



HOME EARTHQUAKE RETROFIT SERIES

OVERVIEW



The Standard Home Earthquake Retrofit Plan is limited to wood-framed single-family homes and multiple-family buildings with fewer than four dwelling units. The standard plan is not a suitable strengthening method for all homes. Review plan qualification criteria to determine if you may use this plan.

Disclaimer

The information in the Home Earthquake Retrofit Series is based on current home earthquake retrofit practice and standards for the retrofit of existing buildings. Practice and standards may change as new information is learned. No guarantee is made that the use of the information in the series will prevent all losses in all earthquakes. Liability for any losses caused by earthquakes or as a result of applying the information in these publications is specifically disclaimed.

Acknowledgments

The Home Earthquake Retrofit Series is based on materials provided by the cities of San Leandro and Los Angeles, California. The Seattle Project Impact Permitting and Standards Committee modified San Leandro's *Planset Information Booklet* to meet local building practice. The plan detail sheets (construction drawings) from both cities were used to produce the Seattle Project Impact plan sheets for the Seattle Department of Design, Construction and Land Use (DCLU) permit application packet. The assistance of building department personnel from both cities is gratefully acknowledged.

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Home Earthquake Retrofit Information Series

The Home Earthquake Retrofit Information Series booklets are intended to promote public safety and welfare by helping you, the homeowner or contractor, reduce the risk of earthquake-induced damage in existing wood-frame residential buildings.

The booklets contain detailed information to help you understand and use the Standard Home Earthquake Retrofit (SHER) Planset to increase the structural safety of your home. The primary purpose of the minimum prescriptive requirements in the standard plan is to reduce the likelihood that residential buildings will fall off their foundations during an earthquake. California homes retrofitted according to the requirements in the standard plan remained on their foundations during the 1994 Northridge Earthquake in Los Angeles. When applied to qualified buildings, the SHER Planset will improve the performance of existing buildings.

This series also guides you through obtaining a building permit to retrofit a wood-frame residential building using the plan's simplified construction methods.

The information series consists of three booklets:

- (1) The *Overview* summarizes the information contained in each of the series booklets, provides general information on why it makes sense to strengthen residential homes to reduce earthquake-induced damage, and introduces the advantages and limitations of the voluntary SHER Planset. Appendix A of the Overview contains a Definition of Terms.
- (2) The *Guide to Completing the Home Assessment Checklist* provides detailed information to help you determine if your home qualifies to use the prescriptive requirements and if earthquake retrofit work is needed.
- (3) The *Guide to Completing a Home Earthquake Retrofit Plan for Wood Framed Residential Buildings* shows you how to complete a plan for your own earthquake retrofit project according to the minimum prescriptive requirements in the SHER Planset. The earthquake retrofit plan is submitted to the building department as part of the permit application.

These booklets accompany the Home Earthquake Retrofit Permit Application Packet in the City of Seattle. The application packet includes the Home Assessment Checklist and two-sheet planset that summarize the elements of the SHER Planset and provide a space to draw your plan. Outside of Seattle, additional inserts may be included in the application packet to provide local information about home earthquake retrofit programs and building construction requirements.

If you are familiar with earthquake retrofit construction practices, the information provided in the application packet may be all you need to understand the plan requirements, complete the permit application, and identify local resources to assist you.

To qualify for special Project Impact Earthquake Retrofit loans, the Home Assessment Checklist must be prepared by a contractor or homeowner who has completed a Project Impact home retrofit class. Submit a copy of the class certificate with your loan application.

