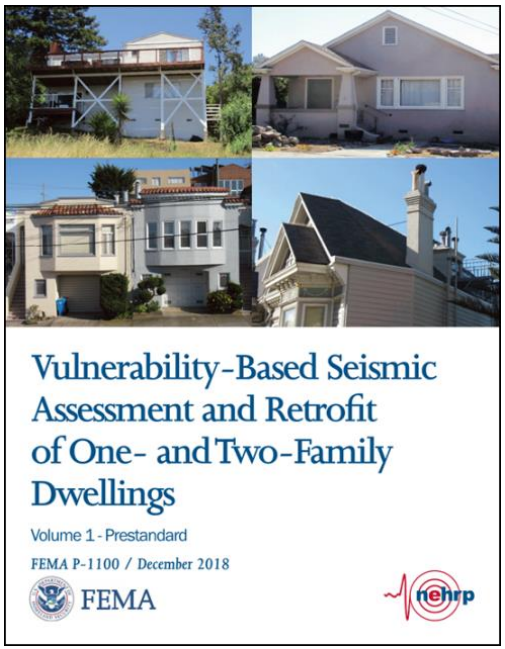
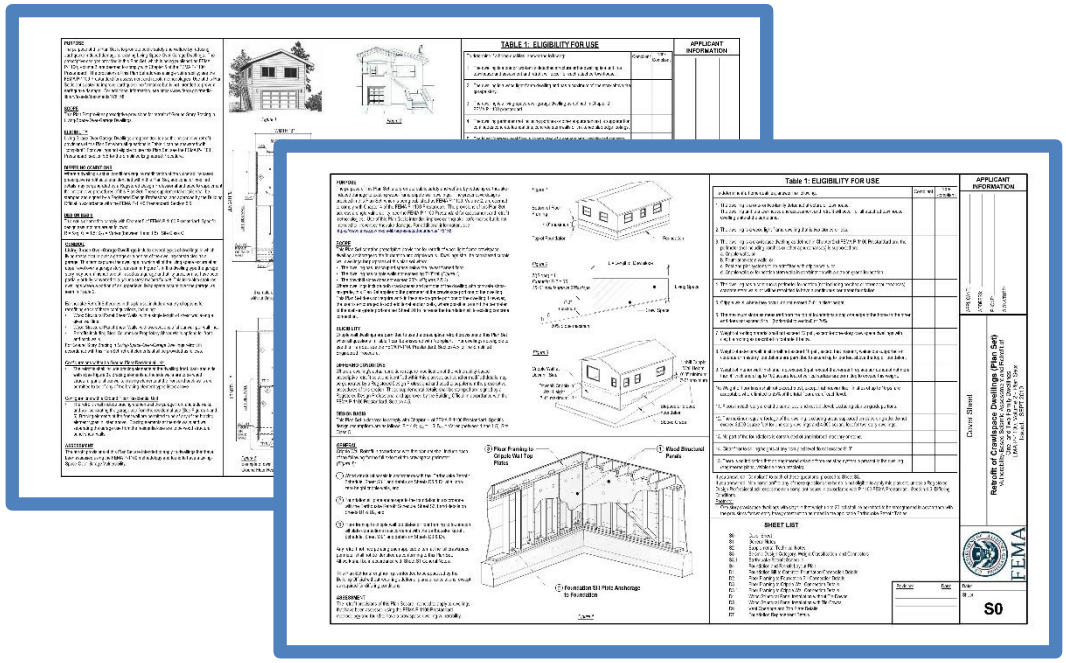
FEMA P-1100

Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings





Module 1C – P-1100 Overview

Acknowledgements

Project funded by:

CEA

The California Earthquake Authority

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

The Federal Emergency Management Agency

FEMA P-1100 Available Training

TOPIC	Primary Audience and Training Modules		
	Building Official	Contractor	Engineer
FEMA P-1100 Introduction		***1C***	
Crawlspace Dwellings			
Living-Space-Over-Garage Dwellings		3C	
Chimneys and Fireplace Surrounds			
Hillside Dwellings			

Module 1C Outline

- FEMA P-1100 purpose, scope, and documents
- Why retrofit and why use vulnerability-based retrofit?
- What vulnerabilities are addressed?
- Retrofit performance objectives
- Seismic retrofit concepts
- Eligibility, assessment and retrofit methods
- Introduction to the plan sets and commonalities
- When is the Volume 1 prestandard helpful?
- When is a design professional needed?
- Permitting and building department approval
- Safety considerations for contractors

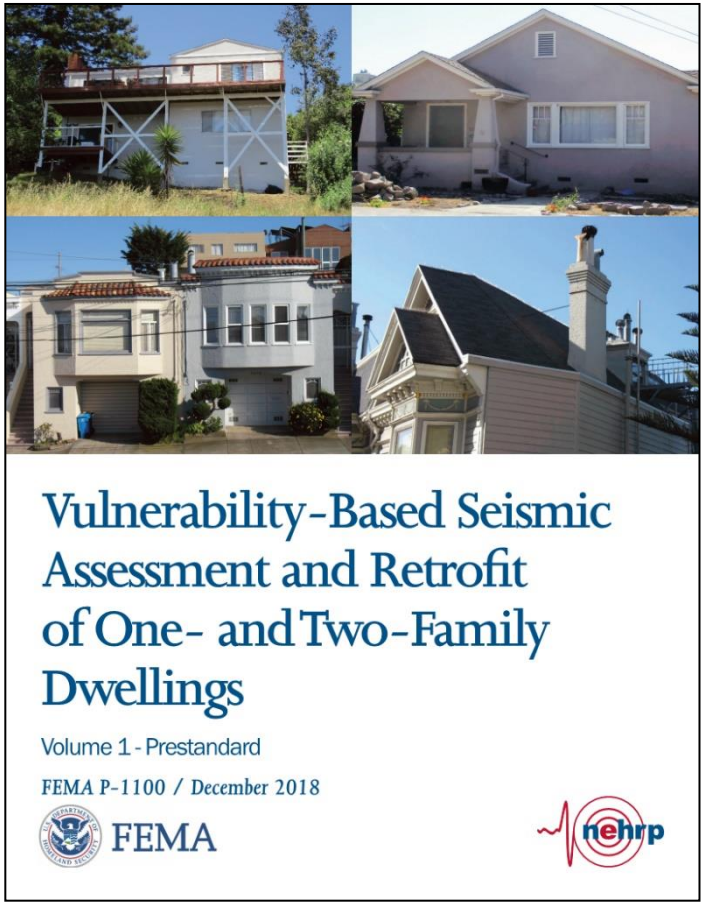
FEMA P-1100 Purpose

- To promote public safety and welfare by reducing earthquake-induced damage to existing wood light-frame dwellings
- To provide a simple and systematic procedure to identify and retrofit known vulnerabilities in wood light-frame dwellings
- To establish a retrofit scope and target performance objective based on best available science

FEMA P-1100 Scope

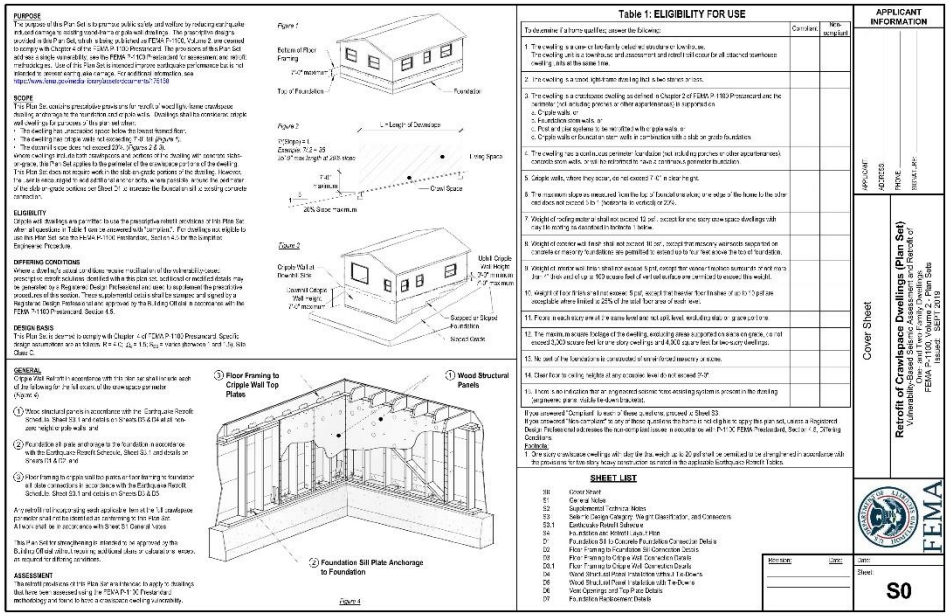
- Wood light-frame
- One- and two-family dwellings
- Townhouses
- Single-family dwellings divided into multiple dwelling units
- Seismic Design Category (SDC) B through E

FEMA P-1100 Documents



VOLUME 1 – Prestandard and Commentary

FEMA P-1100 Documents



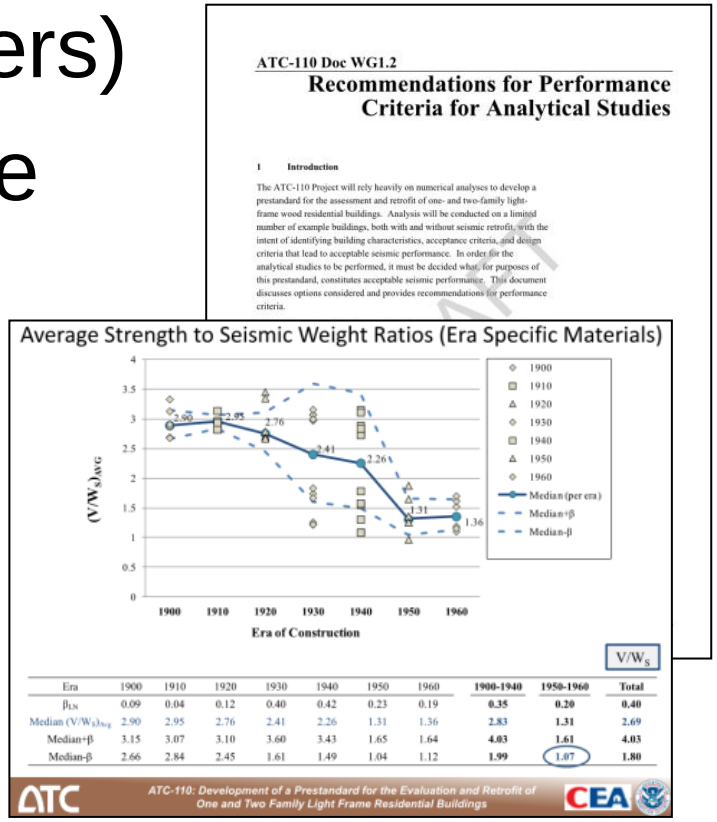
- Volume 2A- Plan Set for Crawlspace Dwellings
- Volume 2B: Plan Set for Living Space Over Garage Dwellings
- Volume 2C: Plan Set for Masonry Chimneys

VOLUME 2 – Plan Sets

FEMA P-1100 Documents

VOLUME 3: Background Documentation (Engineers and Researchers)

- Hillside dwelling example
- Background information
- White papers



ATC-110 Doc WG1.2

Recommendations for Performance Criteria for Analytical Studies

1 Introduction

The ATC-110 Project will rely heavily on numerical analyses to develop a prestandard for the assessment and retrofit of one- and two-family light-frame wood residential buildings. Analysis will be conducted on a limited number of example buildings, both with and without seismic retrofit, with the intent of identifying building characteristics, acceptance criteria, and design criteria that lead to acceptable seismic performance. In order for the analytical studies to be performed, it must be decided what, for purposes of this prestandard, constitutes acceptable seismic performance. This document discusses options considered and provides recommendations for performance criteria.

Average Strength to Seismic Weight Ratios (Era Specific Materials)

Era	1900	1910	1920	1930	1940	1950	1960	1900-1940	1950-1960	Total
β_{LN}	0.09	0.04	0.12	0.40	0.42	0.23	0.19	0.35	0.20	0.40
Median $(V/W_S)_{Avg}$	2.90	2.95	2.76	2.41	2.26	1.31	1.36	2.83	1.31	2.69
Median+β	3.15	3.07	3.10	3.60	3.43	1.65	1.64	4.03	1.61	4.03
Median-β	2.66	2.84	2.45	1.61	1.49	1.04	1.12	1.99	1.07	1.80

V/W_S

ATC-110: Development of a Prestandard for the Evaluation and Retrofit of One and Two Family Light Frame Residential Buildings

Why Retrofit One- and Two-Family Wood-Frame Dwellings?

- Most common dwelling type in the US
- Well known vulnerabilities that have repeatedly led to significant damage and dwellings being uninhabitable following earthquakes

Source: CEA

Source: City of Los Angeles, DBS

Source FEMA P-1024

Source: Ron Gallagher

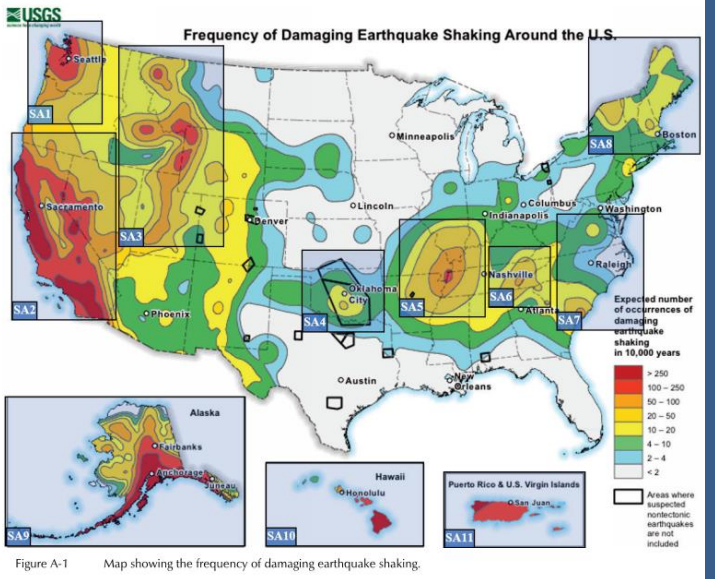
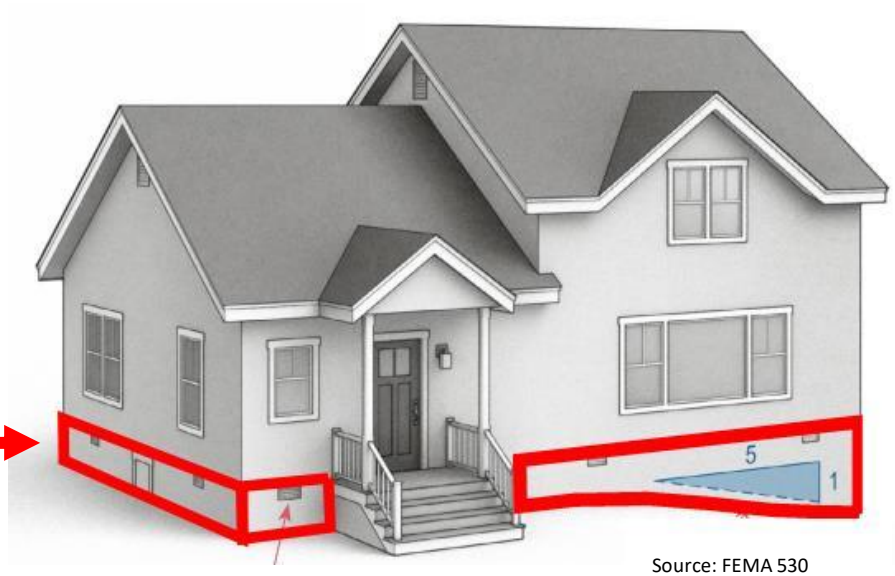


Figure A-1 Map showing the frequency of damaging earthquake shaking.

