



Wood Frame and Soft-Story Buildings CEA/FEMA Seismic Retrofit Standard

ATC-110

Colin Blaney S.E.

ZFA STRUCTURAL ENGINEERS

OUTLINE

- Overall Project Goal
- What is the Vision of CEA/FEMA
- Past Residential Damage
- Typical Deficiencies
- Prescriptive vs. Engineered Approach
- What we have now ...Codes, Standards and Plan Sets
- Next Steps

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OVER-ARCHING GOAL

- National Pre-Standard and eventually Standard which will specifically address the seismic rehabilitation of one and two family residential dwellings (R3)

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ATC -110 PROJECT TEAM

Project Technical Committee

Colin	Blaney	ZFA
John	Osteraas	Exponent
Kelly	Cobeen	WJE
Andre	Filiatrault	SUNY Buffalo
Tom	Anderson	Anderson Niswander Constr.
Frank	Rollo	Treadwell & Rollo
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ATC-110 PROJECT TEAM

Project Steering Committee

David	Bonowitz	Consultant
Dan	Dolan	Washington State
David	Khorram	City of Long Beach
Vikki	Bourcier	Hobach-Lewin
Philip	Line	APA
Steve	Pryor	Simpson
Thor	Matteson	Consultant

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WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- National Standard to Address most Residential Construction
 - Cripple Wall Buildings
 - Slabs on Grade
 - Pole Type Foundations, Pier and Beam Systems
 - Hillside Homes
 - House over Garages

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WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- **Focus on Prescriptive Approaches**
 - **Embed the Engineering**
 - **Make Implementation Simple & Effective**

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WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- **Streamline an Engineered Approach**
 - Create Design Tools and Detail Libraries to assist Engineers.

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WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- **To Answer other important Questions**
 - When does a certain vulnerability become an elevated concern?
 - When does the slope of a particular site warrant additional design or rehabilitation measures
 - Can the rehabilitation of Hillside Homes follow prescriptive Standards.
 - How do we address the variance of construction practices

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WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- **To Address other important Goals**
 - Can we develop a better idea of expected drift, the onset of damage and possible collapse for specific structures types and materials.
 - Cost to Benefit Indicators for Retrofits

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PAST RESIDENTIAL DAMAGE

1983 Coalinga Earthquake- M 6.3¹

- Almost destroyed - 309 single-family homes
- Major damage - 558 single-family homes
- Minor damage - 811 single-family homes

1. A disaster assessment by the American Red Cross



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PAST RESIDENTIAL DAMAGE

1989 Loma Prieta Earthquake -M 6.9

- Older homes that were not bolted to their foundations or which lacked properly braced cripple walls accounted for over 2,800 of the 16,000 or 17.5% of all housing units made uninhabitable. ¹
- In Watsonville 10-20% of all pre-1940 residences suffered cripple wall damage. Some blocks suffered nearly 100% ²

1. "Preventing the Nightmare" 2003- Report by ABAG

2. The October 17th 1989 Loma Prieta Earthquake. EQE Report October 1989.



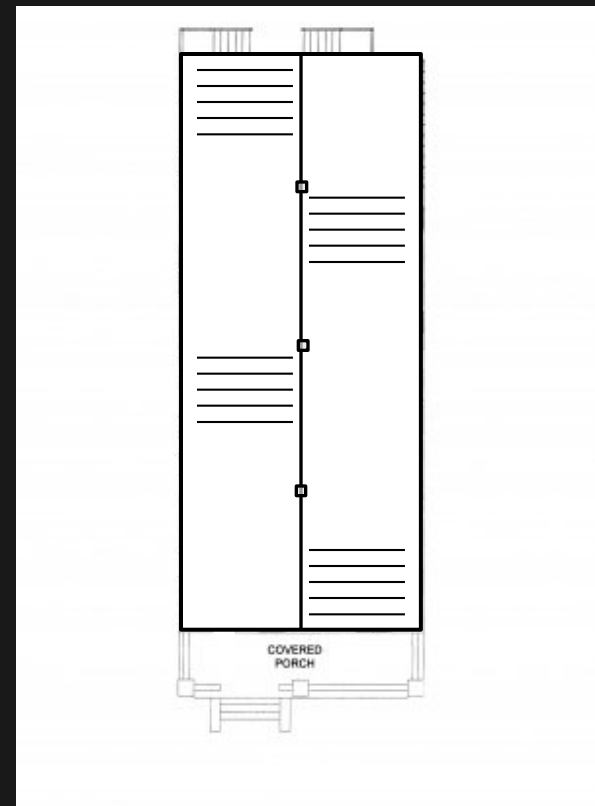
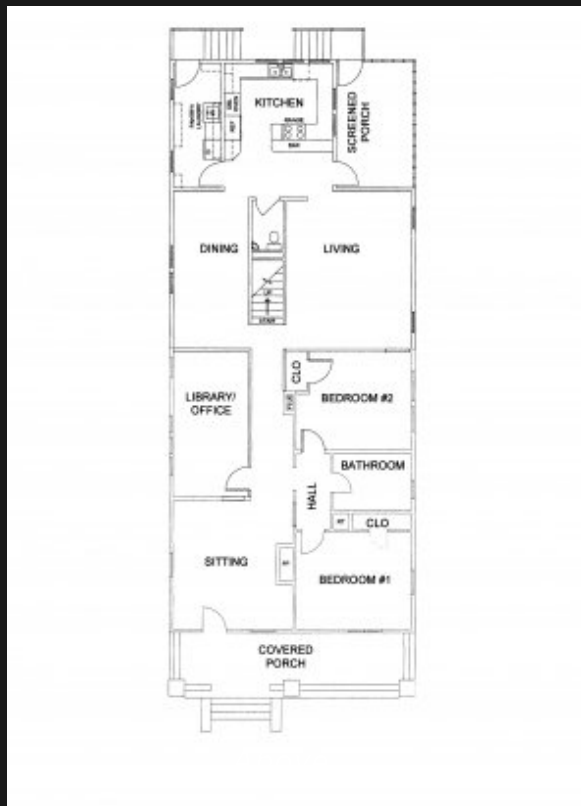
WHAT'S DEFICIENT?

- The lack of continuous concrete or reinforced masonry footings at the perimeter,
- Cripple walls with inadequate bracing,
- Minimal or no attachment between the floor framing and the top of cripple wall or mudsill,
- The lack of appropriate anchorage between the mudsill and foundation system.

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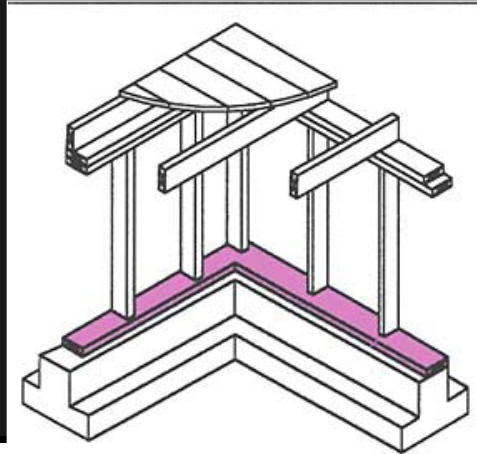
WHAT'S REALLY DEFICIENT?

