Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings
Volume 2A – Plan Set for Crawlspace Dwellings

Prepared by
APPLIED TECHNOLOGY COUNCIL
201 Redwood Shores Parkway, Suite 240
Redwood City, California  94065
www.ATCouncil.org

Prepared for
CALIFORNIA EARTHQUAKE AUTHORITY
Janiele Maffei, Chief Mitigation Officer
Erin Waters, Research Program Coordinator
Sacramento, California

FEDERAL EMERGENCY MANAGEMENT AGENCY
Michael Mahoney, Project Officer
Robert D. Hanson, Subject Matter Expert
Washington, D.C.

ATC MANAGEMENT AND OVERSIGHT
Jon A. Heintz
Ayse Hortacsu

PROJECT TECHNICAL COMMITTEE
Colin Blaney (co-Project Tech. Director)
Kelly Cobeen (co-Project Tech. Director)
Thomas Anderson
Vikki Bourcier
Michael Cochran
Daniel Dolan
Andre Filiatrault
Brian McDonald
John Osteras
Weichiang Pang

PROJECT STEERING COMMITTEE
David Bonowitz (Chair)
Ifa Kashefi
Philip Line
Thor Matteson
Bill Nagel
Steve Pryor
Frank Rollo
Williston Warren (ATC Board Contact)

WORKING GROUP
Angela Arias
Gaurav Bali
Michael Ty Billings
Brent Crawford
Steve Fedorchak
Gayle Jensen
Kari Klaboe
Dave Laverdiere
David McCormick
Javier Pascacio
Michael Stoner
Doug Thompson
Taylor Vincent
Dave Welch

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Notice

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Cover photograph – Photograph showing crawlspace dwelling.
Purpose and Scope

This Plan Set is for retrofit of crawlspace dwellings and is provided as a supplement to FEMA P-1100, *Vulnerability-Based Seismic Assessment and Retrofit of One-and Two-Family Dwellings, Volume 1 – Prestandard*. The Plan Set presents prescriptive, pre-engineered plans for a suggested minimum level of retrofit design for use by a general contractor or homeowner without necessarily having to involve a registered design professional. Use of this Plan Set is limited to dwellings that are compliant with eligibility statements presented in Table 1 on Sheet S0. The extent of the scope of this Plan Set is described on Sheet S0.

The Plan Set is intended to contain all of the necessary supplemental technical information and guidance for preparation of a complete set of plans for submittal to the local building department and for use during construction; however, supplemental information may be required by some building departments. Note that building permits are always required when performing the work described in this Plan Set.

The Plan Set does not attempt to address all potential deficiencies in a home and does not eliminate the risk of potential damage in future earthquakes.

Instructions for use are provided on Sheet 01.

Limitation of Liability

Earthquake strengthening constructed in accordance with this Plan Set is intended to reduce the risk of earthquake-related damage to existing residential dwellings with wood-frame cripple walls. The content of this Plan Set is based on the experience and judgment of practicing engineers and limited research. All circumstances, forms, or types of construction have not necessarily been contemplated in the preparation of this Plan Set, and it is not possible to control the quality of construction or predict or test all conditions that may occur during an earthquake. No party associated with the preparation of this Plan Set makes any representation, warranty, or covenant, expressed or implied, with respect to the design, condition, quality, durability, operation, fitness for use, or suitability of earthquake strengthening based on this Plan Set.
A. Before you begin:

- This Plan Set is intended for use by a general contractor or homeowner without necessarily having to involve a Registered Design Professional.
- Contact your local Building Official, often known as the Building Department, to understand the building permit application process.

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 SDS 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 sheet 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);
   b. The floor framing to foundation sill connection (Sheet D2);
   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 Step 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 D2.2 above. Indicate the connection type and the maximum number of connectors for each wall line.
   c. Conform to Sections L and M of Sheet S1.
   d. Identify the details used for the wood structural panel (Sheets D4 or D5).
   e. If tie-downs are used, identify the details used (Sheet D8).
   f. Identify the details used for the top plate splice (Sheet D6).
2. Complete the following:
   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.

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 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). In some cases, the use of this plan set may be applicable. A “non-compliant” answer to any question disqualifies the home from using this plan set, unless a Registered Design Professional is involved.

Do not submit this plan set to the Building Official.
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 3, 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 to improve earthquake performance but is not intended to prevent earthquake damage. For additional information, see https://www.fema.gov/media-library/assets/documents/173615.

SCOPE

This Plan Set contains prescriptive provisions for retrofit of wood-light-frame crawlspaces dwelling anchorage to the foundation and cripple walls. Dwellings shall be considered cripple wall dwellings for purposes of this plan set when:
- The dwelling has unoccupied space below the lowest framed floor.
- The dwelling has cripple walls not exceeding 7'-0" in clear height.
- The dwelling has unoccupied space below the lowest framed floor.
- The dwelling has cripple walls not exceeding 7'-0" in clear height.

Where dwellings include both crawlspaces and portions of the dwelling with concrete slabs-on-grade, this Plan Set applies to the perimeter of the crawlspace portions of the dwelling. This Plan Set does not require work in the slab-on-grade portions of the dwelling. However, the user is encouraged to take additional anchor bolts, where possible, around the perimeter of the slab-on-grade portions per Sheet D1 to increase the foundation sill to existing concrete connection.

ELIGIBILITY

Cripple wall dwellings are permitted to use the specified 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.

OFFERING 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 provisions 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 the FEMA P-1100 Prestandard. Specific design assumptions are as follows: R = 4.0; \( S_{1} = 1.5; S_{2} = \text{Varies (between 1 and 1.5)}; \) Site Class C.

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 D3 & 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 deemed to conform 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 offering 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.

Table 1: ELIGIBILITY FOR USE

<table>
<thead>
<tr>
<th>Vulnerability</th>
<th>Compliant</th>
<th>Non-compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The dwelling is a one-story family detached structure or townhouse.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2. The dwelling is a wood light-frame dwelling that is two stories or less.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. The dwelling is a crawlspace dwelling as defined in Chapter 2 of the FEMA P-1100 Prestandard and the perimeter (not including porches or other appurtenances) is supported on:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Cripple walls, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Foundation stem walls, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Post and pier systems to be retrofitted with cripple walls, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Cripple walls or foundation stem walls in combination with a slab on grade foundation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5. Cripple walls, when they occur, do not exceed 7'-0&quot; in clear height.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6. The maximum slope as measured from the top of the foundations along one edge of the home to the other end does not exceed 5 to 1 (horizontal to vertical) or 20%.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>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.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>8. Weight of exterior wall finish shall not exceed 10 psf, except that masonry walls supported on concrete or masonry foundations are permitted to extend up to four feet above the top of foundation.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>9. Weight of interior wall finish shall not exceed 8 psf, except that venner fireplace surrounds of not more than 4&quot; thick and of up to 100 square feet of vertical surface are permitted to exceed this weight.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>10. Weight of floor finish shall not exceed 5 psf, except that heavier floor finishes up to 10 psf are acceptable where limited to 25% of the total floor area of each level.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>11. Floors in each story are at the same level and not split level, excluding slab on grade portions.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>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.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>13. No part of the foundations is constructed of unreinforced masonry or stone.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>14. Clear floor to ceiling heights at any occupied level do not exceed 9'-0&quot;.</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>15. There is no indication that an engineered seismic-force-resisting system is present in the dwelling (engineered plans, visible tie-down brackets).</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

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, Offering 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.

SHEET LIST

<table>
<thead>
<tr>
<th>Sheet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>Cover Sheet</td>
</tr>
<tr>
<td>S1</td>
<td>General Notes</td>
</tr>
<tr>
<td>S2</td>
<td>Supplemental Technical Notes</td>
</tr>
<tr>
<td>S3</td>
<td>Seismic Design Category, Weight Classification, and Connectors</td>
</tr>
<tr>
<td>S3.1</td>
<td>Earthquake Retrofit Schedule</td>
</tr>
<tr>
<td>S4</td>
<td>Foundation and Retrofit Layout Plan</td>
</tr>
<tr>
<td>S5</td>
<td>Foundation Sill Plate Anchorage to Foundation樂</td>
</tr>
<tr>
<td>S6</td>
<td>Floor Framing to Foundation Sill Plate Anchorage to Foundation快乐</td>
</tr>
<tr>
<td>S7</td>
<td>Foundation Sill Plate Anchorage to Foundation快乐</td>
</tr>
<tr>
<td>S8</td>
<td>Footing Reinforcement Details</td>
</tr>
<tr>
<td>S9</td>
<td>Wood Structural Panel Installation with Tie-Downs快乐</td>
</tr>
<tr>
<td>S10</td>
<td>Wood Structural Panel Installation with Tie-Downs快乐</td>
</tr>
<tr>
<td>S11</td>
<td>Vent Openings and Top Plate Details快乐</td>
</tr>
<tr>
<td>S12</td>
<td>Foundation Replacement Details快乐</td>
</tr>
</tbody>
</table>
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 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. Excessive 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 members shall be repaired in place or supplemented with new members. 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 is 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 (greater than 6" on center or on average), or low concrete strength or mortar easily scuplable with a metal or mortar drill. Strengthening should be avoided in areas of low quality.