Why Vulnerability-Based Retrofit?

- Focus on known vulnerabilities
- Most cost-effective performance improvement
- Does not eliminate damage

Vulnerable cripple wall →



Source: FEMA 530

What's Included?

Crawlspace Dwellings

Source: Kelly Cobeen

Vulnerable cripple walls and bolting to foundations

Source: Ron Gallagher

Source: FEMA P-1024

What's Included?

Hillside Dwellings

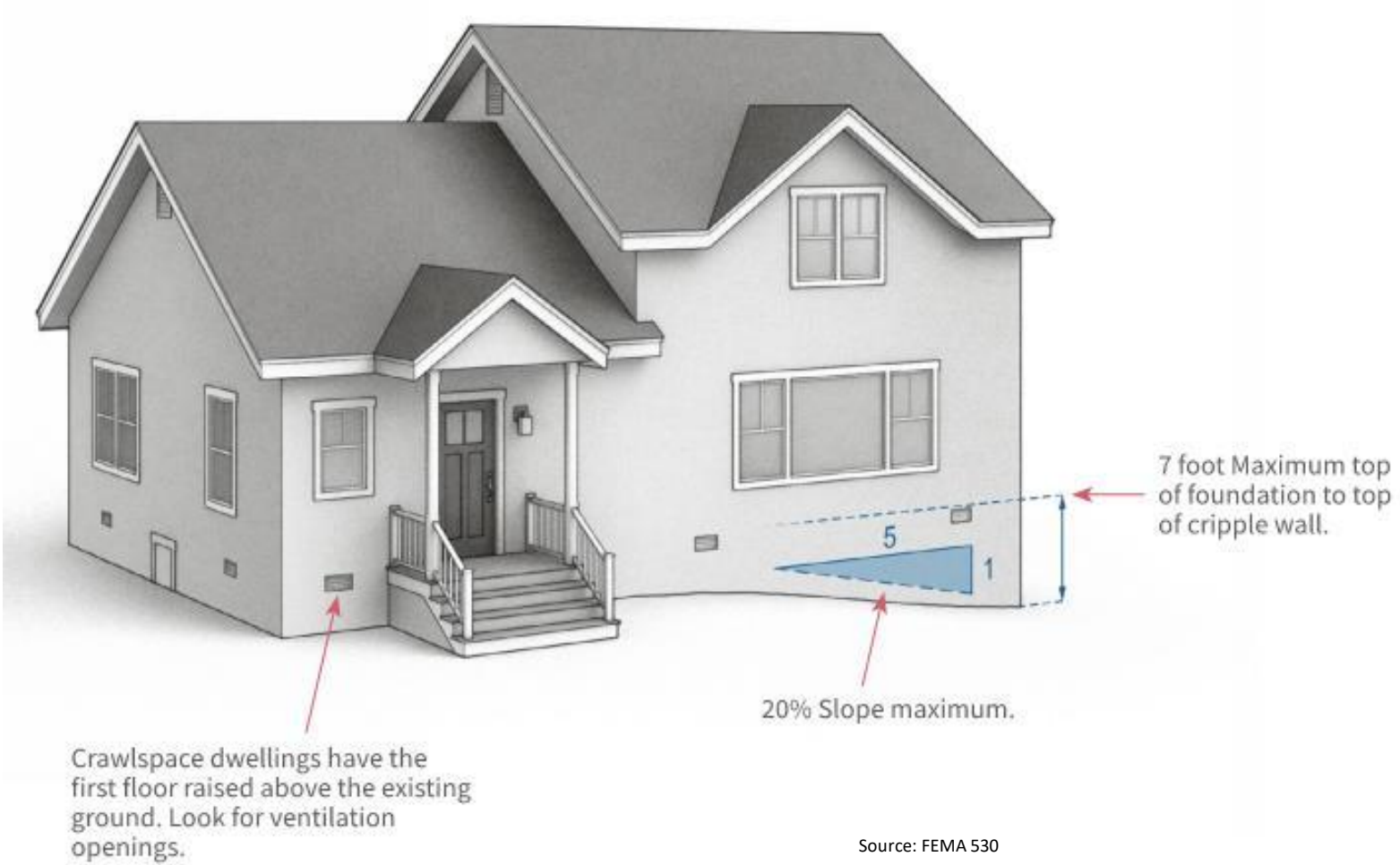
Source: Kelly Cobeen

Tall cripple walls and moderate to high site slope make house vulnerable

Source: (Top and Bottom) City of Los Angeles, DBS

What's Included?

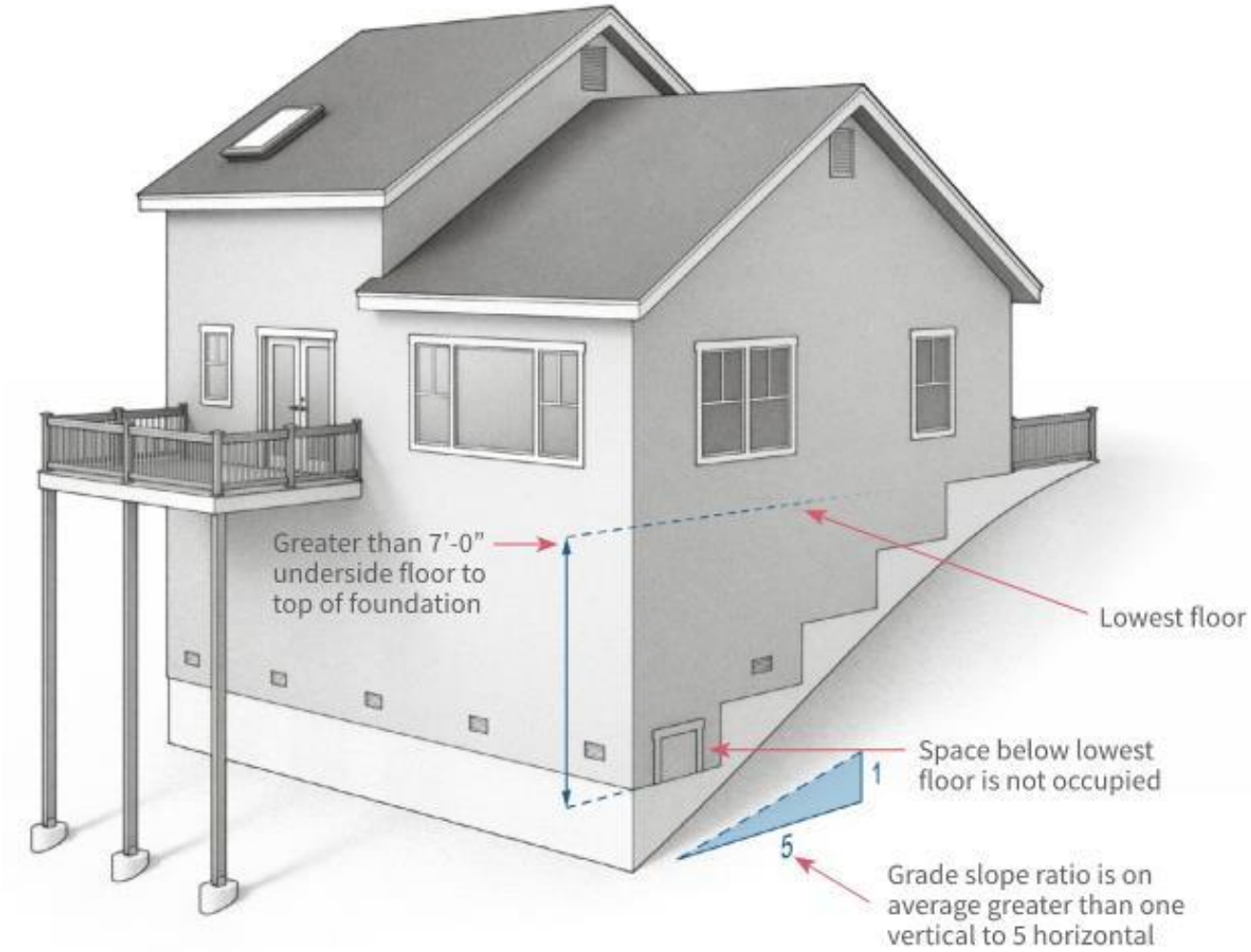
Crawlspace vs. Hillside Dwellings



Source: FEMA 530

What's Included?

Crawlspace vs. Hillside Dwellings



Source: FEMA 530

What's Included?

Living-Space-Over-Garage Dwellings

Source: Kelly Cobeen

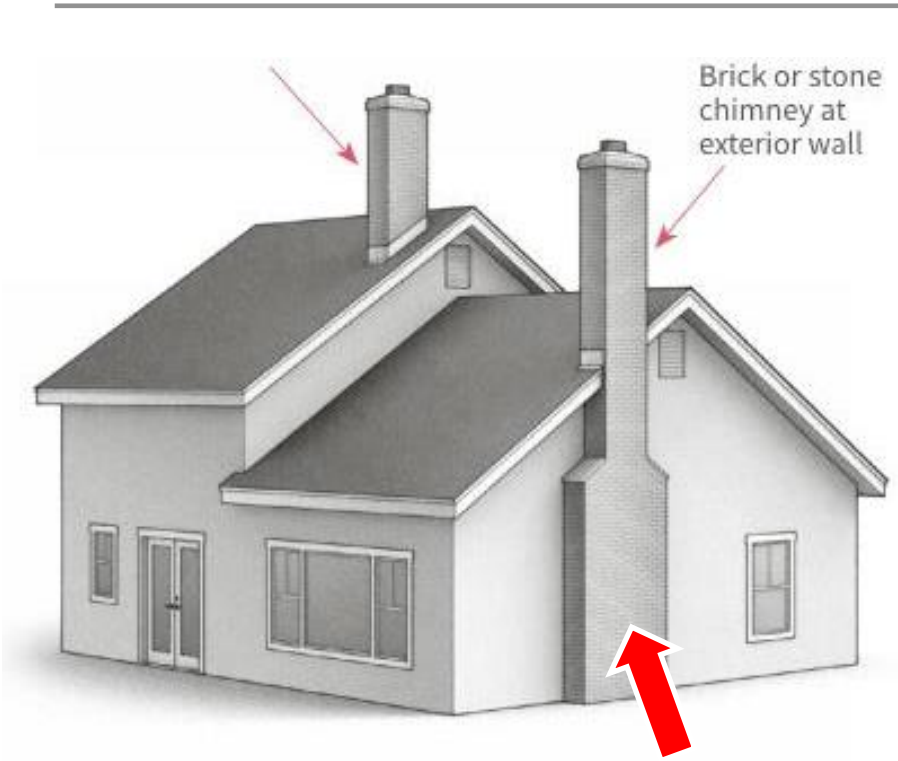
Slender walls make garage wing vulnerable to damage and possibly collapse

'HOTO COURTESY OF J.K NAKATA, AVAILABLE AT WWW.USGS.GOV, AST ACCESSED 7/7/19

'HOTO COURTESY OF RONALD GALLAGHER

What's Included

Chimneys and Fireplace Surrounds



Source: FEMA 530

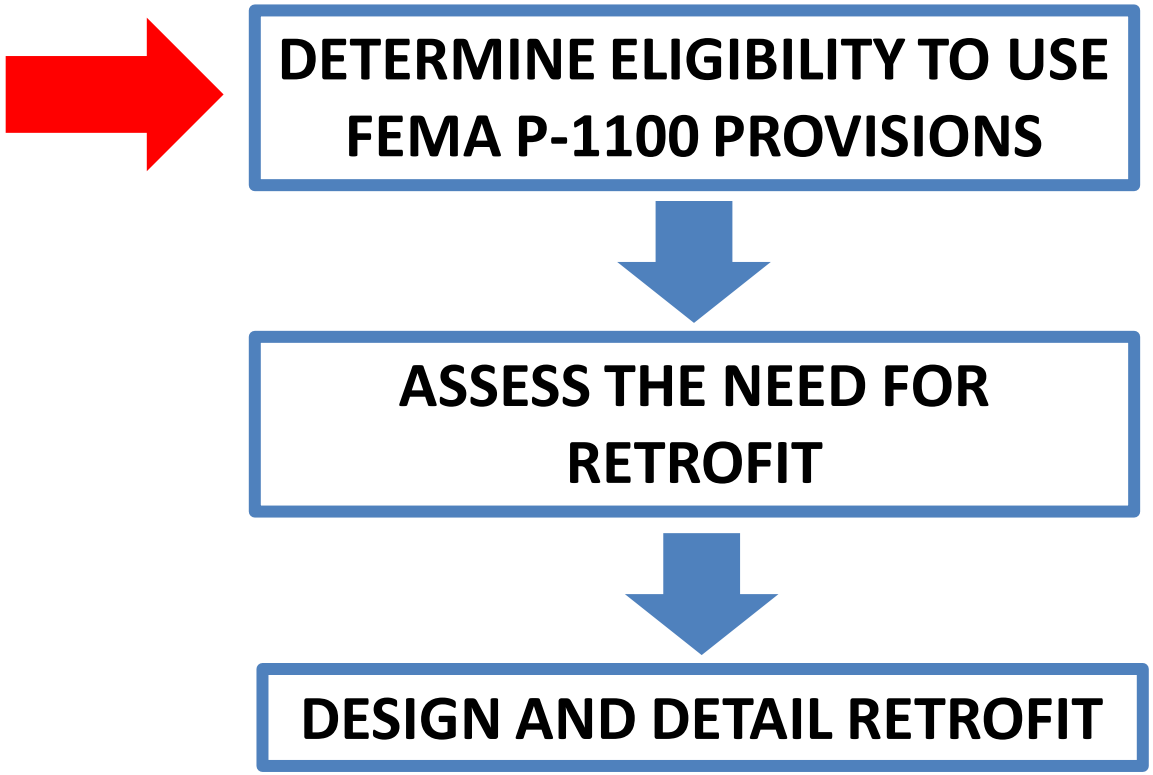
Brick or stone chimneys are vulnerable to damage

Source: Ron Gallagher

Retrofit Performance Objective

- Primary objective is reduction of risk to occupants
- Results in reduction of damage but does not eliminate damage
- Target performance somewhat lower than but as close as practical to the performance targeted for new buildings

Use of FEMA P-1100



Eligibility for Use

- Can I use the prestandard, chapter and prescriptive provisions (Volume 1)?