- Lack of redundancy below first floor



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MUDSILL ATTACHMENTS



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MUDSILL ATTACHMENTS



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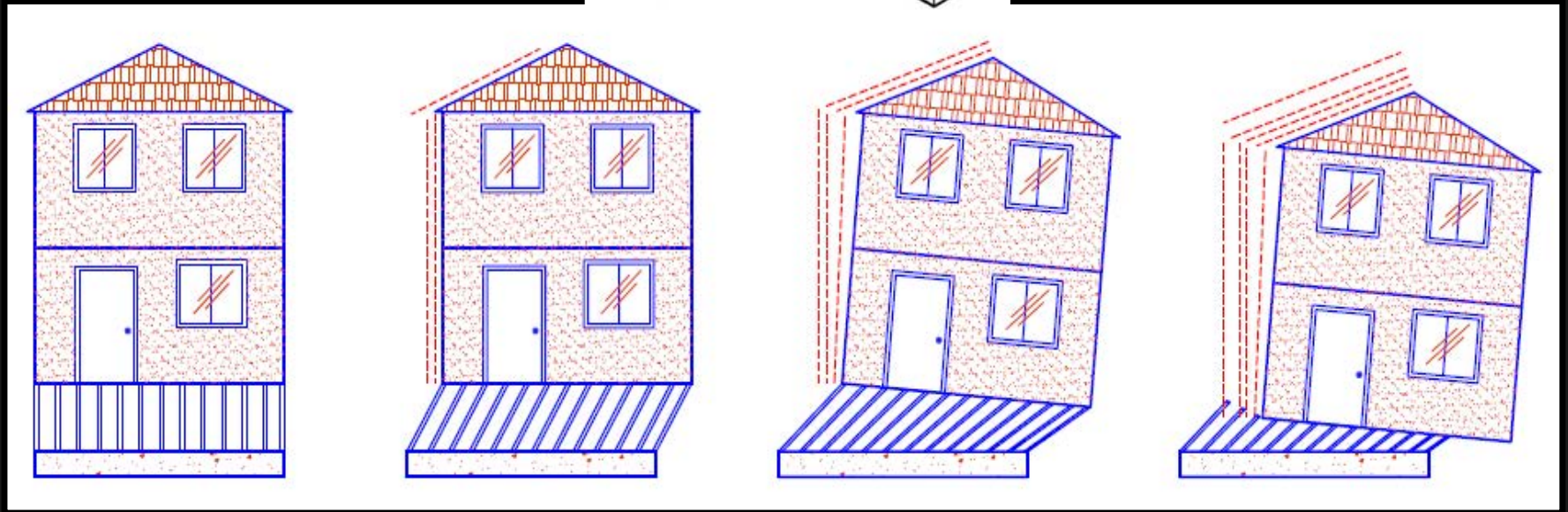
CRIPPLE WALL FAILURES



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ZFA Structural Engineers

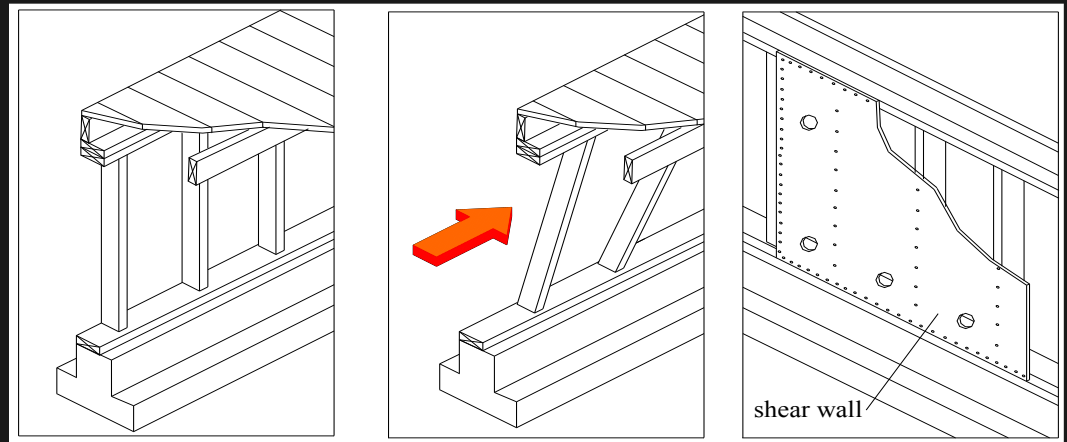
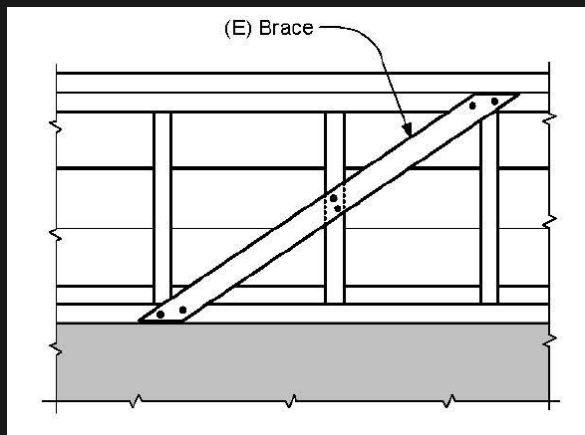
INADEQUATELY SHEATHED CRIPPLE WALLS



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WHAT DOESN'T WORK?

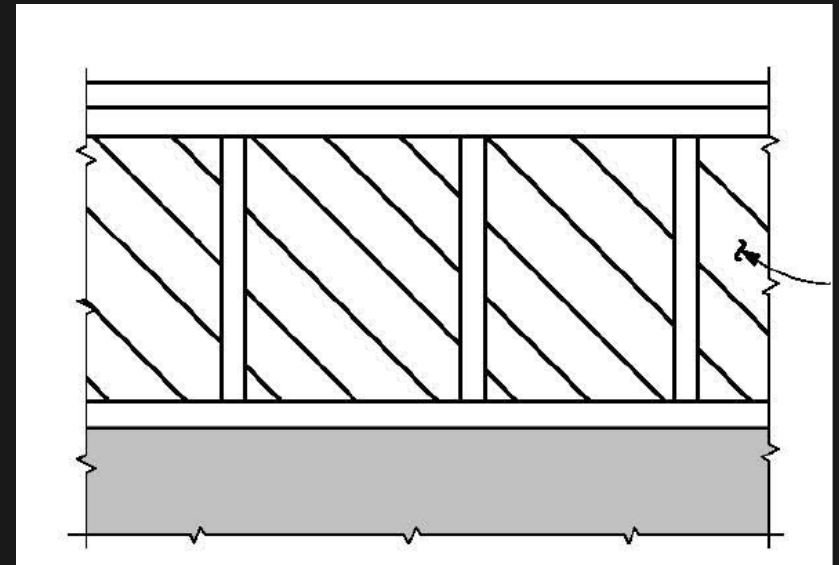
- Horizontal Wood Sheathing/Shingles
- Stucco/Plaster ?
- T1-11 Siding ?
- Let in Bracing



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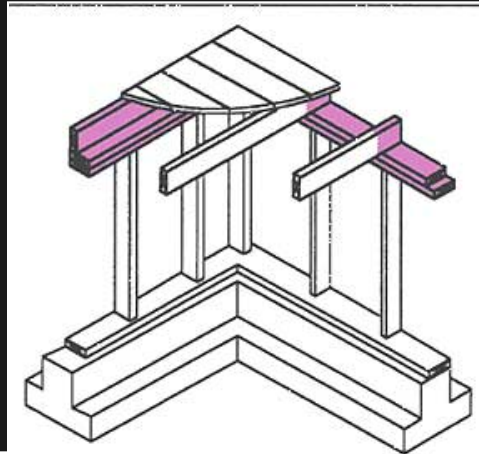
WHAT DOES WORK?

