recovery Advisory No. 3, Residential Sheltering: In-Residence and Stand-Alone Shelters (updated in 2011).



RA 8, *Reconstructing Non-Residential Buildings After a Tornado* (2011)

The purpose of this advisory is to identify which standard of construction should be considered for repairing buildings damaged in high-wind events. The intended audience for this Tornado Recovery Advisory is architects, engineers, builders, and building owners. This advisory explains how to determine which building code is appropriate, incorporating best practices into construction, common building failures and how to avoid them, and resources for installing shelters and safe rooms.

MISSISSIPPI TORNADO OUTBREAK (2010)

Mississippi Tornado Outbreak, April 23rd-24th Pre-Mitigation Assessment Team Report (2010)

In response to the April 23rd–April 24th, 2010 tornado outbreak in Mississippi, FEMA deployed a Pre-Mitigation Assessment Team (PMAT) to survey the general structural damage and the performance of the residential and community safe rooms located along the path of the Tallulah-Yazoo City-Durant tornado. These investigations allowed the Team to capture important observations, lessons learned, and recommendations regarding the performance of FEMA-funded residential safe rooms impacted by tornadic winds and debris that had been constructed in accordance with FEMA 320, FEMA-funded community safe rooms impacted by tornadic winds and debris that had been constructed in accordance with FEMA 361, and community safe room operations plans.

HURRICANE IKE IN TEXAS

FEMA P-757 – *Hurricane Ike in Texas and Louisiana: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance* (2009)

In response to Hurricane Ike, FEMA deployed a MAT to evaluate and assess damage from the hurricane and provide observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The conclusions and recommendations are intended to provide decision-makers with information and technical guidance that can be used to reduce future hurricane damage.

MAT ACTIVITIES PUBLICATIONS

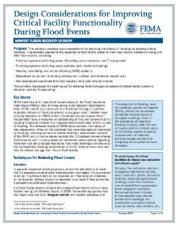
Hurricane Ike Mitigation Assessment Team (MAT) Presentation (2009)

In response to Hurricane Ike, FEMA deployed a MAT to evaluate and assess damage from the hurricane and provide observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The conclusions and recommendations of this Report are intended to provide decision-makers with information and technical guidance that can be used to reduce future hurricane damage. This presentation provides a summary of these findings.

Hurricane Ike Recovery Advisories Combined (2009)

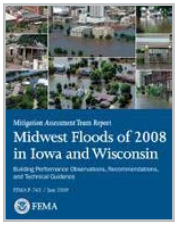
These 8 Recovery Advisories are part of the MAT report for Hurricane Ike (2008) in Texas and Louisiana.

2008 MIDWEST FLOODS RECOVERY ADVISORY



2008 Midwest Floods Recovery Advisories (2009)

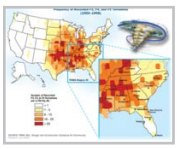
These three Recovery Advisories are part of the MAT report for Midwest Floods of 2008 in Iowa and Wisconsin. They deal with design considerations for improving critical facility functionality during flood events, and considerations for rebuilding your flood-damaged house.



FEMA P-765 – *Midwest Floods of 2008 in Iowa and Wisconsin* (2009)

In response to the 2008 Midwest floods, FEMA deployed a MAT to evaluate and assess the damages caused by the riverine flooding in Iowa and southern Wisconsin. This report documents the MAT's observations, conclusions, and recommendations on the performance of buildings and other structures impacted by the flooding. The MAT included FEMA Headquarters and Regional Office staff, representatives from other federal agencies and academia, and experts from the design and construction industry. The conclusions and recommendations in this report are intended to provide decision makers with information and technical guidance that can be used to reduce future flood damage. A Power Point presentation and the document are supplied in PDF format.

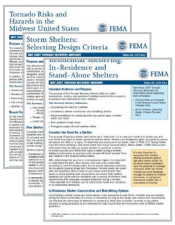
2007 TORNADOES IN FLORIDA RECOVERY ADVISORIES



2007 Tornadoes in Florida Recovery Advisories (RA1-RA5) (2007)

The following 2007 Recovery Advisories provide information about tornado risk, sheltering from tornadoes, and improving manufactured homes against damage from high winds.

