

Submitted to:

John Doe
222 Earthquake Lane
San Andreas Fault, CA

Dear Mr. Doe

While reading this proposal you will be prompted to watch videos and read information from our website Bayarearetrofit.com. At the same time please look at the included drawing and its legend where you will see the location of each retrofit component. If you have not already done so, you may like to know who we are and how our [20 years experience and research](#) may make you feel more comfortable trusting your home in our hands.

You will see prompts such as "Link to" If you click on the link you will find information relevant to your retrofit

We made a webpage that contains a general overview of the material you will find in this proposal. Going to this webpage now you will get a good sense of what we plan to do and why. Link to ["Retrofit Principles"](#) Be sure and watch the video.

If you are interested in the geology that makes all of this necessary I can highly recommend this [PBS documentary on Bay Area seismic geology](#).

Sincerely,

Howard Cook

Office: 510-548-1111
Fax: 510-704-4408



The type of hardware and retrofit techniques we use vary considerably from house to house and what you see here may not constitute exactly what we do. This is because no two houses are the same and we invariably run into something that was not done “by the book” such that the methods and hardware seen in the videos are not used in all areas of the house.

Our technicians have however been trained in seismic engineering so they know what to do no matter what they find.

Our recommendations for your retrofit consist of the following:

The Rationale Behind your Design: Link to [“*Designing a Cripple Wall Retrofit*”](#) This is the mathematical/engineering basis behind your and every retrofit. It will only make sense to you when you understand the terminology. That is why the [“*Retrofit Principles*”](#) webpage mentioned above is so important.

The Building Department

It is important for you to know the role of the building department in the retrofit process. Link to [“*Permits*”](#)

Install Bolts: Link to [“*Foundation Bolts*”](#)

FINDING: Bolts are an integral part of any retrofit and the mudsills need to be bolted to the foundation.

RECOMMENDATION: Bolt the mudsill to the foundation at shear wall locations with laboratory tested foundation bolts.

❖ You may be surprised to see that bolts are only placed at shear wall locations. Link to [“*Ask an Engineer*”](#) and read the answer to question 1.

Install Mudsill Plates: Link to [“Mudsill Plates”](#)

FINDING: The Northridge Earthquake showed mudsills tend to split if the mudsill-to-bolt connection is not strengthened with Mudsill Plates. In addition, tests have shown mudsill plates increase the strength of a bolt by 59%.

RECOMMENDATION: Install Mudsill Plates on all new bolts. Mudsill Plates were developed after the Northridge Earthquake due to the large number of mudsills that split.

Install Plate Washers on all Bolts Link to [“Cross Grain Bending and Mudsill Splitting”](#)

FINDING: Plate washers prevent a very serious and common shear wall failure possibility called cross grain bending, in addition to preventing the mudsill from splitting in a different manner than Mudsill Plates.

RECOMMENDATION: Install Plate Washers on all new bolts 2 feet apart to be sure cross grain bending is resisted.

Bolt House to Foundation with Foundation Anchors Link to [“No Cripple Wall Retrofit”](#)

FINDING: The short 6 inch vertical distance between the foundation and the floor at the front prevents the installation of standard bolts because bolt drilling equipment will not fit.

RECOMMENDATION: Install Foundation Anchors tested and approved for use as bolt substitutes by International Code Council testing laboratories. There are 3 different types of Foundation Anchors we use depending on the exact conditions we find.

Attach Joists to Mudsill with Shear Transfer Ties Link to [“Transfer Ties”](#)

FINDING: The Floor Joists can slide off the mudsill where the Foundation Anchors are to be installed. This can be corrected by attaching the joists to the mudsill with Shear Transfer Ties. There are 4 different types of steel Shear Transfer Ties we use as well as 2 or 3 we fabricate on site, depending on the exact conditions we find.

RECOMMENDATION: Install Shear Transfer Ties approved by the International Code Council

Brace Cripple Walls

It is critical that you understand this part of your retrofit proposal because it is one of many areas where we outperform our competitors

Attaching the Plywood to the Mudsill: Link to [“Tested Shear Walls”](#) and after reading this page go to [“a world experts opinion”](#) The password on this page is “Skaggs”

[All retrofit guidelines](#) use the “Nailed Blocking Method” referenced in the webpage above and require that plywood be nailed to the blocks 4 inches apart. We have discovered nails can be much closer than this, which creates a much stronger shear wall if the Nailed Blocking Method is not used.