- Plywood
- OSB (oriented strand board)
- Diagonal Wood Sheathing



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FLOOR TO CRIPPLE WALL ATTACHMENTS

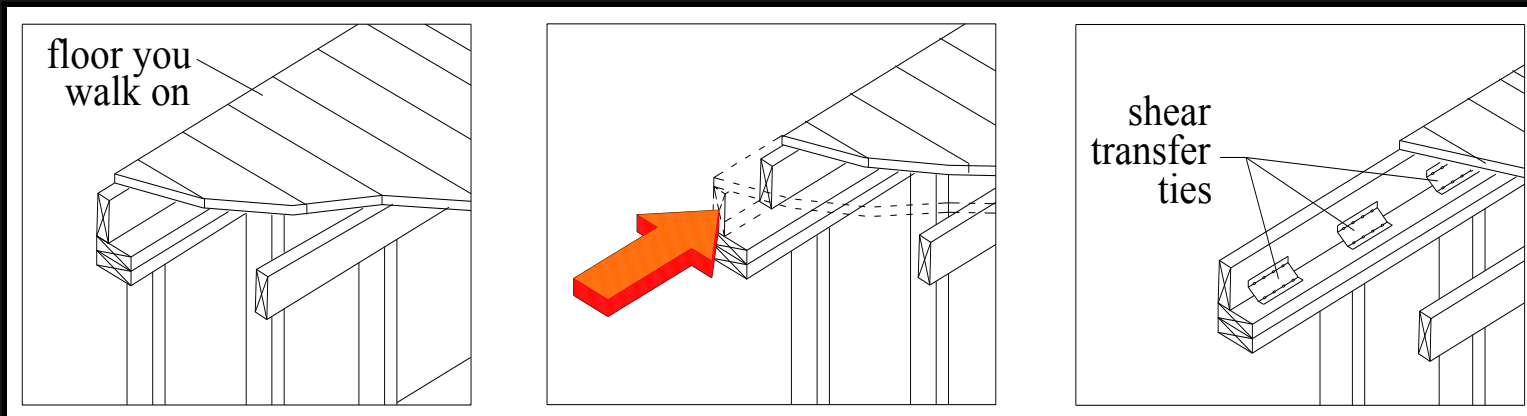


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FLOOR TO CRIPPLE WALL ATTACHMENTS

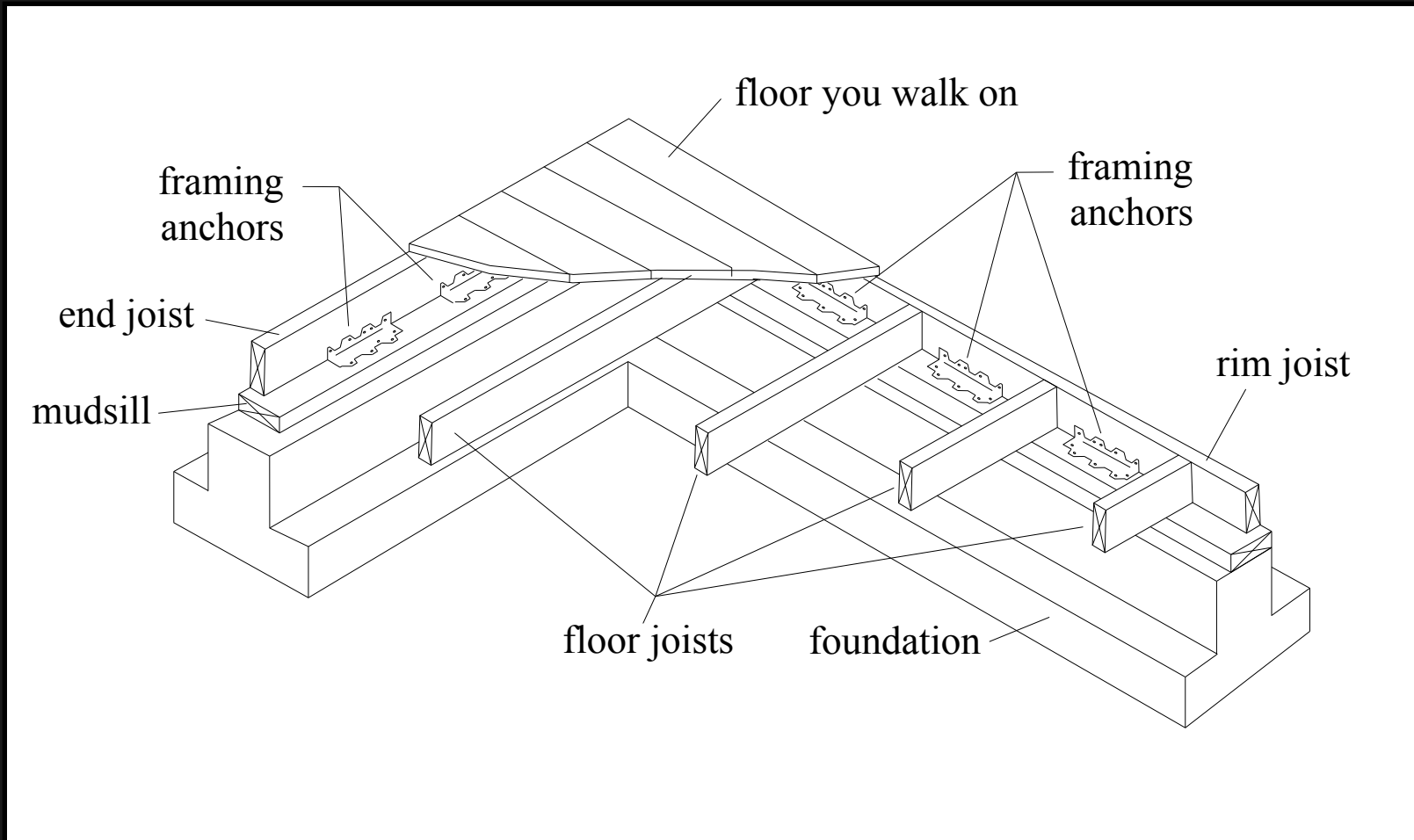


Photos Courtesy By Area Retrofit



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FLOOR TO MUDSILL ATTACHMENTS



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WHAT DOCUMENTS DO WE HAVE

- FEMA P-50, P50.1
- IEBC A3
- Plan Set A
- City of LA - DBS Anchor Bolt Plan (2009)
- Simpson Strong-Tie
- Plan Set B ?? - (Standard Plan B)

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PRESCRIPTIVE STANDARDS

- Engineering Intent “Embedded”
- Developed for Specific “Most Typical Conditions”
- Use in Manner Consistent with Details

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ENGINEERED SOLUTION

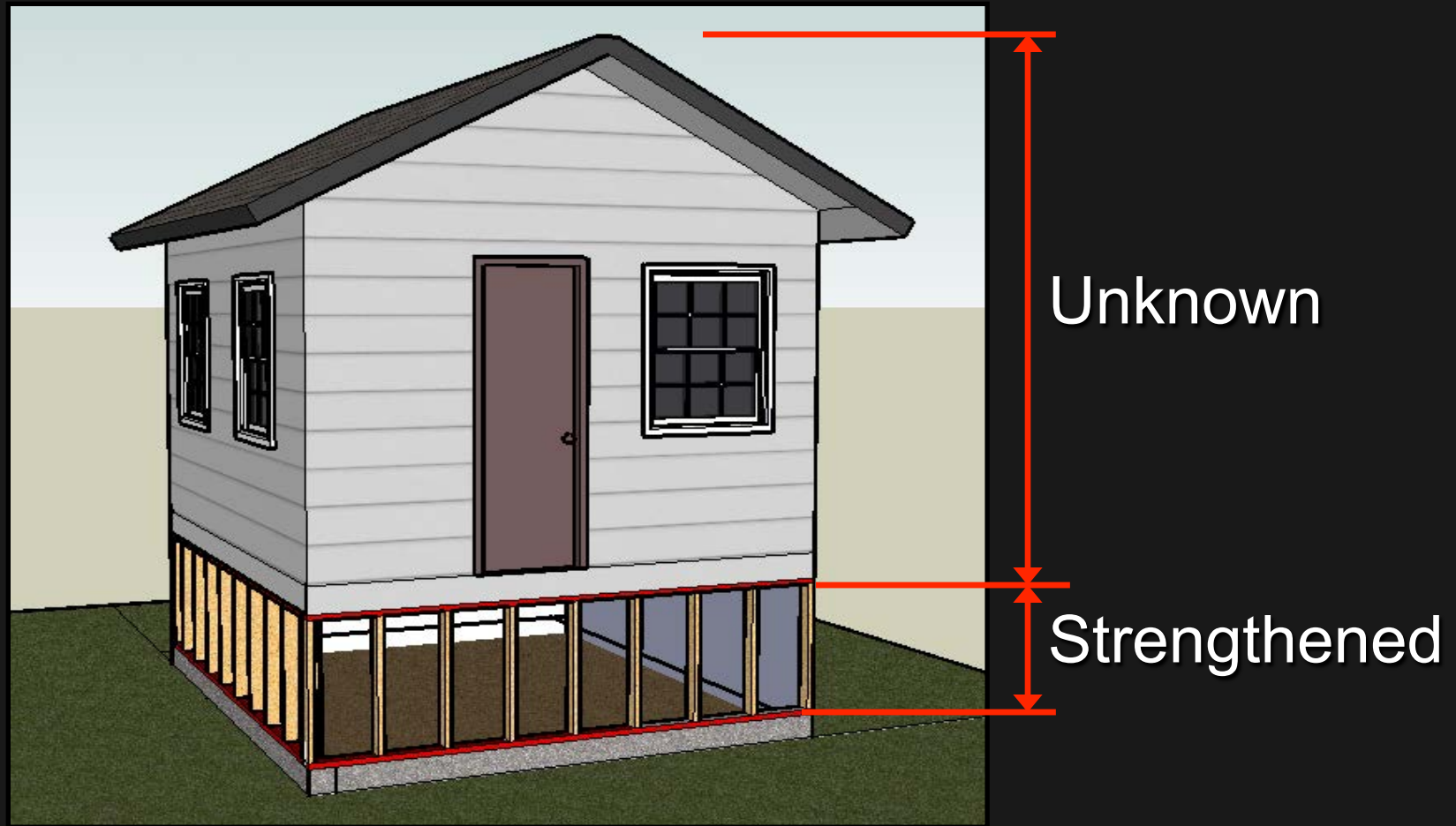
- Required when building falls outside of Scope (Example-A301.2)
- When the existing detailing falls outside of the “Most Typical Conditions”
- 75% of Code Design Forces