Vulnerability	Eligible for Prestandard	Eligible for Chapter Use	Eligible to use prescriptive provisions (plan sets)
Crawlspace cripple walls	Table 1.8-1	Table 4.1-1	Table 4.1-2
Living-space-over-garage Dwellings	Table 1.8-1	Table 5.1-1	Table 5.1-2
Hillside Dwellings	Table 1.8-1	Table 6.1-1	Not applicable
Chimneys	Table 1.8-1	One- and two-family wood light-frame dwellings of three-stories or less	Table 7.1-1

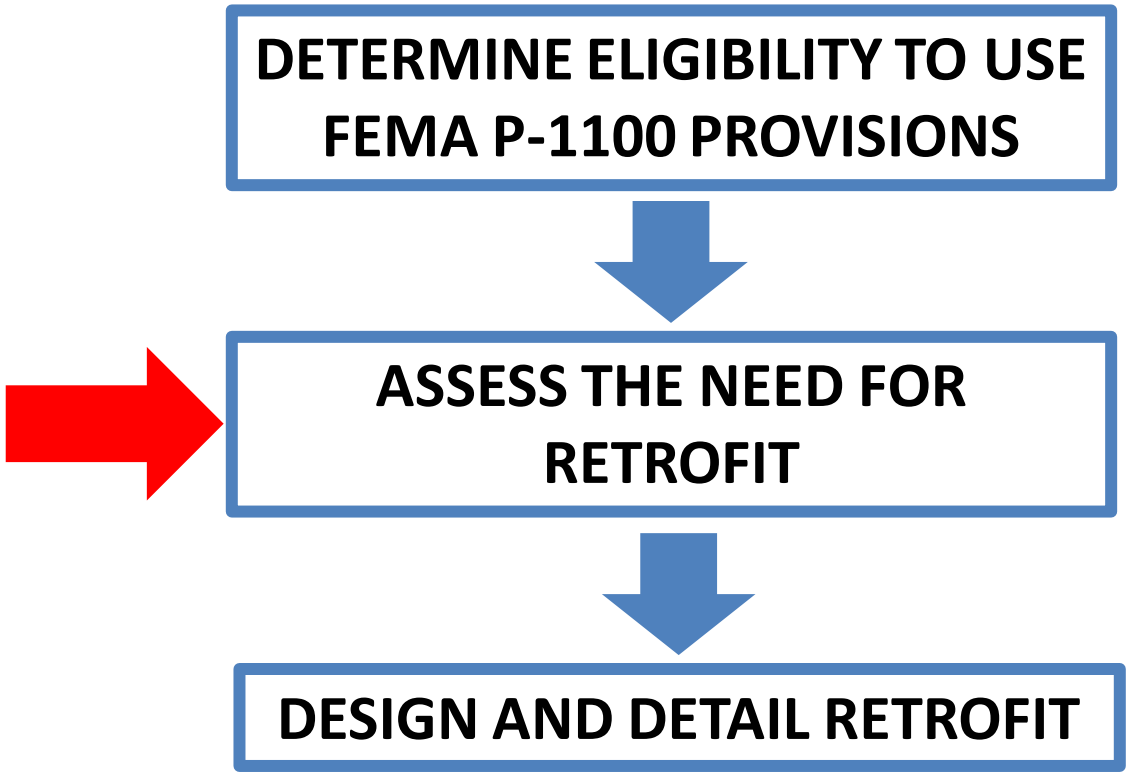
Eligibility for Use

- Can I use the plan set?

Table 1: ELIGIBILITY FOR USE

To determine if a home qualifies; answer the following:	Compliant	Non-compliant
1. The dwelling is a one- or two-family detached structure or townhouse. The dwelling unit is a townhouse and assessment and retrofit will occur for all attached townhouse dwelling units at the same time.		
2. The dwelling is a wood light-frame dwelling that is two stories or less.		
3. The dwelling is a crawlspace dwelling as defined in Chapter 2 of FEMA P-1100 Prestandard and the perimeter (not including porches or other appurtenances) is supported on: a. Cripple walls, or b. Foundation stem walls, or c. Post and pier systems to be retrofitted with cripple walls, or d. Cripple walls or foundation stem walls in combination with a slab on grade foundation.		
4. The dwelling has a continuous perimeter foundation (not including porches or other appurtenances), concrete stem walls, or will be retrofitted to have a continuous perimeter foundation.		
5. Cripple walls, where they occur, do not exceed 7'-0" in clear height.		
6. The maximum slope as measured from the top of foundations along one edge of the home to the other end does not exceed 5 to 1 (horizontal to vertical) or 20%.		

Use of FEMA P-1100

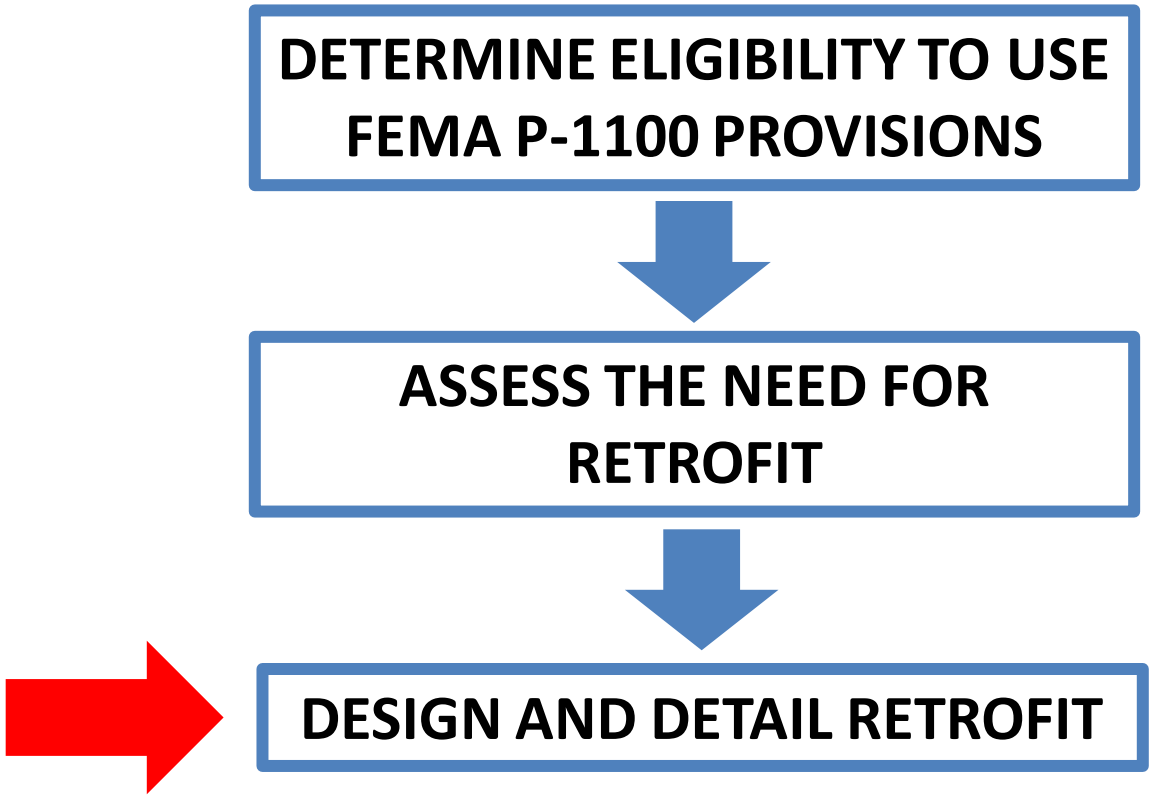


Assessment Methods Available

- Does the dwelling need this retrofit?

Vulnerability	Simplified Assessment	Detailed Assessment	Engineered Assessment
Crawlspace cripple walls	Table 4.3-1 true or false statements	Sections 8.1 through 8.4	Section 4.5 engineering criteria
Living-space-over-garage Dwellings	Table 5.3-1 true or false statements	Section 8.5	Section 5.5 engineering criteria
Hillside Dwellings	NA	Sections 6.3.3 and 8.1 to 8.3	Section 6.5 engineering criteria
Chimneys	Table 7.3-1 true or false statements	Section 7.3.3	Not applicable
Fireplace Surrounds	Table 7.3-2 true or false statement	Section 7.3.5	Not applicable

Use of FEMA P-1100



Retrofit Methods Available

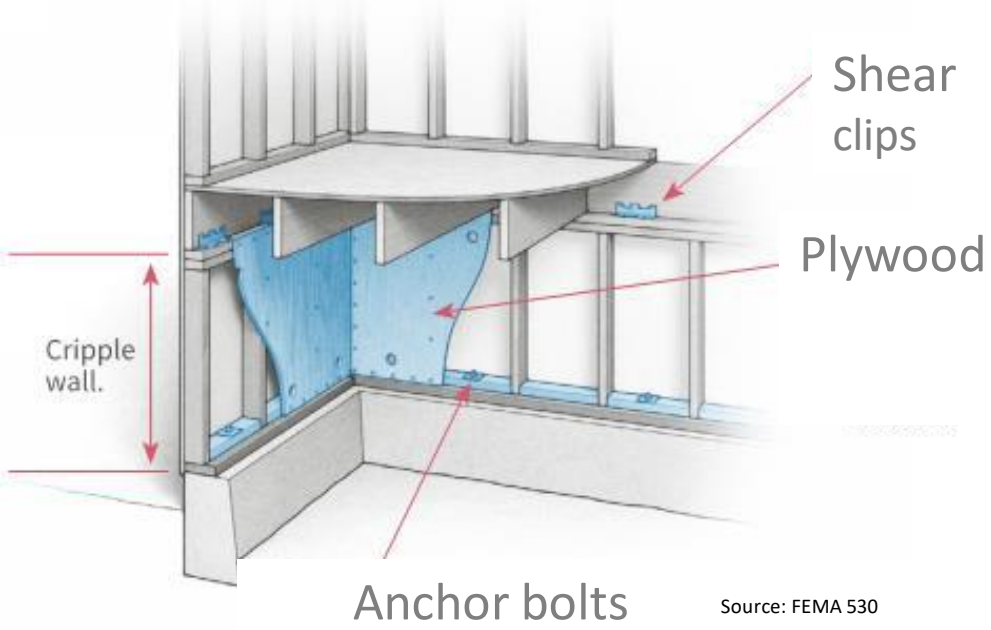
- What retrofit methods are available?

Vulnerability	Prescriptive (Pre-engineered)	Simplified Engineered	General Engineered
Crawlspace cripple walls	***Plan Set 2A*** or Section 4.4	Section 4.5	Section 1.7.2
Living-space-over-garage Dwellings	***Plan Set 2B*** or Section 5.4	Section 5.5	Section 1.7.2
Hillside Dwellings	NA	Section 6.5	Section 1.7.2
Chimneys	Section 7.4	Section 7.6.1	Section7.6.2
Fireplace Surrounds	***Plan Set 2C*** or Section 7.5	NA	NA

Retrofit Design Concepts
Crawlspace Dwellings

Crawlspace dwelling cripple walls and anchorage

- Same concepts as IEBC Appendix A3, South Napa FEMA recovery advisory plan set, and locally adopted plan sets
- Meets of exceeds retrofit requirements from these sources