2007 TORNADOES IN KANSAS RECOVERY ADVISORIES



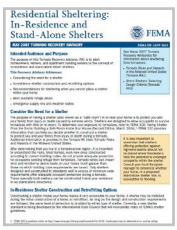
The purpose of these three Tornado Recovery Advisory (RAs) is to provide information about tornado risks and hazards, storm shelter design criteria, and residential sheltering from tornadoes

RA 1, *Tornado Risks and Hazards in the Midwest United States* (2007)

The purpose of this Tornado Recovery Advisory (RA) is to summarize facts about the Midwest tornado hazard, specifically the area served by FEMA Region VII. In addition, this RA identifies FEMA resources that can be used to help design and construct shelters that provide safe haven from tornadoes. These resources also guide construction of most building types (including residences) to minimize damage from extreme wind events.

RA 2, *Storm Shelter: Selecting Design Criteria* (2007)

The purpose of this Tornado Recovery Advisory (RA) is to present information on different types of shelter design guidelines, code requirements, and other criteria that pertain to the design and construction of tornado shelters. The intended audience for this RA is anyone involved in the planning, policy-making, design, construction, or approval of tornado shelters, including designers, emergency managers, public officials, policy or decision makers, building code officials, and home or building owners.

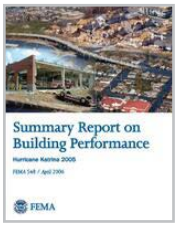


RA 3, *Residential Sheltering: In-Residence and Stand-Alone Shelters* (2007)

The purpose of this Tornado Recovery Advisory (RA) is to alert homeowners, renters, and apartment building owners to the concept of in-residence and stand-alone storm shelters. This Recovery Advisory Addresses: Considering the need for a shelter In-residence shelter construction and retrofitting options. Recommendations for sheltering when you cannot place a shelter within your home

MAT ACTIVITIES PUBLICATIONS

HURRICANE KATRINA IN THE GULF COAST



FEMA 548 – *Summary Report on Building Performance: Hurricane Katrina 2005* (2006)

In the weeks following Hurricane Katrina, a MAT was deployed to the affected Gulf Coast areas to assess the performance of buildings. Based on the observed damage, the MAT also evaluated the adequacy of current building codes and provided suggestions to update the codes.

FEMA 549 – *Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance* (2006)

In response to Hurricane Katrina, FEMA deployed a MAT to evaluate and assess damage from the hurricane and provide observations, conclusions, and recommendations on the performance of buildings and other structures impacted by wind and flood forces. The conclusions and recommendations of the report provide decision-makers with information and technical guidance that can be used to reduce future hurricane damage.

Hurricane Katrina Combined Recovery Advisories (2005)

These eight hurricane recovery advisories are part of the Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance (FEMA 549).

HURRICANE CHARLEY IN FLORIDA

FEMA 488 – *Mitigation Assessment Team Report: Hurricane Charley in Florida* (2005)

This report summarizes the observations, conclusions, and recommendations of the MAT deployed by FEMA on August 19, 2004, in response to Hurricane Charley. The team assessed damage across the width of the storm track, from its landfall near the communities on Sanibel and Captiva Islands to inland areas around Orlando.

Hurricane Charley Recovery Advisories Combined (2004)

These three hurricane recovery advisories are part of the MAT report for Hurricane Charley (2004) in Florida.

HURRICANE IVAN IN ALABAMA AND FLORIDA

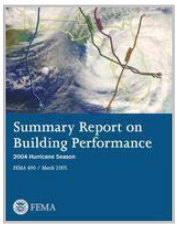
FEMA 489 – *Hurricane Ivan in Alabama and Florida: Observations, Recommendations and Technical Guidance* (2005)

This report summarizes the observations, conclusions, and recommendations that resulted from post-disaster assessments sponsored by FEMA in response to Florida's 2004 hurricane season. During the 2004 season, the State was struck by Hurricanes Charley, Frances, Jeanne, and Ivan. More than 10 rapid-response teams and two MATs were deployed to document observations and provide recommendations concerning building performance under the effects of hurricane winds and hurricane-related flooding. The information presented in this report is intended to assist the States of Florida and Alabama, communities, businesses, and individuals in the reconstruction process. This information will also help reduce future wind and water damage and promote the economic well-being of the nation.

Hurricane Ivan Recovery Advisories Combined (2004)

These four hurricane recovery advisories are part of the MAT report for Hurricane Ivan (2004) in Alabama and Florida (FEMA 489).

2004 HURRICANE SEASON



FEMA 490 – *Mitigation Assessment Team Report: Summary Report on Building Performance 2004 Hurricane Season* (2005)

The purpose of this document is to summarize the observations, conclusions, and recommendations that were obtained during post-disaster assessments sponsored by the FEMA Mitigation Division in response to Florida 2004 hurricane season. More than ten rapid response teams and two MATs were deployed to document observations and provide recommendations. The rapid response data collection teams focused on coastal high water marks, inland wind effects, residential and commercial building performance, critical and essential facility performance, and mitigation program effectiveness. The MATs assessed damage to the built environment and relied on the perishable data, such as high water marks, collected by the rapid response teams to quantify flood and wind effects of the hurricanes.