D. NOTCHING, BORING AND CUTTING
1. Do not rout, bore, or notch structural members except as shown in drawings or as specifically permitted by the building inspector.

E. CONCRETE
1. Concrete shall have a strength of not less than 3,000 psi at 28 days. Concrete mixed on site shall be mixable with potable water.
2. When drilling in concrete or reinforcing steel, if hot drilling, move one of one inch and drill relocated holes. Fill original hole with non-shrink grout.

F. REINFORCING STEEL (REBAR)
1. Concrete or reinforcing steel for foundations. Design is based on an ultimate concrete strength of 2,500 psi or less.
2. Reinforcing steel lap splice lengths:
   - No. 4: 24 inches
   - No. 5: 32 inches

3. Anchor bolts shall be a maximum spacing of 64" on center for one-story dwellings and 48" on center for two-story dwellings. Anchor bolts shall be a minimum depth of 8" from the top of the base plate or from the surface of the footing for a 2-story dwelling. Unless specifically permitted otherwise, anchor bolts shall not be less than 1/2" in diameter or 12" minimum from top of brick or to the top of masonry wall. Anchor bolts shall be torque-tested in accordance with Table R-2, Sheet S2.

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 or plan areas, greater than 33% of the largest plan dimension shall meet the following special provisions in that direction:
   - Foundation shall be positioned to be as close as practicable to the exterior wall lines.
   - Foundation shall be positioned along the exterior wall lines to be as close as practicable to the exterior wall lines.
   - Where possible, disconnection of utilities if necessary.
2. 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.
3. Braced wall sections along the length of a wall line should be nearly equal in length. Using increases of existing stud spacing is expected. The length of braced wall sections 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.

K. FRAMEWORK
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 pressure-treated in accordance with APA W1 (Commodity Specification A, Use Category 4B). Field installed cobs, bents and notches per APA 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 0.85 OZ zinc coating in accordance with ASTM A665. Connectors exposed to weather or in contact with preservative treated wood shall be provided with a minimum hot-dip galvanized coating or O168 coating in accordance with ASTM A653, and fasteners conforming to ASTM A533.
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. Increasing the wall line 1/2" over 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, or Powers Fasteners Wedge-Bolt, or approved equivalent.

N. PERMITS
1. All work required by this Plan Set shall be permitted through the building department.
2. Special inspection by a third party inspector is not required for the following:
   - Concrete or reinforcing steel for foundations. Design is based on an ultimate concrete strength of 2,500 psi or less.
   - Installation of cavity in-place or post-installed anchors.
   - Installation of adhesive anchors for tie-down devices, provided that each anchor is torque-tested in accordance with Table R-2, Sheet S2.
   - Nailing of wood structural panel shear walls, provided a building department inspection is performed.

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

Table C-1: Foundation Verification Requirements

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Screw Anchor</th>
<th>Adhesive Anchor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot;</td>
<td>36</td>
<td>16</td>
</tr>
<tr>
<td>5/32&quot;</td>
<td>50</td>
<td>20</td>
</tr>
</tbody>
</table>

Graph 1: Special Provisions per Section J do not apply.
Q. PURPOSE OF SUPPLEMENTAL TECHNICAL NOTES
1. These Supplemental Technical Notes provide guidance for the installation of wood structural panels that use tie-downs and existing foundation systems. Tie-downs shall be used where there is insufficient wall length to install the length of wood structural panels specified in the Earthquake Retrofit Schedule, Sheet S3.1.
2. Where "With Tie-down" (as specified on the Earthquake Retrofit Schedule, Sheet S3.1) is used to determine the amount of strengthening required along each wall length, additional visual verification and testing of the existing foundation system is required to be completed by the owner or general contractor and approved by the Building Official, and documented in Table R-1 prior to commencing any work. Visual verification and testing shall be as noted in Section R.
3. Where these requirements are not met, a new foundation system will be required in accordance with Sheet D7.

R. EXISTING FOUNDATION REQUIREMENTS AND TESTING
1. The size of existing foundation systems at the location of new tie-down anchors shall be verified to be at least 15" deep ("D") and 8" wide ("W"). The dimension "D" shall be measured from the bottom of footing to the underside of the existing mudsill. The dimension "W" shall be measured from the top outside face of footing to the inside top face of footing. See Table R-1, item A.1.
2. Verification of the overall quality of concrete along any wall line requiring tie-downs shall be made and documented within Table R-1, item B.1. This verification shall be made by use of a minimum of two sacrificial torque tests along each wall line where tie-downs are used. These tests shall consist of installing 1/2" or 5/8" diameter screw-type bolts into the existing concrete and verifying that a value per Table R-2 can be achieved. Torque tests can be performed either by the owner, a general contractor, or a special inspection company or testing agency hired by the owner and as approved by the Building Official.
3. Where "Tie-downs" are used to determine the sheathed panel length required along a wall line, each adhesive anchor shall be torque tested in accordance with Table R-2.

S. TIE-DOWN REQUIREMENTS
1. Tie-downs shall be Simpson HDU2-SDS2.5, KC Metals ADST2, USP Structural Connectors PHD2A, or an equivalent with an allowable tensile load of 3075 lbs or more, installed per manufacturer's instructions.
2. All holes shall be cleaned with an oil-free compressed air for a minimum of 4 seconds.
3. All holes shall be cleaned with a nylon brush for a minimum of 4 cycles.
4. Check adhesive cartridge expiration date, open, and install per the manufacturer's instructions.
5. Blow holes clean of dust with oil-free compressed air for a minimum of 4 seconds.
6. Insert a clean and oil-free anchor turning slowly until the anchor contacts the bottom of the hole.
7. Do not disturb the anchor until fully cured. See manufacturer’s instructions.

T. MINIMUM INSTALLATION REQUIREMENTS FOR TIE-DOWN ANCHORS TO FOUNDATIONS
1. All holes shall be drilled to the specified diameter and depth.
2. All holes shall be blown clean of dust with oil-free compressed air for a minimum of 4 seconds.
3. All holes shall be cleaned with a nylon brush for a minimum of 4 cycles.
4. Check adhesive cartridge expiration date, open, and install per the manufacturer's instructions.
5. Blow holes clean of dust with oil-free compressed air for a minimum of 4 seconds.
6. Insert a clean and oil-free anchor turning slowly until the anchor contacts the bottom of the hole.
7. Do not disturb the anchor until fully cured. See manufacturer's instructions.

Table R-1: Verification of Existing Foundation System

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes or N/A</th>
<th>Signature of Owner or Contractor (Owner performing work)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1 The size of the existing foundation is greater than or equal to that specified in Section R, item 1.</td>
<td></td>
<td>Signature</td>
</tr>
<tr>
<td>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 2.</td>
<td></td>
<td>Signature</td>
</tr>
<tr>
<td>C.1 The capacity of each new tie-down anchor has been verified by passing the torque tests specified in Table R-2.</td>
<td></td>
<td>Signature</td>
</tr>
<tr>
<td>D.1 All adhesive anchors were installed per the manufacturer's instructions per the minimum steps as noted in Section T.</td>
<td></td>
<td>Signature</td>
</tr>
</tbody>
</table>

Table R-2: Foundation Verification Requirements

<table>
<thead>
<tr>
<th>Screw Anchor</th>
<th>Adhesive Anchor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter ø</td>
<td>Torque (ft-lbs)</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>35</td>
</tr>
<tr>
<td>5/8&quot;</td>
<td>50</td>
</tr>
</tbody>
</table>

Supplemental Technical Notes
(Where Tie-downs are Required)
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
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 \( S_{d} \) value, which is directly related to the Seismic Design Category (SDC).
2. To find the appropriate \( S_{d} \) value, which is either 0.0, 0.1, 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-110
   b. Click on one of the five (5) geographic areas listed to find your location on the appropriate map.
   c. Locate your SDC (A-D) on Figure 1. SDC versus \( \%g \) by the color contour shown on the map which corresponds to the \( \%g \) values shown.
   d. For SDC A-D, use \( S_{d} = 1.5 \).
   e. For SDC E, use \( S_{d} = 1.2 \) unless the site class can be determined as A, B, or D, in which case use \( S_{d} = 1.0 \).

