

Part 5 discusses in detail how to develop seismic rehabilitation plans using CEBC Appendix Chapter A3.

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CEBC Chapter A3 is a prescriptive construction method that uses rules and tables rather than relying on engineering methods to calculate earthquake demand and building capacity. Homeowners and contractors using Chapter A3 should check with the local building department for any modifications or additions required prior to beginning the work.

## CEBC Chapter A3 Rehabilitation Plans

### How to Use Provisions

STEP 1 – Verify IEBC scope limitations are met  
(A301.2)

STEP 2 – Draw plan of house and crawlspace

STEP 3 – Conduct Condition Survey



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The Application of CEBC Appendix Chapter A3 has been broken into a series of 11 steps, which will be covered one at a time. These steps are also covered in the separate 8-1/2x11 hand out.

STEP 1 - Verify IEBC scope limitations are met

STEP 2 - Draw plan of house and crawlspace

STEP 3 –Conduct condition survey

## CEBC Chapter A3 Rehabilitation Plans

### How to Use Provisions (continued)

STEP 4 – Determine new foundation requirements, if applicable (A304.2)

STEP 5 – Identify foundation sill plate anchor spacing (A304.3)



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STEP 4 – Determine new foundation requirements, if applicable

STEP 5 – Identify foundation sill plate anchor spacing

## CEBC Chapter A3 Rehabilitation Plans

### How to Use Provisions (continued)

- STEP 6 – Select foundation sill plate anchorage details (A304.3)
- STEP 7 – Verify rim joist, blocking and connection (A304.1.3 & A304.1.4)
- STEP 8 – Identify distribution and amount of bracing (A304.4.2)



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- STEP 6 – Select foundation sill plate anchorage details
- STEP 7 – Verify rim joist, blocking and connection
- STEP 8 – Identify distribution and amount of bracing



## CEBC Chapter A3 Rehabilitation Plans

### How to Use Provisions (continued)

STEP 9 – Select details of cripple wall bracing  
(A304.4.1)

STEP 10 – Verify ventilation, access and flood  
openings (A304.4.3 &.4.4)

STEP 11 – Quality control (A304.5)



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STEP 9 – Select details of cripple wall bracing

STEP 10 – Verify ventilation, access and flood openings

STEP 11 – Quality control

## CEBC Chapter A3 Rehabilitation Plans

### STEP 1

VERIFY IEBC SCOPE LIMITATIONS ARE MET (A301.2)

#### Building Configuration Scope

**YES** **NO** One-to four-family detached dwelling with crawlspace

**YES** **NO** Lateral resistance is not from poles or columns embedded in the ground



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Step 1 involves checking to make sure that the dwelling falls within the intended scope of CEBC App Ch A3 provisions.

If answers to these questions are YES, then proceed. If any of the above answers are NO, then the dwelling is outside the intended scope of CEBC Appendix Chapter A3 provisions. Consult with a building official, architect, or engineer regarding recommended rehabilitation measures.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 1 – SCOPE (continued)

#### Building Configuration Scope

**YES** **NO** Cripple walls do not exceed **4'** in height

**YES** **NO** **3 stories** or less with no cripple walls,  
OR  
**3 stories** or less with cripple walls **<14"**  
OR  
**2 stories** or less with cripple walls **≤4'**



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If answers to these questions are YES, then proceed. If any of the above answers are NO, then the dwelling is outside the intended scope of CEBC Appendix Chapter A3 provisions.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 1 – SCOPE (continued)

#### Structural Weakness to Rehabilitate

- |            |           |   |
|------------|-----------|---|
| <b>YES</b> | <b>NO</b> | 1. Sill plates or floor framing supported on ground without foundation system |
| <b>YES</b> | <b>NO</b> | 2. Perimeter foundation system: isolated footings supporting posts/beams      |
| <b>YES</b> | <b>NO</b> | 3. Perimeter foundation system: not continuous (exceptions for porches)       |
| <b>YES</b> | <b>NO</b> | 4. Perimeter foundation system: unreinforced masonry or stone                 |



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This list identifies weaknesses that require rehabilitation. In this list, a “yes” identifies a weakness that must be further evaluated and/or rehabilitated. This list is based on CEBC Section A303.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 1 – SCOPE (continued)

#### Structural Weakness to Rehabilitate

**YES** **NO** 5. Foundation sill plates not connected or inadequately connected to foundation

**YES** **NO** 6. Cripple walls not braced/inadequately braced



Photo credit: Kelly Cobeen.



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This is a continuation of the same list. In this list a “yes” identifies a weakness that must be further evaluated and/or rehabilitated.

For Item 5, foundation sill plates would be considered inadequately connected if anchor bolts are on average spaced more than 6 feet on center.

For Item 6, cripple walls would be considered inadequately braced if there is no plywood or OSB sheathing, or if plywood or OSB is not properly installed.

If the answer is YES to one or more items above, then proceed with rehabilitation of those items.

In this photo, foundation sill plates are not bolted to the foundation. Exterior walls are poorly braced with straight sheathing. For this dwelling an answer of yes should be provided for items 5 and 6. This is a candidate for foundation anchorage and cripple wall bracing.

Photo credit: Kelly Cobeen.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 2

#### DRAW PLAN OF DWELLING AND CRAWLSPACE

*(Check each item when done)*

- \_\_\_ Identify location and extent of foundation
- \_\_\_ Identify location of existing anchor bolts, if applicable
- \_\_\_ Identify location and extent of cripple walls, if applicable



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Step 2. It is recommended that a plan be drawn of the dwelling and crawlspace. The list identifies information recommended for inclusion on the plan. Check off each item, as it is completed.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 2 – PLAN (continued)

*(Check each item when done)*

\_\_\_\_\_ Indicate locations of cripple wall openings and interruptions, including:

- Ventilation and flood openings
- Access openings
- Fireplaces
- Utility meters, plumbing, water heaters, HVAC equipment

\_\_\_\_\_ Indicate direction of floor framing



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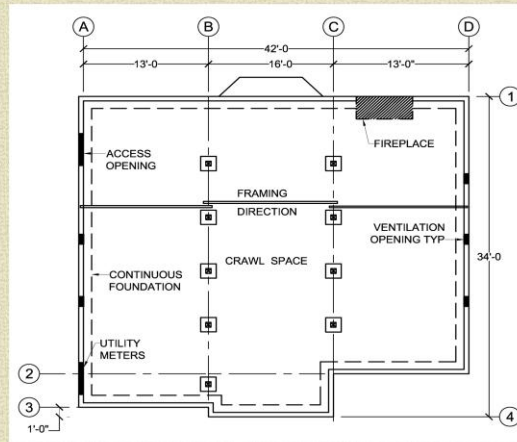
Step 2 (continued).

Ventilation opening requirements for crawlspaces in new dwellings can be found in the CBC or CRC. It is recommended that adequacy of vent openings be evaluated, and possibly improved as part of the cripple wall rehabilitation.

