

Howard Cook  
737 Page St.  
Berkeley, CA 94710

February 1, 2011

Dear Mr. and Mrs. Doe,

This proposal has three parts. We recommend reading the Contract, the Plans, and Part Two: Understanding Your Retrofit, together to gain the greatest understanding of our proposal.

Your home is different from the one discussed in this proposal insofar as your cripple walls are much taller and more susceptible to damage. However, the retrofit principles are the same for both short cripple walls and tall cripple walls.

If you have not already done so, I suggest you look at the PBS video Dangers of the Hayward Fault on YouTube. This video discusses the geology of the Hayward Fault and has an informative section on retrofitting homes similar to yours.

If you accept this proposal, structural engineer Thor Matteson will review this design and make sure we have approached your retrofit in the most cost effective manner. He is perhaps the finest retrofit engineer in the country and wrote a book on shear walls for the International Code Council. Please see [www.shearwalls.com](http://www.shearwalls.com) If he suggests less work, the price of this proposal will be reduced accordingly, if he suggests more work, there will be no extra charge.

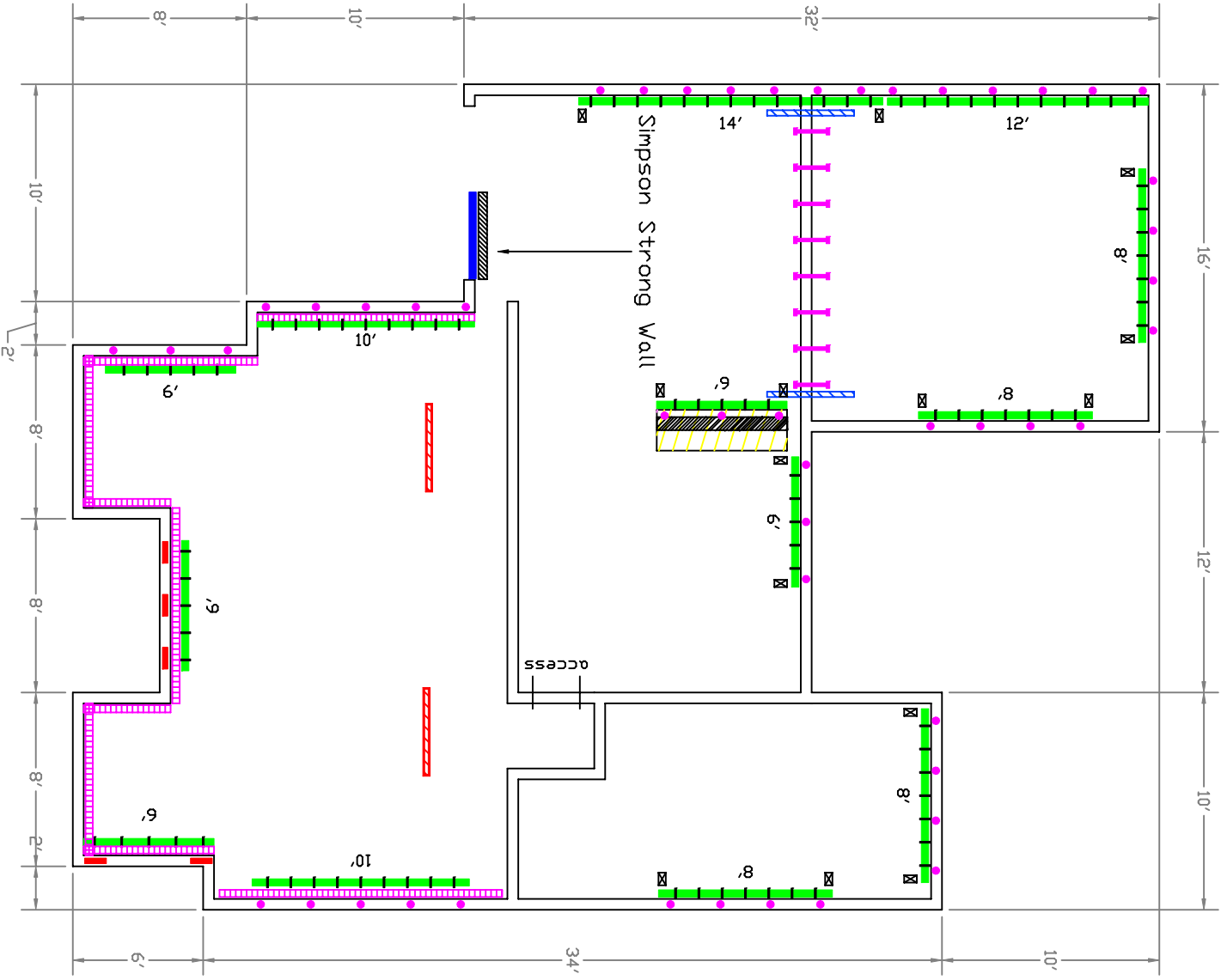
In you wish to proceed, please fill out the Terms and Signature page, write in the dollar amount of the contract, sign and date it. You can then mail it to the above address or fax it.

If you have any questions, please do not hesitate to call.

Sincerely,



Jeff Bailey  
Office: 510-548-1111  
Fax: 510-704-4448



Design and actual placement of bolts, plywood panels and other hardware may vary depending on existing site conditions.

Legend	
	bolt
	foundation anchor
	new plywood shear panel
	continuity tie
	hold down
	shear transfer tie
	shear transfer diaphragm
	new foundation
	existing plywood shear panel
	tension tie
	floor connector

Sample Drawing  
 1234 Mock St  
 Anywhere, CA 44444  
 123-456-7890

**Bay Area Retrofit**  
 Howard Cook, Contractor  
 (510) 548-1111

## Professional Affiliations

Former member and current consultant to The Structural Engineer's Association's Existing Buildings Committee on residential wood-frame retrofit procedures.

Member: Earthquake Engineering Research Institute.

Lecturer on Retrofit Principles and Practice for the American Society of Home Inspectors

Residential Earthquake Damage Inspector for the Federal Emergency Management Agency. On call since 1989.