WHAT MAKES THESE DOCUMENTS DIFFERENT?

- Developed for Homeowners, Contractors, & Engineers
- Focus on “Critical Risk”
- Recipe of “Prescriptive Requirements & Details”

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WHAT IS “CRITICAL RISK”



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IEBC A3 & WHERE DOES IT APPLY?

- Residential Buildings of Light Frame Construction (R-3)
- Not More than Four Dwelling Units
- 16 or fewer Primarily Permanent Occupants
- Cripple Walls Less Than 4' in Height

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WHERE DOES IEBC A3 APPLY?

- Homes with post & pier and URM Foundation Systems
- Engineering Assessment or Prescriptive Foundations



Jim Russell



Anderson Niswander

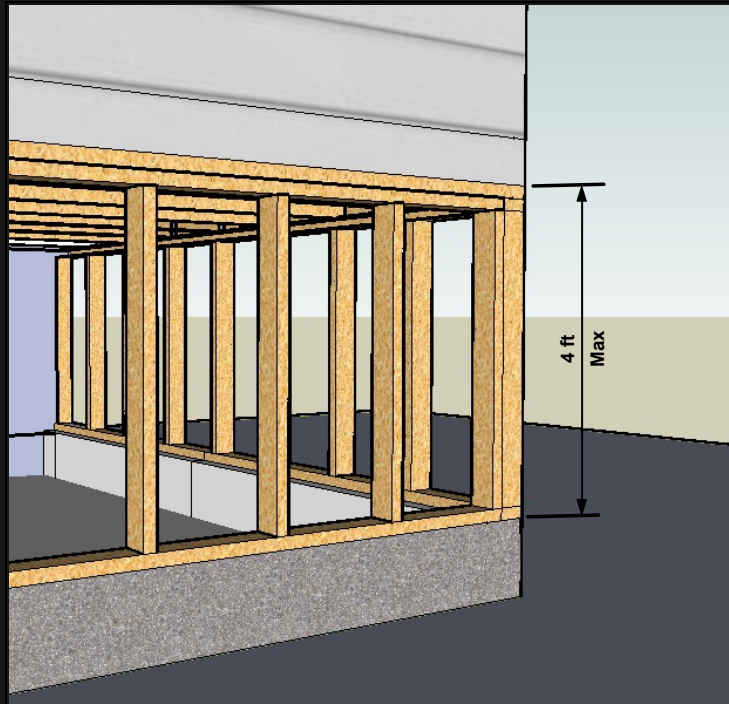
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WHERE DOESN'T A3 APPLY?

- Cripple walls over 4' in Height
- Homes with Pole Foundations
- Buildings Exceeding Three Stories in Height
- Buildings With Slabs on Grade

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WHERE DOESN'T A3 APPLY?

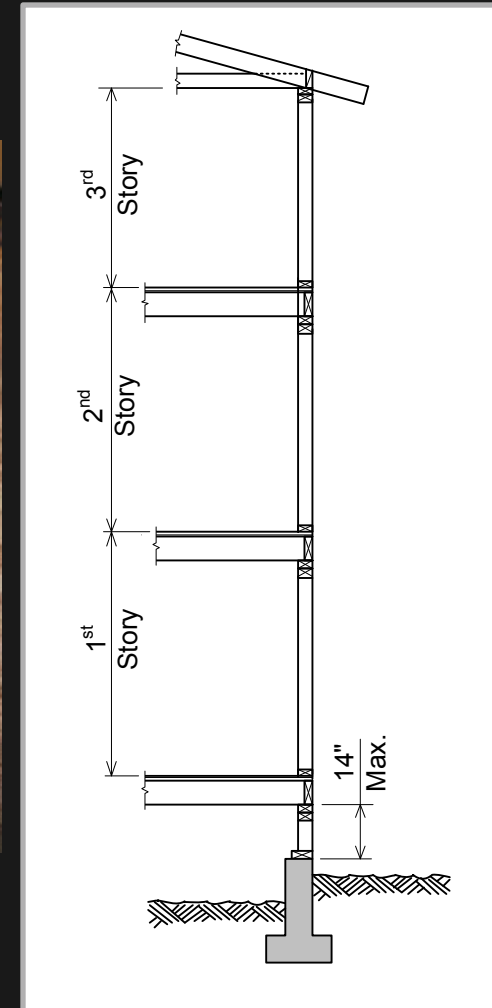


4' Max Height

Steinbrugge Collection EERC, UCB
Homeowner's Guide to Earthquake
Retrofit



Wall Stud Movement

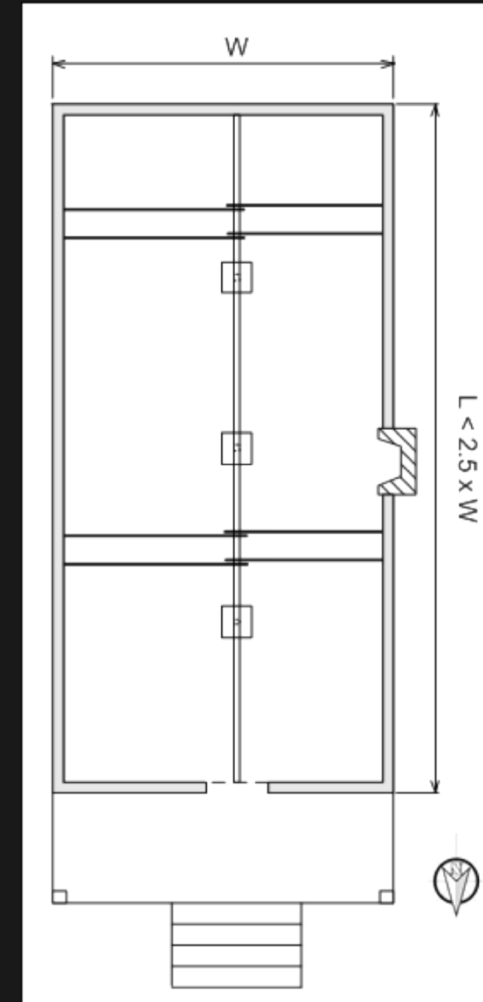


Cut-Off Height

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WHERE SHOULD YOU APPLY IEBC A3 WITH CAUTION?