Flood opening requirements for crawlspaces in new dwellings constructed in whole or in part in flood hazard areas can be found in CRC Section 324. It is recommended that adequacy of flood openings be evaluated, and possibly improved as part of the cripple wall rehabilitation.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 2 – PLAN (continued)



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Step 2. This foundation plan illustrates location of the required and recommended information items. It serves as an ideal basis for choosing bolting and cripple wall bracing locations.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 CONDUCT CONDITION SURVEY

Identify whether any of the following conditions exist:

**YES**   **NO**

- a. Decay in members to be part of strengthening?  
If so, must replace with decay-resistant material.



Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)



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A survey of the existing conditions needs to be made in order to determine the scope of work required for installation of the rehabilitation measures. See CEBC Section A304.1.2. A series of yes/no questions are posed for this condition survey. Questions a and b are based on Section A304.1.2. Questions c and d are based on Section A304.2.2. Questions e through j are recommended based on past California rehabilitation experience. Items that are answered yes will impact the extent of rehabilitation work.

Survey item a addresses decay in framing members that are part of the strengthening. This photo shows decay damage to existing cripple walls. It is necessary to replace decayed or otherwise deteriorated framing members, in order for the seismic rehabilitation to perform as intended. Signs of ongoing decay damage should also be brought to the attention of the homeowner so that sources of water can be identified and fixed.

Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)

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### STEP 3 – SURVEY (continued)

#### *Inside crawlspace*

Hidden decay in foundation  
sill plates?

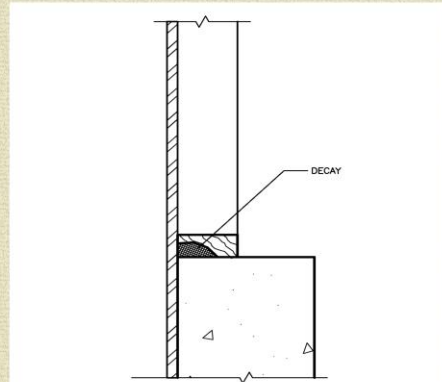


Figure 4-5 Section showing deep decay in sill plate.

Figure credit: Seismic Rehabilitation Guidelines for Detached, Single-Family Wood-Frame Dwellings (ATC 50-1, Chapter 4)



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Potentially hidden decay in foundation sill plates is an item of interest. ATC 50-1 Chapter 4 discusses the investigation of moisture content and the replacement of decayed sills. Probing of sills for decay damage extensive enough to affect anchor bolt strength is recommended. To be of concern, look for moderate to extensive decay in the immediate vicinity of anchor bolts or other condition that would significantly affect ability of the anchor bolts to perform.

Figure credit: Seismic Rehabilitation Guidelines for Detached, Single-Family Wood-Frame Dwellings (ATC 50-1, Chapter 4)

## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

Identify whether any of the following conditions exist:

- |     |    |   |
|-----|----|---|
| YES | NO | b. Insect infestation in members to be part of strengthening? If so, must strengthen or replace.                              |
| YES | NO | c. Partial perimeter foundation – adequate for anticipated cripple wall loads?<br><i>Architect or engineer must evaluate.</i> |



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### Step 3. Condition survey continued

Item b, similar to item a, affects the framing to which rehabilitation work will be installed. Note also that termite repairs to the cripple wall or foundation can sometimes result in a modified configuration that requires evaluation by an architect or engineer. If unusual conditions are encountered during the condition survey, evaluation by an engineer or architect is encouraged.

Item c addresses partial perimeter foundations, and requires evaluation by an architect or engineer. When evaluation by an architect or engineer is required, this should be a licensed professional with experience in seismic rehabilitation, who can evaluate whether or not the existing condition of a dwelling is adequate for the earthquake loading anticipated by the building code.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

Identify whether any of the following conditions exist:

YES NO

d. Unreinforced masonry foundation – adequate for anticipated cripple wall loads and is anchorage to foundation adequate?

*Architect or engineer must evaluate.*

#### ADDITIONAL RECOMMENDED SURVEY ITEMS

YES NO

e. Deteriorated existing foundation:

- Cracking
- Moisture damage

*Architect or engineer must evaluate*



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### Step 3. Condition survey continued

Item d addresses unreinforced masonry foundations, and item e addresses deteriorated foundations. The concerns raised by these items are very similar, and so are discussed in combination.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ***URM & moisture deteriorated existing foundations***

- Unreinforced masonry foundations and existing foundations exposed to moisture over time can have low material strength, leading to 2 questions:
- Is in-plane strength adequate?
- Is foundation strong enough for required anchor bolt capacities?



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Unreinforced masonry foundations and existing foundations that have been exposed to moisture over a long period of time can have substantially reduced material strength. This is true of both concrete and masonry foundations. Checking with the local building official is recommended to see if there is a history of foundation deterioration problems in your area.

For these foundations, one potential concern is inadequate in-plane shear strength. ATC 50-1, Chapter 4 recommends that existing, potentially weak concrete footings be tested by striking them with a hammer. Concrete that does not readily break off is considered adequate for carrying the relatively low stresses borne by the cripple walls. Where mortar in unreinforced masonry foundations can be very easily scraped out with a screw driver, additional evaluation is suggested; testing methods are available to verify in-plane strength of masonry where adequacy is of concern.

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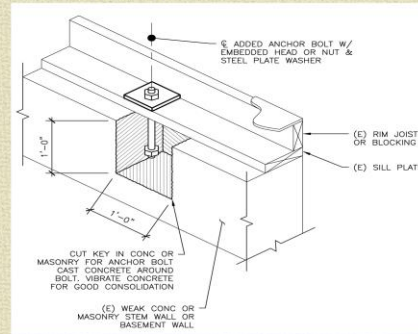
### STEP 3 – SURVEY (continued)

#### ***URM & moisture deteriorated existing foundations***

Unreinforced masonry foundations and existing foundations exposed to moisture over time can lose material strength

Is foundation strong enough to develop required anchor bolt capacities?

Cut out 1' by 1' keys in foundation and cast new concrete around new anchor bolts



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Where weak existing foundations are found, another potential concern is whether the foundation will be strong enough to develop required anchor bolt capacities.

This figure shows a detailing approach that might be considered for anchor bolts in weak concrete or masonry. A key of concrete is cast around a new bolt. To resist sliding, the bolt will push on the concrete key, and the key will push on a larger area of the existing foundation. This will lower stresses and increase the effectiveness of the anchorage. This detail has had limited usage in Southern California. Judgment is required in deciding if this detail is adequate, or if the foundation is so weak or deteriorated that foundation replacement is needed.