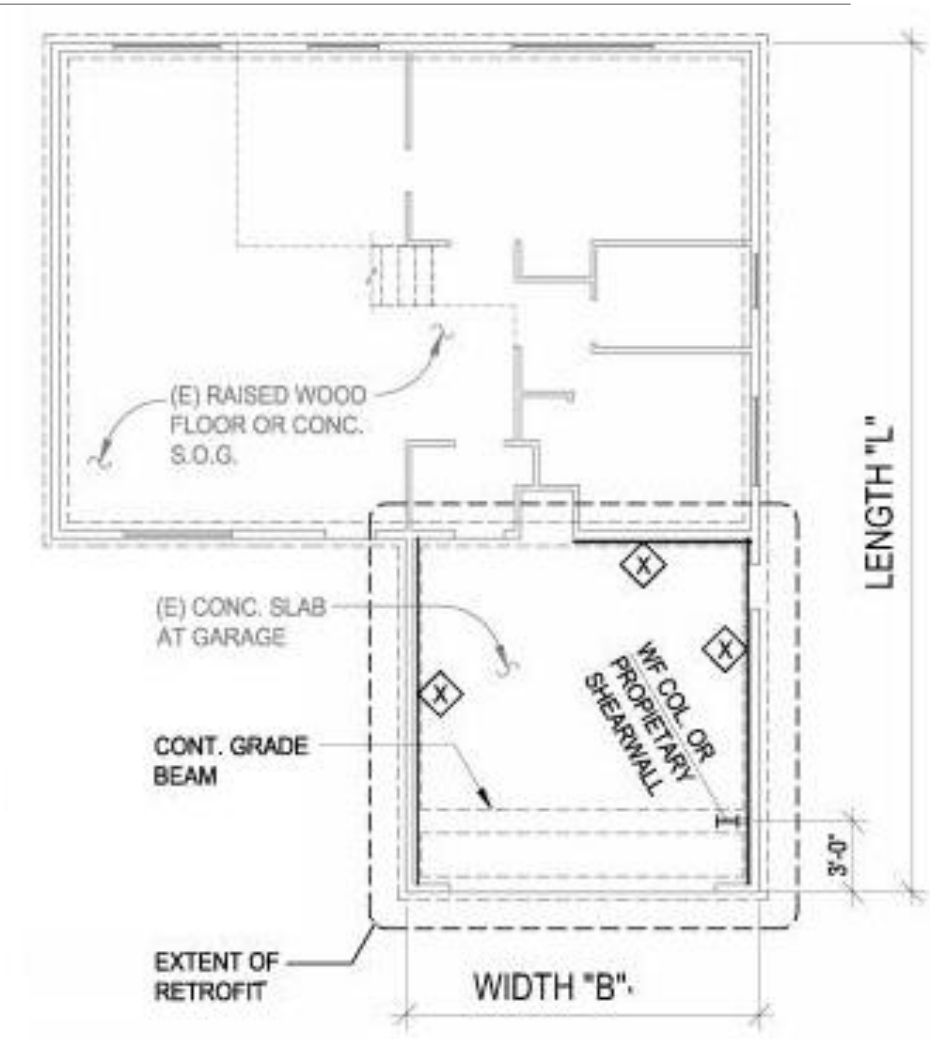


Source: FEMA 530

Retrofit Design Concepts
Living-Space-Over-Garage Dwellings

Living-space-over-garage dwelling soft-story retrofit

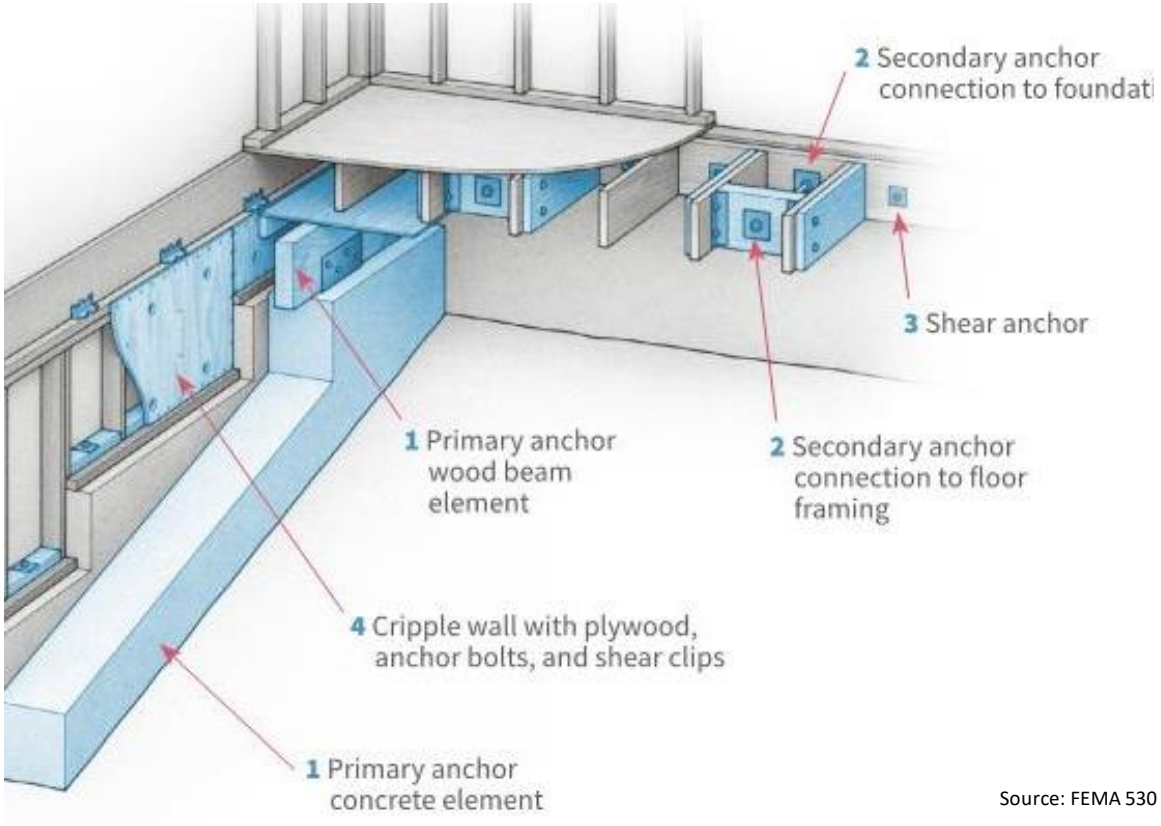
- Addresses soft-story vulnerability (not just open-front)
- Retrofit scope includes full perimeter of the garage



Retrofit Design Concepts
Hillside Dwellings

Hillside dwelling retrofit

- Focus is diaphragm anchorage to the uphill foundation

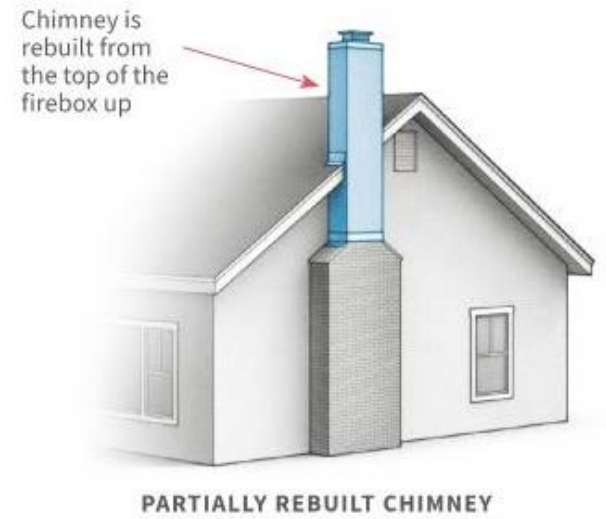


Source: FEMA 530

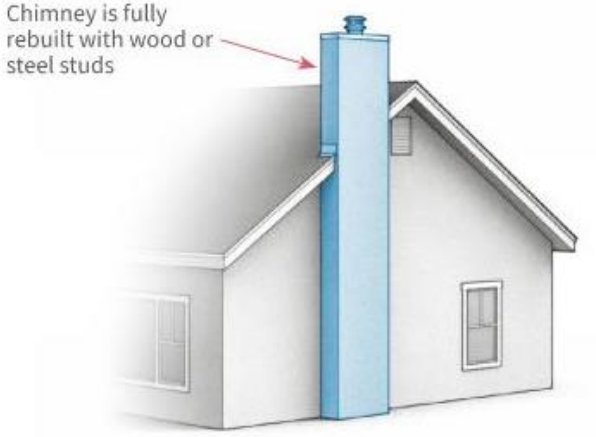
Retrofit Design Concepts
Chimneys

Chimney retrofit

- Focus is on replacing brick masonry with light-frame construction
- Wood burning fireplace might be replace with gas burning
- Plan set covers chimneys and fire boxes with plan dimensions not greater than 40 inches, larger requires engineering



PARTIALLY REBUILT CHIMNEY



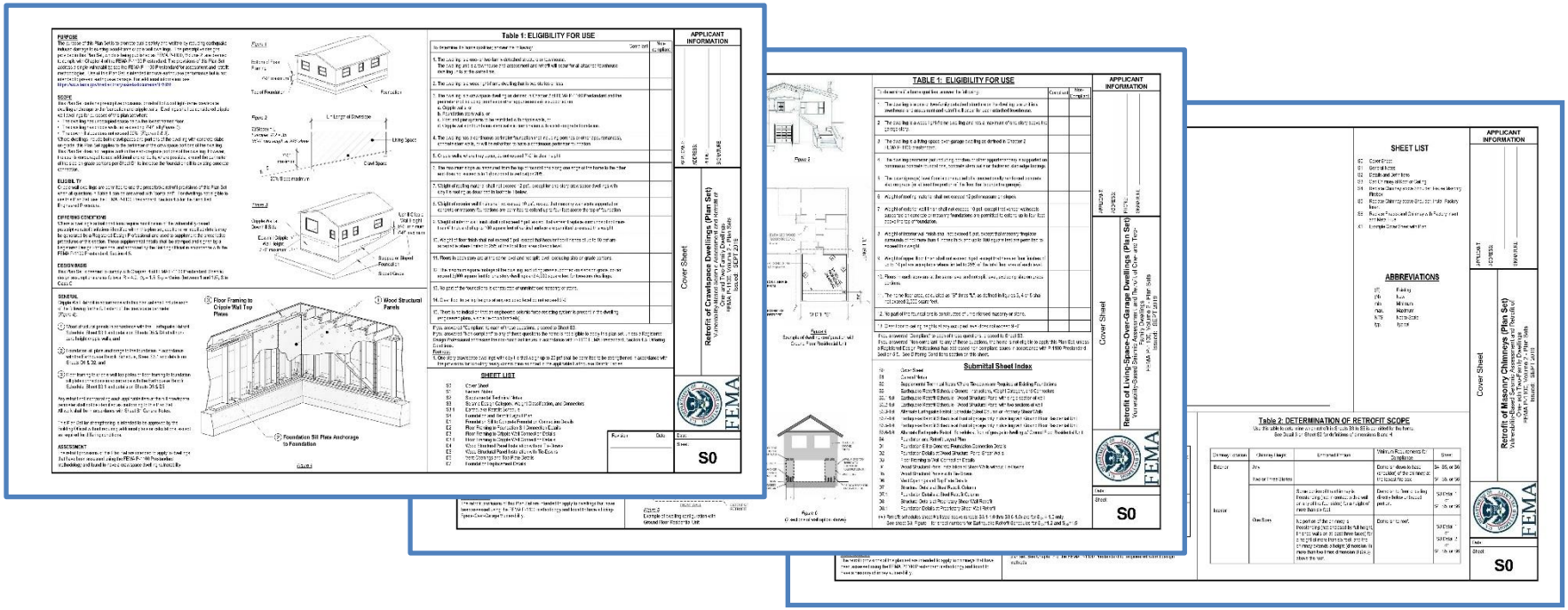
Source: FEMA 530

FULLY REBUILT CHIMNEY

Relationship to Other Available Retrofit Guidelines and Provisions

- Other guidelines and code provisions have been available for retrofit:
  - For cripple walls and anchorage, provisions are found in IEBC Appendix Chapter A3, FEMA P-1024 plan set, and locally available plan sets
  - For chimneys, post-earthquake repair guidelines with similar content have been published in FEMA P-1024 and locally available information
- These previously available resources will be discussed in the modules that address these retrofits

Introduction to the Plan Sets



- Volume 2A- Plan Set for Crawlspace Dwellings
- Volume 2B: Plan Set for Living Space Over Garage Dwellings
- Volume 2C: Plan Set for Masonry Chimneys

VOLUME 2 – Plan Sets

Plan Set Commonalities

- Intended to be used by a contractor or owner without an engineer for most common configurations
- Intended to be submitted for permit
- Standalone self-contained package
- Does not include assessment, assumes that the need to retrofit has already been identified.

Plan Set Commonalities

- All plan sets include:
  - Instructions for use
  - Purpose and scope
  - Eligibility checklists
  - General notes for materials and implementation
  - Sheet to draw plan and note details
  - Multiple details from which to choose those most applicable
  - Examples of use

Prescriptive Design- Plan Set

A. Before you begin:

1. This Plan Set is intended for use by a general contractor or homeowner without necessarily having to involve a Registered Design Professional.
2. Contact your local Building Official, often known as the Building Department, to understand the building permit application process. Inquire about:
   a. fees,
   b. how many copies of the plans must be submitted, and
   c. which city inspections are required, see F.3 below.
3. The Building Official may also be able to assist with assessing the applicability of this plan set to a home. See Eligibility For Use, Sheet S0.
4. Complete the Eligibility For Use questionnaire on Sheet S0 (Table 1), to determine if this plan set is applicable. A "non-compliant" answer to any question disqualifies the home from using this plan set, unless a Registered Design Professional is involved.

B. Determine your Seismic Design Category (SDC) and Weight Classification:

1. See Sheet S3 and determine the Seismic Design Category (SDC) and Weight Classification for the dwelling. This information will be used to determine which S3.1 sheet is applicable. Note that there are three unique S3.1 sheets for one-story dwellings with differing S_{DS} values and three similar sheets for two-story dwellings. Only one Sheet S3.1 will be applicable to any given dwelling and included within the set of drawings used for submission to the Building Official.

C. Prepare your plans:

1. Draw a scaled plan of the perimeter of the home in the graph layout area provided on Sheet S4, Foundation and Retrofit Layout Plan. Your plan should include the following:
   a. The location of any obstructions along the perimeter of the foundation that make the retrofitting work difficult or impossible such as fireplaces, water heaters, or utilities. These areas should be avoided when laying out the required retrofitting work.
   b. An arrow to indicate the direction of the span of your floor joists plus the spacing such as "floor joists at 16" on center." This will be helpful when selecting the appropriate details shown on Sheets D1 - D6.
   c. Indicate the height of the tallest cripple wall for each wall line. The minimum required length of retrofitting along each wall line will be based, among other variables, on this height. See the sections in Details 1 and 2 on Sheet D4 for measurement of "cripple wall height."
   d. Dimensions for each length of perimeter wall segment and overall dimensions of wall lines.
   e. An arrow pointing to North.
   f. Label the street side (front) of the home.
   g. See Sheet X1 for an example of a plan sheet submittal.
   h. See Sheets X2 and X3 for additional examples and instructions of how certain items are calculated, such as the length of bracing at offset walls of non-rectangular "T" or "L" shaped dwellings, as noted in Section J, General Notes, Sheet S1.
   i. See Sheets X4 and X5 for illustrations and definitions of terms for retrofit conditions.

D. Gather information to complete the plans:

1. Review Sheets S1 and S2 for guidance on materials and installation for the required work.
2. Review the Detail Sheets included in this plan set (Sheets D1-D7). Locate the details that most substantially match the home's framing conditions. Not all details or sheets will apply. As a minimum, you should have one detail each for:
   a. The foundation sill to concrete foundation connection (Sheet D1); and
   b. The floor framing to foundation sill connection (Sheet D2); or
   c. Floor framing to cripple wall connection (Sheet D3 and/or Sheet D3.1).
3. Differences in existing conditions from those illustrated on the details that result in changes to these drawings will need to be reviewed by a Registered Design Professional. See "Purpose" on Sheet S0 for additional information.
4. Once you have chosen the correct (applicable) S3.1 sheet, follow the instructions provided to determine the amount and type of earthquake retrofitting required along each perimeter wall line. Once Steps 1 through 7 of the instructions are completed, document the results within the Retrofit Table as explained in Step 8.
5. Refer to Supplemental Technical Notes on Sheet S2 where tie-downs are required.

E. Complete your plans:

1. Using the information from the Earthquake Retrofit Schedule on Sheet S3.1, add the following to complete your Foundation and Retrofit Layout Plan on Sheet S4:
   a. Indicate and dimension the total length of braced wall sections required at each wall line.
   b. Identify the details used for the connections as noted in D.2 above. Indicate the connection type and the minimum number of connectors for each wall line. Conform to Sections L and M of Sheet S1.
   c. Identify the details used for the wood structural panel (Sheets D4 or D5).
   d. If tie-downs are used, identify the details used (Sheet D5).
   e. Identify the detail used for the top plate splice (Sheet D6).
   f. Identify the details used for notching and/or cutouts (Sheet D6.)

F. Submit your plans:

1. Submit a permit application and the required number of completed sheets (Sheets S0 through D7) to the Building Official for review. Photographs of the foundation sill, cripple wall, and floor framing conditions may assist the review process.
2. Before starting work, the permit holder may be required to schedule a preconstruction inspection with the Building Official to verify that field conditions are consistent with the information provided on the approved plan.
3. Inspection(s) by the Building Official may be required for:
   a. Foundation Anchor bolts / Anchor Plate installation,
   b. Blocking installation,
   c. Wood structural panel on cripple wall, sheathing and nailing,
   d. Metal hardware "connectors" installation,
   e. Tie-downs, and
   f. Final inspection.

SHEET LIST

01*	Instructions for Use
S0	Cover Sheet
S1	General Notes
S2	Supplemental Technical Notes
S3	Seismic Design Category, Weight Classification, and Connectors
S3.1**	Earthquake Retrofit Schedule - S_{DS} 1.0, One-Story
S3.1**	Earthquake Retrofit Schedule - S_{DS} 1.2, One-Story
S3.1**	Earthquake Retrofit Schedule - S_{DS} 1.5, One-Story
S3.1**	Earthquake Retrofit Schedule - S_{DS} 1.0, Two-Story
S3.1**	Earthquake Retrofit Schedule - S_{DS} 1.2, Two-Story
S3.1**	Earthquake Retrofit Schedule - S_{DS} 1.5, Two-Story
S4	Foundation and Retrofit Layout Plan
D1	Foundation Sill to Concrete Foundation Connection Details
D2	Floor Framing to Foundation Sill Connection Details
D3	Floor Framing to Cripple Wall Connection Details
D3.1	Floor Framing to Cripple Wall Connection Details
D4	Wood Structural Panel Installation without Tie-Downs
D5	Wood Structural Panel Installation with Tie-Downs
D6	Vent Openings and Top Plate Details
D7	Foundation Replacement Details
X1*	Example of Foundation and Retrofit Layout Plan
X2*	Example - Foundation Plan (Dwelling without Tie-Downs)
X3*	Example - Foundation Plan (Dwelling with Tie-Downs)
X4*	Illustration - Cripple Wall Retrofit
X5*	Illustration - Retrofit - No Cripple Wall

* Sheet for reference only. Do not submit to the Building Official.
** Only one "S3.1" sheet will be submitted to the Building Official.