MAT REPORTS BEFORE 2004

To see all of the MAT reports or look at MAT reports from before 2004, visit the link below.

https://www.fema.gov/emergency-managers/risk-management/building-science/mitigation-assessment-team

BUILDING CODES RESOURCES

Building Codes Toolkit (2021)

This toolkit contains guidance and tools on building codes for property owners, engineers and design professionals, building codes officials, and the general public. Materials referenced here are based on local best practices, input from local, regional, and federal subject matter experts, industry partners, and existing FEMA standards and guidance.

Building Codes Resources

This page outlines documents that provide guidance on the hazard-resistant provisions in the building codes for property owners, engineers and design professionals, building codes officials, and the general public. These resources are divided by natural hazard and address earthquake, flood, and wind (including information on hurricane and tornado shelters).

https://www.fema.gov/emergency-managers/risk-management/building-science

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INDEX OF FEMA BUILDING SCIENCE BRANCH & EARTHQUAKE AND WIND PROGRAMS BRANCH PUBLICATIONS

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FEMA 351 – *Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings* (June 2000)

FEMA 352 – *Recommended Post-earthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings* (June 2000)

FEMA 353 – *Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications* (June 2000)

FEMA 389 – *Primer for Design Professionals: Communicating with Owners and Managers of New Buildings on Earthquake Risk* (January 2004)

FEMA 395 – *Incremental Seismic Rehabilitation of School Buildings (K-12): Providing Protection to People and Buildings* (June 2003)

FEMA 396 – *Incremental Seismic Rehabilitation of Hospital Buildings : Providing Protection to People and Buildings* (December 2003)

FEMA 412 – *Installing Seismic Restraints for Mechanical Equipment* (December 2002)

FEMA 413 – *Installing Seismic Restraints for Electrical Equipment* (January 2004)

FEMA 424 – *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds* (2010)

FEMA 439B – *Blast-Resistant Benefits of Seismic Design, Phase 2 Study: Performance Analysis of Structural Steel Strengthening Systems* (November 2012)

FEMA 445 – *Next-Generation Performance-Based Seismic Design Guidelines: Program Plan for New and Existing Buildings* (August 2006)

FEMA 454 – *Designing for Earthquakes: A Manual for Architects* (December 2006)

FEMA 460 – *Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public* (September 2005)

FEMA 461 – *Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components* (June 2007)

FEMA 488 – *Mitigation Assessment Team Report: Hurricane Charley in Florida* (2005)

FEMA 489 – *Hurricane Ivan in Alabama and Florida: Observations, Recommendations and Technical Guidance* (2005)

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FEMA P-757 – *Hurricane Ike in Texas and Louisiana: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance* (2009)

FEMA P-758 – *Substantial Improvement/Substantial Damage Desk Reference* (2010)

FEMA P-762 – *Local Officials Guide for Coastal Construction* (2009)

FEMA P-765 – *Midwest Floods of 2008 in Iowa and Wisconsin* (2009)

FEMA P-774 – *Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs* (October 2009)

FEMA P-784 – *Substantial Damage Estimator (SDE) Tool* (2017)

FEMA P-795 – *Quantification of Building Seismic Performance Factors: Component Equivalency Methodology* (June 2011)

FEMA P-798 – *Natural Hazards and Sustainability for Residential Buildings* (2010)

FEMA P-804 – *Wind Retrofit Guide for Residential Buildings* (2010)

FEMA P-807 – *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings With Weak First Stories* (May 2012)

FEMA P-811 – *Earthquake Publications for Businesses (QuakeSmart Toolkit)* (September 2011)

FEMA P-85 – *Protecting Manufactured Homes from Floods and Other Hazards* (2009)

FEMA P-908 – *Mitigation Assessment Team Report – Spring 2011 Tornadoes: April 25-28 and May 22* (2012)

FEMA P-936 – *Floodproofing Non-Residential Building*s

FEMA P-938 – *Hurricane Isaac in Louisiana: Mitigation Assessment Team Report, Building Performance Observations Recommendations, and Technical Guidance* (2013)

FEMA P-942 – *Mitigation Assessment Team Report: Hurricane Sandy in New Jersey and New York, Combined* (2013)

FEMA P-957 – *Snow Load Safety Guide* (2013)

FEMA P-1000 – *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety* (August 2017)

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