   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 \( S_{d} \) value. It will be used together with the number of stories the dwelling has to determine the appropriate Earthquake Retrofit Schedule. Do not submit the unused S3.1 sheets to the Building Official.

---

**Weight Classification**

The next factor to establish the appropriate amount of earthquake strengthening is the dwelling weight classification.

For the purposes 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. Locate your 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 includes finishes of similar weight, including but not limited to fiber-cement and aluminum siding.
2. The “comp or shingles” roofing material category 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 finishes 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 finish type shall be assumed where 25% or more of the heavier finish type exists within the dwelling.

---

**Connectors**

1. Manufacturer 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.

---

**Seismic Design Category, Weight Classification, and Connectors**

**Connectors**

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>MANUFACTURER</th>
<th>MODEL</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE A</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>LEFP</td>
</tr>
<tr>
<td>TYPE B</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>FRFP</td>
</tr>
<tr>
<td>TYPE C</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>RFP</td>
</tr>
<tr>
<td>TYPE D</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>L70</td>
</tr>
<tr>
<td>TYPE E</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>L90</td>
</tr>
<tr>
<td>TYPE F</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>LG4</td>
</tr>
<tr>
<td>TYPE G</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>L30</td>
</tr>
<tr>
<td>TYPE H</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>L20</td>
</tr>
<tr>
<td>TYPE I</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>L10</td>
</tr>
<tr>
<td>TYPE J</td>
<td>Simpson Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>L90</td>
</tr>
</tbody>
</table>

---

**TIE-DOWNS**

**Supplemental Technical Notes, Sheet S2, Section S**

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>MANUFACTURER</th>
<th>MODEL</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIPM Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>HDL2</td>
<td>3075#</td>
</tr>
<tr>
<td>SIPM Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>ADE52</td>
<td>4275#</td>
</tr>
<tr>
<td>SIPM Strong-Tie</td>
<td>USP Structural Connectors</td>
<td>PH40A</td>
<td>3215#</td>
</tr>
</tbody>
</table>

---

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 500# based on anchorage to existing foundation systems. Tie-down anchors must be installed per Detail 1. Sheet 06.
### EARTHQUAKE RETROFIT SCHEDULE (Sot= 1.0 Seismic) ONE-STORY

<table>
<thead>
<tr>
<th>Total Area</th>
<th>Weight Category</th>
<th>Type A</th>
<th>Type B</th>
<th>Type C</th>
<th>Type E</th>
<th>Type F</th>
<th>Type G</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 800</td>
<td>up to 1&quot;</td>
<td>5.3</td>
<td>5.3</td>
<td>8.0</td>
<td>6.3</td>
<td>9.3</td>
<td>5.3</td>
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<tr>
<td>801 to 1000</td>
<td>1&quot; to 2&quot;</td>
<td>6.7</td>
<td>6.7</td>
<td>8.0</td>
<td>6.7</td>
<td>10.7</td>
<td>6.7</td>
</tr>
<tr>
<td>1001 to 1200</td>
<td>2&quot; to 4&quot;</td>
<td>6.7</td>
<td>6.7</td>
<td>9.3</td>
<td>6.7</td>
<td>10.7</td>
<td>8.0</td>
</tr>
<tr>
<td>1201 to 1500</td>
<td>4&quot; to 6&quot;</td>
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<td>8.0</td>
<td>10.7</td>
<td>8.0</td>
<td>13.3</td>
<td>9.3</td>
</tr>
<tr>
<td>1501 to 2000</td>
<td>6&quot; to 7&quot;</td>
<td>9.3</td>
<td>10.7</td>
<td>13.3</td>
<td>10.7</td>
<td>14.7</td>
<td>10.7</td>
</tr>
<tr>
<td>2001 to 2500</td>
<td>12.0</td>
<td>12.0</td>
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<td>12.0</td>
<td>17.3</td>
<td>12.0</td>
<td>18.7</td>
</tr>
<tr>
<td>2501 to 3000</td>
<td>14.7</td>
<td>14.7</td>
<td>16.0</td>
<td>14.7</td>
<td>18.7</td>
<td>14.7</td>
<td>20.0</td>
</tr>
<tr>
<td>up to 800</td>
<td>without downs</td>
<td>5.3</td>
<td>6.7</td>
<td>8.0</td>
<td>6.3</td>
<td>9.3</td>
<td>6.7</td>
</tr>
<tr>
<td>801 to 1000</td>
<td>with downs</td>
<td>6.7</td>
<td>6.7</td>
<td>8.0</td>
<td>6.7</td>
<td>10.7</td>
<td>6.7</td>
</tr>
<tr>
<td>1001 to 1200</td>
<td>with downs</td>
<td>6.7</td>
<td>6.7</td>
<td>9.3</td>
<td>6.7</td>
<td>10.7</td>
<td>8.0</td>
</tr>
<tr>
<td>1201 to 1500</td>
<td>with downs</td>
<td>8.0</td>
<td>8.0</td>
<td>10.7</td>
<td>8.0</td>
<td>13.3</td>
<td>9.3</td>
</tr>
<tr>
<td>1501 to 2000</td>
<td>with downs</td>
<td>9.3</td>
<td>10.7</td>
<td>13.3</td>
<td>10.7</td>
<td>14.7</td>
<td>10.7</td>
</tr>
<tr>
<td>2001 to 2500</td>
<td>with downs</td>
<td>12.0</td>
<td>12.0</td>
<td>14.7</td>
<td>12.0</td>
<td>17.3</td>
<td>12.0</td>
</tr>
<tr>
<td>2501 to 3000</td>
<td>with downs</td>
<td>14.7</td>
<td>14.7</td>
<td>16.0</td>
<td>14.7</td>
<td>18.7</td>
<td>14.7</td>
</tr>
</tbody>
</table>

**Notes:**
1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally as each wall line as possible. Note that where using 1/2" or 5/8" bolts, one additional anchor is required at the end of each braced wall panel per Sheet DS.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on Sheet S3 may be used for strengthening the particular condition.
5. The Plan Set was developed using the lowest listed manufacturer's capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

---

### BRACING, ANCHORS, CONNECTORS, AND TIE-DOWNS

<table>
<thead>
<tr>
<th>Number of Foundation Connectors or Anchors at Each Perimeter Wall Line</th>
<th>Assumed Distributed Along Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;øhit 5/8&quot; Bolt</td>
<td>Type G</td>
</tr>
<tr>
<td>Min required</td>
<td>Max required</td>
</tr>
<tr>
<td>8.0</td>
<td>10.7</td>
</tr>
<tr>
<td>9.3</td>
<td>12.0</td>
</tr>
<tr>
<td>10.7</td>
<td>14.7</td>
</tr>
<tr>
<td>12.0</td>
<td>18.7</td>
</tr>
<tr>
<td>14.7</td>
<td>20.0</td>
</tr>
</tbody>
</table>

### INSTRUCTIONS

1. Locate the section that matches your home's construction. Use the flowchart on Sheet S2 to determine "Weight Category.
2. Find the home's Total Floor Area in the schedule, this number should be at least as large as the number listed below. Do not use a smaller number, even if it is closer.
3. Connector Type "F" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on Sheet S3 may be used for strengthening the particular condition.
5. The Plan Set was developed using the lowest listed manufacturer's capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

---

### RETROFIT SUMMARY

1. **Min.** minimum required length of Wood Structural Panels per wall line. (check boxes where condition applies)
   - North Wall
   - East Wall
   - South Wall
   - West Wall

2. **Max.** maximum required length of Wood Structural Panels per wall line. (check boxes where condition applies)
   - North Wall
   - East Wall
   - South Wall
   - West Wall

3. **Min.** minimum required length of Wood Structural Panels per wall line. (check boxes where condition applies)
   - North Wall
   - East Wall
   - South Wall
   - West Wall

4. **Floor Framing Connectors** (at Cripple Wall or Foundation Sill)
   - North Wall
   - East Wall
   - South Wall
   - West Wall

5. **Min.** minimum required length of Wood Structural Panels per wall line. (check boxes where condition applies)
   - North Wall
   - East Wall
   - South Wall
   - West Wall

---

### RETROFIT OF CRAWLSPACE DWELLINGS (Plan Set)

- **Vulnerability:** One
- **ISSUED:** SEPT 2019
- **PROPERTY ADDRESS:**
- **APPLICANT:**
- **INSTRUCTIONS:**
- **REVIEW:**
- **PREPARED BY:**
- **ISSUING AGENCY:**
- **FEMA:** PW-1100
- **VOLUME:** 2
- **SEPT 2019**
### EARTHQUAKE RETROFIT SCHEDULE (Sec 1.2 High Seismic) ONE-STORY