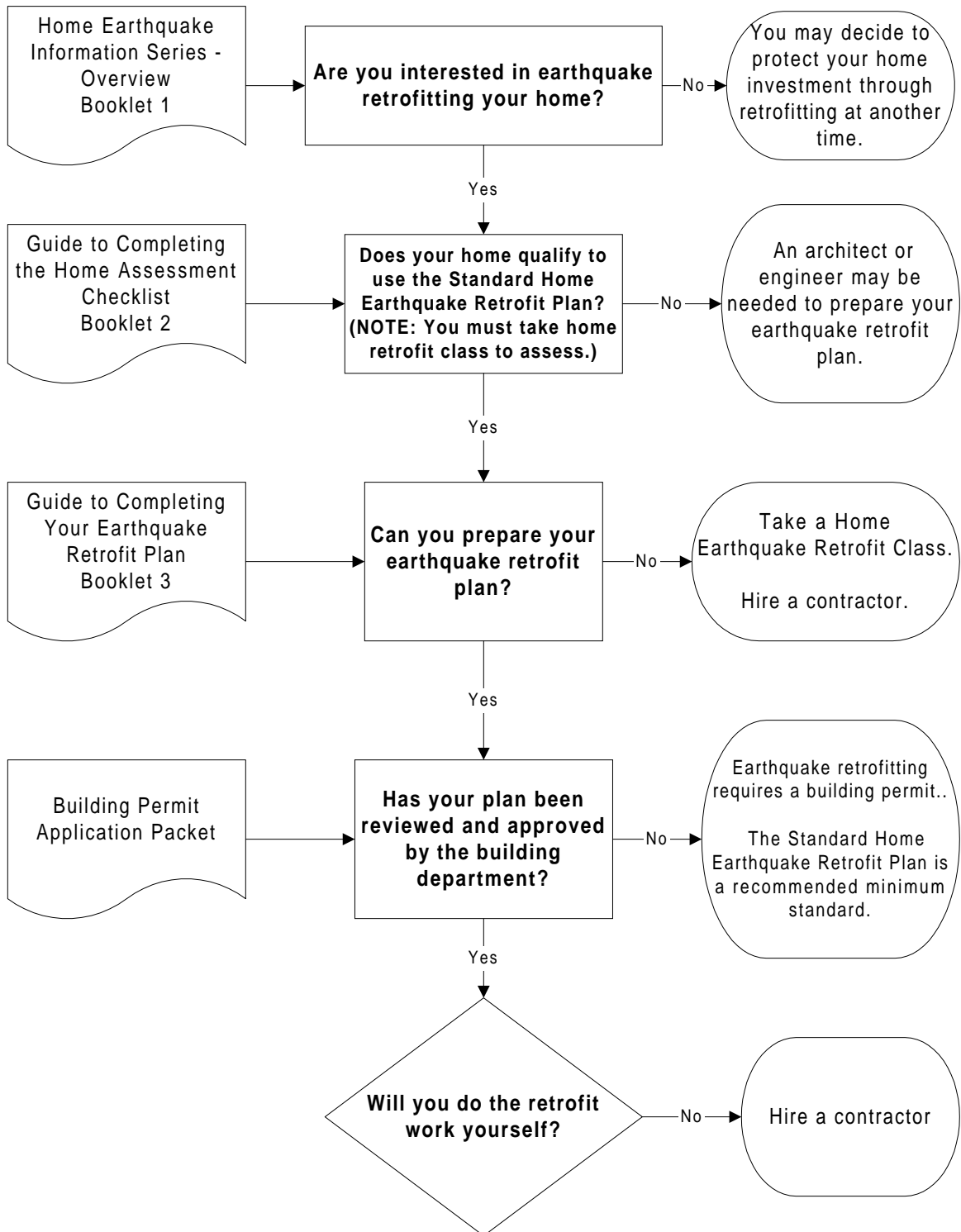


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INTRODUCTION

Pacific Northwest Earthquake Hazards

The Pacific Northwest lies within an area of high earthquake hazard extending from the middle of Vancouver Island in British Columbia down through Washington and Oregon to northern California. The interaction of three large slabs of slowly moving rock, called the North American Plate, the Juan de Fuca Plate, and the Pacific Plate, largely determines the region's earthquake potential. This area of high earthquake hazard is called the Cascadia Region (Fig. 1).