This sheet is for instruction and reference only.
Do not submit to the Building Official.

Instructions for Use

Retrofit of Crawlspace Dwellings (Plan Set)
Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings
FEMA P-1100, Volume 2 - Plan Sets
Issued: SEPT 2019

FEMA

01

Step-by-step instructions for use

Prescriptive Design- Plan Set

PURPOSE
The purpose of this Plan Set is to promote public safety and welfare by reducing earthquake-induced damage to existing wood-frame cripple wall dwellings. The prescriptive designs provided in this Plan Set, which is being published as FEMA P-1100, Volume 2, are deemed to comply with Chapter 4 of the FEMA P-1100 Prestandard. The provisions of this Plan Set address a single vulnerability; see the FEMA P-1100 Prestandard for assessment and retrofit methodologies. Use of this Plan Set is intended improve earthquake performance but is not intended to prevent earthquake damage. For additional information, see https://www.fema.gov/media-library/assets/documents/175158

SCOPE
This Plan Set contains prescriptive provisions for retrofit of wood light-frame crawlspace dwelling cripple walls to the foundation and cripple walls. Dwellings shall be considered cripple wal
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Purpose and Scope

ELIGIBILITY
Cripple wall dwellings are permitted to use the prescriptive retrofit provisions of this Plan Set when all questions in Table 1 can be answered with "compliant". For dwellings not eligible to use this Plan Set, see the FEMA P-1100 Prestandard, Section 4.5 for the Simplified Engineered Procedure.

DIFFERING CONDITIONS
Where a dwelling's actual conditions require modification of the vulnerability-based prescriptive retrofit solutions identified within this plan set, additional or modified details may be generated by a Registered Design Professional and used to supplement the prescriptive procedures of this section. These supplemental details shall be stamped and signed by a Registered Design Professional and approved by the Building Official in accordance with the FEMA P-1100 Prestandard, Section 4.5.

DESIGN BASIS
This Plan Set is deemed to comply with Chapter 4 of FEMA P-1100 Prestandard. Specific design assumptions are as follows: R = 4.0; Ω_o = 1.5; S_{DS} = Varies (between 1 and 1.5), Site Class C.

Figure 1

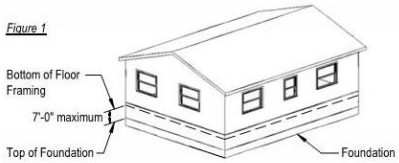


Figure 2

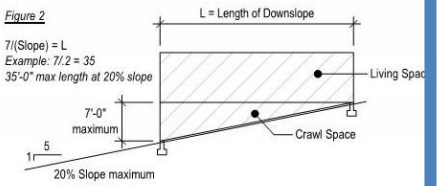
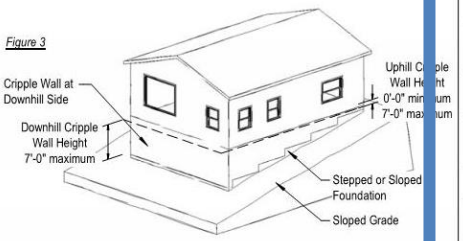


Figure 3



GENERAL
Cripple Wall Retrofit in accordance with this plan set shall include each of the following for the full extent of the crawlspace perimeter (*Figure 4*):

1. Wood structural panels in accordance with the Earthquake Retrofit Schedule, Sheet S3.1 and details on Sheets D5 & D4 at all non-zero height cripple walls, and
2. Foundation sill plate anchorage to the foundation in accordance with the Earthquake Retrofit Schedule, Sheet S3.1 and details on Sheets D1 & D2, and
3. Floor framing to cripple wall top plates or floor framing to foundation sill plate connections in accordance with the Earthquake Retrofit Schedule, Sheet S3.1 and details on Sheets D3 & D5.

Any retrofit not incorporating each applicable item at the full crawlspace perimeter shall not be identified as conforming to this Plan Set.
All work shall be in accordance with Sheet S1 General Notes.

This Plan Set for strengthening is intended to be approved by the Building Official without requiring additional plans or calculations, except as required for differing conditions.

ASSESSMENT
The retrofit provisions of this Plan Set are intended to apply to dwellings that have been assessed using the FEMA P-1100 Prestandard methodology and found to have a crawlspace dwelling vulnerability.

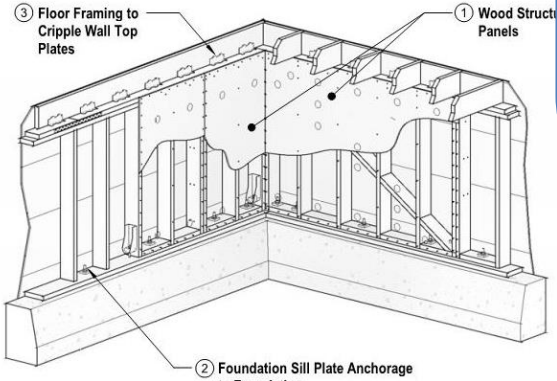


Figure 4

Table 1: ELIGIBILITY FOR USE

To determine if a home qualifies; answer the following:	Compliant	Non-compliant
1. The dwelling is a one- or two-family detached structure or townhouse. The dwelling unit is a townhouse and assessment and retrofit will occur for all attached townhouse dwelling units at the same time.		
2. The dwelling is a wood light-frame dwelling that is two stories or less.		
3. The dwelling is a crawlspace dwelling as defined in Chapter 2 of FEMA P-1100 Prestandard and the perimeter (not including porches or other appurtenances) is supported on: a. Cripple walls, or b. Foundat c. Post an d. Cripple		
4. The dwelli concrete s		
5. Cripple walls, where they occur, do not exceed 7'-0" in clear height.		
6. The maximum slope as measured from the top of foundations along one edge of the home to the other end does not exceed 5 to 1 (horizontal to vertical) or 20%.		
7. Weight of roofing material shall not exceed 12 psf., except for one-story crawlspace dwellings with clay tile roofing as described in footnote 1 below.		
8. Weight of exterior wall finish shall not exceed 10 psf., except that masonry wainscots supported on concrete or masonry foundations are permitted to extend up to four feet above the top of foundation.		
9. Weight of interior wall finish shall not exceed 8 psf, except that veneer fireplace surrounds of not more than 4" thick and of up to 100 square feet of vertical surface are permitted to exceed this weight.		
10. Weight of floor finish shall not exceed 5 psf, except that heavier floor finishes of up to 10 psf are acceptable where limited to 25% of the total floor area of each level.		
11. Floors in each story are at the same level and not split level, excluding slab on grade portions.		
12. The maximum square footage of the dwelling, excluding areas supported on slabs on grade, do not exceed 3,000 square feet for one story dwellings and 4,000 square feet for two-story dwellings.		
13. No part of the foundations is constructed of unreinforced masonry or stone.		
14. Clear floor to ceiling heights at any occupied level do not exceed 9'-0".		
15. There is no indication that an engineered seismic force-resisting system is present in the dwelling (engineered plans, visible tie-down brackets).		

Eligibility

If you answered "Compliant" to each of these questions, proceed to Sheet S3.
If you answered "Non-compliant" to any of these questions the home is not eligible to apply this plan set, unless a Registered Design Professional addresses the non-compliant issues in accordance with P-1100 FEMA Prestandard, Section 4.5, Differing Conditions.
Footnote:
1. One story crawlspace dwellings with clay tile that weigh up to 20 psf shall be permitted to be strengthened in accordance with the provisions for two-story heavy construction as noted in the applicable Earthquake Retrofit Tables.

S0	Cover Sheet
S1	General Notes
S2	Supplemental Technical Notes
S3	Seismic Design Category, Weight Classification, and Connectors
S3.1	Earthquake Retrofit Schedule
S4	Foundation and Retrofit Layout Plan
D1	Foundation Sill to Concrete Foundation Connection Details
D2	Floor Framing to Foundation Sill Connection Details
D3	Floor Framing to Cripple Wall Connection Details
D3.1	Floor Framing to Cripple Wall Connection Details
D4	Wood Structural Panel Installation without Tie-Downs
D5	Wood Structural Panel Installation with Tie-Downs
D6	Vent Openings and Top Plate Details
D7	Foundation Replacement Details

APPLICANT INFORMATION
APPLICANT:
ADDRESS:
PHONE:
SIGNATURE:

Cover Sheet

Retrofit of Crawlspace Dwellings (Plan Set)
Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings
FEMA P-1100, Volume 2 - Plan Sets
Issued: SEPT 2019

FEMA

Revision:	Date:

Date:
Sheet:
S0

Prescriptive Design- Plan Set

Table 1: ELIGIBILITY FOR USE

To determine if a home qualifies; answer the following:	Compliant	Non-compliant
1. The dwelling is a one- or two-family detached structure or townhouse. The dwelling unit is a townhouse and assessment and retrofit will occur for all attached townhouse dwelling units at the same time.		
2. The dwelling is a wood light-frame dwelling that is two stories or less.		
3. The dwelling is a crawlspace dwelling as defined in Chapter 2 of FEMA P-1100 Prestandard and the perimeter (not including porches or other appurtenances) is supported on: a. Cripple walls, or b. Foundation stem walls, or c. Post and pier systems to be retrofitted with cripple walls, or d. Cripple walls or foundation stem walls in combination with a slab on grade foundation.		
4. The dwelling has a continuous perimeter foundation (not including porches or other appurtenances), concrete stem walls, or will be retrofitted to have a continuous perimeter foundation.		
5. Cripple walls, where they occur, do not exceed 7'-0" in clear height.		
6. The maximum slope as measured from the top of foundations along one edge of the home to the other end does not exceed 5 to 1 (horizontal to vertical) or 20%.		

Prescriptive Design- Plan Set

General Notes

A. CODE

1. All work not otherwise specified shall conform to the locally adopted version of the building code or residential code. Contractor shall comply with all locally adopted building codes and ordinances.

B. GENERAL

1. The contractor is responsible for maintaining a safe job site and complying with relevant state and/or federal OSHA standards. Contractor is responsible for the means and methods for accomplishing the work shown in this plan set, including any shoring and bracing of existing construction as required to safely install new work. Exercise caution working around existing utilities, locate underground utilities before excavating, and arrange for temporary disconnection of utilities if necessary.
2. All existing under floor ventilation and access shall be maintained.

C. EXISTING CONDITIONS

1. Contractor shall confirm that existing conditions match plans and details prior to start of work.
2. Contractor shall verify that existing concrete, anchor bolts, wood framing, and other materials that will become part of the work or to which retrofit construction is attached is in reasonably sound condition and free of defects that would substantially reduce the capacity of the material. Where possible, damaged or deteriorated elements shall be repaired in place or supplemented with new elements. Otherwise damaged or deteriorated members shall be replaced. Repair or replacement shall be in accordance with the adopted building or residential code.
3. The Owner or Contractor shall verify that the existing concrete within all areas to receive new anchor bolts are in reasonably good condition. Examples of poor concrete quality would include excessive spalling, large rock pockets, cracks extending completely through the footing greater than 1/4" wide (closer than 6'-0" on center on average), or low strength concrete cement or mortar easily scrapable with a metal knife or trowel. Strengthening should be avoided in local areas of poor quality. Where these areas cannot be avoided, or where locations of poor quality are widespread, the new anchors shall be torque tested in accordance with Table C-1. Where torque tests continue to fail, the existing foundation system shall be replaced locally for a minimum of 30 inches on each side of the proposed anchor location.

Table C-1 : Foundation Verification Requirements

	Screw Anchor	Adhesive Anchor
Diameter ø	Torque (ft-lbs)	Torque (ft-lbs)
1/2"	35	15
5/8"	50	20

D. NOTCHING, BORING AND CUTTING

1. Do not cut, bore, or notch structural members excep
   Exception: Notching and boring of framing shall be
2. When drilling in concrete, do not drill through existir
   relocated hole. Fill original hole with non-shrink gro

E. CONCRETE

1. Concrete shall have a strength of not less than 3,00
   accordance with the manufacturer's instructions usi

F. REINFORCING STEEL (REBAR)

1. Reinforcing steel shall confirm to ASTM A615 Grade 40 or 60, ASTM A706, or ASTM A996 Type R.
2. Reinforcing steel bend radii and other rebar detailing shall be in accordance with Concrete Reinforcing Steel Institute.
3. Minimum concrete cover over reinforcing steel:
   a. Concrete cast against and permanently exposed to soil: 3 inches
   b. Formed concrete exposed to weather: 2 inches
   c. Concrete not exposed to weather or in contact with soil: 1-1/2 inch
   d. Reinforcing steel lap splice lengths:

	No. 4	No. 5
• Horizontal bars with more than 12 inches concrete below:	32 inches	42 inches
• Other bars:	24 inches	32 inches

G. STRUCTURAL STEEL

1. Structural steel W-sections, plate, bar and miscellaneous steel shall be ASTM A36, A992, or A572. Welding shall comply with AWS D1.1 requirements using prequalified welding procedures. All welding shall be conducted by welders certified for the materials and welding procedures used.
2. Bolts shall conform to ASTM A-307. Threaded rods shall conform to ASTM A-36.

H. FASTENERS

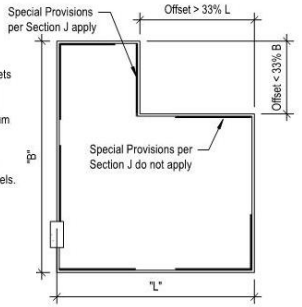
1. General
   a. All bolts, nails, and other fasteners in contact with preservative-treated wood or exposed to weather shall be hot-dip galvanized or stainless steel.
2. Nails
   a. Unless otherwise noted, all nails specified are to be common nails.
   b. Special care is required when installing nails in existing framing. Where required to avoid splitting of framing, predrill to 75% of nail shank diameter.
   c. Fasteners for wood structural panel sheathing shall be full length 8d common nails (0.131" x 2.1/2"). Drive sheathing nail head flush with face of sheathing.
   d. Do not overdrive, countersink, or otherwise damage the outermost ply when installing nails. A nail is over-driven when it breaks the surface ply. Where nails are overdriven to the point that the veneer is fractured, add one new nail for every (2) overdriven nails. Space new nails between existing.
3. Anchor Bolts
   a. Predrill bolt holes to not more than 1/16th inch larger than bolt or anchor bolt to be placed.
   b. At each perimeter wall line, provide a minimum quantity of Foundation Sill Anchors as required by the Earthquake Retrofit Schedule. Place new anchors between 8 and 12 inches from the end of each foundation sill plate and distrubute the remaning anchors as evenly as practical along the wall line.
   c. Provide steel plate washers 0.229 x 3 x 3 inch minimum at all anchor bolts. Centerline of washer should be 1-1/2" to 2" from face of sheathing.
   d. Anchor bolts shall be a maximum spacing of 64" on center for one-story dwellings and 48" on center for two-story dwellings along the entire portion of all exterior walls, except as noted in Section J.
   e. For braced wall sections without tie-downs, provide one of the required anchor bolts within 8" of each end and one additional anchor bolt at each end as noted on Sheet D4.
   f. For braced wall sections with tie-downs, provide one additional anchor bolt within 8" minimum and 12" maximum from tie-down as noted on Sheet D5.