Note that expansion bolts are not recommended for installation in weak foundations.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ***Cracked existing foundations***

Roughly uniform vertical cracks are of possible concern when **>1/8 in.**

For vertical cracks of varying dimension and diagonal cracks:

- Thin cracks are not of concern
- Wider cracks may indicate soils issue – bring to attention of owner/geotechnical engineer



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Vertical cracks that have approximately uniform width in a concrete foundation are often due to concrete shrinkage, and they are only of possible concern if more than 1/8 inch wide.

Vertical cracks of varying dimension and diagonal cracks are often due to differential movement of the foundation (settlement, soil creep, expansive soils, etc.). Thin cracks are not of concern, but wider cracks may indicate a soils issue that should be brought to the attention of the owner or of a geotechnical engineer.

Significant vertical or horizontal offsets to either side of a foundation crack are one indication that foundation movement might be significant. In that case, evaluation by a geotechnical (soils) engineer is recommended.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ADDITIONAL RECOMMENDED ITEMS

**YES**    **NO**    f. Anchor bolts rusted to extent that their area is significantly reduced?

**RECOMMEND:** add replacement bolts



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Item f addresses rusted anchor bolts. A few local areas have experienced significant rusting of anchor bolts, to the extent that they might not perform as intended. Check with the building department to see if the problem has been experienced in your area. Light rusting of anchor bolts is a common occurrence that is generally not of significance. Significant rusting of anchor bolts can often be identified by applying a torque wrench, hammer blows, twisting with locking pliers, or prying with a crow bar. Where extensive rust is suspected, addition of replacement bolts is recommended.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ADDITIONAL RECOMMENDED ITEMS

**YES**   **NO**   g. Unusual framing conditions?

**RECOMMEND:** identify whether Chapter A3 details apply or additional engineering guidance is required.



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Item g addresses unusual framing conditions. Framing conditions that are not reflected in CEBC Chapter A3 may occur from original construction, repairs, or alterations. Where typical details do not apply, additional engineering guidance will be required. It is important to identify this condition prior to start of construction if possible so the additional cost of engineering guidance can be identified for the homeowner.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ADDITIONAL RECOMMENDED ITEMS

**YES**   **NO**   h. Damaged existing framing?  
Inadequate previous repairs?

**RECOMMEND:** advise homeowner, identify whether Chapter A3 details apply or additional engineering guidance is required.



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Item h addresses damaged existing framing and inadequate repairs. These conditions should be brought to the attention of the homeowner. These conditions may also result in framing conditions that are not reflected in CEBC Chapter A3 may occur from original construction, repairs, or alterations. Where typical details do not apply, additional engineering guidance will be required. It is important to identify this condition prior to start of construction if possible so the additional cost of engineering guidance can be identified for the homeowner.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ADDITIONAL RECOMMENDED ITEMS

**YES**   **NO**   i. Inadequate crawlspace ventilation?

**RECOMMEND:** identify if decay has resulted, if so improve ventilation



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Inadequate ventilation should be identified. Where inadequate ventilation has led to wood decay, it is recommended that ventilation be improved as part of seismic rehabilitation work.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 3 – SURVEY (continued)

#### ADDITIONAL RECOMMENDED ITEMS

**YES**   **NO**   j. Inadequate drainage?

**RECOMMEND:** identify if decay or other drainage related damage has resulted, if so improve drainage



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Inadequate site drainage should be identified. Where inadequate drainage has led to wood decay, it is recommended that drainage be improved.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 4 DETERMINE NEW FOUNDATION REQUIREMENTS IF APPLICABLE (A304.2)

**New foundation is needed when:**

- Framing is supported directly on the ground, or
- Existing footings are isolated piers, not continuous



Photo credit: Kelly Cobeen.



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### Step 4 – Determine when new foundations are required

These photos show dwellings damaged by the 1992 Cape Mendocino Earthquake. The dwellings have isolated foundations at each wood post. A new continuous foundation or partial foundation would be required for these dwellings.

Photo credit: Kelly Cobeen.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 4 – FOUNDATION (continued)

**New foundation is needed, when an architect or engineer:**

- Finds partial continuous footings to be inadequate
- Finds unreinforced masonry foundations to be inadequate
- Determines that A304.2 provisions apply for other reasons



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New foundations are also necessary when:

- Partial continuous footings have been evaluated by an architect or engineer and found not to be adequate, (Step 1, Weakness 3)
- Unreinforced masonry foundations have been evaluated by an architect or engineer and found not to be adequate, (Step 1, Weakness 4)
- Otherwise determined to be applicable. This may include deteriorated foundations that are found to be too weak to carry in-plane shear or to anchor to.

# CEBC Chapter A3 Rehabilitation Plans

## STEP 4 – FOUNDATION (continued)

New foundation may be designed per Figure A3-1 or A3-2, or be designed by an architect or engineer

A local building official may require a soils report.



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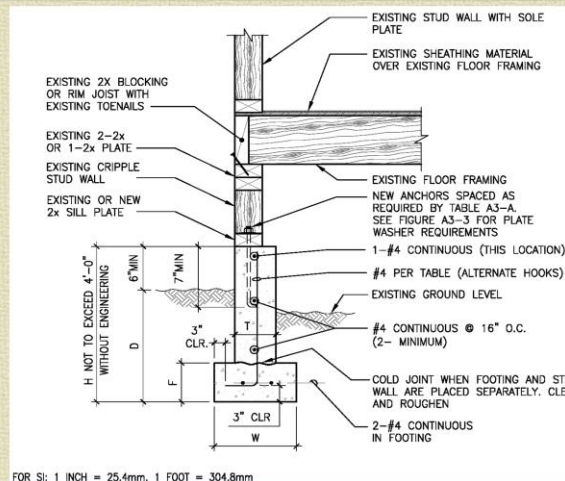


Figure credit: IEBC/CEBC

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CEBC provides two details for new foundations where existing foundations are found to be inadequate. Detail A3-1, shown here, is a concrete foundation with a concrete stem wall. Detail A3-2 provides a concrete foundation and masonry stem wall. All details of dimensions and reinforcing are provided. Foundations could also be designed by an architect or engineer. Where foundations are being replaced, a shoring system adequate to provide temporary support for the dwelling will need to be constructed.