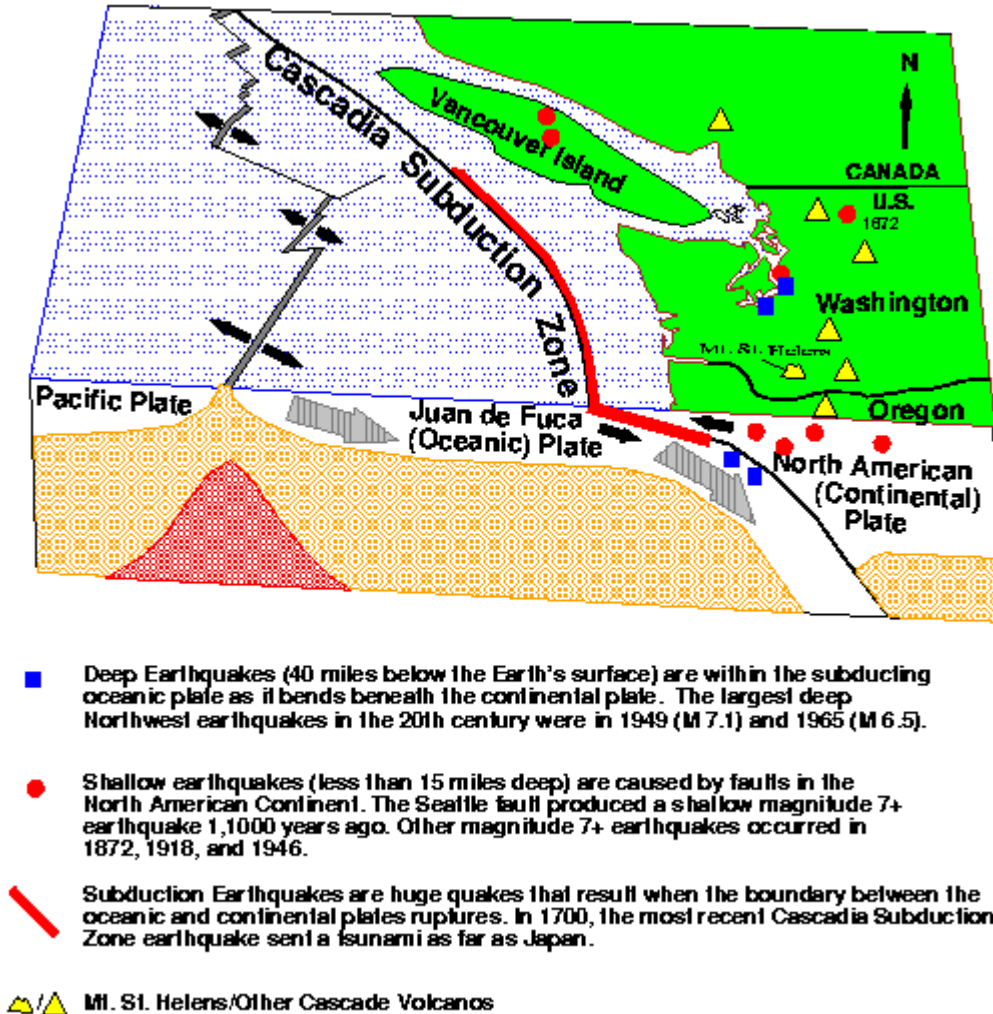


Figure 1 Cascadia Region earthquake hazards. The Oregon and Northern California parts of Cascadia not shown. The Cascadia Subduction Zone marks the surface boundary between the downward moving Juan de Fuca Plate and the overlying North American Plate. (From U.S. Geological Survey). Magnitude ranks the size of an earthquake using a scale based on the amplitude of the earthquake wave as recorded by a special instrument. See Definitions in Appendix A.

Several thousand earthquakes occur in the Cascadia region each year. A dozen or more of these shake the Earth's surface hard enough to be felt by people. Every few decades earthquakes shake Cascadia communities hard enough to crumble older brick buildings, damage homes, and disrupt utility and transportation systems (Table 1). Every few hundred years huge earthquakes permanently shift Cascadia coastal margins, burying marsh grasses (Fig. 2), drowning coastal forests, generating crushing water waves (tsunamis) and producing shaking that damages communities over the entire region.

Selected Damage from the 1949 Earthquake	
Community	Description
Auburn	Junior High School condemned; four blocks of downtown district damaged severely
Castle Rock	Castle Rock High School damaged severely (one fatality)
Centralia	Collapse of building walls and most chimneys; two schools permanently closed
Chehalis	Most downtown buildings schools and churches damaged; 1351 chimneys damaged
Olympia	Nearly all large buildings damaged with cracked or fallen walls and cracked or fallen plaster
Puyallup	High School damaged severely; nearly every house chimney toppled at roof line; several houses jarred off foundations
Seattle	Many houses on filled ground were demolished. School partially destroyed and closed. Many old buildings on soft ground damaged. Heavy damage to docks
Tacoma	Two schools damaged and closed; few homes escaped some damage; several houses slide into Puget Sound;
Tenino	Every business and house suffered some damage

Table 1 Selected damage in Washington communities from 1949 earthquake. From Thorsen, G. W., compiler, 1986, Washington Department of Natural Resources, Information Circular 81.

Geologic evidence reveals the presence of a major east-west trending fault, called the Seattle Fault, that cuts across Puget Sound from Bainbridge Island through Seattle. A large, shallow earthquake occurred on the Seattle Fault about 1,100 years ago, producing tsunamis in Puget Sound and landslides into Lake Washington. How this fault is related to present-day earthquake activity and the existence of other shallow fault systems in Cascadia are the subject of on-going studies aimed at improving our understanding of earthquake hazards in the Pacific Northwest.



Figure 2 The dark band records marsh grasses buried by sudden downwarping of PNW coastal area caused by a past Cascadia subduction zone earthquake (Photo by Brian Atwater, U.S. Geological Survey).

Building Codes and Practices Requirements

The Uniform Building Code (UBC) is the model building code currently adopted by most of the western half of the United States. The UBC was first issued in 1927 by a non-profit, independent organization called the International Council of Building Officials (ICBO). It is updated and reissued every three years. The most recent update is the 1997 UBC.