<table>
<thead>
<tr>
<th>Slope</th>
<th>Type</th>
<th>Footer Edge Nailing</th>
<th>Type &quot;A&quot;</th>
<th>Type &quot;B&quot;</th>
<th>Type &quot;C&quot;</th>
<th>12&quot;ø Bolt</th>
<th>5/8&quot;ø Bolt</th>
<th>Type &quot;D&quot;</th>
<th>Type &quot;E&quot;</th>
<th>Type &quot;F&quot;</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001 to 1200</td>
<td>6.7'</td>
<td>8.0'</td>
<td>10.7'</td>
<td>6.7'</td>
<td>12.0'</td>
<td>8.0'</td>
<td>4'</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>1201 to 1500</td>
<td>9.3'</td>
<td>9.3'</td>
<td>9.3'</td>
<td>14.7'</td>
<td>10.7'</td>
<td>16.0'</td>
<td>4'</td>
<td>3</td>
<td>7</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>1501 to 2000</td>
<td>12.0'</td>
<td>12.0'</td>
<td>14.7'</td>
<td>12.0'</td>
<td>17.3'</td>
<td>12.0'</td>
<td>18.3'</td>
<td>3'</td>
<td>4</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>2001 to 2500</td>
<td>14.7'</td>
<td>14.7'</td>
<td>17.3'</td>
<td>14.7'</td>
<td>20.0'</td>
<td>14.7'</td>
<td>21.3'</td>
<td>16'</td>
<td>4</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>2501 to 3000</td>
<td>17.3'</td>
<td>17.3'</td>
<td>18.7'</td>
<td>17.3'</td>
<td>21.3'</td>
<td>17.3'</td>
<td>22.7'</td>
<td>17'</td>
<td>4</td>
<td>14</td>
<td>23</td>
</tr>
</tbody>
</table>

**Notes:**
1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that where using 12" or 5/8" bolts, one additional anchor is required at the end of each braced wall panel per Sheet D4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a limit of unacceptability when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S22 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "P" should be used as an alternative only if joists have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on Sheet S3 may be used for strengthening the particular condition.
5. This Plan Set was developed using the lowest listed manufacturer's capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.

---

**EARTHQUAKE RETROFIT SCHEDULE**

**INSTRUCTIONS**

1. Locate the section that matches your home's construction. Use the checkmark on Sheet S3 to determine "Weight Category".

2. Find the home's Total Floor Area in the schedule, this number should be at least as large as the number listed below. Do not use a smaller number, even if it is closer.

3. Approximate 1" floor area over crawlspace:
   (Do not include areas built over slab-on-grade.)

4. Check the box that matches your home's construction type, number of stories, and total floor area. You will use information in this row of the schedule to determine length of wood structural panels, nailing requirements, quantities of hardware, etc.

5. Measure the maximum height of the cripple wall along each wall line of the house.

6. Determine the length of wood structural panel bracing required. The column contains the length of required bracing, depending on the height of the cripple wall. The length of bracing is given for cripple wall heights of zero to 1', 1' to 2', 2' to 4', 4' to 6', and 6' to 7'. Furthermore, choose is given for bracing without tie-downs and with tie-downs. If the cripple wall height exceeds along the length of the wall, use the tallest height to determine the required bracing length.

7. Follow the row across from the total floor area that you checked for your home (in Step 2) to find the bracing length for the cripple wall height on each side of the house. Review General Notes, Sheet S1, Section J for instructions on non-rectangular "T" or "L" shaped dwellings. Check boxes where Special Provisions apply.

8. Determine the number of Foundation Sill Anchors required. The columns show the number of anchors required, depending on whether you use Types A through C, or 1/2" or 5/8" anchor bolts. (ø = diameter of the bolts.) See Sheet S3.

9. Determine the number of Floor to Cripple Wall of Foundation Sill Connectors. The columns indicate how many framing connectors are required, depending on whether you use Types D, E, F, or G.

10. Complete the Retrofit Summary for your project. Fill in the lengths found in the rows of the schedule with the length required for the cripple wall sheathing to be distributed along a wall line either in one full length or in a maximum of two panel lengths of approximately equal length (offset cuts can be made). If you intend to use tie-downs, check the box for tie-downs for each wall line where use is intended. Check the box on line 4, and read the Supplemental Technical Notes for additional information. Where the length of required panel does not fit within the available length, the dwelling may have an engineered solution. Alternately, if 100% of the length along any particular wall can be sheathed, then that wall shall be considered acceptable and an engineered solution is not required.

---

**RETOFIT SUMMARY**

**BRACING, ANCHORS, CONNECTORS, AND TIE-DOWNS**

1. Minimum required length of Wood Structural Panels per wall line (check boxes where condition applies):
   - North Wall Type: Min required
   - East Wall Type: Min required
   - West Wall Type: Min required

2. Panel Edge Nailing: **on center.**

3. New Foundation Sill Anchorage:
   - North Wall Type: Min required
   - East Wall Type: Min required
   - West Wall Type: Min required

4. Floor Framing Connectors (to Cripple Wall or Foundation Sill):
   - North Wall Type: Min required
   - East Wall Type: Min required
   - West Wall Type: Min required

5. Check this box if tie-downs and SUPPLEMENTAL TECHNICAL NOTES on Sheet S22 will be used.
### EARTHQUAKE RETROFIT SCHEDULE (SoS= 1.5 Very High Seismic) ONE-STORY

**Notes:**
1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally as each wall line as possible. Note that where using 1/2" or 5/8" bolts, one additional anchor is required at the end of each braced wall panel per Sheet S4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "F" should be used as an alternative only if jacks have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on Sheet S3 may be used for strengthening the particular condition.
5. This Plan Set was developed using the lowest listed manufacturer’s capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.

### RETROFIT SUMMARY

1. Minimum required length of Wood Structural Panels per wall line. (check boxes where condition applies)

<table>
<thead>
<tr>
<th>North Wall</th>
<th>East Wall</th>
<th>South Wall</th>
<th>West Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: Min required</td>
<td>Type: Min required</td>
<td>Type: Min required</td>
<td>Type: Min required</td>
</tr>
</tbody>
</table>

2. Additional types/quantities (if used):

<table>
<thead>
<tr>
<th>North Wall</th>
<th>East Wall</th>
<th>South Wall</th>
<th>West Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: Min required</td>
<td>Type: Min required</td>
<td>Type: Min required</td>
<td>Type: Min required</td>
</tr>
</tbody>
</table>

3. New Foundation Sill Anchorage:

<table>
<thead>
<tr>
<th>North Wall</th>
<th>East Wall</th>
<th>South Wall</th>
<th>West Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: Min required</td>
<td>Type: Min required</td>
<td>Type: Min required</td>
<td>Type: Min required</td>
</tr>
</tbody>
</table>

5. Check this box for tie-downs and SUPPLEMENTAL TECHNICAL NOTES on Sheet S2 will be used.
### EARTHQUAKE RETROFIT SCHEDULE (SSE = 1.0 Seismic) TWO-STORY

<table>
<thead>
<tr>
<th>Total Area in Square Feet</th>
<th>Wood Structural Panels</th>
<th>Foundation Sill Anchors</th>
<th>Floor to Cripple Wall or Foundation Sill</th>
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<tr>
<td></td>
<td>Cripple Wall Height</td>
<td>Panel Edge Nailing Type</td>
<td>Type &quot;A&quot;</td>
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<tr>
<td></td>
<td></td>
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<td>Type &quot;A&quot;</td>
</tr>
<tr>
<td>up to 1600</td>
<td>8.0' 10.7' 8.0'</td>
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<tr>
<td>1601 to 2000</td>
<td>9.3' 12' 9.3'</td>
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<tr>
<td>2001 to 2400</td>
<td>10.7' 13.3' 10.7'</td>
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<tr>
<td>2401 to 3000</td>
<td>12.0' 14.7' 12.0'</td>
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<td>10</td>
</tr>
<tr>
<td>3001 to 4000</td>
<td>14.7' 17.3' 16.0'</td>
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<td>4001 to 5000</td>
<td>16.0' 18.7' 17.3'</td>
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<td>16</td>
</tr>
</tbody>
</table>

Notes:
1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that where using 1/2" or 5/8" bolts, one additional anchor is required at the end of each braced wall panel per Sheet D4.

2. Tie-downs: If your foundation permits, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations. Therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplementary Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)

3. Connector Types "F" should be used as an alternative only if posts have blocking on both sides and where accessibility makes the use of Types "C" or "E" impractical.

4. Any of the connectors listed within a particular group and as shown on Sheet S5 may be used for strengthening the particular condition.

5. This Plan Set was developed using the lowest listed manufacturer’s capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.