I. WOOD STRUCTURAL PANEL SHEATHING

1. Wood structural panels shall be 15/32" plywood sheathing, all veneer, conforming to US voluntary Product Standard PS-1, Exposure I or Exterior Exposure, manufactured with exterior glue, and minimum 4-ply.
2. Oriented Strand Board (OSB) shall be 15/32" thick and conform to US Voluntary Product Standard PS 2 with an exposure rating of Exposure 1 or Exterior Exposure, manufactured with exterior glue, and minimum 4-ply.
3. Provide 1/8-inch minimum gap at all sheathing panel ends and edges.
4. Maintain a minimum edge distance of 3/8" from center of nail to edges of sheathing, studs, or top and sill plates. See Sheet D4 for double stud at sheathing panel joints.
5. Braced wall sections closest to the ends of wall lines shall be located as near to the ends as practicable. Braced wall sections may be located away from the ends of a wall line when existing obstructions or limited clearance necessitate such relocations.
6. Braced wall sections along the length of a wall line should be nearly equal in length and should be nearly equal in spacing where possible. Using increments of existing stud spacing is expected.
7. The length of each braced wall section shall not be less than 48 inches. The length of braced wall sections without tie-downs should be equal to or exceed twice the height of the cripple wall. Exceptions are permitted when obstructions do not allow braced wall sections of the required length.

J. ADDITIONAL REQUIREMENTS FOR NON-RECTANGULAR DWELLINGS WITH "T OR "L" PLAN CONFIGURATIONS

1. Plan configurations other than rectangular such as "T" or "L" shapes that have offsets in the exterior wall lines, within the crawl space plan area, greater than 33% of the largest plan dimension shall meet the following special provisions in that direction:
   a. Foundation sill to foundation connections along offset walls shall have a maximum spacing of 32" on center.
   b. Floor joist to foundation sill and floor joist framing to the top of cripple wall connections along offset walls shall have a maximum spacing of 16" on center.
   c. Cripple walls, where they occur, shall be sheathed with new wood structural panels.



1. Framing shall be Douglas Fir-Larch, or an approved species having a greater or equal specific gravity.
2. Framing in contact with foundations or exposed to weather shall be preservative treated in accordance with AWPA U1 (Commodity Specification A, Use Category 4B). Field treat all cuts, bores and notches per AWPA M-4.

L. CONNECTOR DEVICES

1. Connectors shall be pre-engineered pre-manufactured devices, approved by the Building Official and installed in accordance with the manufacturer's instructions.
2. Connectors protected from weather shall be provided with a minimum of G90 zinc coating in accordance with ASTM A653. Connectors exposed to weather or in contact with preservative treated wood shall be provided with a minimum hot-dip galvanized coating or G185 coating in accordance with ASTM A653, and fasteners conforming to ASTM A153.
3. Connector devices shall be of the type and size specified in these drawings.
4. Connectors required by the Earthquake Retrofit Schedule (Sheet S3.1) shall be distributed equally along the length of each wall line or within the length of the braced wall panel(s).
5. Connector spacing may not be less than 8" on center.
6. Increase nail or screw length 1/2-inch minimum when installing connectors over wood structural panels.

M. POST-INSTALLED ANCHORS

1. Post-installed anchors shall be installed in accordance with the manufacturer's installation instructions.
2. Adhesive anchors shall be Simpson Strong-Tie SET-XP, HILTI RE 500 SD, CIA GEL 7000C, or approved equivalent.
3. Concrete screws shall be Simpson Strong-Tie Titen HD, KC Metals Kwik-HUS-EZ, or Powers Fasteners Wedge-Bolt, or approved equivalent.
4. See H.3. for additional anchor bolt requirements.

N. PERMITS

1. All work required by this Plan Set shall be permitted through the building department.

O. INSPECTIONS

1. Contractor shall coordinate with the building inspector to ensure that work is accessible for building department inspections, and shall correct non-compliant work as identified by the inspector.

P. SPECIAL INSPECTIONS

1. Special inspection by a third party inspector is not required for the following:
   a. Concrete or reinforcing steel for foundations. Design is based on an ultimate concrete strength of 2,500 psi or less.
   b. Installation of cast-in-place or post-installed anchor bolts.
   c. Installation of adhesive anchors for tie-down devices, provided that each anchor is torque-tested in accordance with Table R-2, Sheet S2.
   d. Nailing of wood structural panel shear walls, provided a building department inspection is performed.

APPLICANT:

PROPERTY ADDRESS:

General Notes

Retrofit of Crawlspace Dwellings (Plan Set)
Vulnerability-Based Seismic Assessment and Retrofit of
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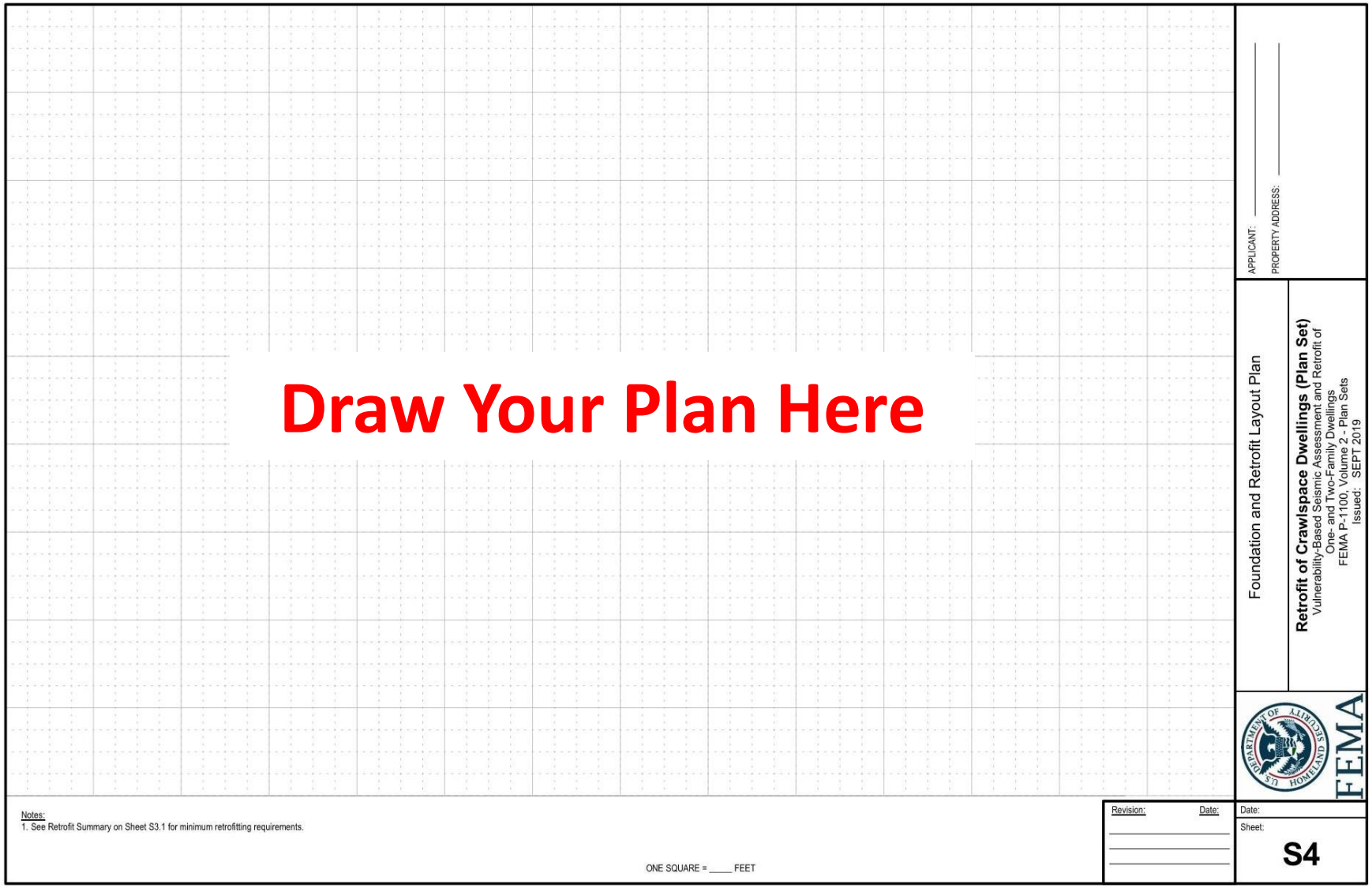
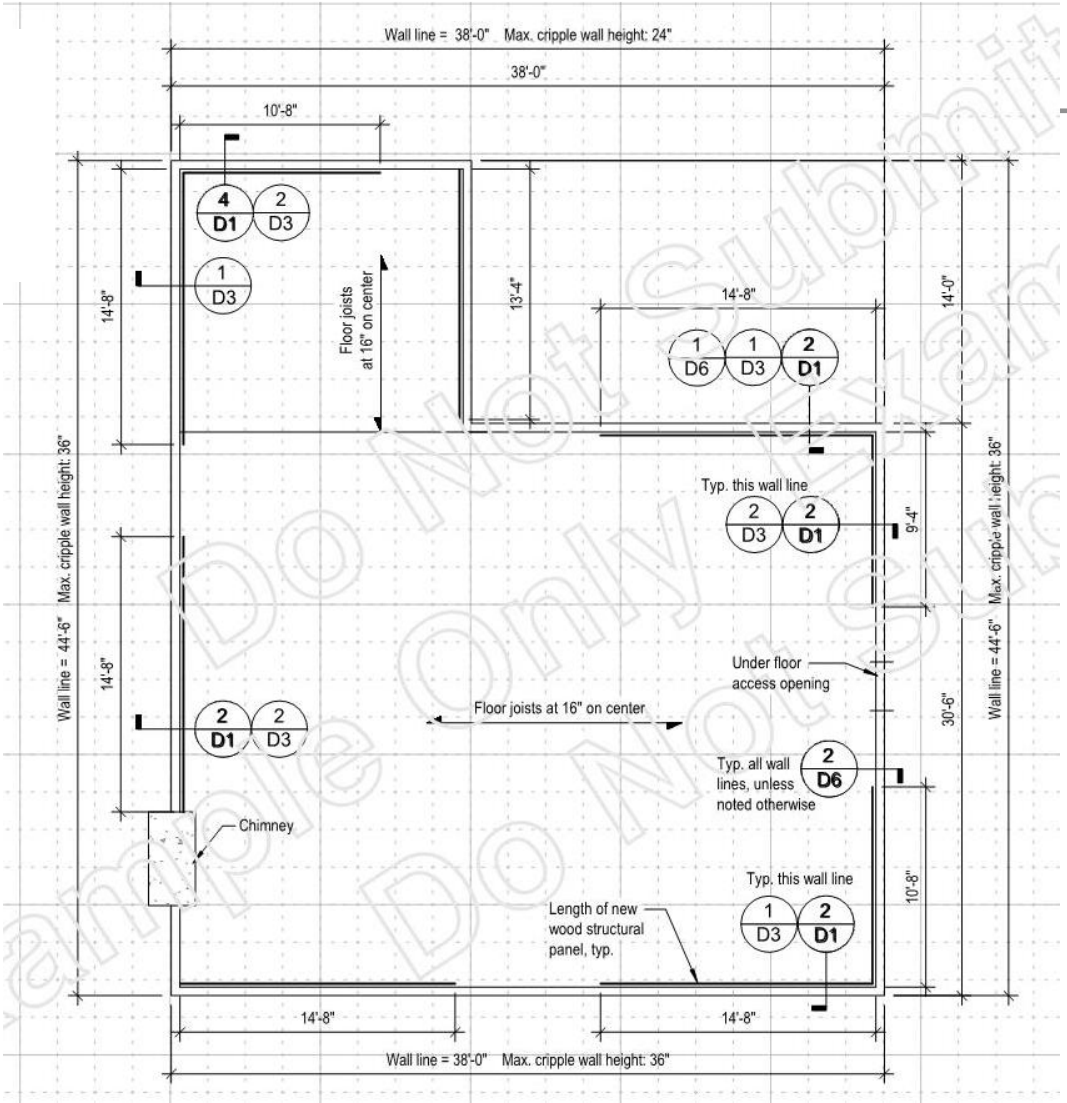
S1

Prescriptive Design- Plan Set

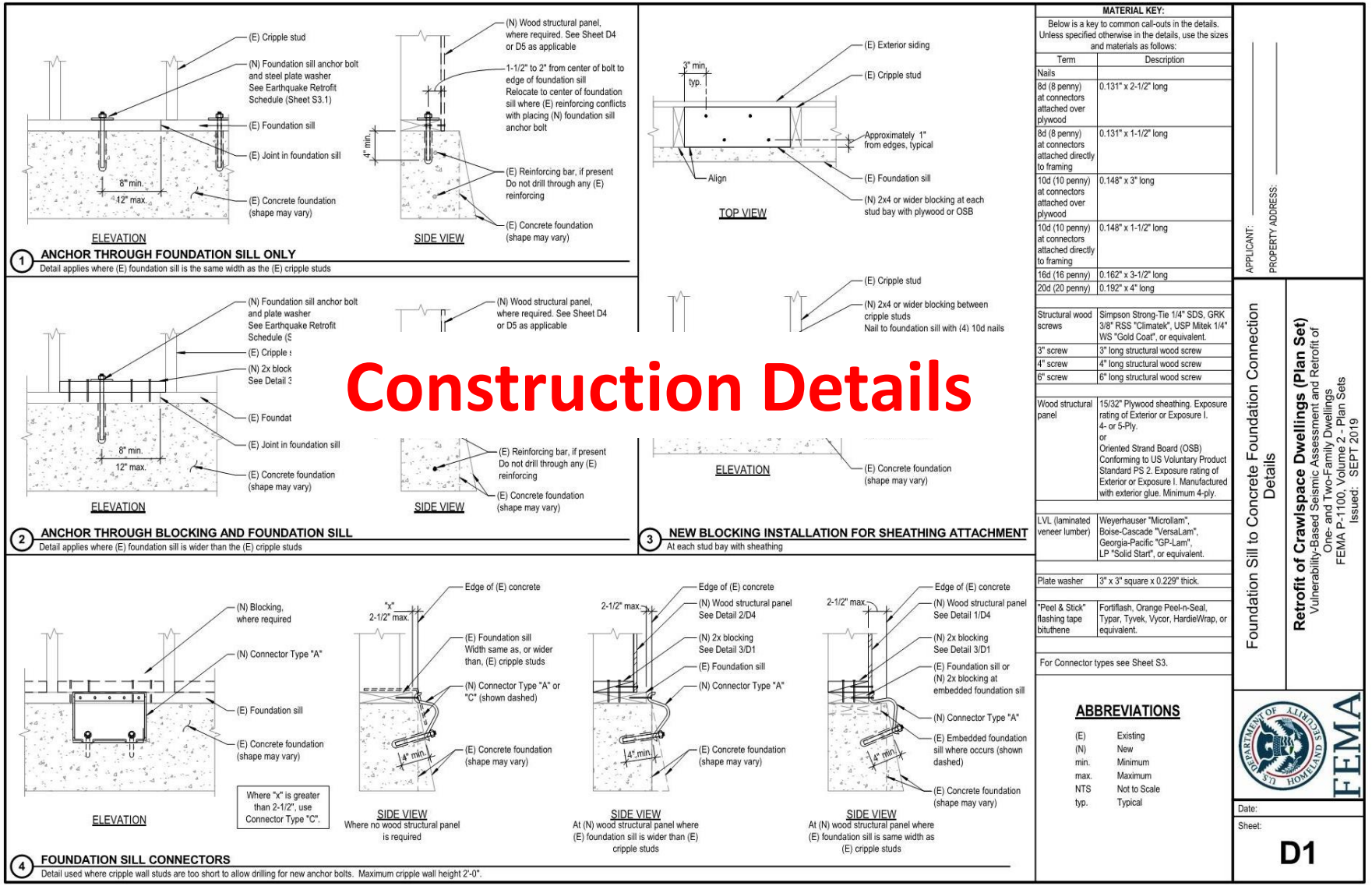


Prescriptive Design- Plan Set

Example Plan



Prescriptive Design- Plan Set



Construction Details

Prescriptive Design- Plan Set

- Crawlspace and living-space-over-garage dwellings also include:
  - Weight classification of dwelling
  - Identification of seismic hazard level
  - Tabulated requirements for extent of retrofit (extent of bracing, number of connectors) Need to choose the sheet that is applicable

Prescriptive Design- Plan Set

Seismic Design Category (SDC)

1. The first factor taken into consideration when determining the appropriate amount of earthquake strengthening is the anticipated level of seismic shaking or S_{DS} value, which is directly related to the Seismic Design Category (SDC).