Figure credit: IEBC/CEBC

# CEBC Chapter A3 Rehabilitation Plans

## STEP 4 – FOUNDATION (continued)

NUMBER OF STORIES	MINIMUM FOUNDATION DIMENSIONS					MINIMUM FOUNDATION REINFORCING	
	W	F	D <sup>A, B, C</sup>	T	H	VERTICAL REINFORCING	
						SINGLE-POUR WALL AND FOOTING	FOOTING PLACED SEPARATE FROM WALL
1	12 INCHES (305mm)	6 INCHES (152mm)	12 INCHES (305mm)	6 INCHES (152mm)	≤24 INCHES (610mm)	#4 @ 48" (1219mm) ON CENTER	#4 @ 32" (813mm) ON CENTER
2	15 INCHES (381mm)	7 INCHES (178mm)	18 INCHES (457mm)	8 INCHES (203mm)	≥36 INCHES (914mm)	#4 @ 48" (1219mm) ON CENTER	#4 @ 32" (813mm) ON CENTER
3	18 INCHES (457mm)	8 INCHES (203mm)	24 INCHES (610mm)	10 INCHES (254mm)	≥36 INCHES (914mm)	#4 @ 48" (1219mm) ON CENTER	#4 @ 18" (457mm) ON CENTER

- A. WHERE FROST CONDITIONS OCCUR, THE MINIMUM DEPTH SHALL EXTEND BELOW THE FROST LINE.  
 B. THE GROUND SURFACE ALONG THE INTERIOR SIDE OF THE FOUNDATION MAY BE EXCAVATED TO THE ELEVATION OF THE TOP OF THE FOOTING.  
 C. WHEN EXPANSIVE SOIL IS KNOWN TO EXIST, THE FOUNDATION DEPTH AND REINFORCEMENT SHALL BE AS APPROVED BY THE ENFORCING AGENCY.

Table credit: IEBC/CEBC



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Step 4 – This table provides minimum dimensions for new foundations (see IEBC, Figure A3-1)

Table credit: IEBC/CEBC



# CEBC Chapter A3 Rehabilitation Plans

## STEP 5

### IDENTIFY FOUNDATION SILL PLATE ANCHOR SPACING (A304.3)

Perimeter foundation sill plates must be anchored to foundation. Spacing of anchor bolts or alternate connectors must meet requirements of Table A3-A:

TABLE A3-A—SILL PLATE ANCHORAGE AND CRIPPLE WALL BRACING

NUMBER OF STORIES ABOVE CRIPPLE WALLS	MINIMUM SILL PLATE CONNECTION AND MAXIMUM SPACING <sup>a,b</sup>	AMOUNT OF BRACING FOR EACH WALL LINE <sup>c,d,e</sup>	
		A Combination of Exterior Walls Finished with Portland Cement Plaster and Roofing Using Clay Tile or Concrete Tile Weighing More than 6 psf (287 N/m <sup>2</sup> )	All Other Conditions
One story	1/2 inch (12.7 mm) spaced 6 feet, 0 inch (1829 mm) center-to-center with washer plate	Each end and not less than 50 percent of the wall length	Each end and not less than 40 percent of the wall length
Two stories	1/2 inch (12.7 mm) spaced 4 feet, 0 inch (1219 mm) center-to-center with washer plate; or 5/8 inch (15.9 mm) spaced 6 feet, 0 inch (1829 mm) center-to-center with washer plate	Each end and not less than 70 percent of the wall length	Each end and not less than 50 percent of the wall length
Three stories	5/8 inch (15.9 mm) spaced 4 feet, 0 inch (1219 mm) center-to-center with washer plate	100 percent of the wall length <sup>f</sup>	Each end and not less than 80 percent of the wall length <sup>f</sup>

Table credit: IEBC/CEBC



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Step 5 addresses size and spacing of anchorage between the wood foundation sill plate and the foundation. Required foundation sill plate anchor spacing is determined per second column of Table A3-A, depending on the number of stories above. This anchorage requirement may be met using a combination of existing and new bolts.

Table credit: IEBC/CEBC

# CEBC Chapter A3 Rehabilitation Plans

## STEP 5 – ANCHOR SPACING (continued)

Number of anchor bolts (or alternate connectors) per sill section must meet requirements of Table A3-B:

TABLE A3-B—SILL PLATE ANCHORAGE FOR VARIOUS LENGTHS OF SILL PLATE<sup>a,b</sup>

NUMBER OF STORIES	LENGTHS OF SILL PLATE		
	Less than 12 feet (3658 mm) to 6 feet (1829 mm)	Less than 6 feet (1829 mm) to 30 inches (762 mm)	Less than 30 inches footnote (762 mm) <sup>c</sup>
One story	Three connections	Two connections	One connection
Two stories	Four connections for 1/2-inch (12.7 mm) anchors or bolts or Three connections for 5/8-inch (15.9 mm) anchors or bolts	Two connections	One connection
Three stories	Four connections	Two connections	One connection

a. Connections shall be either chemical anchors or expansion bolts.

b. See Section A304.3.2 for minimum end distances.

c. Connections shall be placed as near to the center of the length of plate as possible.

Table credit: IEBC/CEBC



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In addition to the spacing requirements of Table A3-A, the number of anchor bolts per section of sill needs to meet the requirements of Table A3-B.

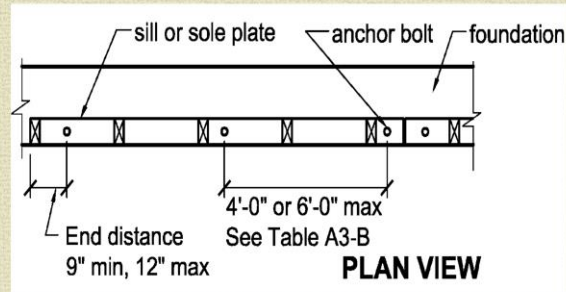
Table credit: IEBC/CEBC

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### STEP 5 – ANCHOR SPACING (continued)

Placement: start between 9" and 12" from end of sill, place in center of stud bay closest to required spacing.

**RECOMMEND:**  
Show new anchor locations on retrofit plan.



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This illustration shows a plan view of a foundation and foundation sill plate. End and center to center distances for anchor bolts are shown. See Chapter A3 Section A304.3.2.

It is recommended to show new anchor locations on the retrofit plan.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 6 SELECT FOUNDATION SILL PLATE ANCHORAGE DETAILS (A304.3)

Anchor as in Figure A3-3 if cripple walls exist and if height allows for use of rotary hammer



Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225).

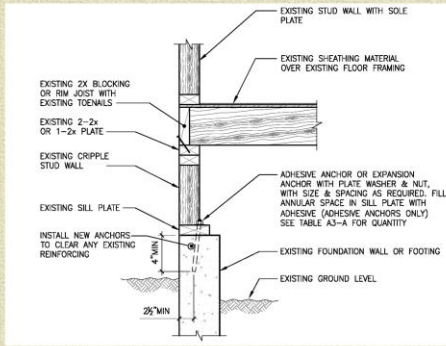


Figure credit: IEBC/CEBC



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Step 6 addresses selection of foundation sill plate anchorage details.

Where sufficient height exists, the simplest anchorage approach is to install anchor bolts using adhesive or expansion anchors. The anchor hole needs to be installed using a rotary hammer, which requires significant height at the cripple wall. For moderate and low wall heights, alternate details are usually used. Steel plate washers are required at each anchor bolt in the foundation sill plate.