Course Instructor: "*Principles and Practice of Earthquake Retrofitting*" for the Association of Bay Area Governments

Contributor: Wood-Framed Shear Wall Construction: An Illustrated Guide. Matteson, Thor, Structural Engineer. Illinois: The International Code Council, 2010.

Featured Contractor: "*The Hayward Fault. Predictable Peril*." KQED, Channel 9. October 2008

Co-Author: Wendy, Allen P.E. Anchorage Systems Engineer for Simpson StrongTie and Howard Cook, "*Retrofit Mudsill Anchorage Systems*" Unpublished, 2007

Author: "*Seismic Retrofit for Cripple Walls*", The Journal of Light Construction. 15 April, 2006

Featured Contractor: "*The Coming Bay Area Earthquake*" \_ PBS, The NewsHour with Jim Lehrer, April, 2006

Co-Author: Bay Area's Retrofit Guidelines: Standard Plan A, Residential Seismic Strengthening Plan, San Francisco Bay Area: The International Code Council, 2005.

Mayoral Appointee to the Berkeley Disaster Commission 2005 and 2006 as an advisor on Berkeley's Earthquake Retrofit programs.

Five time graduate of the course "Earthquake Retrofit for Wood-Frame Homes" presented by the Association of Bay Area Governments, starting with the first course in 1995.

August 25, 2010

**Submitted to:**  
John Doe  
San Francisco, CA  
415-222-2222

Dear Mr. Doe,

The greatest weakness you have is something called a soft story which is caused by the garage door opening. Unfortunately, stabilizing this part of the house requires expensive foundation work and/or pre-fabricated shear walls called StrongWalls or engineered steel posts that are attached to the garage door opening called moment columns. The former represents the most cost-effective approach to this problem and is the one I recommend here.

A soft-story hazard is a weakness caused when a wood-frame building has a first story that has at least one floor-supporting wall that is substantially weaker and more flexible than the stories above. This is due to the lack of a wall and foundation under the garage door opening.

In summary, this means the floor above the garage door opening would in all likelihood swing wildly when subjected to earthquake forces parallel to the street and could cause catastrophic collapse. For this reason I recommend installing a pre-fabricated shear wall called a StrongWall at the garage door opening that has far greater strength than a normal shear wall and will allow you to keep an opening at the garage door.

If you accept this proposal, structural engineer Thor Matteson will review this design and make sure we have approached your retrofit in the most cost effective manner. He is perhaps the finest retrofit engineer in the country and wrote a book on shear walls for the International Code Council. Please see [www.shearwalls.com](http://www.shearwalls.com) If he suggests less work, the price of this proposal will be reduced accordingly, if he suggests more work, there will be no extra charge.

My examination of your home showed a need for the following structural modifications:

**Bolt House to Foundation:** Please see the section on bolting found in “Understanding Your Retrofit”

**FINDING:** **The cripple walls that support the floor are not bolted to the foundation.** The mudsill (the part of the house that rests directly on top of the concrete foundation) needs to be bolted to the foundation. The bolts we use have been tested and approved by the International Code Council Evaluation Service for retrofit applications.

**RECOMMENDATION:** Where shown on the enclosed drawing, bolt the mudsill to the foundation

**Install Mudsill Plates:** Please see the section on mudsill plates found in “Understanding Your Retrofit”

**FINDING: Mudsills tend to split if the wood to bolt connection is not strengthened with Mudsill Plates.** These were developed after the Northridge earthquake when it was observed that a large number of mudsills split. In addition mudsill plates can increase the strength of the bolt from 59% to 200%.

**RECOMMENDATION:** Install Mudsill Plates on all bolts shown on the drawing.

### **Tear Out sheet rock and/or plaster**

**FINDING: In order to access the wall framing, some of the walls in the garage/basement will require removal of existing sheetrock and/or plaster**

**RECOMMENDATION:** Remove finish material in garage/basement as required. Installation of fire-resistance sheetrock over the plywood is EXCLUDED.

Installation of fire resistant sheetrock will only be required at new shear wall locations in the garage and basement. This is a code requirement for new construction because flammable materials in a garage can catch fire and burn through the plaster or sheetrock on the walls and ceiling and into the living area. The building department enforces this code requirement whenever an existing wall is disturbed. However, the hazard to your home will not actually be reduced by this code enforcement because the fire-resistance of the predominant undisturbed portions of wall and ceiling will remain the same.

You need to be aware installing 5/8 thick sheet rock over the proposed shear walls will create an uneven wall surface.

I suggest we install sanded and painted smooth plywood. This is what I did on my house and it is impossible to tell the difference between the plywood and the plaster.

**Install Plywood** Installing plywood is discussed in “Understanding Your Retrofit”

**FINDING: The cripple walls have inadequate lateral bracing to prevent collapse.** This hazard can be corrected by bracing these walls with plywood. Our plywood is installed in accordance with information found in the American Plywood Association Research Report 154 for high capacity shear walls.

**RECOMMENDATION:** Where shown on the enclosed drawing, install structural grade plywood manufactured specifically for shear wall construction.

**Use the Flush Cut Method:** The flush cut method is discussed in “Understanding Your Retrofit”.

Attach the plywood to the bolted mudsill with the flush cut method rather than the nailed blocking method used by our competitors whenever possible. This method has been used in thousands of tests conducted in American Plywood Association laboratories. Copies of these test results are available upon request.

**Install Shear Transfer Ties to Connect Floor to Cripple Walls on the front and back.** These are discussed in “Understanding Your Retrofit”.

**FINDING: The floor of the home can slide off the plywood braced and bolted cripple walls.** This can be corrected by attaching the floor to the walls with steel shear transfer ties. **Note: *Shear transfer ties are required by all published retrofit guidelines and are an important part of any retrofit.***

While examining your house I discovered you had adequate floor to cripple wall nailing on the long sides of the house. For this reason I decided to forego strengthening this already fully adequate connection.