- Sloping Sites
- Long - Rectangular Homes
- High Seismicity ($C_S > .192g$, $SDS > 1.25$)
- Split Levels
- Homes with Heavy Finishes
- Unusual Configurations & HOG

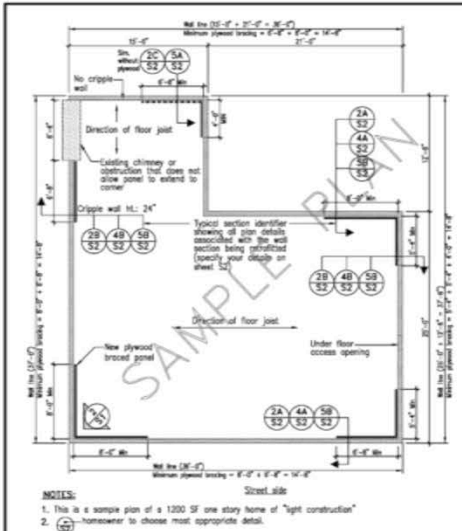


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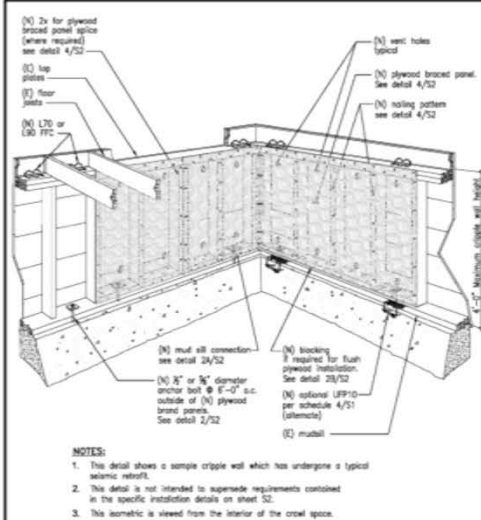
OTHER PRESCRIPTIVE METHODS

- **Plan Set A - (Standard Plan A - 2008)**
- City of LA - DBS Anchor Bolt Plan (2009)
- Simpson Strong-Tie
- Plan Set B ?? - (Standard Plan B)

PLAN SET A - PAGE 1



1 SAMPLE FOUNDATION AND PLYWOOD LAYOUT PLAN
SCALE: 3/16"=1'-0"



2 TYPICAL CRIPPLE WALL BRACING DETAIL

- ### A. GENERAL:
- All existing concrete and wood material will be part of the strengthening work...
 - All metal connectors and hardware shall meet or approved standard for its intended use...
 - All existing upper floor verticals shall be maintained.
 - Due to the corrosive nature of new pressure treated wood which can cause premature failure of the metal hardware...
 - Legend: (N) = Existing construction; (N) = New construction
- ### B. MUDDSILL CONNECTIONS:
- New bolts or UFP100 anchors installed with plywood braced panels.
 - Where an existing concrete rim joist, sill, or joint, or solid blocking between joists, does not extend above the perimeter cripple wall or mud sill, new blocking and/or supplemental connections shall be provided...
 - All new mud sill bolts shall have a 3" x 3" x 3/4" plate washer installed between the mud sill (or blocking) and the mud.
 - New bolts shall be 1/8" inch minimum from the edges of the mud sill and 6" from the ends.
- ### C. FLOOR TO CRIPPLE WALL / MUDDSILL CONNECTION:
- See "Reinforcement Schedule" 4/51 and detail 5/52 for required connections.
 - Increase length of nails "X" when attaching floor framing clips through plywood.
 - If splices in double lap joints do not have a minimum 48" lap, provide a new minimum 4" strap.
 - Use single lap plates still reinforced with a 1/8" x 48" metal strap.
 - Where plate straps occur within a braced panel, the strap shall be placed over the plywood and the plywood nails omitted where the strap is installed.
- ### D. PLYWOOD BRACED PANEL INSTALLATION:
- See "Reinforcement Schedule" for the required length of new plywood panel bracing along each wall line.
 - Install plywood braced panels at each end of each wall line and space additional panels, as needed, along each wall line.
 - Plywood braced panels closest to the ends of wall lines shall be located as near to the ends as possible.
 - Panel may be located away from the ends of a wall line when existing obstructions or limited clearance necessitates such relocation.
 - Plywood braced panels should be nearly equal in length and should be nearly equal in spacing along the length of the wall where possible.

3 TECHNICAL NOTES

GENERAL INFORMATION	PLYWOOD BRACING		MUDDSILL ANCHORS		FLOOR TO CRIPPLE WALL / MUDDSILL CONNECTIONS	
	MIN. TOTAL BRACING LENGTH (FT)	MIN. NO. OF ANCHORS PER LINE (FT)	MIN. TOTAL ANCHOR LENGTH (FT)	MIN. NO. OF ANCHORS PER LINE (FT)	MIN. TOTAL STRAP LENGTH (FT)	MIN. NO. OF STRAPS PER LINE (FT)
12'0" x 10'0" (12'0" x 10'0")	120	12	120	12	120	12
12'0" x 10'0" (12'0" x 10'0")	120	12	120	12	120	12
12'0" x 10'0" (12'0" x 10'0")	120	12	120	12	120	12
12'0" x 10'0" (12'0" x 10'0")	120	12	120	12	120	12

4 REINFORCEMENT SCHEDULE

GENERAL HOME INFORMATION:

A. Square footage calculation:
 1. No. of stories above cripple wall/mud sill: ___ of ___
 2. Approximate 1st floor area over crawl space: ___ of ___
 3. Approximate 2nd floor area over crawl space: ___ of ___
 4. Total floor area: ___ of ___

B. Is your home of "light" or "heavy" construction?
 LIGHT CONSTRUCTION HEAVY CONSTRUCTION

FLOOR FRAMING CONNECTION:
 MUDDSILL OR LAP JOINT

FRAMING CLIP:
 Part No. _____
 Manufacturer _____
 Load value applied to cripple wall and/or mud sill _____

5 CONSTRUCTION DATA

- The length of each individual panel must be twice the height of the cripple wall being braced, but never less than 48 inches in length.
 - The perimeter of all new plywood braced panels shall be nailed to existing cripple wall studs, top joists, and the mud sill at 4" on center. Attach plywood to intermediate cripple wall studs at a maximum of 12" on center.
 - Nails shall be 16d common x 3 1/2" long with a minimum shank diameter of 1/32 inches (1/32 x 3 1/2" x 2 1/2" x 2 1/2" nails may be used for installations using nail guns).
 - Plywood braced panel shall be 5'-P.L.T. 5/8" exterior grade.
 - Attach plywood to existing wall, from center of nail to any plywood edge.
 - Do not overdrive, countersink, or otherwise damage the "ackerman pin" when installing nails.
 - Do not staple nails closer than 3/8" in plywood braced panels.
 - Nails must be fully embedded in framing behind plywood without causing splitting. See detail 4A/52 for double stud at plywood ends.
- ### E. PERMIT & INSPECTION REQUIREMENTS:
- Submit a permit application and 2 completed plan sets to the Building Dept. for review (photographs of the mud sill, cripple wall, and floor framing connections may assist the review process).
 - Before starting work the permit holder may be required to schedule a pre-construction inspection with the building department to verify that field conditions are consistent with the information provided on the approved plan.
 - Inspections by the building department are required for:
 - foundation bolt/anchor plate installation,
 - installation of blocking,
 - plywood braced panel installation on cripple wall,
 - metal hardware installation, and
 - final inspection.
 - Work requiring inspection shall be covered until it has been inspected and approved by the Building Department.
 - Prior to final inspection, smoke detectors shall be installed in the attached dwelling(s) in accordance with building code requirements.