The revised construction standards in updated versions of the UBC and other building codes apply to new construction and are not retroactive to address design deficiencies in older construction. Significant UBC changes in home earthquake design requirements over time have improved the performance of newer homes in recent California earthquakes. Table 2 lists the years that key earthquake design requirements related to home construction were first included in the UBC.

The Uniform Building Code Seismic Zone Map

The UBC Seismic Zone Map is used to determine two earthquake design factors: (1) the minimum level of earthquake side-to-side shaking, called ground acceleration, that must be used to calculate the structure's design forces, and (2) the need to include special earthquake resistant connections in the design. The UBC Seismic Zone Map divides the United States into zones of potential earthquake damage. Prior to 1976, the four UBC earthquake zones were Zone 0 (no damage), Zone 1 (minor damage), Zone 2 (moderate damage), and Zone 3 (major damage). In 1976, a Zone 4 classification (major damage caused by near-by fault movements) was added.

Earthquake design factors and special earthquake connection details are not required in UBC Seismic Zone 0 or Seismic Zone 1. Increasing ground shaking values are used in the calculation of design forces in Seismic Zone 2, 3, and 4. Special earthquake connection details, however, are only required in Seismic Zone 3 and Seismic Zone 4. The lack of earthquake connection details and the lower force level required in UBC Seismic Zone 2 designs make buildings designed to these standards substantially less earthquake resistant than buildings designed to Seismic Zone 3 or Seismic Zone 4 design requirements.

Revisions to the UBC Seismic Zone Map are based on information from geologists, seismologists, and engineers. Figure 3 shows significant changes to the UBC Seismic Zone Map from 1946 to 1988. Fig. 4 shows the 1997 UBC Seismic Zone Map.

Impact of UBC Seismic Zone Map Changes on Cascadia Region Design

Washington was included in UBC Seismic Zone 1 prior to 1952. Because the UBC does not specify earthquake design requirements for Seismic Zone 1, Washington homes built to UBC construction standards prior to 1952 were not required to meet the earthquake design requirements then being used in California. Revision of the UBC Seismic Zone Map in 1952 changed Washington state from Seismic Zone 1 to two seismic zones: Seismic Zone 3 in Puget Sound and Seismic Zone 2 in the rest of the state. This revision was in response to the occurrences of earthquakes causing significant damage in the region, most notably in 1946 and 1949. The 1952 UBC Seismic Zone Map adopted for Washington generally resulted in a tripling of the design force requirements for Puget Sound and a doubling of force requirements for the rest of the state. In addition, the 1952 UBC required the design of special earthquake connection details in Puget Sound for the first time.

Adoption of Building Codes in the Cascadia Region

In 1955, the Washington State Legislature passed building standards that required hospitals, schools, buildings for public assembly, and publicly owned structures to be designed and constructed to resist earthquakes. For all other buildings, however, the adoption of earthquake design standards depended upon local building departments. Nearly twenty years later, the legislature adopted the 1973 UBC as a minimum construction code for all buildings in communities throughout the state. (State Building Code Acts RCW 19.27 and 19.27.A, effective 1/1/75.)

Table 1 lists when (1) the UBC adopted special earthquake design requirements for home design, (2) the UBC was adopted as a Washington state construction standard for all communities, and (3) Seattle, Tacoma and Everett adopted special earthquake design provisions. Until 1975, communities generally adopted only sections of the UBC as amendments to local codes rather than adopting all of the UBC requirements. There is usually a delay of several years between the proposed change of local building codes and adoption of revised building codes. These delays reflect the need by local communities to review, amend, and adopt newly published standards into community building codes.

Changes to local building practice do not directly correspond to the date design requirements were included in state and local building codes. Building professionals familiar with earthquake damage in other parts of the country and concerned with the potential for earthquake damage in the Pacific Northwest, may include higher design forces and earthquake connection details in design and construction before these are required by state and community building codes. Often the local design community must be educated to understand the methods and reasons behind the changes and how to implement them into local design practice. Because of the complexity of code changes and variations in local building practice, local officials may have difficulty determining the exact design requirements that may have been used in the design of a specific home.

Earthquake Building Practice for Home Construction

In most cases, homes built before 1965 in Seattle, Everett, and Tacoma lack foundation anchor bolts. The bolts that were installed generally do not meet today's requirements for bolt size, spacing, and condition. Homes built between 1965 and 1975 *may* have foundation bolts, and those built after 1975 generally *will* have foundation bolts.

Strengthening of the short wall that exists in some homes between the first floor and the top of the foundation wall, called the pony wall, generally did not occur in any Washington communities until after 1975, and some homes built as recently as 1985 may lack proper pony wall strengthening as well.