6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

### RETROFIT SUMMARY

<table>
<thead>
<tr>
<th>Type</th>
<th>Min required:______</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Minimum required length of Wood Structural Panels per wall line (check boxes where condition applies): North Wall Type: ______ Min required:______ with tie-downs ______ with Special Provisions South Wall Type: ______ Min required:______ with tie-downs ______ with Special Provisions West Wall Type: ______ Min required:______ with tie-downs ______ with Special Provisions

2. Panel Edge Nailing: ______ on center.


4. Floor Framing Connectors (to Cripple Wall or Foundation Sill) North Wall Type: ______ Min required:______ with tie-downs ______ with Special Provisions South Wall Type: ______ Min required:______ with tie-downs ______ with Special Provisions West Wall Type: ______ Min required:______ with tie-downs ______ with Special Provisions

5. Check this box for tie-downs and SUPPLEMENTAL TECHNICAL NOTES on Sheet S2 will be used.
### EARTHQUAKE RETROFIT SCHEDULE (Seismic 1.2 High Seismic) TWO-STORY

<table>
<thead>
<tr>
<th>Weight Category</th>
<th>Length Each of Two Braced Wall Sections Required Along Each Perimeter Wall Line</th>
<th>Number of Foundation Connectors or Anchors at Each Perimeter Wall Line</th>
<th>Assumed Distributed Along Length</th>
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</thead>
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<tr>
<td></td>
<td>Wood Structural Panels</td>
<td>Floor to Cripple Wall or Foundation Sill Anchors</td>
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<td>Cripple Wall Height</td>
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<tr>
<td></td>
<td>with Tie- downs</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Without Tie- downs</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>With Tie- downs</td>
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</tr>
<tr>
<td></td>
<td>With Tie- downs</td>
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<tr>
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<td>With Tie- downs</td>
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<tr>
<td></td>
<td>With Tie- downs</td>
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<td></td>
<td>with Tie- downs</td>
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<td></td>
<td>Without Tie- downs</td>
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</tr>
<tr>
<td></td>
<td>With Tie- downs</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Panel Edge Nailing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type “A”</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Type “E”</td>
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<td>Type “F”</td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
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<td>1”Ø x 2” x 44” Bolt</td>
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<td>1”Ø x 2” x 64” Bolt</td>
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<td></td>
<td>Type “NN”</td>
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<td>1”Ø x 2” x 66” Bolt</td>
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<td></td>
<td>1”Ø x 2” x 72” Bolt</td>
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</tbody>
</table>

Notes:

1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that where using 1/2” or 5/8” bolts, one additional anchor is required at the end of each braced wall panel per Sheet D4.

2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)

3. Connector Type “P” should be used as an alternative only if piers have blocking on both sides and where accessibility makes the use of Types “C” or “E” impractical.

4. Any of the connectors listed within a particular group and as shown on Sheet S3 may be used for strengthening the particular condition.

5. This Plan Set was developed using the lowest listed manufacturer’s capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.

6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 feet.

### RETROFIT SUMMARY

**BRACING, ANCHORS, CONNECTORS, AND TIE-DOWNS**

1. Minimum required length of Wood Structural Panels per wall line (check boxes where condition applies)
   - North Wall
     - Type: ______ Min required:______
   - East Wall
     - Type: ______ Min required:______
   - South Wall
     - Type: ______ Min required:______
   - West Wall
     - Type: ______ Min required:______

2. Panel Edge Nailing
   - “A” on center

3. New Foundation Sill Anchorage:
   - North Wall
     - Type: ______ Min required:______
   - East Wall
     - Type: ______ Min required:______
   - South Wall
     - Type: ______ Min required:______
   - West Wall
     - Type: ______ Min required:______

4. Floor Framing Connectors (to Cripple Wall or Foundation Sill)
   - North Wall
     - Type: ______ Min required:______
   - East Wall
     - Type: ______ Min required:______
   - South Wall
     - Type: ______ Min required:______
   - West Wall
     - Type: ______ Min required:______

5. Check this box if tie-downs and SUPPLEMENTAL TECHNICAL NOTES on Sheet S2 will be used.
## Earthquake Retrofit Schedule

### Notes:
1. Anchor bolts and Connectors shown in the Earthquake Retrofit Schedule are the minimum required per wall line, placed within the length of strengthening where possible and spaced as equally along each wall line as possible. Note that where using 1/2" or 5/8" bolts, one additional anchor is required at the end of each bracket wall panel per Sheet D4.
2. Tie-downs: If your foundation meets the criteria, you may choose the tie-down option to decrease the required length of strengthening. This may be required where the length of the wall without tie-downs specified in this schedule is longer than can be accommodated by existing conditions. However, there is a level of uncertainty when dealing with existing foundations, therefore, where possible, longer lengths of strengthening, without tie-downs, are preferred. (See Supplemental Technical Notes, Sheet S2 to verify the existing foundation is suitable and meets criteria.)
3. Connector Type "P" should be used as an alternative only if joints have blocking on both sides and where accessibility makes the use of Types "D" or "E" impractical.
4. Any of the connectors listed within a particular group and as shown on Sheet S3 may be used for strengthening the particular condition.
5. This Plan Set was developed using the lowest listed manufacturer's capacity within a particular group. Required number of connectors on the Earthquake Retrofit Schedule may be found to have an acceptable spacing where an alternate connector is used. Any such substitution can only be designed or specified by a Registered Design Professional.
6. Foundation sill anchor types A, B, and C should not be used with cripple walls over 2 ft. high.

### Additional Types/Quantities (if used):

<table>
<thead>
<tr>
<th>Weight Category</th>
<th>Wood Structural Panels</th>
<th>Foundation Sill Anchors</th>
<th>Floor to Cripple Wall Connectors</th>
<th>Floor to Foundation Sill Connectors</th>
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<tbody>
<tr>
<td>S1a: High Seismic</td>
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<tr>
<td>S1b: Medium Seismic</td>
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<td></td>
</tr>
<tr>
<td>S1c: Low Seismic</td>
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</tr>
</tbody>
</table>

### Earthquake Retrofit Schedule (S3.1) Very High Seismic Two-Story

| Total Area in Square Feet | Wood Structural Panels | | Foundation Sill Anchors | | Floor to Cripple Wall or Floor to Foundation Sill |
|---------------------------|------------------------|-----------------|------------------------|----------------------------------|
| Up to 1600                |                        |                 |                        |                                  |
| 12'0" x 12'0"            | 12'0"                  | 12'0"           | 14'7"                  | 12'0"                            |
| 13'3" x 13'3"            | 13'3"                  | 16'0"           | 13'3"                  | 18'7"                            |
| 16'0" x 16'0"            | 16'0"                  | 16'0"           | 16'0"                  | 20'0"                            |
| 21'3" x 16'0"            | 21'3"                  | 16'0"           | 16'0"                  | 22'7"                            |
| 22'7" x 22'7"            | 22'7"                  | 22'7"           | 26'7"                  | 24'0"                            |
| 26'7" x 24'0"            | 26'7"                  | 24'0"           | 28'0"                  | 24'0"                            |
| 10'7" x 14'7"           | 10'7"                  | 14'7"           | 10'7"                  | 13'7"                            |
| 12'0" x 14'7"           | 12'0"                  | 14'7"           | 12'0"                  | 18'7"                            |
| 14'7" x 14'7"           | 14'7"                  | 14'7"           | 16'0"                  | 22'7"                            |
| 16'0" x 16'0"           | 16'0"                  | 16'0"           | 18'7"                  | 24'0"                            |
| 20'0" x 16'0"           | 20'0"                  | 16'0"           | 22'7"                  | 24'0"                            |
| 22'7" x 22'7"           | 22'7"                  | 22'7"           | 26'7"                  | 24'0"                            |
| 26'7" x 24'0"           | 26'7"                  | 24'0"           | 28'0"                  | 24'0"                            |