DEFINITIONS - "LIGHT" AND "HEAVY" CONSTRUCTION

LIGHT CONSTRUCTION is your home constructed using any of the following:
 1. Stucco exterior wall.
 2. Heavy masonry consisting of concrete or clay tile.
 (Penalty up to 11 months per square foot.)

HEAVY CONSTRUCTION is any building constructed using any of the following:
 1. Wood exterior or stucco.
 2. Corrugated or asphalt shingles.
 3. Metal roofing (finished 5 pounds per square foot or less).

ROOFING MATERIALS:
 1. Wood exterior or stucco.
 2. Corrugated or asphalt shingles.
 3. Metal roofing (finished 5 pounds per square foot or less).

EXTERIOR WALL FINISHES:
 1. Wood exterior.
 2. Wood board siding.
 3. Sinter light board siding.

INTERIOR WALL FINISHES:
 1. Gypsum board.
 2. Gypsum or plaster lath.

CONNECTOR CAPACITY (Pounds) and Connection Description

400 lbs.	3/8" x 3" x 2" lag
400 lbs.	3/8" x 3" x 2" lag
600 lbs.	3/8" x 3" x 2" lag
800 lbs.	3/8" x 3" x 2" lag
1000 lbs.	3/8" x 3" x 2" lag
1200 lbs.	3/8" x 3" x 2" lag
1400 lbs.	3/8" x 3" x 2" lag
1600 lbs.	3/8" x 3" x 2" lag
1800 lbs.	3/8" x 3" x 2" lag
2000 lbs.	3/8" x 3" x 2" lag

APPLICANT INFORMATION

APPLICANT: _____
 ADDRESS: _____
 TELEPHONE: _____
 PROPERTY ADDRESS: _____
 OWNER: _____
 APPLICANT'S SIGNATURE: _____

PURPOSE:

This plan set standards for strengthening may be approved by the building official without treating additional joints or calculations. They provide an economical method to help improve your home's chance of surviving an earthquake.

The intent of these standards is to promote public safety and welfare by reducing the risk of earthquake damage to existing wood-framed residential buildings.

The requirements contained herein are prescriptive minimum standards intended to improve the seismic performance of residential buildings. They will not necessarily prevent earthquake damage, nor make your home earthquake proof. These recommendations are based on assumptions that apply to houses of average construction. You are encouraged to have a competent licensed engineer or architect review the plans & modify them as appropriate for your home.

All of the prescriptive details and provisions are not intended to be the only acceptable strengthening methods permitted (alternative details and methods may be used when approved by the building official).

When the building official determines that conditions exist that are beyond the scope of these prescriptive standards, analysis and documentation shall be prepared by a California licensed architect or engineer.

This prescriptive plan addresses only seismic strengthening work. Alternative designs will be considered on a case-by-case basis. Work done under permit payment to this prescriptive plan does not require any previous work done without a permit.

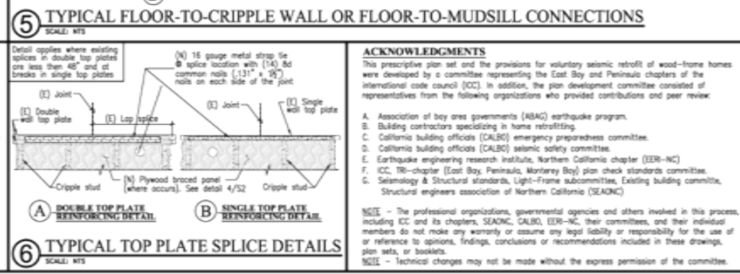
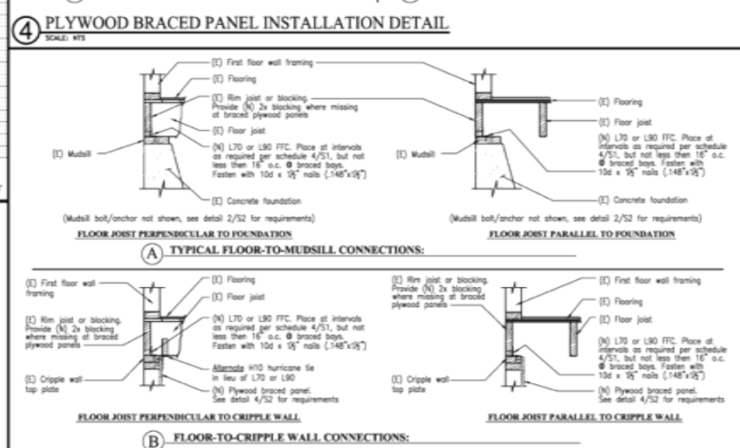
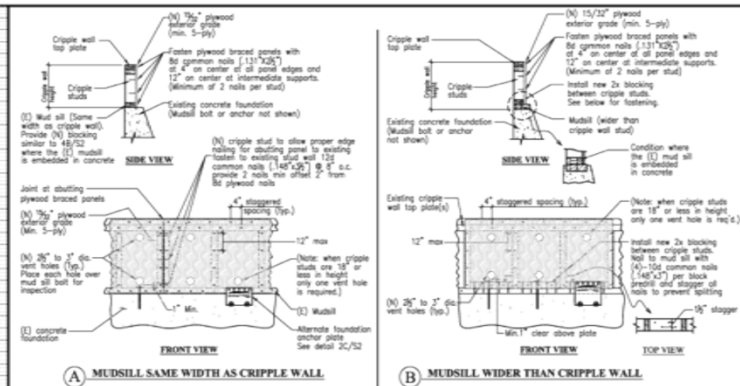
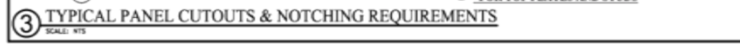
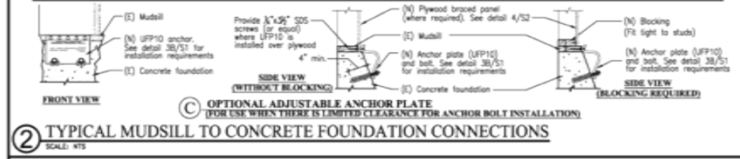
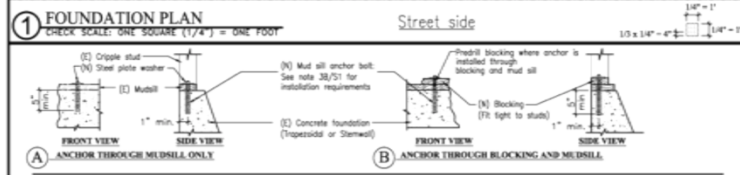
APPLICATION INSTRUCTIONS:

- Draw a second foundation plan of the house. In the graph space provided on sheet S2 (refer to the "sample foundation and plywood layout plan" Detail 1/51 for guidance).
- Provide appropriate construction information in the "Construction Data", detail 5/51. Determine the spacing requirements for the mud sill bolts or anchor plates to be used and identify the type of FIP clip to be used.
- Based upon the homes square footage, number of stories and type of construction "heavy" or "light", determine the requirements for plywood bracing, mudsill anchorage, and floor to cripple wall/mudsill connections. Based on the "Reinforcement Schedule", detail 4/51.
- Identify on the "Foundation Plan" the direction of run of all your floor joists.
- Identify on the "foundation plan" (along the perimeter walls) the location of all fireplaces.
- For each wall segment on the foundation plan indicate the plan details which represent:
 step: the mud sill anchoring method. See detail 2/52.
 step: the floor-to-cripple wall/mudsill attachment. See detail 5/52.
 step: the cripple wall bracing method to be used. See detail 4/52.
- For each wall segment on the foundation plan indicate the maximum cripple wall height and the length and location of all plywood braced panels to be installed (identify all wall sections that do not have cripple walls).