Year	UBC	Washington State	Tacoma/Everett	Seattle
1935	Foundation bolting/reinforcement of masonry foundations first included in UBC for Seismic Zone 3	No State earthquake design requirements	No city earthquake design requirements	No city earthquake design requirements
1946 Vancouver Island Earthquake (Magnitude 7.4)				
1946	Washington State in UBC Seismic Map Zone 1, which did not have earthquake design requirements			
1946	UBC requires some reinforcement of masonry chimneys in UBC Seismic Zone 3			First earthquake force requirement; 50% UBC Seismic Zone 3
1949 Olympic Earthquake (Magnitude 7.1)				
1952	UBC Seismic Zone Map changes: Puget Sound Zone3; Remainder of state in Zone2; Portland Zone2; First UBC earthquake design requirements for state.			
1953			Sections of 1952 UBC adopted; amended to place Tacoma in Zone 2 to 2.5; deleted foundation-bolting req.	Sections of 1952 UBC adopted; Seattle in UBC Zone3; design force 2 to 4 times higher req.
1955		Earthquake forces required in design of public buildings		
1960			1958 UBC adopted; foundation bolting first required	
1961	UBC requires all structural members to be designed to resist earthquake forces			
1965 Seattle-Tacoma Earthquake (Magnitude 6.5)				
1965				1964 UBC Adopted
1971 San Fernando Earthquake (Magnitude 7.1)				
1971	Pony wall bracing first mentioned in UBC for Seismic Zone 3		1970 UBC adopted	Seattle Parapet Ordinance
1973	UBC pony wall requirements specified for Seismic Zone 3			
1975		1973 UBC adopted as minimum State standard; formation of State Building Code Council	1973 UBC adopted as required by state	1973 UBC adopted as required by state
1988	Revised WA State Seismic Zone 3, expanded to south and northeast			
1989 Loma Prieta Earthquake (Magnitude 7.1)				
1991	Pony wall requirements increased.; water heater bracing required			
1994	Revised WA State Seismic Zone 3 All Western Washington and Oregon in Seismic Zone 3			
1994 Northridge California Earthquake (Magnitude 6.8)				
1998			Home Retrofit Committee	Home Retrofit Program

Table 2 Key changes in UBC and local building code earthquake design requirements

Structural Weaknesses in Older Homes

Wood-framed residential buildings are generally among the safer types of construction. Nevertheless, 46,000 homes were damaged in the Los Angeles area after the 1994 California Northridge earthquake and 23,000 homes were damaged in the San Francisco Bay area after the 1989 Loma Prieta earthquake. The 1949 and 1965 Washington earthquakes caused considerable damage to communities throughout Puget Sound (Table 1).

The most common structural weaknesses affecting the capability of an older wood-framed home to resist earthquake damage are in the foundation area under the first floor framing system, including:

- The foundation below the exterior walls is discontinuous, non-existent, or in poor condition.
- The connections between the home's exterior walls and the underlying foundation are absent or inadequate (Fig. 5).
- The short wall between the foundation and the first floor, commonly called the pony wall or cripple wall, is not braced with structural panels to prevent collapse during earthquake ground shaking or the existing bracing is inadequate or damaged (Fig. 6).
- The design, construction, and/or inspection process is inadequate.

Additional structural weaknesses observed in past earthquakes include collapse of areas with large openings like garage doors and picture windows. These openings weaken the wall and increase the potential for collapse during earthquake shaking (Fig. 7, 8).

Damage to or deterioration of a home's structural elements or poor construction practices may reduce the capability of even new or retrofit construction to survive earthquake-induced damage.



Figure 3. Home moved off the foundation wall (photo from Applied Technology Council)



Figure 4. Collapse of the short wall between the first floor and the foundation (photo from Applied Technology Council)



Figure 5. Collapse of garage. The large garage door opening weakens the ability of the structure to resist earthquake shaking (Photo from Applied Technology Council)



Figure 6. Collapse of apartment building with weakened first floor. The apartment on the left was a three-story building (Photo by Eugene Trahern, Coughlin Porteer Lundeen)

Benefits of a Home Retrofit

Safer Homes

Improved safety is the primary concern of the Standard Home Earthquake Retrofit Plan. The plan defines cost-effective minimum requirements to address the common structural weaknesses described above.

Implementing the plan will result in stronger homes that can better protect the lives of building occupants during ground shaking and more likely provide safe shelter after the ground shaking stops.

Lower Repair Costs

After the Loma Prieta, California, earthquake of 1989, the average cost to repair houses damaged due to structural weaknesses described above was \$25,000 to \$35,000. The average cost for a licensed contractor to install sill bolts and brace pony walls in undamaged houses is \$2000 to \$4000. If homeowners elect to perform the earthquake retrofit work themselves, the cost will generally be under \$1,000.