2. To find the appropriate S_{DS} value, which is either 1.0, 1.2, or 1.5, you must first determine your Seismic Design Category (SDC) by clicking the link below.

   a. In your internet browser go to http://www.atcouncil.org/fema-p-1100
   b. Click on one of the five (5) geographic areas listed to find your location on the appropriate map.
   c. Locate your SDC (SDC A-SDC E) by the color contour shown on the map which corresponds to the % g values shown.
   d. For SDC A-D_1, use S_{DS} = 1.0.
   e. For SDC D_2, use S_{DS} = 1.2 unless the site class can be determined as A, B, or D, in which case use S_{DS} = 1.0.
   f. For SDC E, use S_{DS} = 1.5

   Note: where your location is on, or close to, the border of two SDC's, it is prudent to choose the higher value.

3. Make a note of the appropriate S_{DS} value. It will be used together with the number of stories the dwelling has to determine the appropriate Earthquake Retrofit Schedule (Sheet S3.1) to use in preparing and submitting the plans. You will only use one of the following six Earthquake Retrofit Schedule Sheets. Do not submit the unused S3.1 sheets to the Building Official.

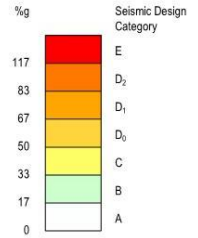
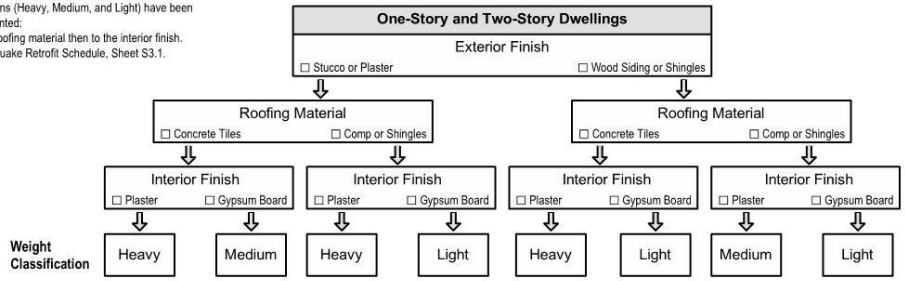


Figure 1. SDC versus %g

Weight Classification

The next factor used to establish the appropriate amount of earthquake strengthening is the dwelling weight. For the purposed of this Plan Set, three weight classifications (Heavy, Medium, and Light) have been established as described below. Using the flowchart presented:
1. Start with the exterior finish and move progressively to roofing material then to the interior finish.
2. Note the weight classification result for use in the Earthquake Retrofit Schedule, Sheet S3.1.

Specific notes for exterior, interior and roof coverings:
1. The "wood siding or shingles" exterior finish category also includes finishes of similar weight, including but not limited to fiber-cement and aluminum siding.
2. The "comp or shingles" roofing material category also includes roofing materials of similar weight, including but not limited to roll roofing, built-up felt roofing, single-ply membrane roofing, and metal roofing.
3. The "gypsum board" interior finish category also includes wall finish materials of similar weight, including but not limited to wood board or panel siding.
4. The exterior finish, roofing material, and interior finish categories are intended to be identified based on the predominant materials used in construction. Where interior or exterior finishes vary, a heavier type finish shall be assumed where 25% or more of the heavier finish type exists within the dwelling.



Connectors

1. Manufacturer's model numbers and installation instructions are subject to change. Verify and follow manufacturer's written instructions.
2. Connector images are general in nature only. Individual manufacturer's connectors may vary.
3. Any of the connectors listed within a particular group may be used for strengthening the particular condition.
4. This Plan Set was developed using the lowest listed manufacturer's capacity within a particular group.
5. Where connectors listed within the applicable Earthquake Retrofit Schedule will not fit within a particular wall line due to limitations in length, alternate connections may be substituted but shall be designed or selected by a registered design professional and approved by the Building Official.

CONNECTORS

IMAGE	MANUFACTURER	MODEL	CAPACITY
	TYPE A Simpson Strong-Tie USP Structural Connectors	 URFP SRC	 1530# 1450#
	TYPE B Simpson Strong-Tie KC Metals USP Structural Connectors	 FRFP RFP SRCP	 1065# 960# 1570#
	TYPE C Simpson Strong-Tie KC Metals KC Metals USP Structural Connectors	 FRFP RFA86/88 RFA136/138 SFA8	 1065# 725# 1145# 875#
	TYPE D Simpson Strong-Tie KC Metals USP Structural Connectors	 L70 CA70 AC7	 740# 565# 725#
	TYPE E Simpson Strong-Tie KC Metals USP Structural Connectors	 L90 CA90 AC9	 925# 740# 905#
	TYPE F (Note 3) Simpson Strong-Tie KC Metals USP Structural Connectors	 H10A HT10A RT16A	 590# 590# 800#
	TYPE G Simpson Strong-Tie KC Metals USP Structural Connectors	 LTP4 FAL MP4F	 600# 445# 660#
	TYPE H Simpson Strong-Tie KC Metals USP Structural Connectors	 L30 CA30 A3	 250# 275# 590#
	TYPE S1 Simpson Strong-Tie KC Metals USP Structural Connectors	 MSTA36 TSA36 MSTA36	 2050# 2075# 2065#

ANCHOR BOLTS

MANUFACTURER	MODEL	EMBEDMENT DEPTH	
		1/2"ø	5/8"ø
SCREW-TYPE Simpson Strong-Tie KC Metals Powers Fasteners	 Titen HD Kwik-HUS-EZ Wedge-Bolt	 3-1/2" 4-1/2" 3-3/8"	 3-1/2" n/a 3-3/8"
ADHESIVE Simpson Strong-Tie Hilti USP Structural Connectors	Threaded Rod with: SET Adhesive HIT-HY 200 CIA GEL 7000C	 4-1/4" 2-3/4" 2-3/4"	 5" 3-1/8" 3-1/8"

TIE-DOWNS

Supplemental Technical Notes, Sheet S2, Section S

IMAGE	MANUFACTURER	MODEL	CAPACITY (ASD)
	Simpson Strong-Tie KC Metals USP Structural Connectors	HDU2 ADST2 PHD2A	3075# 4275# 3215#

Note: Tie-down capacities listed above are ASD and based on manufacturer's data. The allowable ASD capacity used for development of this plan set has been reduced to 3000# based on anchorage to existing foundation systems. Tie down anchors must be installed per Detail 1, Sheet D5.

APPLICANT:

PROPERTY ADDRESS:

Seismic Design Category, Weight Classification, and Connectors

Retrofit of Crawlspace Dwellings (Plan Set)
Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings
FEMA P-1100, Volume 2 - Plan Sets
Issued: SEPT 2019

FEMA

Date:

Sheet: **S3**

Prescriptive Design- Plan Set

Seismic Design Category (SDC)

1. The first factor taken into consideration when determining the appropriate amount of earthquake strengthening is the anticipated level of seismic shaking or S_{DS} value, which is directly related to the Seismic Design Category (SDC).

2. To find the appropriate S_{DS} value, which is either 1.0, 1.2, or 1.5, you must first determine your Seismic Design Category (SDC) by clicking the link below.

   a. In your internet browser go to http://www.atcouncil.org/fema-p-1100
   b. Click on one of the five (5) geographic areas listed to find your location on the appropriate map.
   c. Locate your SDC (SDC A-SDC E) by the color contour shown on the map which corresponds to the % g values shown.
   d. For SDC A-D_1, use S_{DS} = 1.0.
   e. For SDC D_2, use S_{DS} = 1.2 unless the site class can be determined as A, B, or D, in which case use S_{DS} = 1.0.
   f. For SDC E, use S_{DS} = 1.5

   Note: where your location is on, or close to, the border of two SDC's, it is prudent to choose the higher value.

3. Make a note of the appropriate S_{DS} value. It will be used together with the number of stories the dwelling has to determine the Retrofit Schedule (Sheet S3.1) to use in preparing and submitting the plans. You will only use one of the following six Earthqua
   Do not submit the unused S3.1 sheets to the Building Official.

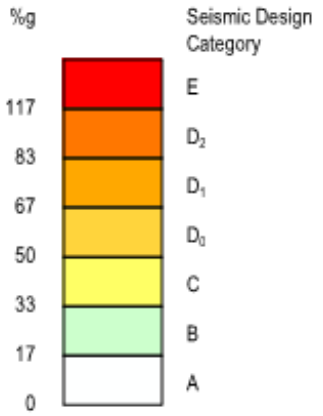
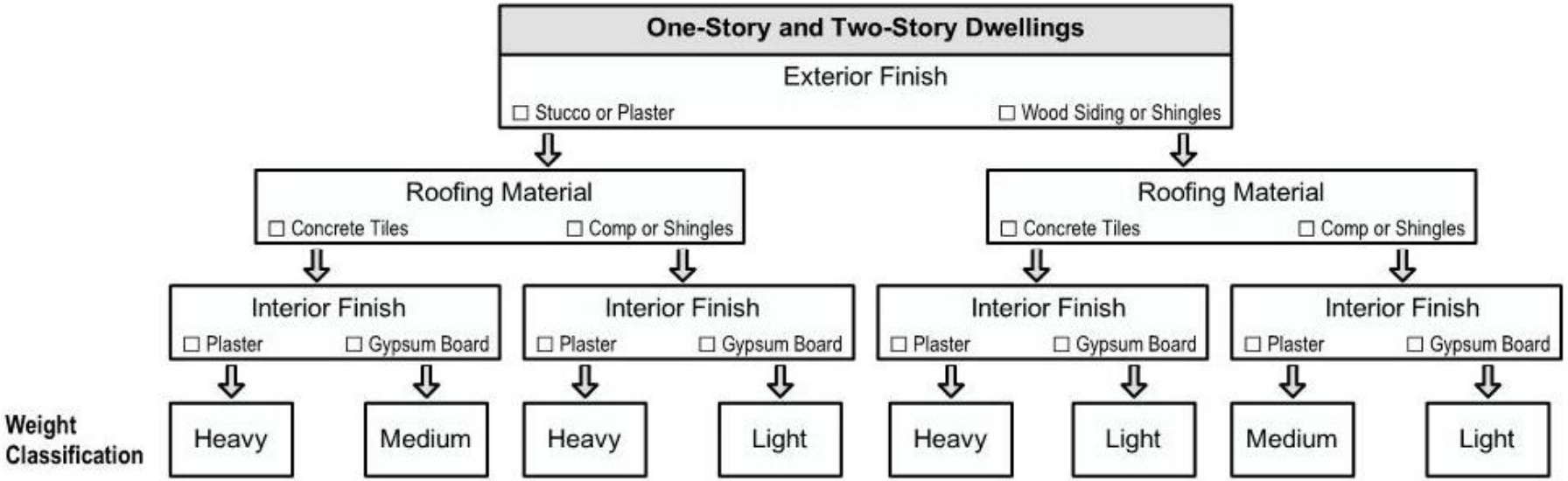


Figure 1. SDC versus %g

Prescriptive Design- Plan Set



Prescriptive Design- Plan Set

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.0 Seismic) ONE-STORY

① Weight Category	② Total Area in Square Feet	③ Mark row that applies ☒	⑤ Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line — Wood Structural Panels — ④ Cripple Wall Height									Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length							
			up to 1'	1'-1" to 2'	2'-1" to 4'-0"		4'-1" to 6'-0"		6'-1" to 7'-0"			⑥ Foundation Sill Anchors					⑦ Floor to Cripple Wall or Floor to Foundation Sill		
			Without Tie-downs	Without Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Without Tie-downs	With Tie-downs	Panel Edge Nailing	Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	Type "D"	Type "E" or "F"	Type "G"
1-Story Light Construction	up to 800		5.3'	5.3'	8.0'	5.3'	9.3'	5.3'	9.3'	6.7'	4"	4	7	7	7	5	11	10	14
	801 to 1000		6.7'	6.7'	8.0'	6.7'	10.7'	6.7'	10.7'	8.0'	4"	5	8	8	8	6	13	12	16
	1001 to 1200		6.7'	6.7'	9.3'	6.7'	10.7'	8.0'	12.0'	8.0'	4"	6	9	10	10	7	15	14	19
	1201 to 1500		8.0'	8.0'	10.7'	8.0'	13.3'	9.3'	13.3'	9.3'	4"	7	11	12	12	8	18	17	22
	1501 to 2000		9.3'	10.7'	13.3'	10.7'	14.7'	10.7'	16.0'	12.0'	4"	9	14	15	15	10	23	22	29
	2001 to 2500		12.0'	12.0'	14.7'	12.0'	17.3'	12.0'	18.7'	13.3'	4"	10	16	18	18	12	27	26	35
	2501 to 3000		14.7'	14.7'	16.0'	14.7'	18.7'	14.7'	20.0'	16.0'	4"	12	19	21	21	14	32	31	40
1-Story Medium Construction	up to 800		5.3'	6.7'	8.0'	5.3'	9.3'	6.7'	10.7'	6.7'	3"	5	8	8	8	6	13	12	16
	801 to 1000		5.3'	6.7'	9.3'	6.7'	10.7'	8.0'	12.0'	8.0'	3"	6	9	10	10	7	15	14	19
	1001 to 1200		6.7'	8.0'	9.3'	6.7'	12.0'	8.0'	12.0'	9.3'	3"	7	10	11	11	8	17	17	22
	1201 to 1500		8.0'	8.0'	10.7'	8.0'	13.3'	9.3'	14.7'	10.7'	3"	8	12	13	13	9	20	20	26
	1501 to 2000		9.3'	10.7'	13.3'	9.3'	14.7'	10.7'	16.0'	12.0'	3"	10	15	17	17	11	25	24	32
	2001 to 2500		10.7'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	13.3'	3"	12	18	20	20	14	30	29	38
	2501 to 3000		12.0'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	3"	13	21	23	23	16	35	34	45

When is the Prestandard Helpful?