STANDARD PLAN A (2008)
RESIDENTIAL SEISMIC STRENGTHENING PLAN
PRESCRIPTIVE SEISMIC STRENGTHENING PLAN FOR CRIPPLE WALL BRACING AND FOUNDATION SILL PLATE ANCHORAGE OF LIGHT WOOD FRAMED RESIDENTIAL STRUCTURES.

S1 1 OF 2

PLAN SET A - PAGE 2



APPLICANT INFORMATION

APPLICANT: _____

ADDRESS: _____

TELEPHONE: _____

PROPERTY ADDRESS: _____

OWNER: _____

APPLICANT'S SIGNATURE _____

STANDARD PLAN A (2008)
RESIDENTIAL SEISMIC STRENGTHENING PLAN
 PRESCRIPTIVE SEISMIC STRENGTHENING PLAN FOR CRIPPLE WALL BRACING
 AND FOUNDATION SILL PLATE ANCHORAGE OF LIGHT WOOD FRAMED
 RESIDENTIAL STRUCTURES.

S2

2 OF 2

PLAN SET B

E. PURPOSE OF THIS SHEET

- This sheet provides guidance for the installation of higher capacity plywood braced panels that employ additional holdowns and/or new foundation systems.
- The sheet is a supplement to sheets S1 and S2 and is intended to be used where any of the following conditions exist:
 - The height of any existing cripple walls is over 4'-0" high, but less than or equal to 7'-0" or 7'-6";
 - There is insufficient length to install the specified length of plywood braced panels as specified in the "Foundation Schedule" 4/53, or
 - Where an existing foundation either needs to be replaced or a new foundation system added due to insufficient area, poor condition or where a new foundation must be added to provide additional lines of cripple wall bracing.
- When the "Minimum Reinforcement Schedule" on S4/53 is used to determine the strength of plywood bracing required along each wall length, additional checks for your existing foundation system are required in order to verify adequate capacity and integrity. Special procedures are also required for the installation of the required holdowns and for installation of the plywood braced panels. See sections 6, 8 and 1 of the notes.

G. EXISTING FOUNDATION REQUIREMENTS & TESTING:

- The strengthening of cripple walls using the alternative reinforcement schedule of 4/53 and holdowns (where connections), as required by this sheet, will impart greater forces on existing foundation systems during seismic events. Where the "Minimum Reinforcement Schedule" as specified in 4/53 is proposed to strengthen any existing cripple walls, additional visual verification and testing of the existing foundation systems is required as noted below prior to commencing any work. The use of the "Minimum Reinforcement Schedule" as specified in 4/53, can only be used once this verification process has been completed and

the size and strength of the existing foundation system has been verified. The owner or general contractor completes Table G below which will be reviewed by the Building Official. The size of existing foundation systems shall be verified and noted relative to Table G of 26 below. The use of photos to document these conditions is encouraged.

- In the presence of existing foundation systems, bars can not be verified or a minimum, existing foundations shall be of least 24" high (18" and 12" wide (W) as indicated by detail 3/53.
- If the presence of at least 2-#4 horizontal continuous reinforcing bars can be verified, the existing foundations shall be of least 18" high (18" and 8" wide (W) as indicated by detail 3/53. See detail 4/53 for procedures for verifying the presence of existing structures.

In addition to conformance with items G2 and G4, the owner or general contractor shall verify that the existing concrete walls:

- is made of good quality. Expiration of joint concrete quality shall include compressive strength, crack widening, complete through the footing greater than 3/8" wide, excessive efflorescence, or by strength concrete cores or moisture ratio available with a field hole or trend.
- The quality of the existing concrete or reinforced masonry foundation adjacent to the installation of new holdowns shall be verified by either torque or tension tests. The owner or general contractor shall verify that these tests have been conducted in Table G1 below. These tests shall be conducted by either of the below:

Table G1 - Verification of Existing Foundation System

Table G1 - Verification of Existing Foundation System

Requirement	Yes	No	Signature of Owner or General Contractor
G2. The quality of the existing foundation is verified by either torque or tension tests in accordance with Table G1 below.			
G4. The quality of the existing concrete or reinforced masonry foundation adjacent to the installation of new holdowns shall be verified by either torque or tension tests.			

Table G2 - Verification of Existing Foundation System

Requirement	Yes	No	Signature of Owner or General Contractor
G2. The quality of the existing foundation is verified by either torque or tension tests in accordance with Table G1 below.			
G4. The quality of the existing concrete or reinforced masonry foundation adjacent to the installation of new holdowns shall be verified by either torque or tension tests.			

Notes:

- The owner/contractor shall verify that these tests have been conducted in Table G1 below. These tests shall be conducted by either of the below:
 - A minimum of two torque tests shall be made within 10' but not less than 12" from the location of any proposed holdowns. Where the location of new holdowns has not been established, one test shall be made for each 12' of existing foundation length.
 - These tests shall consist of installing 3/8" or 1/2" diameter expansion bolts into the existing concrete and verifying that a value per Table G2 can be achieved.
- The quality of the existing foundation is verified by either torque or tension tests in accordance with Table G1 below.

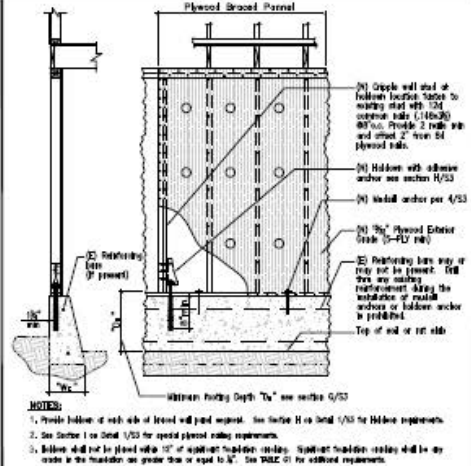
Table G2 - Foundation Test Results Summary

Anchor	Torque		Tension	
	Load (lb)	Turns (1/4-20)	Load (lb)	Turns (1/4-20)
1/2"	3000	50	800	20
5/8"	2500	80	1100	45

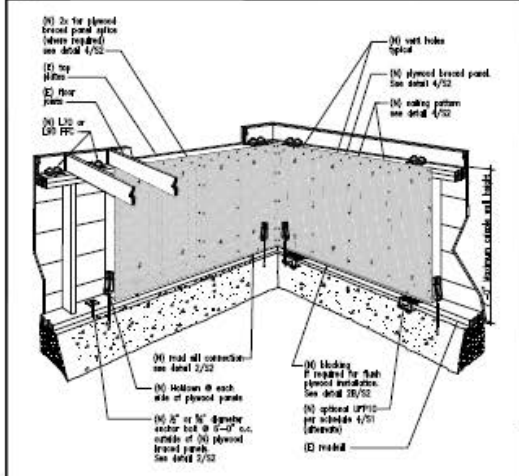
VERIFICATION OF THE EXISTING FOUNDATION SYSTEM

- The general contractor or Owner (Owner performing the work) shall complete the table below acknowledging that the existing foundation system has been visually reviewed and tested and conforms to the requirements to verify the existing foundation system.

Table G2 - Verification of Existing Foundation System



1 SUPPLEMENTAL TECHNICAL NOTES



- Notes:
- This detail shows a sample cripple wall which has undergone a typical seismic retrofit.
 - The detail is not intended to supersede requirements contained in the specific foundation details on sheets S2 and S3.
 - The concrete is viewed from the interior of the crawl space.

2 TYPICAL CRIPPLE WALL BRACING DETAIL

1. When the presence of existing foundation needs to be verified by the presence of existing bars or torque conducted by the general contractor or home owner. When the presence of existing bars is confirmed, it shall verify as noted in Table G2.

H. HOLD-DOWN REQUIREMENTS

- Hold-downs shall be Simpson H4U-DSD24, MC Metals AN37 or an equivalent with a minimum allowable tensile load capacity of 3025.
- For Simpson H4U-DSD24:
 - Use 3-#55 1/4" dia. anchors.
 - Use 3/8" dia. threaded rod anchor.
 - Post shall be 3x minimum or double 2x (see detail 3/53 for railing of double stud/For MC Metals AN37:
 - Use 10-#55 3/4" dia. anchors.
 - Use 3/8" dia. threaded rod anchor.
 - Post shall be 3x minimum or double 2x (see detail 3/53 for railing of double stud).