As discussed on the webpage above, nailed blocks have severe limitations because of splitting of the blocks. I suggest you ask your other prospective contractors which system they use.

The blue arrow shows the strength of plywood nailed 4” apart as 430 pounds of resistance per linear foot when nailed 4 inches apart. This is the nailing required in the retrofit guidelines mentioned above. The red arrow shows the plywood strength when nailed 2 inches apart with the same nails and provides 730 pounds of resistance per linear foot, a 58% increase in strength.

If larger 10 penny nails are used the earthquake resistance of the plywood goes up to 870 pounds of resistance per linear foot, creating a shear wall that is over twice as strong. This is the capacity of the shear walls we may be using on your house depending on what we find.

15/32 plywood with 10d nails 2” apart (red arrow) are twice as strong as code allowed 8d nails 4” apart (blue arrow). The numbers represent the amount of force the plywood can resist per linear foot.

TABLE 1.

RECOMMENDED SHEAR (POUNDS PER FOOT) FOR APA PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS-FIR, LARCH, OR SOUTHERN PINE^(a) FOR WIND OR SEISMIC LOADING^(b)

| Panel Grade | Minimum Nominal Panel Thickness (in.) | Minimum Nail Penetration in Framing (in.) | Panels Applied Direct to Framing | | | | Panels Applied Over 1/2" or 5/8" Gypsum Sheathing | | | | | |
|--|---------------------------------------|---|--------------------------------------|-----------------------------------|--------------------|--------------------|---|--------------------------------------|-----------------------------------|-----|-----|------------------|
| | | | Nail Size (common or galvanized box) | Nail Spacing at Panel Edges (in.) | | | | Nail Size (common or galvanized box) | Nail Spacing at Panel Edges (in.) | | | |
| | | | | 6 | 4 | 3 | 2 ^(e) | | 6 | 4 | 3 | 2 ^(e) |
| APA STRUCTURAL I grades | 5/16 | 1-1/4 | 6d | 200 | 300 | 390 | 510 | 8d | 200 | 300 | 390 | 510 |
| | 3/8 | 1-1/2 | 8d | 220 ^(d) | 360 ^(d) | 460 ^(d) | 610 ^(d) | 10d ^(f) | 280 | 430 | 550 | 730 |
| | 7/16 | | | 255 ^(d) | 395 ^(d) | 505 ^(d) | 670 ^(d) | — | — | — | — | |
| | 15/32 | | | 280 | 430 | 550 | 730 | — | — | — | — | |
| | 15/32 | 1-5/8 | 10d | 340 | 510 | 665 ^(f) | 870 | — | — | — | — | |
| APA RATED SHEATHING; APA RATED SIDING ^(g) and other APA grades except species Group 5 | 5/16 or 1/4 ^(c) | 1-1/4 | 6d | 180 | 270 | 350 | 450 | 8d | 180 | 270 | 350 | 450 |
| | 3/8 | | | 200 | 300 | 390 | 510 | 10d ^(f) | 260 | 380 | 490 | 640 |
| | 3/8 | | | 220 ^(d) | 320 ^(d) | 410 ^(d) | 530 ^(d) | — | — | — | — | |
| | 7/16 | 1-1/2 | 8d | 240 ^(d) | 350 ^(d) | 450 ^(d) | 585 ^(d) | — | — | — | — | |
| | 15/32 | 1-5/8 | 10d | 260 | 380 | 490 | 640 | — | — | — | — | |
| | 15/32 | | | 310 | 460 | 600 ^(f) | 770 | — | — | — | — | |
| 19/32 | | | 340 | 510 | 665 ^(f) | 870 | — | — | — | — | | |
| APA RATED SIDING ^(g) and other APA grades except species Group 5 | | | | Nail Size (galvanized casing) | | | | Nail Size (galvanized casing) | | | | |
| | 5/16 ^(c) | 1-1/4 | 6d | 140 | 210 | 275 | 360 | 8d | 140 | 210 | 275 | 360 |
| | 3/8 | 1-1/2 | 8d | 160 | 240 | 310 | 410 | 10d ^(f) | 160 | 240 | 310 | 410 |

(e) Framing at adjoining panel edges shall be 3-inch nominal or wider, and nails shall be staggered where nails are spaced 2 inches o.c.

Here is the edge of a 2 by 4 block where the plywood is nailed. The nails are spaced 1 inch apart, showing close edge nailing of the plywood is OK so long as the Nailed Blocking method is not used.