**Connect Breaks in Upper Top Plate** This is discussed in “Understanding Your Retrofit”

**FINDING:** The horizontal 2 by 4’s at the top of the floor cripple walls, (known as the top plate) are not joined together. Instead they are made of several unconnected pieces that are butted together.

**RECOMMENDATION:** The top plates should be nailed together so they work together in transferring earthquake forces from the floor to the shear walls.

**Connect One Break in Upper Top Plate with a large steel strap**

**FINDING:** The horizontal 2 by 4’s at the top of cripple wall on the north side of the house has a break in it. This break in the upper top plates means earthquake forces being generated on the northwest side of the house will not be restrained by the shear walls in the crawl space.

**RECOMMENDATION:** Remove stucco at probable top plate break location and connect the two upper top plates together with a large steel strap.

**Install Hold Downs** These are discussed in “Understanding Your Retrofit”

**FINDING:** The shear walls need hold-downs to resist overturning (or tipping over) forces at specific shear wall locations. The lateral forces of an earthquake pushing against the top of a shear wall cause to tip over, much as a tall chest of drawers will tilt up and overturn if you try and slide it across the floor by pushing it from the top.

**RECOMMENDATION:**

Where shown on the drawing, install hold-downs on shear wall to help keep the wall from tipping over.

**Insufficient Foundation**

**FINDING:** The effectiveness of the proposed shear wall to the left of the west facing window in the basement can be increased by increasing its length and install a new segment of foundation.

**RECOMMENDATION:** Install new segments of foundation as shown on attached plans so that the shear wall at this location can be lengthened. Foundation segment to be designed by a structural engineer.

**Attach floor to shear wall at new foundation location.**

**FINDING:** The new segment of foundation will need to be attached to the floor it is supposed to restrain.

**RECOMMENDATION:** Install a plywood shear transfer diaphragm to connect this shear wall to the shear wall built on the new foundation.

### **Install Simpson StrongWall in Garage Door opening**

**FINDING:** The floor above the garage door opening is not attached to a foundation. This is because of the garage door opening located below this floor.

**RECOMMENDATION:** Install Simpson StrongWall at the location shown on the drawing.

### **Install Continuity Tie in Crawlspace**

**FINDING:** The floor in the crawlspace needs to be attached to the new Simpson StrongWall. As of now the floor joist that extends from above the StrongWall into the crawl space is in two pieces butted together.

**RECOMMENDATION:** As shown on the drawing, join these two lengths of floor framing together with a large steel strap called a continuity tie.

### **Floor to Floor Connectors**

**FINDING:** The floor of the rear addition is not adequately attached to the floor of the main house. Earthquake forces will tend to tear the two floors apart. These two floors should be connected together so that they perform as one floor and transfer earthquake forces adequately to the earthquake resisting elements (bolts, plywood, etc.) located on the perimeter of the house.

**RECOMMENDATION:** Install floor-to-floor connectors to connect the two floors together.

### **Tension Ties**

**FINDING:** The floor of the rear addition is not attached adequately enough to the floor of the main house to prevent it from pulling away from the main house. Earthquake forces will pull the two floors apart.

**RECOMMENDATION:** Two tension ties should be installed on each end of the two floors to keep the rear addition from pulling backwards away from the main house.

### **The Building Department**

#### **Draw plans and submit to building department for review.**

The issue of procuring a permit is discussed on our website under the FALSE SECURITY button. We charge \$275.00 for the time it takes to draw plans for a *voluntary* retrofit, submit the plans for review, and meet with the building inspector after the work is completed. In addition, City permits usually cost between \$300 and \$1,000

**If you desire a permit, please add \$275.00 to the price below.**

**Total Contract Price: \$12,709.00  
Plus price of permit paid to city**

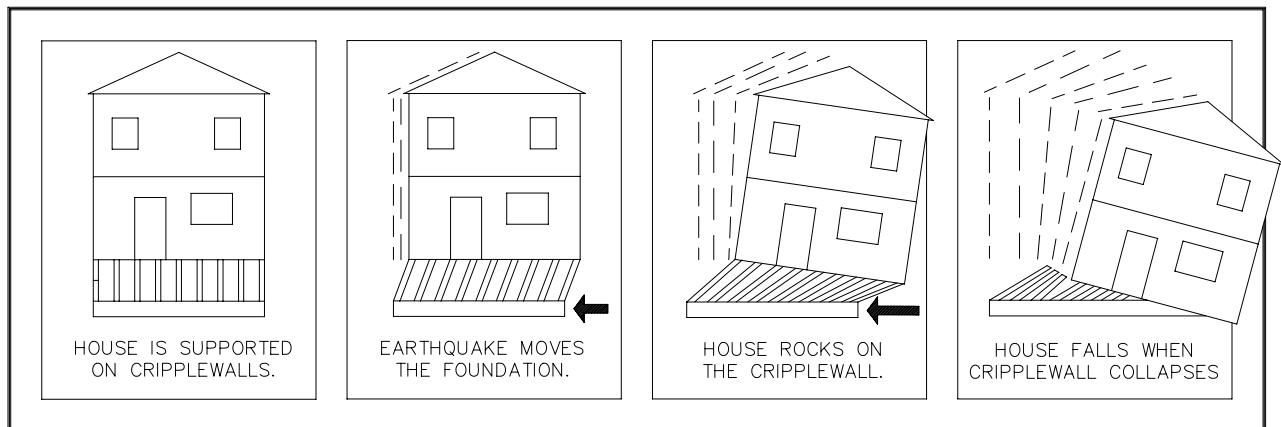
## How a Retrofit Works



If you have a home built before 1945 it probably has a structural weakness called a cripple wall. This is a wall between the foundation and your floor.



A typical cripple wall seen from the outside  
Photo courtesy Summerfield Inspections, Berkeley



A cripple wall will collapse during a large earthquake if it is not retrofitted with a shear wall.