Sill bolts and bolting plates should always be galvanized, because of the damp under dwelling environment. Steel plate washers 3x3x0.229 inches are required on new anchor bolts. See Figure footnotes. Addition of plate washers on existing bolts is recommended where possible, but not required.

Figure credit: IEBC/CEBC

Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225). Anchor bolt installed in existing foundation, where sufficient room existed.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 6 – ANCHOR DETAILS (continued)

Alternate anchorage connector used where existing conditions did not allow for installation of anchor bolts

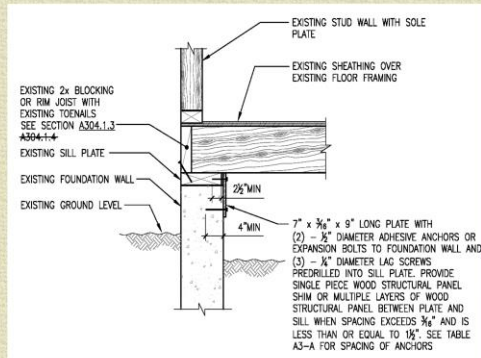


Figure credit: IEBC/CEBC



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Step 6. This photo shows an alternate anchorage connector. Conditions did not allow for installation of anchor bolts. This is an alternate connection from wood dwelling to foundation. Per Section A304.3.4.1 the spacing of these connectors is to be the same as specified by Table A3-3 for anchor bolts.

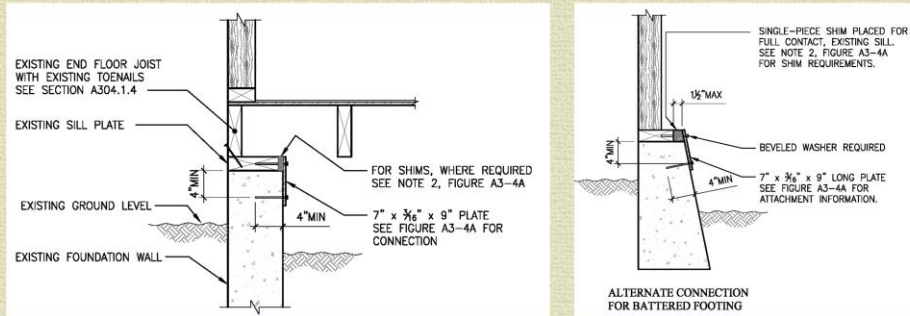
Figure credit: IEBC/CEBC

Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)

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### STEP 6 – ANCHOR DETAILS (continued)

If no cripple walls exist or if height is inadequate, use alternate connectors, as shown in Figs. A3-4A to A3-4C



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Step 6. These figures show alternate details for anchorage to the foundation.

Figure credits: IEBC/CEBC

## CEBC Chapter A3 Rehabilitation Plans

### STEP 7

#### VERIFY RIM JOIST, BLOCKING AND CONNECTION (A304.1.3 & A304.1.4)

*Joists perpendicular to cripple wall:*

**1 & 2-stories** - must have continuous rim joist, **or** blocking in alternate joist bays

**3-stories** - must have continuous rim joist, **or** blocking in all bays



Photo credit: Kelly Cohen



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Step 7 addresses the connection between the floor framing and the cripple wall top plates (where a cripple wall is present) or foundation sill plate (where cripple walls are not present).

Where floor joists are perpendicular to the foundation, this involves two considerations. First, the presence of rim joists or blocking within the floor depth, and second, the fastening from the rim joist or blocking to the top plates or foundation sill plate.

Where floor joists are perpendicular to the foundation, you need:

1. In a 1 or 2 story dwelling, you must have a continuous rim joist or full depth blocking in alternate bays
2. In a 3 story building, you must have a continuous rim joist or full depth blocking in all bays.

This photo shows cripple wall, joists perpendicular to wall and existing blocking between the joists. Close examination can determine whether or not there is an existing rim joist or existing blocking at the perimeter.

Photo credit: Kelly Cobeen.



## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

#### ***Floor joists perpendicular to foundation:***

Where required rim joist or blocking does not exist, add plywood blocking panel (as per Figure A3-9)

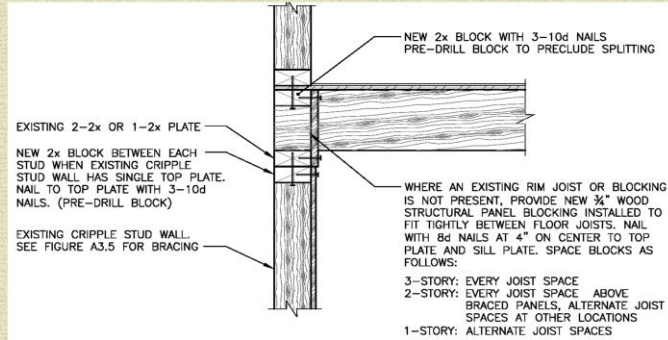


Figure credit: IEBC/CEBC



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In circumstances where rim joist or blocking is required but not existing, provide wood structural panel blocking in accordance with Figure A3-9.

Figure credit: IEBC/CEBC

## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

*Floor joists perpendicular to foundation:*

#### In 2 & 3-stories:

Verify that connection of rim joist or blocking to foundation sill plate or cripple wall top plate meets required minimum.

If not, then retrofit with framing clip (as per Figure A3-8A).



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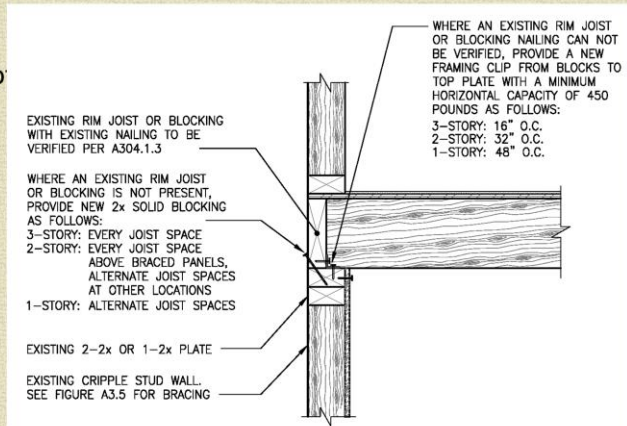


Figure credit: IEBC/CEBC

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In 2 & 3 story buildings where floor joists are perpendicular to the foundation, the connection of the rim joist or blocking to the foundation sill plate or cripple wall top plate must be verified to be a minimum of 8d toenails at 6 in. for rim joist or 3-8d per block, or retrofit with framing clip in accordance with Figure A3-8A.