I. INSTALLATION OF HIGHER CAPACITY FLYWOOD BRACED PANELS AND SPECIAL NAILING REQUIREMENTS:

- Plywood braced panels - minimum of 3/4" structural sheathing.
- Edge nailing - 8d30s common nails @ 3" oc
- Field nailing - 8d30s common nails @ 12" oc

J. NEW FOUNDATION REQUIREMENTS

UNDER REINFORCEMENT

ALTERNATE REINFORCEMENT SCHEDULE USING HOLD-DOWNS

WALL TYPE AND HEIGHT	TOTAL HEIGHT	MINIMUM WALL THICKNESS	FLYWOOD BRACING							REINFORCEMENT									
			1" x 4"	1" x 6"	1" x 8"	2" x 4"	2" x 6"	2" x 8"	3" x 4"	3" x 6"	3" x 8"	4" x 4"	4" x 6"	4" x 8"					
Cripples	8-10	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	10-12	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	12-14	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	14-16	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	16-18	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	18-20	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"
	20-24	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"
Foundations	8-10	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	10-12	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	12-14	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	14-16	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	16-18	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	18-20	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	
	20-24	12"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	

FOOTNOTES FROM TABLE:

- Provide holdowns at each side of braced wall panel segment. See S4/53 and 2/53.
- See Section 1 on detail 1/53 for special placed bracing requirements.

4 REINFORCEMENT SCHEDULE FOR CRIPPLE WALLS UP TO 7'-0" IN HEIGHT

APPLICANT: _____

ADDRESS: _____

TELEPHONE: _____

PROPERTY ADDRESS: _____

OWNER: _____

APPLICANT'S SIGNATURE: _____

STANDARD PLANS (2010)

RESIDENTIAL SEISMI STRENGTHENING PLAN

PRESCRIPTIVE SEISMIC STRENGTHENING PLAN FOR CRIPPLE WALL BRACING AND FOUNDATION SILL PLATE ANCHORAGE OF LIGHT WOOD FRAMED RESIDENTIAL STRUCTURES.



REVISION 1 09/01/2008

S3

PROS & CONS OF IEBC A3

➤ Pro's

- Adopted into the Code/ National Presence
- Regularly Updated
- Coordinated with Other Codes
- Broad applicability with engineered design
- Standardized and prescriptive details

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PROS & CONS OF IEBC A3

- **Con's**
 - **Does not easily Produce Plans and Details**
 - **Not easily available**
 - **Limited prescriptive details**

PROS & CONS OF PLAN SETS

- Pro's
 - Developed for Home Owners and GC's
 - Consistent notes, detail, procedures
 - Formatted for Construction
 - Easy to Follow

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PROS & CONS OF PLAN SETS

- **Con' s**
 - **No Official Update Process**
 - **Limited Applicable Details/ Conditions**
 - **More Limited Applicability**
 - **No Direct Engineered Approach**

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CONTRIBUTORS TO SUCCESS

- **Regulatory Agencies**
 - **Embrace the Program**
 - **Quality Control and Quality Assurance of Program**

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NEXT STEPS

- Review all Current Data
- Study & Define the Opportunities
- Develop & Prioritize Realistic Goals
- Implement- Anticipated 5 year Program

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Thank you

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PAST RESIDENTIAL DAMAGE

1994 Northridge Earthquake- M 6.7

- 48,000 residential units made uninhabitable.
- Only 439 of the 48,000 or slightly less than 1% had cripple wall failures. ¹
- Difference due to newer homes, slab on grade construction, or homes retrofitted after 1971 San Fernando EQ. ¹

1. *"Preventing the Nightmare" 2003- Report by ABAG*

WHAT'S REALLY DEFICIENT?

➤ Cripple Walls Below First Floor

- Sheathed one side
- Stucco, horizontal sheathing

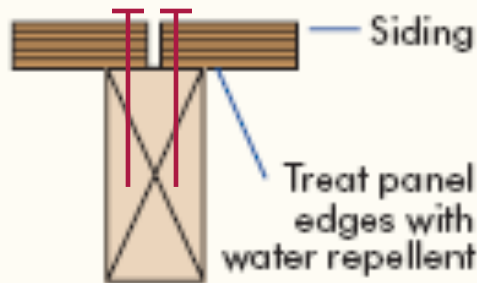
➤ Walls Above First Level

- Covered both sides
- Lathe & plaster, button board & plaster, gypsum board

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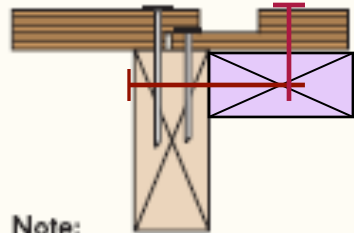
T1-11 siding failure at edges

Butt

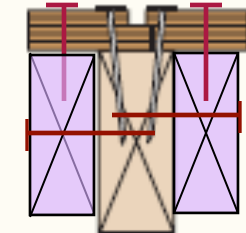


Shiplap

Reverse Board and Batten



T1-11 & Channel Groove



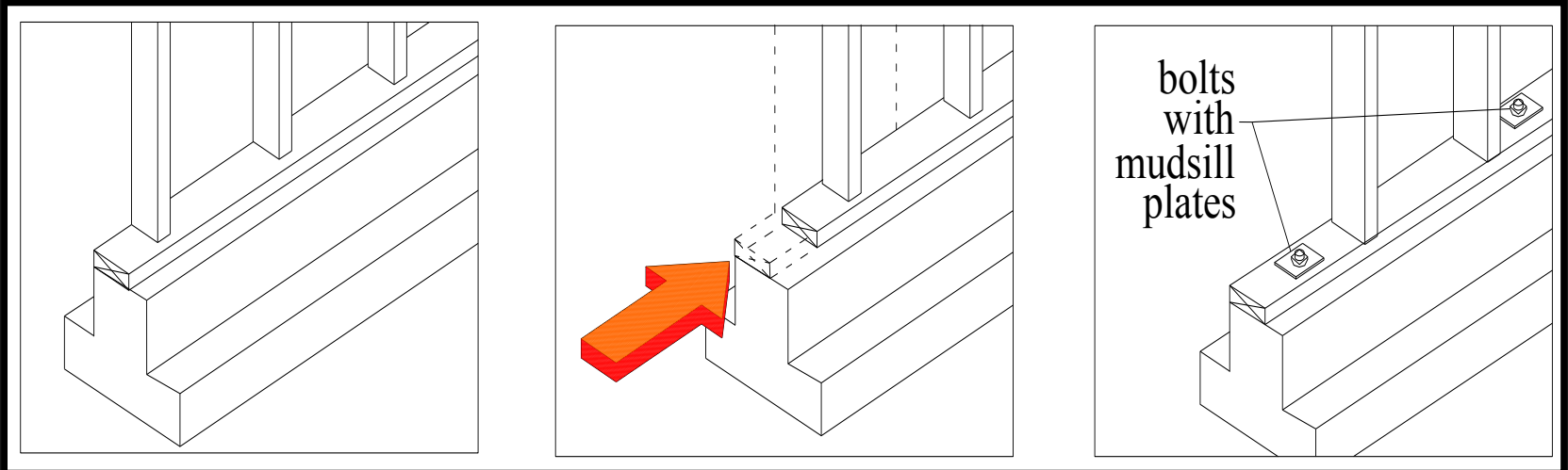
Note:

Nailing of both panel edges along shiplap joint is recommended. The "double nailing" is required when wall segment must meet wall bracing or engineered shear wall requirements.

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MUDSILL ATTACHMENTS

- Anchor Size & Spacing
- Use of Existing Anchors? →
- Check for Sound Concrete



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