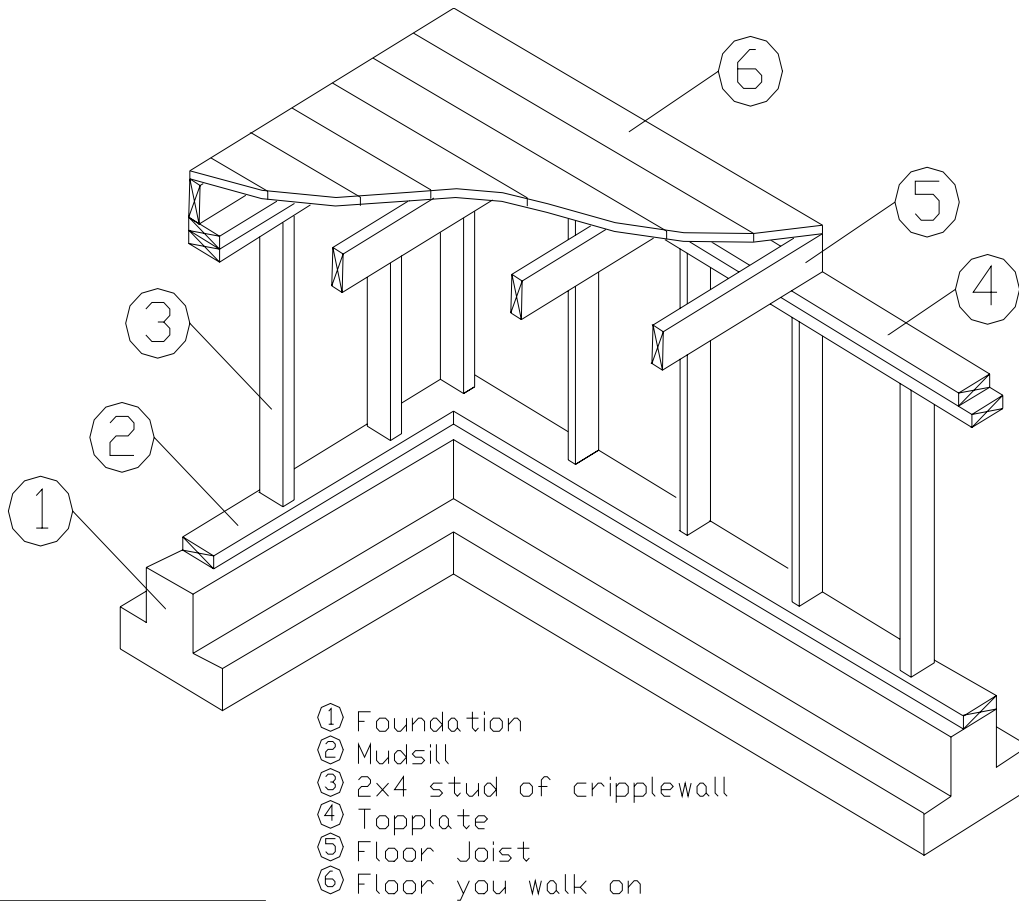
**Example 1:** Cripple wall failure; notice the location of the steps relative to the floor.



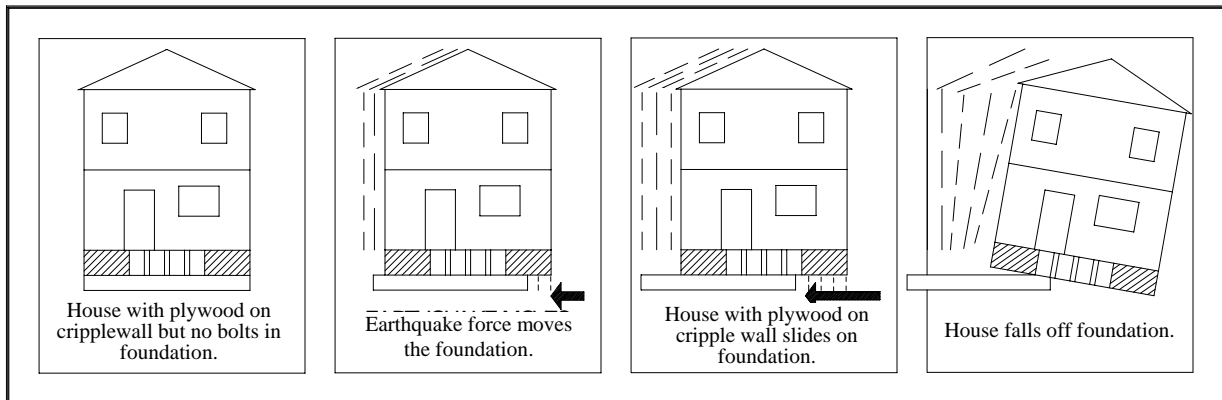
**Example 2:** Cripple wall failure where the floor shifted to the right..

The house on the left has fallen from its foundation but is otherwise intact. This small house in Ferndale California cost over \$150,000 to repair and was unlivable for six months. This damage would have been avoided if it had been retrofitted.

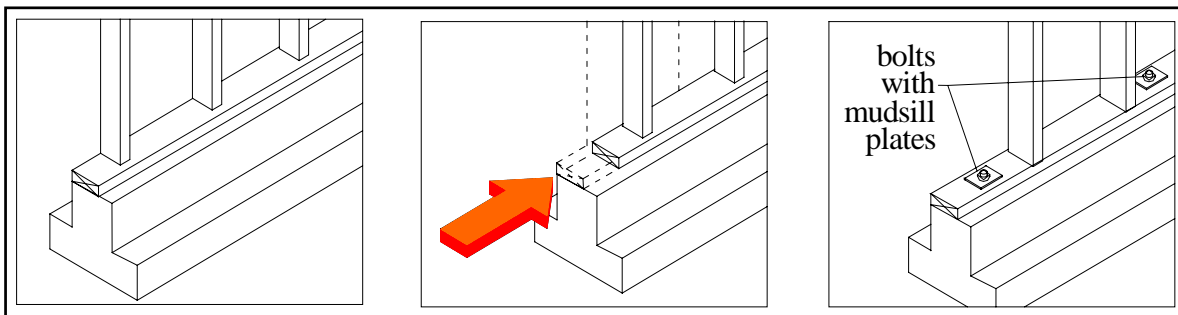
### Glossary of useful terms



## Bolt House to Foundation

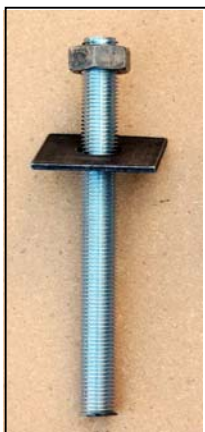


This is what happens when a house is not bolted to the foundation.