Plywood was nailed to this edge of the 2 by 4 one Inch apart with no Splitting



Install Plywood: Link to [“Plywood”](#)

This webpage explains what scientists have discovered about making the strongest shear walls possible..

RECOMMENDATION: Install high capacity structural grade plywood on all retrofit shear walls

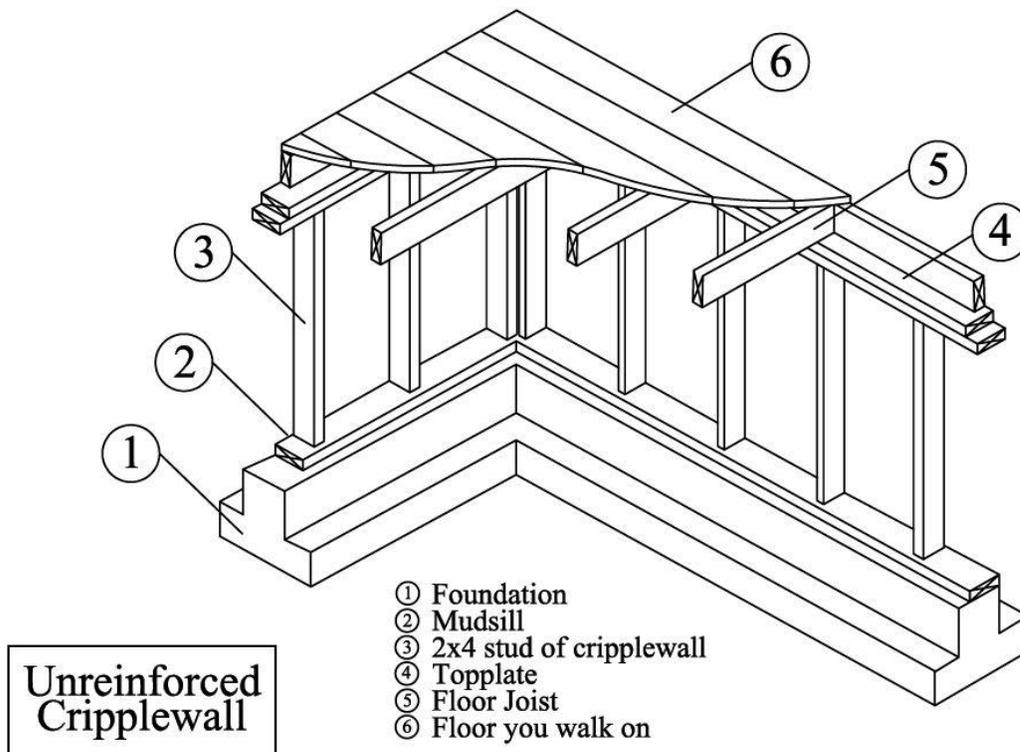
Install Shear Transfer Ties on Cripple Walls: Link to [“Retrofit Principles”](#) and watch minute 3:45 of the video.

FINDING: In order to complete the cripple-wall-to-shear-wall conversion process, the shear walls need to be connected to the floor with steel.

RECOMMENDATION: Install laboratory tested shear transfer ties.

No Topplates

FINDING: The cripple walls at the front and back of the house do not have topplates to nail the plywood to. A top plate is shown by the number “4”.



RECOMMENDATION: Install new top plates at the front and back so that the plywood can be attached to the top of the cripple wall.

Some of the Cripple Walls are too Short to allow the Installation of Standard Bolts Link to [“Short Shear Wall”](#)

FINDING: The vertical distance between the foundation and the floor prevents the installation of standard bolts on these cripple walls.

RECOMMENDATION: Install Foundation Anchors designed to be used as bolt substitutes.

Install Hold Downs: Link to [“Overturning”](#)

FINDING: The tall and narrow shear walls will need hold downs to resist overturning (tipping over)

Lateral forces pushing against the top of a shear can cause it to tip over, in the same way a tall chest of drawers will tip over if you try and slide it across the floor by pushing it from the top. If the shear wall tips over, the shear wall can no longer be effective.

RECOMMENDATION: Where shown on the attached drawing, install hold downs on shear walls to resist overturning.

Connect Breaks in Upper Top Plate Link to [“Top Plate”](#)

FINDING: The horizontal 2 by 4’s at the top of the cripple walls, (known as top plates) are not joined together. They will tend to separate where not connected together.

RECOMMENDATION: The top plates should be connected together with either nails or steel.