Less Damage to Utility Connections

Gas, power, and water service connections can break if there is earthquake-induced displacement between the building and the ground. The shifting of the building's structure off of its foundation may damage power lines and cause breaks or leaks in gas and water pipes.

Availability of Home Retrofit Loans

Lenders recognize the importance of protecting property investments, and some have developed special loans for homeowners who retrofit using the Standard Home Earthquake Retrofit Plan minimum standards.

Improved Chance of Obtaining Earthquake Insurance

Many insurance companies require that the common structural weaknesses noted above be strengthened as one condition for obtaining home earthquake insurance. Completing these strengthening measures does *not* guarantee that earthquake insurance will be available. Some insurance companies choose not to offer earthquake insurance at all, and some may have unique qualification standards.

The Standard Home Earthquake Retrofit Planset

Planset Goal

The goal of the voluntary Standard Home Earthquake Retrofit (SHER) Planset is to improve the safety and soundness of existing wood-framed residential buildings by strengthening selected building elements in the foundation area of the home so that they resist earthquake-induced damage. The planset does the following:

- Encourages the understanding and use of a standardized strengthening method
- Expedites building permits for projects qualifying to use the standard plan;
- Promotes home earthquake retrofit projects.

Planset Elements

The SHER Planset shows how to complete *three essential tasks* required to strengthen the most common structural weaknesses that have contributed to past earthquake damage. The poor performance of incompletely retrofit homes in recent California earthquakes demonstrates the need to complete each of these tasks:

1. Anchor the sill plate to the foundation wall;
2. Strengthen the short walls between the foundation and the first floor, called pony walls, with approved wood structural panels, also called sheathing;
3. Connect the pony walls to the floor framing above and to the sill plate below with metal framing clips; if no pony wall is present, connect the floor joists directly to the sill plate.

Plan Advantages

The SHER Planset helps a homeowner or contractor complete a construction drawing, called the Earthquake Retrofit Planset, that shows how the individual home retrofit will be done. All the information needed to complete your retrofit plan is provided on the Applicant Plan sheet and the Plan Detail Reference sheet, including a space for your plan drawing. These plan sheets may be available from your local building department. Architectural and engineering services are not required to prepare your retrofit plan or to obtain a building permit when the standard plan is used.

Plan Limitations

The SHER Planset does not apply to all residential buildings and will not prevent all earthquake damage. Table 3 lists the criteria that a home must meet in order to use the standard plan. The prescriptive requirements in the SHER Planset provide a recipe for completing your plan. This recipe specifies the type of materials that may be used and how they must be installed. An engineer or architect may be required to design your earthquake retrofit project if the prescriptive requirements do not address your home's conditions. For example, you may need the services of an engineer or architect in the following situations:

- The building, the building's elements, or its occupancy (number of units) preclude the building from qualifying for the simplified construction methods in the plan. See Table 3;
- The strengthening methods or materials to be used are not prescribed in the plan.
- Damage or other building deficiencies need to be repaired before the provisions in the retrofit plan can be carried out.

Your local building department staff may be able to help you determine if you need to hire professional design services or if an alternative solution is available.

The SHER Planset is designed to reduce the risk of earthquake-induced damage to existing wood-frame residential buildings. Earthquake ground shaking may generate forces that damage even strengthened building elements. Common sources of earthquake damage that are not addressed by this plan include:

- Damage related to site conditions, including ground settlement, ground fissuring, and slope failures;
- Damage related to weak areas in the home's structure created by large wall openings like garage doors;
- Damage to exterior and interior finishes, including brick veneers;
- Damage to masonry chimneys and fireplaces;
- Damage to building contents, including water heaters;
- Damage to masonry privacy walls.

Application of the provisions contained in the City's Standard Home Earthquake Retrofit Planset will reduce, but not completely prevent earthquake-induced damage.

Included in the Plan	Excluded from the Plan	Comments
Light, wood-frame residential construction	Commercial wood-frame construction; concrete, masonry, or steel construction	<p>The <i>Guide to Completing the Home Assessment Checklist</i>, a local building official, or a contractor can assist you in determining if your home qualifies to be retrofitted using the standard plan.</p> <p>Buildings excluded from using the Standard Home Earthquake Retrofit Plan may require analysis by an engineer or an architect to design appropriate strengthening methods.</p> <p>Homes not qualifying to use the standard plan may still benefit from being strengthened to resist earthquake ground shaking.</p>
Four or fewer dwelling units.	More than four dwelling units.	
Buildings less than three stories in height	Three story buildings with pony wall studs exceeding 14 inches in height. Buildings greater than three stories in height.	