The arrow represents the earthquake force moving the bottom of the cripple wall. The third frame shows the bolts that prevent this movement.

Structural engineers in Southern California discovered that bolts bent in earthquakes and that this split the mudsill. These same engineers discovered that plate washers as shown below prevent this from happening.



Bolt with plate washer



Bolt with plate washer passing through mudsill and into foundation.



These engineers also discovered that mudsills often split because when the earthquake force pushed on the mudsill against the bolt, the wood was much softer than the bolt or the concrete. They developed a special type of washer called a mudsill plate that not only helps with splitting, but also increases bolt strength by 59% to 200%. Bay Area Retrofit is the only company that uses these special washers.



Mudsill Plate

### **Install Foundation Anchors**

Sometimes there is no room to install a bolt because the distance from the mudsill to the floor you walk on is too short for a concrete drill. In these cases a foundation anchor is bolted to the side of the concrete and the side of the mudsill.

Foundation anchors, as shown in the photo below, are used to attach the mudsill to the concrete foundation. They are stronger than a standard bolt.

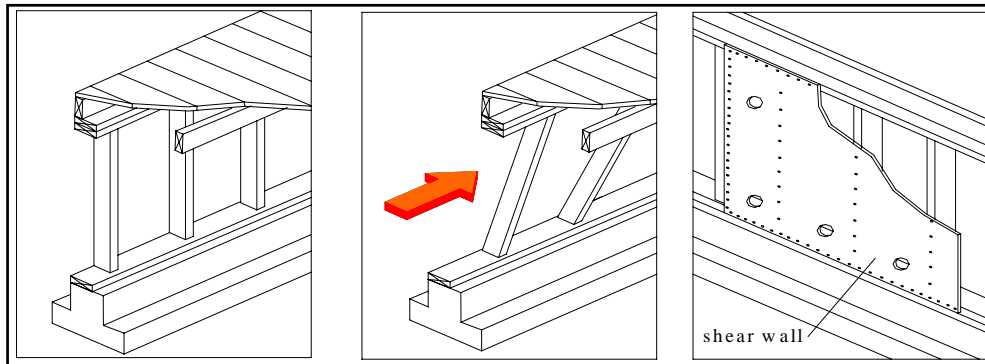


Mudsill

Concrete

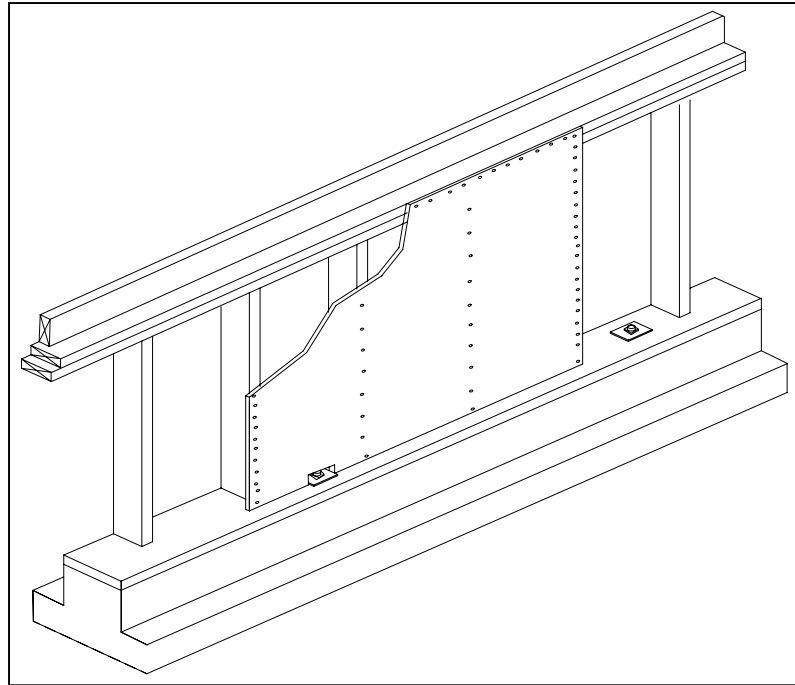
Foundation Anchor

### Install Plywood

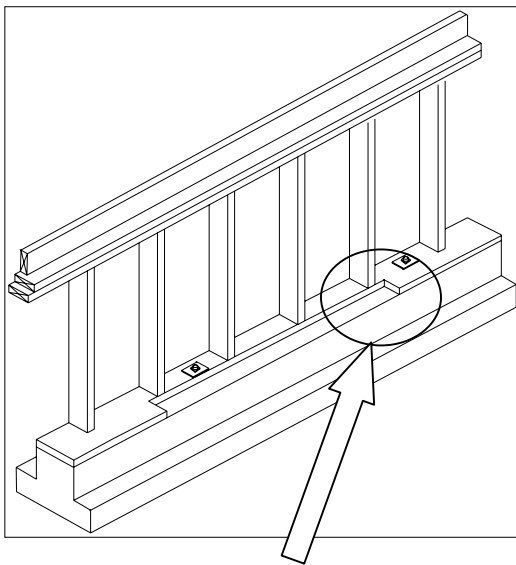


The red arrow in the center drawing shows how earthquake forces push on the cripple wall, causing it to collapse. The last drawing shows how we install plywood to prevent it from collapsing. Even though this drawing makes plywood installation look very simple, entire manuals and even books have been written on this subject