Removal of Plaster or Sheet Rock Link to [“Plaster”](#) in the Search Box

FINDING: In order to access the wall framing and foundation, we will need to be remove plaster or sheet rock at certain locations. This may require removal of lead based paint. We are certified by the Environmental Protection Agency to safely remove lead based paint.

RECOMMENDATION: Remove plaster or sheetrock as required and replace with plywood shear walls. When we are done you will see bare plywood at the new shear wall locations. The plywood can be textured and painted exactly like sheet rock.

If we must remove plaster/sheet rock in the garage, the building department will require the new shear walls be covered with fire-resistant sheetrock. Sheetrock installation in garage is INCLUDED but only fire-taped, not textured or painted.

Install Lag bolts Link to [“Lag Bolts”](#) in the Search Box

FINDING: The shear walls at plaster/sheet rock locations should be attached to the floor with non-invasive lag bolts. Lag bolts do the same thing as Shear Transfer Ties but are installed differently

RECOMMENDATION: Where shown on the attached drawing, install lag bolts. Otherwise strips of ceiling plaster will need to be removed and the ceiling repaired at much greater cost.

Possible Ceiling Replacement Link to [“Ceiling”](#) in the Search Box

When the lag bolts mentioned above won't work, we will need to remove a strip of sheet rock 18 inches wide so we can use conventional Shear Transfer Ties. We charge an extra \$35 per linear foot for this including sheet rock replacement but no finishing.

Mudsill Embedded in Concrete Link to [“Embedded in Concrete”](#)

FINDING: The Foundation Anchors must be attached to the side of the mudsill but the mudsill is sunk into the concrete such that the side of it is not accessible

RECOMMENDATION: Use a small air hammer to expose the side of the mudsill.

Bolt new Mudsills to Side of Foundation and Connect to Floor Link to [“Side Bolt”](#).

FINDING: The floor needs to be attached to the foundation, but at some locations standard retrofit procedures will not work because we cannot access the mudsill.

RECOMMENDATION: Bolt new mudsills made of special lumber that will not split to the side of the foundation and connect this to the floor with either steel or wood.

The Existing Retrofit Uses the Nailed Blocking Method Link to [“Mudsill Connections”](#)

FINDING: When the existing shear walls were built they used the Nailed Blocking Method and the blocks may have split. This method has not been tested for effectiveness by the American Plywood Association research laboratories.

RECOMMENDATION: The existing redwood mudsill should be cut flush with the face of the existing plywood and the bottom edge of a new piece of plywood nailed to the old growth mudsill. This plywood to plywood connection tested by the American Plywood Association and can be found in Research Report 138. At the end of the article



Stepped Shear Wall: Link to [“Stepped Shear Wall”](#)

FINDING: The foundations on the two sides that extend from the bottom of the hill to the top of the hill are stepped. In the Northridge Earthquake it was discovered that shear walls built on stepped foundations have peculiar failure characteristics that must be addressed in your retrofit.

Documentation and the Building Department

We will take progress pictures that provide a record of all phases of the job. If you choose not to get a permit these photos will be provided to you on a DVD after payment is made. Otherwise the City permit provides this documentation.

When the house is sold a private home inspector will be evaluating your retrofit and will not care what the permit says, he will be interested in these photos because they will show what was actually done.

If a permit is requested, we charge \$375.00 for the time it takes to draw plans for a voluntary retrofit, submit the plans for review, and meet with the building inspector during the course of the job. In addition, City permits usually cost between \$400 and \$1,000.

Total Contract Price: \$xx.xxx -
Plus \$375.00 permit processing fee in addition to any fees required by the City.

Placement of retrofit components and methodology may vary depending on existing site conditions.

Smoke and Carbon Monoxide Detectors

***As of July 1, 2011 California State law REQUIRES both smoke detectors and carbon monoxide detectors installed in your home.

Please indicate on the terms and signatures page if you have one smoke detector inside each bedroom, in the hallway outside the bedrooms, on each additional floor in a common area, and in the basement. You will also need a carbon monoxide detector installed outside each sleeping area in the immediate vicinity of the bedrooms, on each additional story, and in the basement.

If they are missing, please install them or the Building Department will not give final approval of your retrofit.

If fire safety is a concern of yours, one common approach is to install a gas shut off valve. We have found the company Quake Prepare at QuakePrepare.com to be a reliable and cost-effective company.