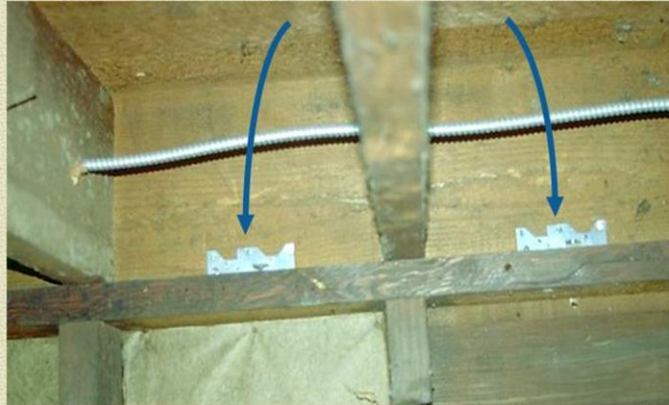
It is often difficult to locate existing nails (if present) because some or all of them may have been driven from the exterior face of the wall. As a result it is common for new framing clips to be provided.

Figure credit: IEBC/CEBC

## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

*Floor joists perpendicular to foundation:*



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Where floor joists are perpendicular to the foundation

The photo shows clips installed from top plates to blocking as an alternate to toe-nails. The angle clips shown are equivalent to the generic clip shown in the figure.

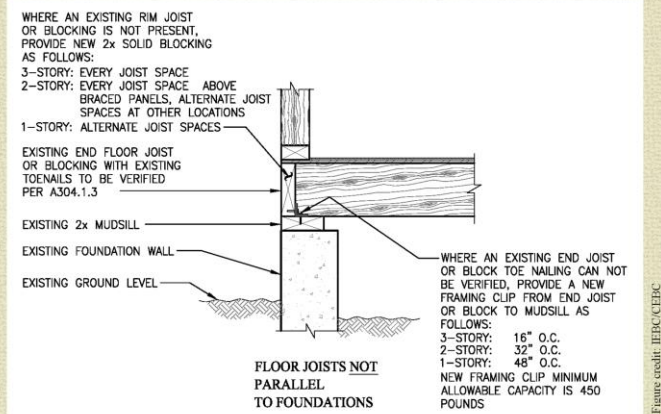
Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)

## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

#### *Floor joists perpendicular to foundation:*

Applies whether a cripple wall exists, or floor joists are supported on a concrete or masonry stem wall (as per Figure A3-8C).



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Figure credit: IEBC/CEBC

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In 2 & 3 story buildings, where floor joists are perpendicular to the foundation the connection of the rim joist or blocking is applicable whether framing is supported on a cripple wall for concrete or masonry stem wall. Figure A3-8C shows connection of rim joists or blocking to the foundation sill plate.

Figure credit: IEBC/CEBC



## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

***Floor joists parallel to foundation:***

End joist must be:

- Located over foundation
- In contact with foundation sill plate or cripple wall top plates
- Continuous except for ventilation/ access openings



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At the sides of the dwelling where floor joists are parallel to the foundation, additional items need to be considered. The end joist or rim joists must be

-located over the foundation

-in contact with the foundation sill plate or cripple wall top plate

-continuous except for access and ventilation openings

This photo shows an existing continuous rim joist parallel to the foundation sitting on a foundation sill plate. Standard floor joist blocking appears at the right hand side.

Photo credit: Kelly Cobein

## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

#### *Floor joists perpendicular to foundation:*

Provide wood structural panel blocking (as per Figure A3-9), where required end joist is not adequately installed.

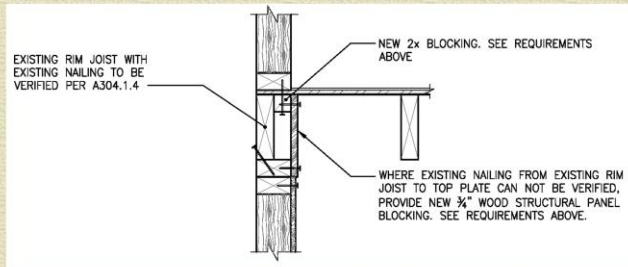


Figure credit: IEBC/CEBC



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Where the required end joist is not adequately installed, provide wood structural panel blocking in accordance with Figure A3-9.

Figure credit: IEBC/CEBC

## CEBC Chapter A3 Rehabilitation Plans

### STEP 7 – RIM JOIST, BLOCKING (continued)

#### *Floor joists parallel to foundation:*

2 & 3-stories:

Verify that connection of end joist to foundation sill plate or cripple wall top plate meets required minimum

If not, then rehabilitate with framing clip (as per Figure A3-8B)

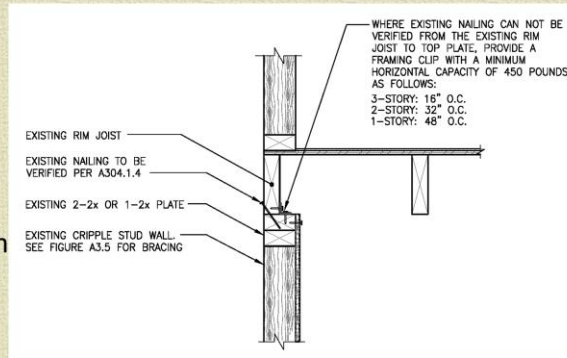


Figure credit: IEBC



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In addition, In 2 & 3 story buildings where floor joists are parallel to the foundation, the connection of the end joist to the foundation sill plate or cripple wall top plate must be:

- Verified to be a minimum of 8d toenails at 6 in., or
- Rehabilitate with framing clip in accordance with Figure A3-8B

Again, it is common to have to provide framing clips because existing toenails cannot be verified.

Figure credit: IEBC

# CEBC Chapter A3 Rehabilitation Plans

## STEP 8

### IDENTIFY DISTRIBUTION AND AMOUNT OF BRACING (A304.4.2)

Amount of cripple wall bracing - must meet requirements of Table A3-A

TABLE A3-A—SILL PLATE ANCHORAGE AND CRIPPLE WALL BRACING			
NUMBER OF STORIES ABOVE CRIPPLE WALLS	MINIMUM SILL PLATE CONNECTION AND MAXIMUM SPACING <sup>a, b</sup>	AMOUNT OF BRACING FOR EACH WALL LINE <sup>c, d, e</sup>	
		A Combination of Exterior Walls Finished with Portland Cement Plaster and Roofing Using Clay Tile or Concrete Tile Weighing More than 6 psf (287 N/m <sup>2</sup> )	All Other Conditions
One story	1/2 inch (12.7 mm) spaced 6 feet, 0 inch (1829 mm) center-to-center with washer plate	Each end and not less than 50 percent of the wall length	Each end and not less than 40 percent of the wall length
Two stories	1/2 inch (12.7 mm) spaced 4 feet, 0 inch (1219 mm) center-to-center with washer plate; or 5/8 inch (15.9 mm) spaced 6 feet, 0 inch (1829 mm) center-to-center with washer plate	Each end and not less than 70 percent of the wall length	Each end and not less than 50 percent of the wall length
Three stories	5/8 inch (15.9 mm) spaced 4 feet, 0 inch (1219 mm) center-to-center with washer plate	100 percent of the wall length <sup>f</sup>	Each end and not less than 80 percent of the wall length <sup>f</sup>

Table credit: IEBC/CEBC



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Step 8. The amount of required cripple wall bracing is determined using CEBC Table A3-A, columns 3 & 4.