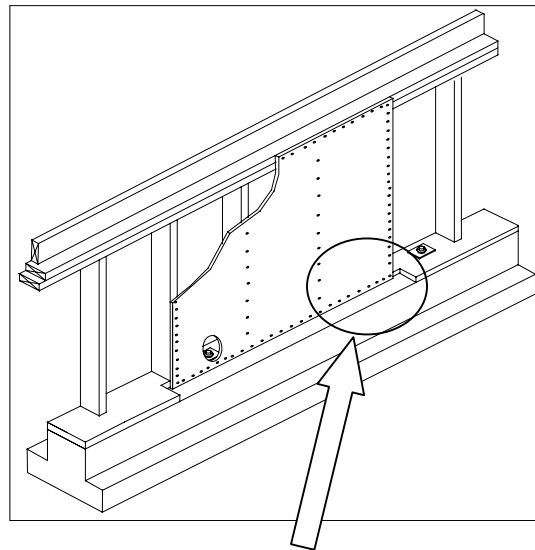
**Use the flush cut method**



Your home is built with mudsills that are 6 inches wide supporting 4 inch wide two by fours. As shown above, unless a modification is made, the plywood will sit on top of the mudsill where it will not be connected to the bolts. One method is the flush cut method. This is the method Bay Area Retrofit uses and is the only company in the Bay Area that does so

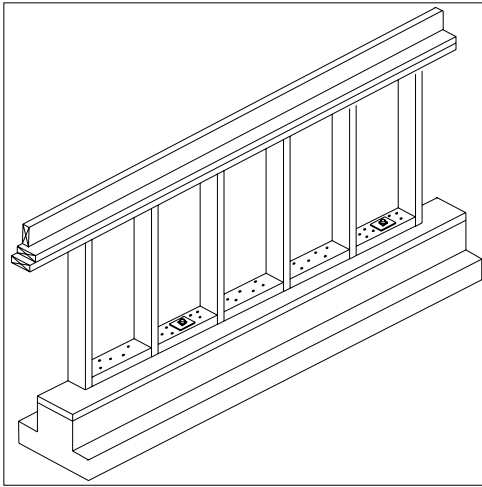


Mudsill is cut flush with the 2 by 4s

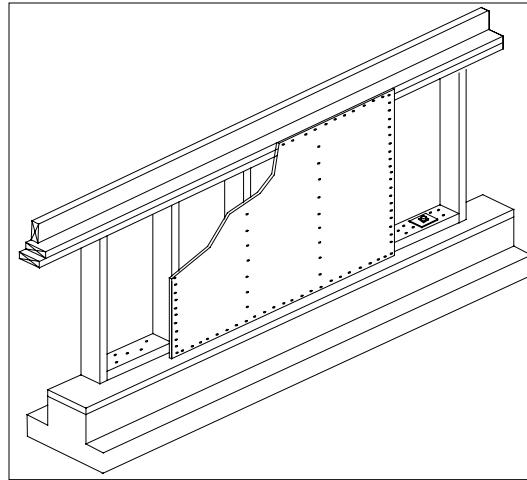


Plywood is nailed to the bolted mudsill.

Another method is to install wooden blocks between the 2 by 4s and then nail the plywood to the blocks.



Blocks nailed between 2 by 4s



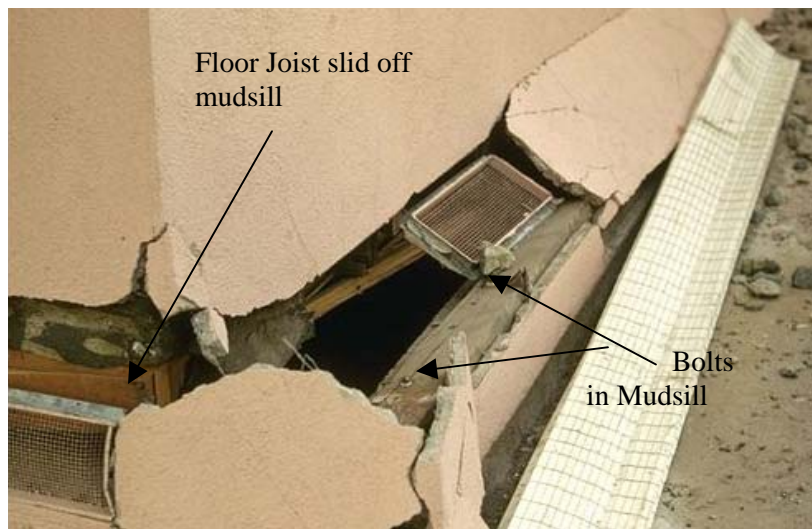
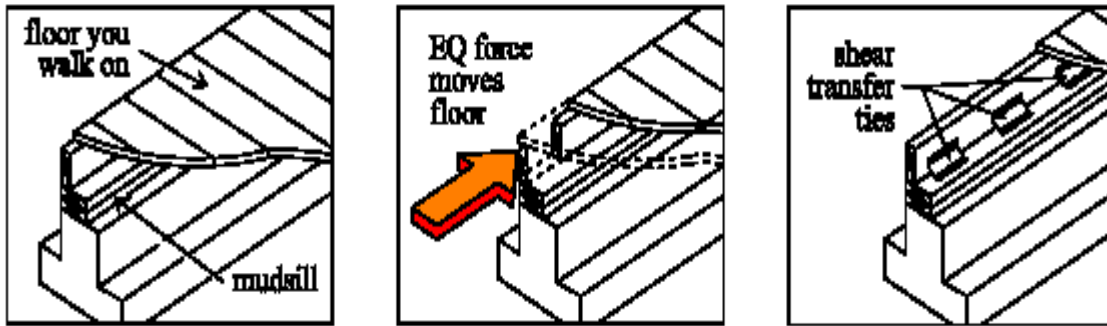
Plywood nailed to the blocks

This method often splits the blocks.