### Instructions:
1. Locate the section that matches your home’s construction. Use the chart on Sheet S3 to determine "Weight Category".
2. Find the home’s Total Floor Area in the schedule; this number should be at least as large as the number calculated in 2.C. Do not use a smaller number, even if it is closer.
   a. Approximate 1st floor area over crawl space (Do not include areas built over slab-on-grade.)
   b. Approximate 2nd floor area over crawl space (Do not include areas where the 1st floor over slab-on-grade.)
   c. Total approximate square footage
3. Check the box that matches your home’s construction type, number of stories, and total floor area.
4. You will find information in this one of the schedule to determine length of wood structural panels, nailing requirements, quantities of hardware, etc.
5. Measure the maximum height of the cripple wall along each wall line of the house.
6. Determine the length of wood structural panel bracing required. The columns contain the length of required bracing, depending on the height of the cripple wall. The length of bracing is given for cripple wall heights of zero to 1', 1' to 2', 2' to 4', 4' to 6', and 6' to 7'. Furthermore, choices are given for bracing without tie-downs and with tie-downs; if the cripple wall height changes along the length of the wall, use the tallest height to determine the required bracing length. Follow the row across from the total floor area that you checked for your home (in Step 3) to find the bracing length for the cripple wall height on each side of the house. Review General Notes, Sheet S1, Section 4 for instructions on non-rectangular "T" or "L" shaped dwellings. Check boxes where Special Provisions apply.
7. Determine the number of Foundation Sill Anchors required. The columns show the number of anchors required, depending on whether you use Types A through C, or 1/2" or 5/8" anchor bolts. (e = diameter of the bolts) See Sheet S3.
8. Determine the number of Floor to Cripple Wall or Foundation Sill connectors. The columns indicate how many framing connectors are required, depending on whether you use Types D, E, F, or G. See Sheet S3.
9. Complete the Retrofit Summary for your project. Fill in the lengths of Wood Structural Panels found in C. Fill in the type and quantity of anchors used on each wall line. The length of new cripple wall bracing should be distributed along a wall line either in one full length or in a maximum of two panel lengths of approximately equal length (offset walls can have three). If you intend to use tie-downs, check the box for tie-downs for each wall line where use is intended. Check the box on line 5, and read the Supplemental Technical Notes for additional information. Where the length of required panel does not fit within the available length, the dwelling must have an engineered solution. Alternatively, if 100% of the length along any particular wall can be sheathing, then that wall line shall be considered acceptable and an engineered solution is not required.

## Supplemental Technical Notes

- Check boxes where Special Provisions apply.
- Check this box for tie-downs and Supplemental Technical Notes on Sheet S2 will be used.
Notes:
1. See Retrofit Summary on Sheet S3.1 for minimum retrofitting requirements.
**Detail applies where (E) foundation sill is wider than the (E) cripple studs.**

1. **ANCHOR THROUGH FOUNDATION SILL ONLY**
   - Where required, See Sheet D4 or D5 as applicable
   - Wood structural panel
   - Cripple stud
   - Joint in foundation sill
   - Concrete foundation (shape may vary)

2. **ANCHOR THROUGH BLOCKING AND FOUNDATION SILL**
   - Where required, See Sheet D4 or D5 as applicable
   - Wood structural panel
   - Cripple stud
   - Joint in foundation sill
   - Concrete foundation (shape may vary)

3. **NEW BLOCKING INSTALLATION FOR SHEATHING ATTACHMENT**
   - Edge of (E) concrete
   - Wood structural panel
   - Concrete foundation (shape may vary)

4. **FOUNDATION SILL CONNECTORS**
   - Where (N) wood structural panel is required
   - Cripple stud
   - Joint in foundation sill
   - Concrete foundation (shape may vary)

---

**Abbreviations**

- **E** Existing
- **N** New
- **Min** Minimum
- **Max** Maximum
- **NTS** Not to Scale
- **Typ** Typical

**MATERIAL KEY:**

- **Nails**
  - 8d (8 penny) 0.131" x 1-1/2" long
  - 8d (8 penny) 0.131" x 2-1/2" long
  - 6d (6 penny) 0.157" x 3" long
  - 6d (6 penny) 0.162" x 3-1/2" long
  - 6d (6 penny) 0.148" x 1-1/2" long

- **Structural wood screws**
  - Simpson Strong-Tie 1/4" SDW 316 Stainless ("Climatek"); USP Mitek 1/4" SDS, GRK "GOLD Coat", or equivalent.
  - 3/8" RSS "Climatek", USP Mitek 1/4" SDS, GRK "GOLD Coat", or equivalent.

- **Fasteners**
  - 6" long structural wood screw
  - 4" long structural wood screw
  - 3" long structural wood screw

- **Block**
  - 2" or 3" blocking at each stud bay with plywood or OSB

- **Flash**
  - Typar, Tyvek, Vycor, HardieWrap, or bituthene equivalent.
  - Peel & Stick" Fortiflash, "Orange Peel-n-Seal", or equivalent.

- **Reinforcing**
  - "C" (shown dashed)
  - Solid "S" from edges, typical

- **Reinforcement**
  - Approximate 1" from edges, typical

**APPLICANT:**

- "FEMA P-1100, Volume 2 - Issued: SEPT 2019"
FLOOR-TO-CRIPPLE WALL CONNECTION

1. AT PARALLEL JOISTS

(Floor framing to cripple wall connection)

2. AT PERPENDICULAR JOISTS

(Floor framing to cripple wall connection)

3. WHERE END JOIST IS NOT ACCESSIBLE

(Floor framing to cripple wall connection)

FLOOR TO CRIPPLE WALL CONNECTION

AT BALLOON FRAMES/WALLS

(AT PARALLEL JOISTS)

(Floor framing to cripple wall connection)

AT FLOOR OVERHANGING

(Floor framing to cripple wall connection)

FLOOR TO CRIPPLE WALL CONNECTION

AT FLOOR-OVERHANG

(Floor framing to cripple wall connection)
Below is a key to common call-outs in the details. Unless specified otherwise in the details, use the sizes and materials as follows:

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**MATERIAL KEY:**

Floor Framing to Cripple Wall Connection Details

**ABBREVIATIONS**

- **APPLICANT:**
- **PROPERTY ADDRESS:**
- **Vulnerability-Based Seismic Assessment and Retrofit of Single-Family Dwellings**
- **FEMA P-1100, Volume 2, Plan Set**
- **Issued: SEPT 2019**

**ABBREVIATIONS**

- **(E)** Existing
- **(N)** New
- **min.** Minimum
- **max.** Maximum
- **NTS** Not to Scale
- **typ.** Typical

**FLOOR-TO-BALLOON FRAMED WALLS**

- **(E) Balloon-framed wall stud**
- **(E) Fire-blocking if present**
- **(N) 2x blocking or (E) floor joist or blocking**
- **(E) Floor sheathing**
- **(E) Floor joist if present**
- **(N) Connector Type "D"**
- **(N) Wood structural panel**
- **(N) Wood structural panel, where required. See Sheet D4 or D5 for installation**
- **(N) 2x ledger with (2) 3" screws to (N) 3x6 blocking**
- **(N) 3x6 blocking every stud bay at (N) wood structural panel**
- **(N) Concrete foundation**
- **(E) Concrete foundation**
- **(E) Let-in ribbon**

**CRIPPLE WALL WITHOUT TOP PLATE**

- **(E) Balloon-framed wall stud**
- **(E) Floor sheathing**
- **(N) Connector Type "D"**
- **(N) Wood structural panel**
- **(N) Wood structural panel, where required. See Sheet D4 or D5 for installation**

**CRIPPLE WALL WITH SINGLE TOP PLATE**

- **(N) Connector Type "D"**
- **(N) Wood structural panel**
- **(N) Wood structural panel, where required. See Sheet D4 or D5 for installation**
- **(N) 2x ledger with (2) 3" screws to (N) 3x6 blocking**
- **(N) 3x6 blocking every stud bay at (N) wood structural panel**
- **(N) Concrete foundation**
- **(E) Concrete foundation**
- **(N) 4" long screw at 8" on center or Connector Type "D" or "E" per Earthquake Retrofit Schedule (Sheet S3.1)**

**FLOOR-TO-BALLOON FRAMED WALLS**

- **(E) Wall framing**
- **(E) End plate**
- **(N) Connector Type "D"**
- **(E) Floor sheathing**
- **(N) Wood structural panel**
- **(N) Wood structural panel, where required. See Sheet D4 or D5 for installation**
- **(N) 2x ledger with (2) 3" screws to (N) 3x6 blocking**
- **(N) 3x6 blocking every stud bay at (N) wood structural panel**
- **(N) Concrete foundation**
- **(E) Concrete foundation**

**CRIPPLE WALL WITH SINGLE TOP PLATE**

- **(E) Balloon-framed wall stud**
- **(E) Fire-blocking if present**
- **(N) 2x blocking or (E) floor joist or blocking**
- **(E) Floor sheathing**
- **(E) Floor joist if present**
- **(N) Connector Type "D"**
- **(N) Wood structural panel**
- **(N) Wood structural panel, where required. See Sheet D4 or D5 for installation**
- **(N) 2x ledger with (2) 3" screws to (N) 3x6 blocking**
- **(N) 3x6 blocking every stud bay at (N) wood structural panel**
- **(N) Concrete foundation**
- **(E) Concrete foundation**
1. Provide additional 2x4 or 2x6 cripple stud where (E) stud is less than 1-3/4" thick. Fasten to (E) stud with 16d nails at 4" on center, staggered to avoid splitting.