Table credit: IEBC/CEBC



## CEBC Chapter A3 Rehabilitation Plans

### STEP 8 – BRACING AMOUNT (continued)

#### Requirements for Bracing (Amount)

- Meet requirements of Figure A3-10
- Plywood or OSB panel meet required dimensions
- Obstructions?
  - Locate as close as possible to intended location
  - Cannot reduce total amount of bracing
- If requirements cannot be met, requires design by engineer or architect



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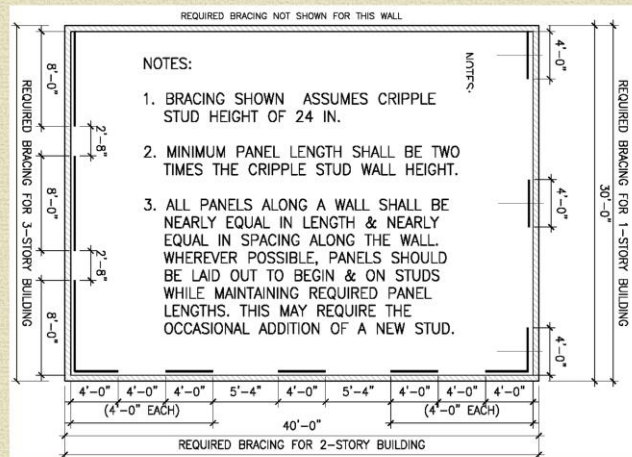
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Step 8. In addition to meeting the required percent of wall length per Table A3-A, the requirements of Table A3-10 for distribution and amount of bracing must be met.

Where these requirements cannot be met, design by an engineer or architect is required

## CEBC Chapter A3 Rehabilitation Plans

### STEP 8 – BRACING AMOUNT (continued)



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In addition, the following are required for bracing:

1. Must have a width not less than two times the sheathing height.
2. Install bracing as close as possible to the intended location, where obstructions occur.

When the requirements for bracing cannot be met, an engineered design will be required.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 9

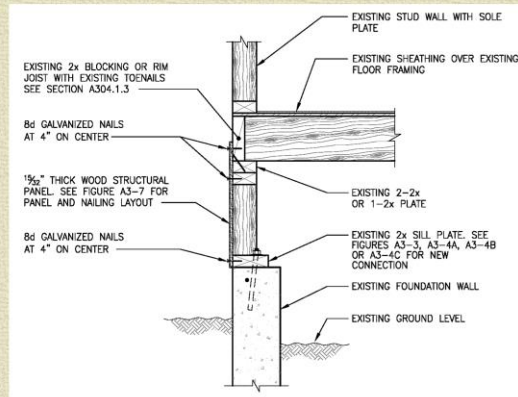
#### SELECT DETAILS OF CRIPPLE WALL BRACING (A304.4.1)

##### Cripple wall bracing detailing requirements:

Conform to Figures A3-5  
(exterior sheathing)

or

A3-6 (interior sheathing) and  
A3-7.



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Step 9 addresses detailing of cripple wall bracing.

Figure A3-5 shows cripple wall sheathing applied on the exterior face of the cripple wall. Exterior wall finish materials would have to be removed to allow this placement, and reinstalled afterwards.

Figure credit: IEBC/CEBC

## CEBC Chapter A3 Rehabilitation Plans

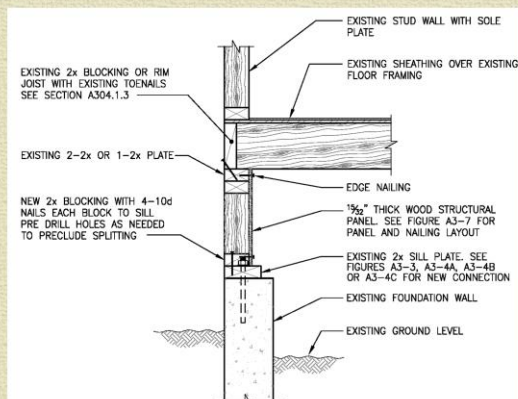
### STEP 9 – BRACING DETAILS (continued)

#### Cripple wall bracing detailing requirements:

Conform to Figures A3-5  
(exterior sheathing)

or

A3-6 (interior sheathing) and  
A3-7.



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Figure A3-6 shows cripple wall sheathing placed on the interior face of the cripple wall. This is the most common placement.

The detail also shows a condition in which the foundation sill plate is wider than the studs. As a result, plywood sheathing installed on the interior face of the studs stops on top of the foundation sill plate. In this case, the bottom edge of the plywood is nailed to plywood blocking between the studs. Nailing of the blocking is specified. An alternate approach cuts the foundation sill plate, flush with the face of the studs.

Figure credit: IEBC/CEBC

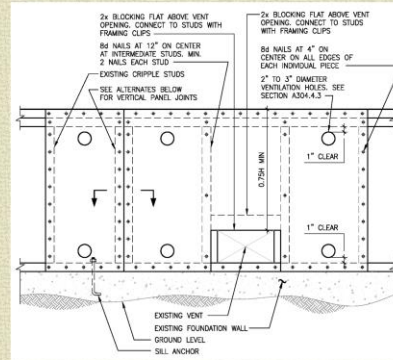
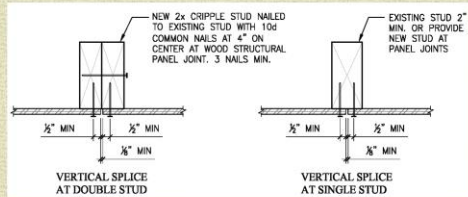


# CEBC Chapter A3 Rehabilitation Plans

## STEP 9 – BRACING DETAILS (continued)

### Cripple wall bracing detailing requirements:

Conform to Figures A3-5 (exterior sheathing) or A3-6 (interior sheathing) and A3-7



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Figure A3-7 shows additional details of cripple wall bracing that must be used with either detail A3-5 or A3-6.

Alternate details for vertical joint at abutting plywood panels:

1. Install with 1/8" gap between abutting panels to allow for expansion with moisture change.
2. 2-2x studs or 3x studs are alternatives.

Vent holes are required to mitigate moisture build-up in stud cavities. Rodent screens on vent holes are suggested.