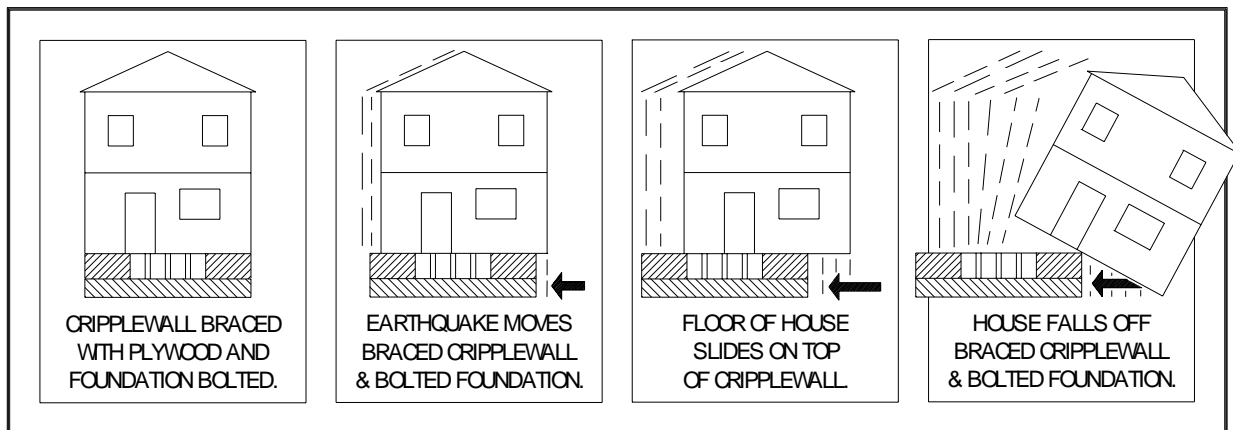
We never use nailed wood blocks. This method has only been tested once and was found to produce shear walls that are half as strong as shear walls built using the flush cut method.

**Install Shear Transfer Ties to Connect Floor to Mudsill**



A house without a cripple wall and no shear transfer ties.

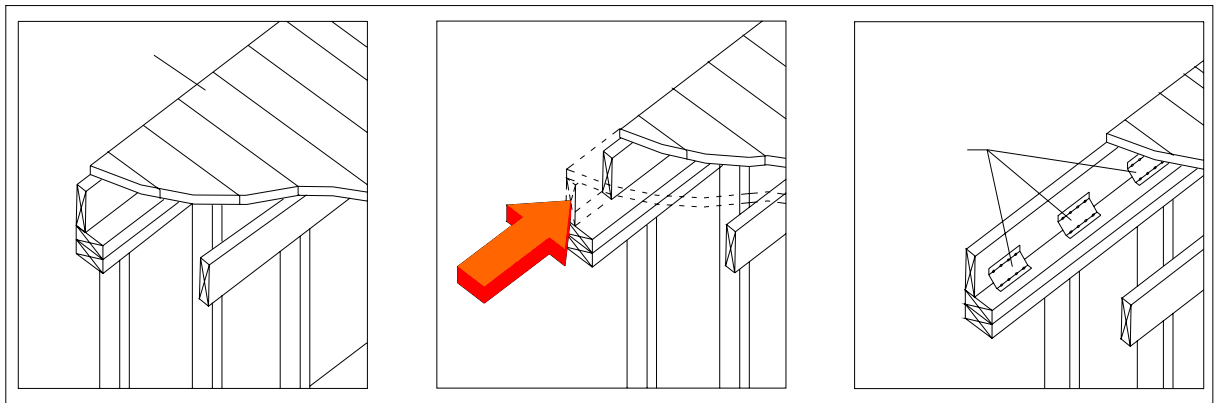
**Install Shear Transfer Ties to Connect Floor Joists to Cripple Wall.**