2. Provide all required nailing at upper top plate.

3. Minimum 1" clear above (E) foundation sill anchor bolt.

4. Connectors Type "A", "B", or "C" - See Detail 4/D1 (use where anchor bolt cannot be installed).

5. Provide 2x4 flat blocking at all horizontal panel edges.

**FOUNDATIONS SILL SAME WIDTH AS CRIPPLE WALL**

1. Provide additional 2x4 on center at bottom plate (where occurs)

2. Provide all required nailing at upper top plate.

3. (N) 2-1/2" to 3" diameter vent holes at each bay. Place each hole over (N) foundation sill anchor bolt for inspection.

4. When cripple wall is less than 15' in height, only one vent hole is required at bottom.

5. Minimum 1" clear above (E) foundation sill anchor bolt.

**FOUNDATIONS SILL WIDER THAN CRIPPLE WALL**

1. Provide additional 2x4 on center at bottom plate (where occurs)

2. Provide all required nailing at upper top plate.

3. (N) 2-1/2" to 3" diameter vent holes at each bay. Place each hole over (N) foundation sill anchor bolt for inspection.

4. When cripple wall is less than 15' in height, only one vent hole is required at bottom.

5. Minimum 1" clear above (E) foundation sill anchor bolt.

6. Provide additional foundation sill anchor at the end of each braced wall line.

**WOOD STRUCTURAL PANEL INSTALLATION WITHOUT TIE-DOWNS**

- **Exterior or Exposure I.** Manufactured Wood Structural Panel Installation without Tie-Downs
- **FEMA P-1100, Volume 2 Plans Set**

**ABBREVIATIONS**

- (E) Existing
- (N) New
- (min.) Minimum
- (max.) Maximum
- NTS Not to Scale
- typ. Typical

**MATERIAL KEY:**

- Wood structural panel - 1/2" to 3" thickness
- Georgia-Pacific "GP-Lam", laminated veneer lumber
- "Solid Start", or equivalent.
- MDF "Solid Start", or equivalent.
- Oriented Strand Board (OSB)
- "Climatek", USP Mitek 1/4" screws
- 20d (20 penny) 0.192" x 4" long
- 16d (16 penny) 0.162" x 3-1/2" long
- 10d (10 penny) 0.148" x 3" long
- 8d (8 penny) 0.131" x 1-1/2" long
- Concrete foundation - less than 18" in height, with 8d nails at 4" on center at bottom plate (where occurs)
- Concrete foundation - greater than 4'-0" tall with 8d nails at 4" on center at bottom plate (where occurs). See Detail 3/D6 for wall blockouts, see Detail 3/D6.

**NOTES:**

1. For strapping at top plate splices, see Details 1/D6 or 2/D6.
2. At crawlspace vents or similar cripple-wall blockouts, see Detail 3/D6.
3. Prior to installing wood structural panels, see Detail 4/D6 where pipes or conduits pass through cripple studs or top plates.
4. Wood structural panels may be installed vertically (face grain parallel to stud) or horizontally.
5. Provide 2x4 flat blocking at all horizontal panel edges.

**DETAIL 1/D1 or 2/D1**

- See Detail 1/D1 or 2/D1 (where applicable)
- Place each hole over (N) foundation sill anchor bolt (N) 2x blocking between (E) cripple studs
- (N) Foundation sill anchor bolt
- See Detail 2/D1 or 2/D1 (where applicable)

**DETAIL 3/D1**

- See Detail 3/D1 (where occurs)
- Provide all required nailing at upper top plate.

**DETAIL 4/D1**

- (E) Connector Type "A", "B", or "C"
- See Detail 4/D1 (where anchor bolt cannot be installed)

**DETAIL 5/D1**

- Provide additional 2x4 flat blocking at all horizontal panel edges.

**DETAIL 6/D1**

- Provide additional foundation sill anchor at the end of each braced wall line.
Wood Structural Panel Installation with Tie-Downs

**Wall framing**

"W" indicates the width of an existing foundation, or new foundation constructed in accordance with Detail D7/D6. Foundation sill blocking required where occurs. 10d (10 penny) 0.148" x 3" long at connectors, attached directly to framing.

**Top plate(s)**

**Tie**

**Floor joist, or (E) or (N) blocking,** Wood structural panels may be installed vertically (face grain parallel to stud) or horizontally.

For existing foundations, see Supplemental Technical Notes, Sheet S2, Section R for additional requirements.

**Reinforcing bars may or may not be** Blocking required where occurs. Provide 2x4 flat blocking at all horizontal panel edges.

**Foundation sill**

"D" indicates the depth of an existing foundation, or new foundation constructed in accordance with Detail 1/D7.

For strapping at top plate splices, see Details 1/D6 or 2/D6. Y.832. Tie-downs. Use connector sizes specified on the Earthquake Retrofit Schedule (Sheet S3.1) and 12" on center at bottom plate plywood. For Connector types see Sheet S3.

**TYPICAL INSTALLATION**

1. "Wall framing" - Provide additional 8d at 12" on center at bottom plate (where occurs)
2. "Floor joist or (E) or (N) blocking" - Wood structural panel. Fasten to (E) stud with 16d nails at 4" on center, staggered to avoid splitting.
3. "Foundation sill" - (N) Foundation sill blocking as required. See Sheet D3. See Detail 1D1 or 2D1
4. "Wood structural panel" - (N) Wood structural panel. Fasten with 8d nails at all panel-edges at spacing specified on the Earthquake Retrofit Schedules (Sheet S3.1) and 12" on center at intermediate supports
5. "Tie-down" - (N) Tie-down with anchor. See "Tie-down" table on Sheet S3.1 and 12" on center at intermediate supports
6. "Concrete foundation" - (E) Concrete foundation. 18" min. 20d (20 penny) 0.192" x 4" long to framing
7. "Wall framing" - (E) Wall framing. 6" min. 12" max.
8. "Floor joist, or (E) or (N) blocking" - Wood structural panel. Fasten to wall blockouts, see Detail 3/D6.
9. "Foundation sill blocking" - See Note 8
10. "Top plate(s)" - Provide all required nailing 10d (10 penny) 0.148" x 3" long at upper top plate at connectors, (E) blocking. Provide additional 8d at 12" on center at top plate (where occurs)
11. "Wood structural panel" - See Sheet D3 or D3.1 for floor framing to cripple wall connections. (Framing may vary from condition shown in this detail)
12. "Concrete foundation" - 7'-0" min. 3" max. 12" max.
13. "Foundation sill" - Foundation sill is wider than (E) cripple studs. 12" on center at top plate at connectors (E) blocking. Provide additional 8d at 12" on center at top plate (where occurs)
14. "Wall framing" - (E) Wall framing. 6" min. 12" max.
15. "Floor joist, or (E) or (N) blocking" - Wood structural panel. Fasten to wall blockouts, see Detail 3/D6

**ABBREVIATIONS**

- APPLICANT:
- PROPERTY ADDRESS:
- Sheet:
- Scale:
- Date:
- MATERIAL KEY:
- Term Description
- Type
- Existing
- New
- min
- Maximum
- NTS
- Not to Scale
- Typical
- Sheet

For Connector types see Sheet S3.

**NOTES:**

1. For strapping at top plate splices, see Details 1D6 or 2D6.
2. At crawlspace vents or similar cripple-wall blockouts, see Detail 3D6.
3. Prior to installing wood structural panels, see Detail 4D6 where pipes or conduits pass through cripple studs or top plates.
4. "W" indicates the width of an existing foundation, or new foundation constructed in accordance with Detail 1D7.
5. "D" indicates the depth of an existing foundation, or new foundation constructed in accordance with Detail 1D7.
6. For existing foundations, see Supplemental Technical Notes, Sheet S2, Section R for additional requirements.
7. Wood structural panels may be installed vertically (face grain parallel to stud) or horizontally.
8. Provide 2x4 flat blocking at all horizontal panel edges.

**MADE KEY:**

Below is a key to common call-outs in the details. Unless specified otherwise in the details, use the sizes and materials as follows:

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<tr>
<td>TYPICAL INSTALLATION</td>
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</table>

**TERMINOLOGY:**

- 1/2" - 3" diameter
- TYPICAL INSTALLATION
- 11/2" to 3" diameter
- 2" min. 3" min.