Three story buildings with pony wall studs less than 14 inches in height		
Buildings with standard light roofing materials, such as wood or composition shingle	Buildings with heavy clay tile or concrete tile, roofing materials	
Pony walls 4 feet or less in height.	Pony walls or pony wall sections that exceed 4 feet in height.	
Buildings constructed on a continuous raised concrete or reinforced masonry perimeter foundation (These buildings will have a crawl space under the house or a basement)	Buildings constructed on a concrete slab-on-grade Note: These buildings have generally performed well in past earthquakes. The expense of installing anchor bolts would likely exceed potential benefits.	
	Buildings constructed on a raised clay tile, concrete block, or stone perimeter foundation	
	Buildings with lateral force-resisting systems using poles or columns embedded in the ground.	
Homes of average size and regular shape	Homes of unusual size or irregular shape	
Home on flat to moderate slopes	Homes on steep slopes (greater than horizontal to 1 vertical)	

Table 3 Criteria for qualifying to use the Standard Home Earthquake Retrofit Plan

Project Impact Earthquake Retrofit Program

Project Impact

Project Impact is a private/public partnership initiated by the Federal Emergency Management Agency (FEMA) to encourage the development of disaster resistant communities. The development of the Standard Home Earthquake Retrofit (SHER) Plan is part of a Seattle Project Impact activity called the Home Retrofit Program. The Seattle Home Retrofit Program includes (1) an expedited permit process, (2) classes on how to use the SHER Plan; (3) classes on earthquake retrofit design; and (4) special earthquake retrofit loan packages from Project Impact partners.

Project Impact Partners

A list of 1998 Seattle Project Impact partners is included in Appendix B. Many of these partners have responsibilities in areas of the state outside of the City of Seattle. The SHER Plan was developed with the cooperation of national, state, and local building organizations to foster use of the plan in other communities.

Project Impact Earthquake Retrofit Loans

Seattle Project Impact partners Seafirst Bank and Washington Mutual Bank have developed special home retrofit loans with special rates and/or fee reductions for home retrofits that use the SHER Plan. To qualify for these special loans, you must retrofit your home using the minimum prescriptive requirements in the SHER Plan or hire an architect or engineer to prepare your Earthquake Retrofit Plan.

Other lenders may follow with their own loan programs. Homeowners should contact banks directly for more information.

Project Impact Training Programs

Home retrofit work requires specialized training in earthquake resistant design. The Seattle Home Retrofit Program provides training courses for building professionals and for homeowners. Qualification for a Project Impact loans may require that a homeowner or contractor who has completed an approved Project Impact class also complete the home assessment. All Project Impact loans require that a building permit be obtained for work done according to the SHER Plan.

Home Assessment Requirement

The Home Assessment Checklist determines if the home qualifies to use the standard plan and provides an initial list of the earthquake retrofit work needed. This checklist must be submitted as part of the Project Impact Earthquake Retrofit Loan application and

as part of the building permit application. A copy of the Home Assessment Checklist is included in the building permit application packet. Booklet 2 of the Home Earthquake Retrofit Series provides step-by-step help to answer the questions on the checklist.

Building Permit Requirement

In the City of Seattle, a building permit is required to earthquake retrofit your home. The building department *plan reviewer* will determine if your Earthquake Retrofit Plan meets the requirements in the SHER Plan. The building inspector will generally complete two inspections to verify that the home retrofit is completed according to the approved plan. One inspection will be completed after the anchor bolts have been installed. The second inspection will be completed after the pony wall has been strengthened. The plan review and building inspection process helps improve the quality of your home retrofit. The plan reviewer and the inspector may be able to recommend solutions or additional resources for solving problems you encounter when using the standard plan.

The building permit fee is based on the value of the proposed project. A City of Seattle building permit to retrofit a home according to the SHER Plan will generally range from \$110 to \$300.

Project Impact earthquake retrofit loans require that the applicant obtain a building permit as a condition of loan approval.

Low-to- Moderate Income Assistance Programs

The City of Seattle's Department of Housing and Human Services (DHHS) REACH Program offers retrofit grants for low to moderate-income homeowners residing within the Seattle city limits. If the homeowner is income eligible, a DHHS staff member will come to the home and complete the Home Assessment Checklist. If the home qualifies for the standard plan, the homeowner may select a contractor to prepare the building permit application and to complete the retrofit work. Retrofit work paid for through DHHS must be performed by specially trained, licensed and bonded contractors. Homeowners seeking more information should call (206) 684-0244.

Appendix A Definition of Terms

Architect. A design professional trained to design and supervise the construction of buildings or other larger structures.

Building Permit. A city permit obtained from the local building department. In Seattle, a building permit is required for the completion of home earthquake retrofit projects. A plan review is part of the building permit process.