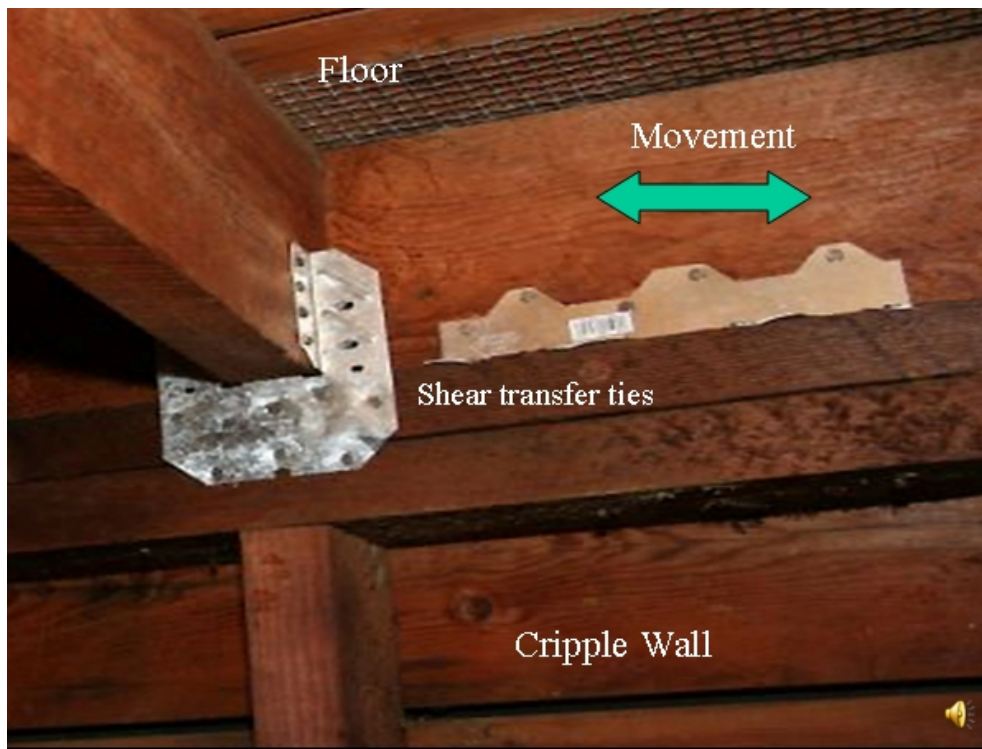
Floor you  
walk on

Earthquake Force

Shear Transfer Ties



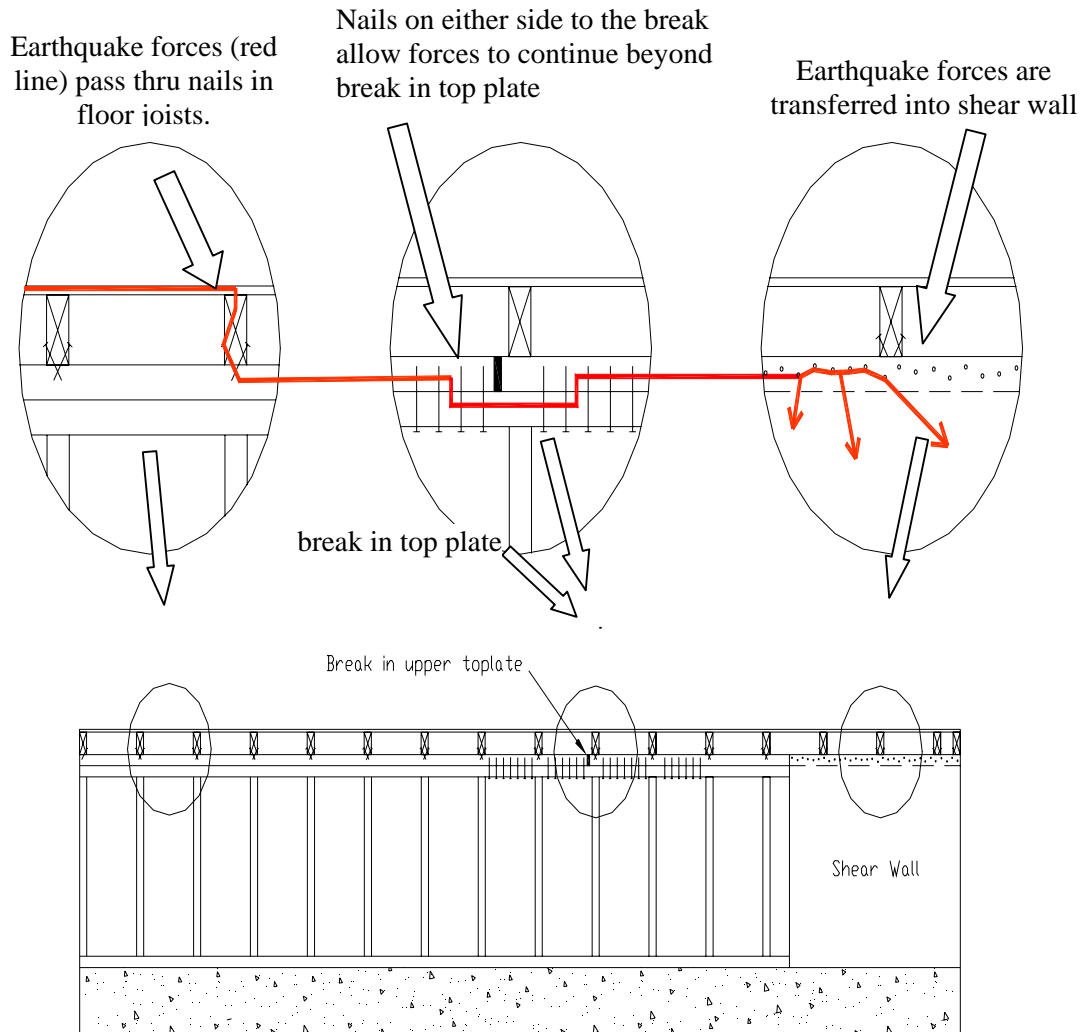
Shear Transfer Ties are a special type of hardware designed to prevent the floor framing from moving on top of the cripple walls.





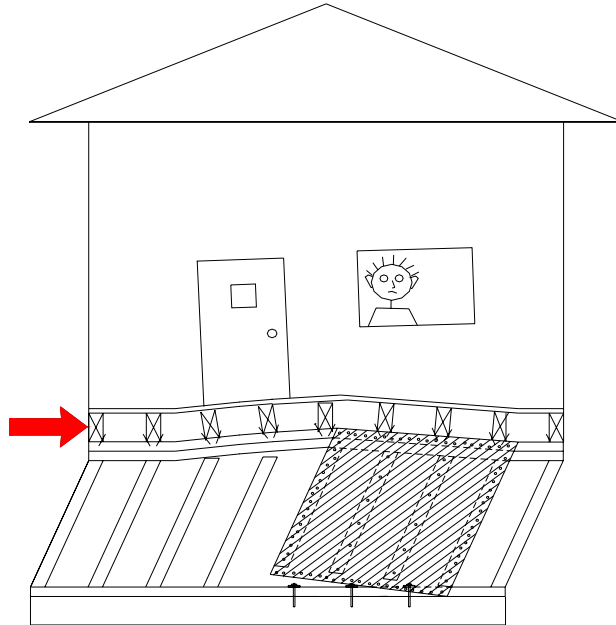
## Connecting Breaks in Upper Top Plate

It is important to make sure any breaks in the top plate are spliced together. In this way earthquake forces traveling through the top plate are transferred to the shear walls. In the following illustrations, the red line represents earthquake forces moving along the top of the wall, into the top plate and down into the shear wall.



## Install Hold Downs

A shear wall can tip over when an earthquake force shown by the red arrow pushes on the floor. This is especially true for tall shear walls. Hold downs prevent this from happening.



Shear walls on either side of a garage with overturning damage

## Does Retrofitting Really Work?



Notice the top of the stairs of this home relative to the position of the floor. This home fell six feet in a 7.1 earthquake in Ferndale California. None of the windows are not cracked and the house is fully intact in every way except the damage to the interior was so extensive it needed to be torn down. The damage to this home would have been quite minimal if it had been retrofitted and not fallen off its foundation.

### An actual laboratory test of retrofitting:

An architect owned two identical Santa Cruz homes. In 1989 he retrofitted one of them. Before retrofitting the other one the 7.1 Loma Prieta earthquake struck. The retrofitted one cost \$5,000 to repair for minor interior plaster cracks. The other one cost \$260,000 to repair because the cripple walls collapsed and it fell off its foundation. .