- When assessment is needed
  - Simplified assessment
  - Detailed assessment
  - Engineered assessment
- When engineering of retrofit or portion of retrofit is required
- For extensive commentary

When is a Design Professional Needed?

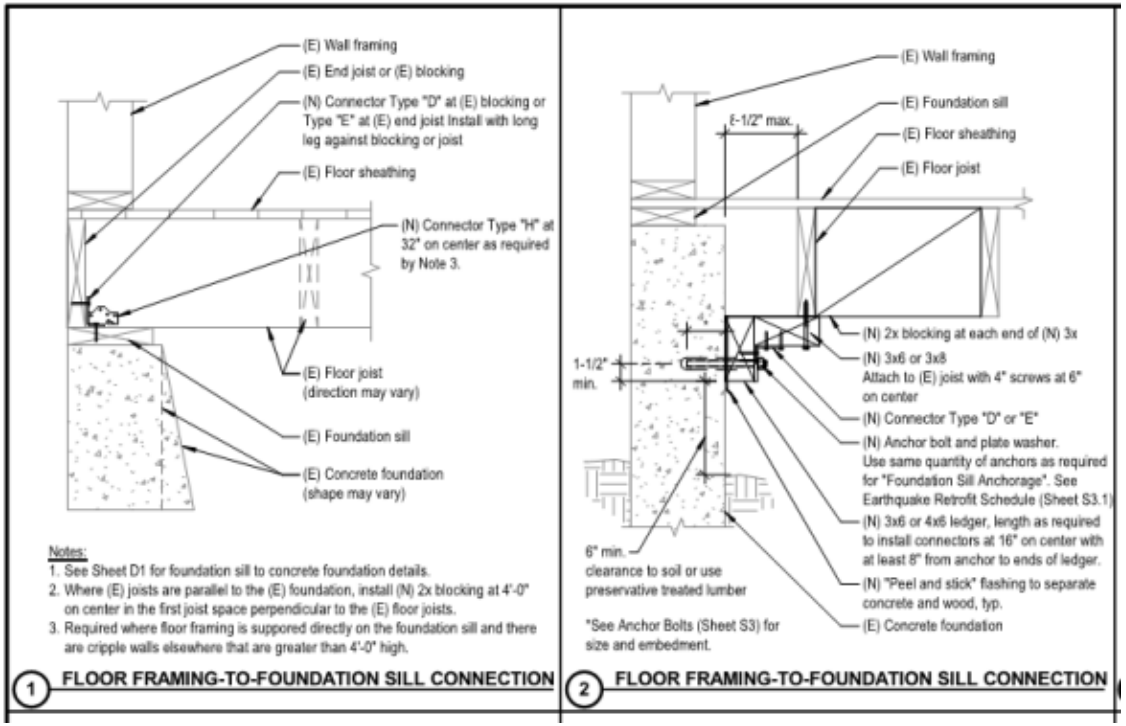
When actual conditions fall outside of prescriptive assumptions

Table C-1: ELIGIBILITY FOR USE

To determine if a home qualifies; answer the following:	Compliant	Non-compliant
1. The dwelling is a one-or two-family detached structure or townhouse. The dwelling unit is a townhouse and assessment and retrofit will occur for all attached townhouse dwelling units at the same time.	✓	
2. The dwelling is a wood light-frame dwelling that is two stories or less.	✓	
3. The dwelling is a crawlspace dwelling as defined in Chapter 2 of FEMA P-1100 Prestandard and the perimeter (not including porches or other appurtenances) is supported on: a. Cripple walls, or b. Foundation stem walls, or c. Post and pier systems to be retrofitted with cripple walls, or d. Cripple walls or foundation stem walls in combination with a slab on grade foundation.	✓	
4. The dwelling has a continuous perimeter foundation (not including porches or other appurtenances), concrete stem walls or will be retrofitted to have a continuous perimeter foundation.	✓	
5. Cripple walls, where they occur, do not exceed 7'-0" in clear height.	✓	
6. The maximum slope as measured from the top of foundations along one edge of the home to the other another does not exceed 5 to 1 (horizontal to vertical) or 20%.	✓	
7. Weight of roofing material shall not exceed 12 psf except for one-story crawlspace dwellings with clay tile roofing as described in footnote 1 below.	✓	
8. Weight of exterior wall finish shall not exceed 10 psf., except that masonry wainscots supported on concrete or masonry foundations are permitted to extend up to four feet above the top of foundation.	✓	
9. Weight of interior wall finish shall not exceed 8 psf, except that veneer fireplace surrounds of not more than 4" thick and of up to 100 square feet of vertical surface are permitted to exceed this weight.	✓	
10. Weight of floor finish shall not exceed 5 psf, except that heavier floor finishes of up to 10 psf are acceptable where limted to 25% of the total floor area of each level.	✓	
11. Floors in each story are at the same level and not split level, excluding slab on grade portions	✓	
12. The maximum square footage of the dwelling, excluding areas supported on slabs on grade, do not exceed 3000 square feet for one story dwellings and 4,000 square feet for two-story dwellings.		✓
13. No part of the foundations is constructed of unreinforced masonry or stone.	✓	
14. Clear floor to ceiling heights at any occupied level does not 9'-0".		✓
15. There is no indication that an engineered seismic force-resisting system is present in the dwelling (engineered plans, visible tie-down brackets).	✓	

When is a Design Professional Needed?

When retrofit details provided are not compatible with actual construction.

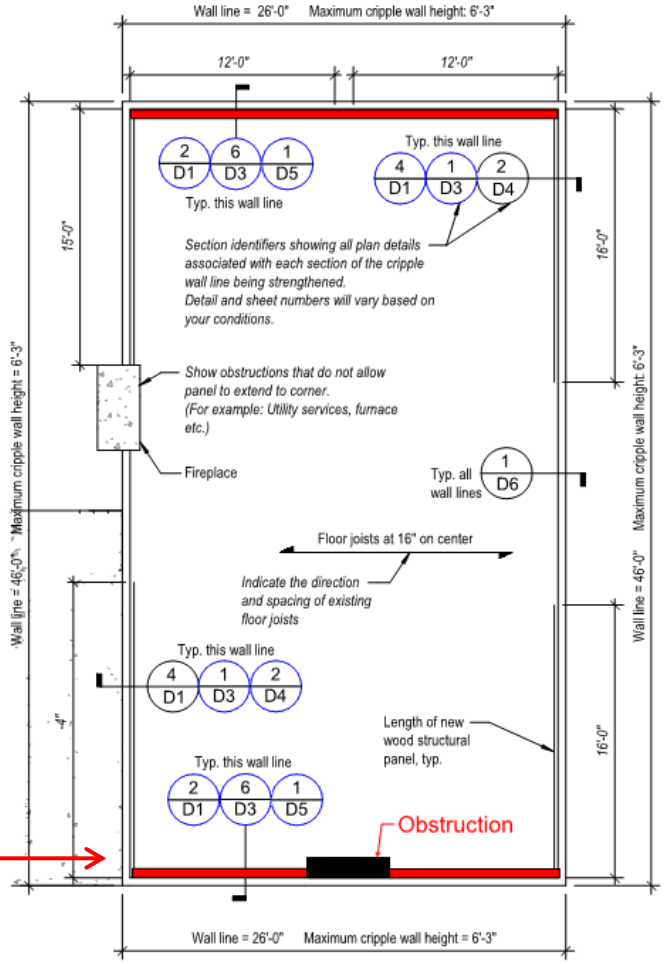


When is a Design Professional Needed?

Where the prescriptive solutions do not fit (e.g. not enough wall length)

EARTHQUAKE RETROFIT SCHEDULE (S_{DS}= 1.5 Very High Seismic) TWO-STORY

① Weight Category	② Total Area in Square Feet	③ Mark row that applies	⑤ Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line: Wood Structural Panels — ④ Cripple Wall Height: up to 1' Without Tie-downs	1'-1" to 2' Without Tie-downs	2'-1" to 4'-0" Without Tie-downs	2'-1" to 4'-0" With Tie-downs	4'-1" to 6'-0" Without Tie-downs	4'-1" to 6'-0" With Tie-downs	6'-1" to 7'-0" Without Tie-downs	6'-1" to 7'-0" With Tie-downs	Panel Edge Nailing	Number of Foundation Connectors or Anchors at Each Perimeter Wall Line Assume Distributed Along Length: ⑥ Foundation Sill Anchors Type "A"	Type "B"	Type "C"	1/2"ø Bolt	5/8"ø Bolt	⑦ Floor to Cripple Wall or Floor to Foundation Sill Type "D"	Type "E" or "F"	Type "G"
2-Story Light Construction	up to 1600		12.0'	12.0'	14.7'	12.0'	17.3'	12.0'	18.7'	13.3'	4"	10	15	17	17	11	26	25	32
	1601 to 2000		13.3'	13.3'	16.0'	13.3'	18.7'	14.7'	20.0'	16.0'	4"	11	18	20	19	13	30	29	38
	2001 to 2400		14.7'	16.0'	17.3'	16.0'	21.3'	16.0'	22.7'	17.3'	4"	13	20	22	22	15	34	33	43
	2401 to 3000		18.7'	18.7'	20.0'	18.7'	22.7'	18.7'	24.0'	18.7'	4"	15	24	26	26	18	41	39	51
	3001 to 4000		22.7'	22.7'	22.7'	22.7'	26.7'	24.0'	28.0'	24.0'	4"	19	30	33	33	22	50	48	64
2-Story Medium Construction	up to 1600		10.7'	12.0'	14.7'	10.7'	17.3'	13.3'	18.7'	14.7'	3"	11	17	18	18	13	28	27	36
	1601 to 2000		12.0'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	3"	13	20	22	22	15	33	32	42
	2001 to 2400		13.3'	14.7'	18.7'	13.3'	21.3'	16.0'	22.7'	17.3'	3"	14	23	25	25	17	38	37	48
	2401 to 3000		16.0'	17.3'	20.0'	16.0'	22.7'	18.7'	24.0'	20.0'	3"	17	27	29	29	20	45	43	58
	3001 to 4000		20.0'	20.0'	22.7'	20.0'	26.7'	21.3'	28.0'	22.7'	3"	21	34	37	37	25	57	54	72
2-Story Heavy Construction	up to 1600		12.0'	13.3'	16.0'	12.0'	18.7'	14.7'	20.0'	16.0'	2"	13	21	23	23	16	35	34	45
	1601 to 2000		13.3'	14.7'	17.3'	14.7'	20.0'	16.0'	21.3'	17.3'	2"	16	25	27	27	19	42	40	53
	2001 to 2400		14.7'	16.0'	20.0'	16.0'	22.7'	18.7'	24.0'	18.7'	2"	18	28	31	31	21	48	46	61
	2401 to 3000		16.0'	18.7'	21.3'	17.3'	24.0'	20.0'	25.3'	21.3'	2"	21	34	37	37	25	57	55	72
	3001 to 4000		18.7'	21.3'	25.3'	20.0'	28.0'	24.0'	29.3'	25.3'	2"	27	42	46	46	31	71	68	90



Permitting, Building Department Approval

- The plan sets are designed to be submitted for permit
- Remove sheets marked “Do Not Submit”
- Remove sheets that are not used
- Fill out sheets that are to be used
- Compile and submit along with permit application

Permitting, Building Department Approval

- Use of the P-1100 or Plan Set requires approval of the building official
- The retrofit will in most cases be voluntary, so should be permitted per IEBC Sec. 503.13
- The building official has discretion over similar conditions
- Visual inspections are assumed to be provided by the building department for foundation anchor bolts, installation of blocking, plywood, metal hardware and any required tie-downs

Permitting, Building Department Approval

New Anchor Bolts in an Existing Foundation:

- Torque testing is required where poor quality of existing concrete is suspected
- Where foundation does not pass torque test, foundation is to be replaced or supplemented

3. The Owner or Contractor shall verify that the existing concrete within all areas to receive new anchor bolts are in reasonably good condition. Examples of poor concrete quality would include excessive spalling, large rock pockets, cracks extending completely through the footing greater than 1/4" wide (closer than 6'-0" on center on average), or low strength concrete cement or mortar easily scrapable with a metal knife or trowel. Strengthening should be avoided in local areas of poor quality. Where these areas cannot be avoided, or where locations of poor quality are widespread, the new anchors shall be torque tested in accordance with Table C-1. Where torque tests continue to fail, the existing foundation system shall be replaced locally for a minimum of 30 inches on each side of the proposed anchor location.

Table C-1 : Foundation Verification Requirements

	Screw Anchor	Adhesive Anchor
Diameter ø	Torque (ft-lbs)	Torque (ft-lbs)
1/2"	35	15
5/8"	50	20

Permitting, Building Department Approval

New Tie-Downs in an Existing Foundation:

- Verification of adequacy of existing foundation is required
- Verification includes torque testing of sacrificial concrete anchors

Table R-1: Verification of Existing Foundation System		
Requirement	**Yes or N/A**	**Signature of Owner or Contractor** (Owner performing work)
A.1 The size of the existing foundation is greater than or equal to that specified in Section R, Item 1.		Signature
B.1 The existing foundation has been verified to be in generally good condition at planned tie-down locations as specified in Section R, item 3.		Signature
C.1 The capacity of each new tie-down anchor has been verified by passing the torque tests specified in Table R2.		Signature
D.1 All adhesive anchors were installed per the manufacturer's instructions per the minimum steps as noted in Section T.		Signature

Permitting, Building Department Approval

- Special inspection is not required for installation of new anchor bolts or tie-down anchors, whether cast into new concrete or installed in existing concrete foundations

Contractor Safety Considerations

Hazards under and around dwelling:

- Electrical lines, especially in combination with moist soils
- Buried utility lines
- Ducts with asbestos
- Carbon monoxide, other harmful substances or chemicals (lime powder, etc.)
- Creatures dead or alive

Contractor Safety Considerations

Hazards from materials and processes:

- Materials being used might present hazards, use material safety data sheets (MSDSs)
- Processes used might present hazards, for example silica dust from drilling into existing concrete foundations to install foundation anchors

Contractor Safety Considerations

Some steps to take:

- Always obtain and use proper personal protective equipment (PPE)
- Always review MSDSs
- Crawlspace may require ventilation
- Always use buddy system for crawlspace
- Know utility shut-off locations
- Be prepared to make calls for emergency response if necessary

Contractor Legal Considerations

- Beyond the scope of this training
- Resource by ABAG:
  - *Seismic Retrofit Training for Building Contractors and Inspectors, 2002*
    - *Chapter 8, Safety and Legal*

FEMA P-1100 Available Training

TOPIC	Primary Audience and Training Modules		
	Building Official	Contractor	Engineer
FEMA P-1100 Introduction	1B	***1C***	1E
Crawlspace Dwellings		2C	2E
Living-Space-Over-Garage Dwellings		3C	3E
Chimneys and Fireplace Surrounds		4C	
Hillside Dwellings		5C	5E

End
Proceed to the Test