Terms and Signature Page

* If you would like to proceed, please fill out this Terms and Signature Page and input the dollar amount of the contract and return it to Howard@bayarearetrofit.com

* To complete the permit process, I will need to meet the inspector for the final inspection so he/she can look at the required smoke detectors. I understand I will need to be home and wait for the inspector for up to 4 hours, either from 8-12 or 12-4 NA **Initial**

*I would like for Bay Area Retrofit to install _____ Smoke Detectors and _____ Carbon Monoxide Detectors for \$75 each. Combination Smoke Carbon Monoxide detectors will cost \$85 each. If I get a permit I will need these to meet City building department requirements. NA **Initial**

* I will give contractor access to inside of house to install these detectors during work hours NA **Initial**

* If unexpected problems arise such as dry rot, termite damage, etc are exposed during the course of the work I understand such repair work will need to be done before we can complete our job. This work can be done by us or others under a separate contract. Our rate is \$90 an hour. **Initial**

* I will remove personal property from work areas. **Initial**

* I understand the type of hardware, quantities, linear footage of plywood etc may vary slightly depending on existing site conditions **Initial**

* Contractor hereby disclaims any express or implied warranties that the seismically strengthened building will be able to withstand an earthquake without damage to its structure or contents. **Initial**

Acceptance with Permit: The specifications, prices, and conditions outlined in this proposal are satisfactory. I authorize Bay Area Retrofit to complete this contract.

I agree to pay the contract price listed above and a \$375 permit processing fee for a total of \$_____. Plus yet to be determined City permit fees of.

I understand my building permit will be my only documentation of work performed **Initial**

Payment:

Full payment is due upon completion of work. Payable by: cash, check, or credit card plus the credit card company's 3% service charge.

Acceptance without Permit: The specifications, prices, and conditions outlined in this proposal are satisfactory. I authorize Bay Area Retrofit to complete this contract. I agree to pay the contract price of \$_____. I do not desire a permit and wish to be given photographs on a DVD for documentation of work performed.

NA **Initial**

Signature _____ Date _____

Print Name _____ E-mail _____

Address _____

Phone _____

Professional Affiliations

Course Instructor: [“Seismic Retrofitting for Homeowners”](#) for the Association of Bay Area Governments

Author [“Seismic Retrofit for Cripple Walls”](#), The Journal of Light Construction. April, 2006

Featured Contractor [“The Hayward Fault. Predictable Peril.”](#) KQED, Channel 9.

Featured Contractor [“California Works to Prepare for the Big One”](#), PBS/News Hour

Lecturer “Retrofit Principles and Practice for the *Home Inspection Industry.*”

Sponsored by the Golden Gate Chapter of the American Society of Home Inspectors

Keynote speaker *“The Preservation of Historical Wood-Framed Buildings”* Sponsored by The City of Victoria Heritage Foundation in British Columbia.

Mayoral Appointee to the Berkeley Disaster Commission

Guest Lecturer: *“Retrofit Principles and Practice for the Canadian Home Inspection Industry.*” Sponsored by the Canadian Association of Home and Property Inspectors

Residential Damage Inspector, FEMA. 1989-1994.

Member Associations:

- Earthquake Engineering Research Institute
- Structural Engineering Association of Northern CA
- City of Oakland Apartment Building Retrofit Committee

Publications:

- Contributor: [Wood-Framed Shear Wall Construction: An Illustrated Guide.](#) Matteson, Thor, Structural Engineer. Illinois: The International Code Council, 2010.
- Co-Author with Wendy, Allen, Engineer for Simpson Strong Tie, “Retrofit Mudsill Anchorage Systems”, 2007
- Co-Author and currently updating Bay Area’s Retrofit Guidelines: [“Standard Plan A, Residential Seismic Strengthening Plan”](#), The International Code Council, 2005.
- “Homeowner’s Guide to Seismic Retrofitting”
- Many other publications available in the PDF Library at Bayarearetrofit.com

References

Earthquake retrofitting is the science of applying structural engineering principles to a building so that it can withstand the violent shaking caused by earthquakes. The people below know us well and can confirm our understanding of these engineering principles and our ability to apply them. We have two consulting structural engineer: Colin Blaney who is [a senior engineer with ZFA Engineering](#) and Mr. Thor Matteson. Mr. Matteson specializes in residential seismic retrofitting and wrote a 180 page book on shear walls published by the prestigious International Code Council for which he was given an award for “Excellence in Structural Engineering” by the Structural Engineers of California.

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