**MATERIALS**

- Wood Structural Panel Installation with Tie-Downs
- Retrofit of Crawlspace Dwellings (Plan Set)
- Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings
- FEMA P-1100, Volume 2
- D5
- Sheet: 1

**MAPS:**

- elevation
- section
- west
- north

**Retrofit of Crawlspace Dwellings (Plan Set)**

- Impacting mitigation strategies
- Improved seismic performance
- Increased property values
- Increased energy efficiency
- Reduced insurance costs
- Improved occupant safety
- Enhanced architectural design

**SUMMARY:**

- Mitigation strategies
- Improved seismic performance
- Increased property values
- Increased energy efficiency
- Reduced insurance costs
- Improved occupant safety
- Enhanced architectural design

**CONCLUSION:**

- Mitigation strategies
- Improved seismic performance
- Increased property values
- Increased energy efficiency
- Reduced insurance costs
- Improved occupant safety
- Enhanced architectural design

**RECOMMENDATIONS:**

- Mitigation strategies
- Improved seismic performance
- Increased property values
- Increased energy efficiency
- Reduced insurance costs
- Improved occupant safety
- Enhanced architectural design
MATERIAL KEY:

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</table>

Notes:

1. Floor framing not shown.
2. In area of sheathing, install strap over sheathing.

CUTOUT REQUIREMENTS IN BRACED PANELS

Notes:

1. Floor framing not shown.
2. Increase wood structural panel length a distance equal to the length of blockout(s) or one stud bay width whichever is greater.

ALLOWABLE NOTCHING AND REINFORCING FOR TOP PLATES AND STUDS

Notes:

1. Do not cover existing vents.

VENT OPENINGS AND TOP PLATE DETAILS

Notes:

1. Floor framing not shown for clarity.
2. In area of sheathing, install strap over sheathing.
CONCRETE FOUNDATION FOR SECTION REPLACEMENT - OPTION 1

- Footing to be deepened as required to bear on firm soils.
- The ground surface along the interior side of the foundation is permitted to be excavated to the elevation of the top of the foundation.
- Where (N) foundations are placed adjacent to (E) foundations, connect (N) and (E) foundations with (3) #4 x 3' dowels. Embed dowels 8" minimum into the (E) foundation with adhesive. See General Notes, Section M.
- If possible, (N) sill should be same size as cripple studs, (N) #4 at 24" on center, alternate hooks.
- When expansive soil is known to exist, the foundation depth and reinforcement shall be as approved by the Building Official.
- A geotechnical report or modified foundation may be required at locations with expansive or liquefiable soils or sites with potential for sliding.

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#### ABBREVIATIONS

- (E) Existing
- (N) New
- min. Minimum
- max. Maximum
- NTS Not to Scale
- typ. Typical

### SECTION

**Foundation Dimensions:**

- One-story: Footing Depth: 12" min. Footing Thickness: 10" min. Footing Width: 12" min. Stairwell Thickness: 8" min.

**CONCRETE FOUNDATION FOR SECTION REPLACEMENT - OPTION 2**

- Footing to be deepened as required to bear on firm soils.
- The ground surface along the interior side of the foundation is permitted to be excavated to the elevation of the top of the foundation.
- Where (N) foundations are placed adjacent to (E) foundations, connect (N) and (E) foundations with (3) #4 x 3' dowels. Embed dowels 8" minimum into the (E) foundation with adhesive. See General Notes, Section M.
- If possible, (N) sill should be same size as cripple studs, (N) #4 at 24" on center, alternate hooks.
- When expansive soil is known to exist, the foundation depth and reinforcement shall be as approved by the Building Official.
- A geotechnical report or modified foundation may be required at locations with expansive or liquefiable soils or sites with potential for sliding.

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#### ABBREVIATIONS

- (E) Existing
- (N) New
- min. Minimum
- max. Maximum
- NTS Not to Scale
- typ. Typical
Example of Foundation and Strengthening Layout Plan

Do not submit.

Do not submit.

Do not submit.

Do not submit.

Do not submit.

Do not submit.

Do not submit.

Do not submit.

Do not submit.

Do not submit.
This example is a 2,598 square foot two-story home (excluding garage and porch), with a "Light" weight classification in a low seismic area.

Using the S51 1:50 Two-story Earthquake Strengthening Schedule from Sheet D3-I, the 2001-2040 Total Area cow shows that the length of strengthening is 32'-0" (16'-8") for the uniform cripple wall height of 8'-3". The side walls allow enough length to use wood structural panels without tie-downs. The front and back walls do not provide enough length and will require tie-downs, this will reduce the required length to 24'-0" (12'-0" each). This example uses 5/8" Anchor Bolts (10 required per wall line) and Type "D" Connectors (21 required per wall line).

Notes:
1. Plan shows typical notation. Instructional notes are in italics and should not be included on submittal drawing. Refer to Sheet 01 for additional instructions.
2. Required length values are rounded up to be at 18" typical stud space increments.

Key:
- (E) Existing
- (N) New
- Strengthening: Foundation and cripple wall work intended to improve performance during an earthquake.
- Wall line: All wall segments forming the overall building dimension on one side.

Definitions:
- Minimum required length of strengthening using wood structural panels, anchors, and connectors
- Foundation anchor bolt or connector
- Additional foundation anchor or connector
- Tie-down
- Floor framing connector

EXAMPLE OF NOTATION FOR SUBMITTAL TO Building Official

- Label the front side of home (street side).
- Wall line = 26'-0" Maximum cripple wall height = 6'-3"
- Minimum required length of wood structural panel sections with tie-downs = 24'-0" (Provided 12'-0" + 12'-0" = 24'-0"
- Minimum required length of wood structural panel sections with tie-downs = 24'-0" (Provided 12'-0" + 12'-0" = 24'-0"

EXAMPLE OF CALCULATING TOTAL STRENGTHENING REQUIREMENTS

- Step 1:
  - Two of the anchor bolts required by the Earthquake Strengthening Schedule within 8" of each end of the braced wall section with tie-downs. See Detail 1 on Sheet D5
  - Two of the anchor bolts required by the Earthquake Retrofit Schedule within 8" of each end of the braced wall section.
  - Additional anchor bolt at each end of the braced wall section as required by Details 1 & 2 on Sheet D4

- Step 2:
  - Indicate the height of the tallest cripple wall for the wall line.
  - Section identifiers showing all plan details associated with each section of the cripple wall line being strengthened.
  - Detail and sheet numbers will vary based on your conditions.

- Example - Foundation Plan (Dwelling with tie-downs)
  - Anchor Bolts (10 required per wall line)
  - Type "D" Foundations (10 required per wall line)
  - Earthquake Strengthening Schedule within 8" of each end of the braced wall section
  - Additional anchors for 48" on center

- Definitions:
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector

- Example - Foundation Plan (Dwelling with tie-downs)
  - Indicate North
  - Min. required length of wood structural panel sections with tie-downs = 24'-0" (Provided 12'-0" + 12'-0" = 24'-0"
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector

- Definitions:
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector

- Example - Foundation Plan (Dwelling with tie-downs)
  - Typ. all wall lines
  - Wall line = 26'-0" Maximum cripple wall height = 6'-3"
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector

- Definitions:
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector

- Example - Foundation Plan (Dwelling with tie-downs)
  - Typ. this wall line
  - Wall line = 26'-0" Maximum cripple wall height = 6'-3"
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector

- Definitions:
  - Minimum required length of strengthening using wood structural panels, anchors, and connectors
  - Foundation anchor bolt or connector
  - Additional foundation anchor or connector
  - Tie-down
  - Floor framing connector
Required (N) Braced wall section with tie-downs. See Earthquake Retrofit Schedule, Sheet S3.1

(N) Connector Type "D" or "E"
See Earthquake Retrofit Schedule, Sheet S3.1

(N) 2x at wood structural panel splice (where required)
See Detail 1/D4, 2/D4, or 1/D5

(N) Vent holes
See Detail 1/D4, 2/D4, or 1/D5

(E) End joint or (E) blocking

(E) Floor joint
(Floor framing)

(N) Wood structural panel
See Detail 1/D4, 2/D4, or 1/D5

(N) Nailing pattern
See Detail 1/D4, 2/D4, or 1/D5

(E) Exterior Finish
See Detail 1/D4, 2/D4, or 1/D5

(E) Foundation sill anchor bolt
See Detail 1/D4 or 2/D4

(E) Foundation sill
See Detail 1/D1

(E) Foundation sill blocking if required to provide flush surface for wood structural panel attachment
See Detail 2/D1

Definitions

(E) Existing

(N) New

Strengthening: Foundation and/or cripple wall work intended to improve performance during an earthquake.

Wall line: All wall segments forming the overall building dimension on one side.

Notes:
1. This detail is to show an example of cripple wall that has gone through an earthquake retrofit and to identify terms and details used in this plan set.
2. This detail is not intended to supersede requirements contained in the specific installation details on Sheets D1 through D7.
3. This view is looking from the interior of the crawl space.
Notes:
1. This detail is to show an example of an earthquake retrofit where there is no cripple wall, and to identify terms and details used in this plan set.
2. This detail is not intended to supersede requirements contained in the specific installation details on Sheets D1 through D6.
3. This view is looking from the interior of the crawl space.

Definitions:
- (E) Existing
- (N) New

Strengthening: Foundation and/or cripple wall work intended to improve performance during an earthquake.

Wall line: All wall segments forming the overall building dimension on one side.