Figure credit: IEBC/CEBC

## CEBC Chapter A3 Rehabilitation Plans

### STEP 9 – BRACING DETAILS (continued)

#### Cripple wall bracing detailing requirements:

- Sheathing (min. 15/32" thickness)
- Vertical edges must
  - fall on existing studs
  - be installed with 1/8" gap between sheathing panels, or
  - be installed on doubled studs (as per Fig. A3-7)

#### All other sheathing edges must

- be blocked (2"x4" minimum)
- with 4" face installed flat against sheathing



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15/32" plywood/OSB sheathing is a practical thickness to use for cripple wall bracing. Thicker sheathing does not hurt to use, but it does not significantly improve performance either (nail bending is predominant behavior).

Sheathing with exterior exposure rating is highly recommended.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 9 – BRACING DETAILS (continued)

#### Cripple wall bracing detailing requirements:

##### Sheathing nailing -

- 8d common nails, min 1-1/2" penetration into framing
- at 4" on center at sheathing edges
- at 12" at other framing
- driven flush with sheathing surface
- do not break sheathing face
- if nail breaks face, add nail halfway between existing nails and hand-drive flush



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Sheathing nailing must be:

- a. 8d common nails with a minimum 1-1/2" penetration into framing
- b. at 4" on center at sheathing edges
- c. at 12" on center at other framing members
- d. driven flush with sheathing surface
- e. do not break sheathing face with the nails
- f. if nail breaks face, add another nail halfway between existing nails and hand-drive flush

## CEBC Chapter A3 Rehabilitation Plans

### STEP 9 – BRACING DETAILS (continued)



Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)



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This photo provides a good opportunity to review the full scope of retrofit, from anchor bolts up: here we can see the foundation sill with anchor bolts, the sheathing, replaced decayed members, and flat clips to new plywood blocking.

Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)



## CEBC Chapter A3 Rehabilitation Plans

### STEP 10 VERIFY VENTILATION, ACCESS AND FLOOD OPENINGS (A304.4.1 & A304.4.4)

**Cripple wall bracing, blocking must allow for ventilation, access and flood openings:**

- Where sheathing is installed on inside face - See [A304.4.3](#) requirements for stud bay ventilation (See also Fig. A3-7)
- See [A304.4.4](#) requirements for under floor ventilation (See also Fig. A3-7)
- See [A304.4.4](#) requirements for flood vents
- Maintain required access openings



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### Step 10. Verify ventilation, access and flood openings

Cripple wall bracing and blocking must allow for ventilation, access and flood openings. Where sheathing is installed on the inside face, see A304.4.3 requirements for stud bay ventilation. See A304.4.4 requirements for under floor ventilation. See A304.4.4 requirements for flood vents. Maintain required access openings.

## CEBC Chapter A3 Rehabilitation Plans

### STEP 10 – OPENINGS (continued)



Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)



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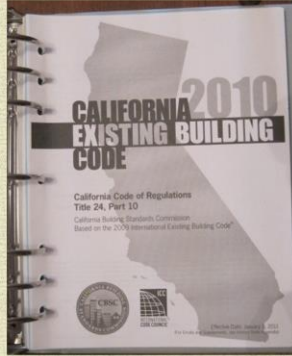
This photo points out vents into the dwelling's crawlspace.

Photo credit: Seismic Retrofit Training for Building Contractors and Inspectors (FEMA G225)

## CEBC Chapter A3 Rehabilitation Plans

### STEP 11 QUALITY CONTROL (A304.5)

CEBC Section A304.5 lists minimum required inspections



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Step 11 - Building department minimum required inspections are listed as:

1. Placement and installation of adhesive and expansion anchors
2. Installation and nailing of cripple wall bracing
3. Work may be specified by the building department, such as requiring special inspection

## CEBC Chapter A3 Rehabilitation Plans

### OTHER NOTES

Steps 1-11 address the primary steps identified in CEBC Appendix Chapter A3. See the chapter for additional details.

### References

This section is drawn primarily from CEBC provisions, FEMA G225 *Seismic Retrofit Training*, and ATC-48 *Built to Resist Earthquakes*.

The ICC commentary to CEBC provides detailed explanations of Appendix Chapter A3 requirements, along with many applicable recommendations and cautions.



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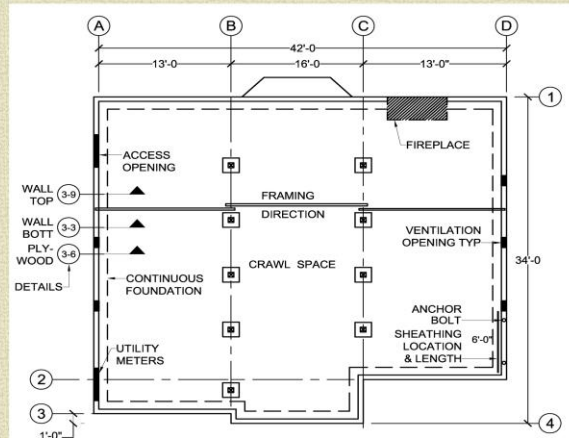
Steps 1-11 address the primary steps identified in CEBC Appendix Chapter A3.

The ICC commentary to IEBC provides detailed explanations of Appendix Chapter A3 requirements, along with many applicable recommendations and cautions.



## CEBC Chapter A3 Rehabilitation Plans

### RETROFIT PLAN



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This figure shows ways to indicate anchor bolt locations and length of new sheathing (right hand side) and details for wall top (connection to rim joist or blocking), wall sheathing, and detail for wall bottom (anchor bolts, etc.).

Note that examples are shown in limited locations, not throughout the structure.

## CEBC Chapter A3 Rehabilitation Plans

### Other Prescriptive Resources

- Seattle Project Impact *Home Earthquake Retrofit Series*
- City of Los Angeles – *Earthquake Hazard Reduction in Existing Wood Frame Residential Buildings with Weak Cripple Wall and Unbolted Sill Plates, Standard Plan Number One*
- City of San Leandro – Residential retrofit handbook and plan set
- Committee of East Bay and Peninsula Chapters of ICC – Plan Set A, Residential Seismic Strengthening Plan  
(available online at **www.abag.org**)



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IEBC Appendix Chapter A3 has been presented here, because it is a national model code. Other resources have been developed by local communities. Some of those resources include:

- Seattle Project Impact *Home Earthquake Retrofit Series: 1. Overview, 2. How to Complete the Home Assessment Checklist, 3. Guide to Completing An Earthquake Retrofit Plan for Wood-Framed Residential Buildings*
- City of Los Angeles – *Earthquake Hazard Reduction in Existing Wood Frame Residential Buildings with Weak Cripple Wall and Unbolted Sill Plates, Standard Plan Number One*
- City of San Leandro – Residential retrofit handbook, residential retrofit plan set.
- Committee of East Bay and Peninsula Chapters of ICC – Plan Set A, Residential Seismic Strengthening Plan, available on the ABAG web site [www.abag.org](http://www.abag.org)

# **CEBC Chapter A3 Seismic Rehabilitation Plans**

## **Part 5 Quiz**



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You have completed part 5 of the educational module.

Contractor's please return to the contractor dashboard to take a short quiz.