Cascadia Region. The areas of British Columbia, Canada, Washington, Oregon, and Northern California bounded by the Cascade Mountains to the west and the Cascadia Subduction Zone boundary to the east.

Earthquake. The shaking caused when the ground suddenly slips along a zone of weakness, called a fault.

Engineer. A design professional trained to design and supervise the construction of buildings and other large structures.

Fault. A weakness in the rocks comprising the upper, brittle part of the Earth along which movement occurs. Earthquakes occur when faults slip suddenly. “Fault creep” refers to very slow movements along a fault that generally are not accompanied by earthquakes.

Foundation. The part of a home’s structure that supports the weight of the building.

Home Assessment Checklist. A simple checklist that determines if a home qualifies to use the SHER Plan and if the home needs to have earthquake retrofit work done.

Home Earthquake Retrofit Series. Three booklets that accompany the Home Retrofit Permit Application Packet and provide step-by-step guidance to homeowner wanting to retrofit.

Magnitude. A measure of the size of an earthquake based on the amplitude of ground displacement recorded by a special instrument. Each increase in magnitude reflects a ten-fold increase in ground amplitude. A magnitude 6.0 earthquake moves the ground 10 times more than a magnitude 5.0 and 100 times more than a magnitude 4.0. Each whole number represents a 32-fold increase in the amount of energy released.

Modified Mercalli Intensity Scale. A measure of the size of an earthquake based on observations of damage by people living in the area. The maximum intensity reported is frequently used to characterize the overall size of the earthquake. The intensity varies depending upon a number of factors, such as magnitude of the earthquake, the distance to the fault causing the earthquake, etc.

Pony Wall. The short wall between the foundation and the first floor of some homes. The pony wall increases the crawl space under the house, improving access to the underfloor area. A basement may also have a pony wall.

Prescriptive. Specific directions telling how to actually perform the work. Any deviation from a prescriptive requirement requires consultation with a building professional. The local building inspector can often help decide the type of help that may be needed to address a condition that is not addressed by the prescriptive requirement. Some changes are simple and can be made with the help of a contractor and some may require the services of an engineer.

Retrofit. Changes to improve the condition of a building after it has been built.

Soft-story. A term used to describe a floor/story of a building that has significant openings or penetrations in the wall(s), such as a garage door or picture windows. These relatively large openings reduce the strength of the wall to resist earthquake or wind forces that act against the side of the building. The SHER Retrofit Plan does not include a prescriptive method for strengthening homes with soft-stories. Homeowners should be aware that soft-story conditions may lead to collapse.

Structural elements of a building. The elements of a building that support the structure against the forces that push or pull against it. The structural elements must be able to prevent a building from collapsing under the forces of gravity, wind, earthquakes, or snow loads.

Appendix B. Seattle Project Impact Partners

Project partners include large corporations, educational institutions, government agencies, non-profit organizations, and community groups that have come together to support the efforts and goals of Project Impact. Current partners include:

CPARM (Contingency Planning and Recovery Managers)
CREW (Cascadia Region Earthquake Workgroup)
Duwamish Peninsula Community Commission
Federal Emergency Management Agency
Home Depot
INCA Engineers Inc.
International Conference of Building Officials
Jackson Place Community Council
Johnson Controls
King County Emergency Management
King County Labor Council, AFL-CIO
KIRO Television
Linda Noson Associates
Master Builders Association
PEMCO Insurance Companies
Phinney Neighborhood Association
Port of Seattle
Puget Sound Energy
RetroFitters
SAFECO
Seafirst Bank
Seattle City Council
Seattle Department of Design, Construction and Land Use
Seattle Department of Housing and Human Services
Seattle Emergency Management (lead agency)
Seattle Mayor's Office
Seattle Police Department
Seattle Public Schools
Seattle Public Utilities
Skilling Ward Magnusson Barkshire
Shannon & Wilson Inc.
United States Geological Survey
United States Small Business Administration
University of Washington
Washington Association of Building Officials
Washington Insurance Council
Washington Mutual Bank
Washington State Department of Natural Resources
Washington State Emergency Management
Washington Structural Engineers Association
Washington Voluntary Organizations Active in Disaster (WAVOAD)
Washington Web Site Services, Inc.

The addition of many more Project Impact partners is anticipated in the coming months. Project Impact's success depends upon community support. We are seeking partners willing to give time and/or resources to help further our goals. If you're interested in becoming a Project Impact partner, let us know. Write a letter telling us about your company or organization, why you would like to become actively involved with the project, and the type of commitment you'd like to make. Send the letter to:

Jim Mullen,
Seattle Emergency Management Director, 2320
Fourth Avenue, Seattle, WA 98121-1718

Or Fax your information to (206) 684-5998.