

**Appendix A**  
**ANGELES**

**CITY OF LOS**  
**PRESCRIPTIVE STANDARD**



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**CHAPTER 92****VOLUNTARY - EARTHQUAKE HAZARD REDUCTION  
IN EXISTING WOOD FRAME RESIDENTIAL BUILDINGS  
WITH WEAK CRIPPLE WALLS AND UNBOLTED SILL PLATES****SECTION 9201 c GENERAL**

**9201.1 Purpose.** The provisions of this Chapter are intended to promote public safety and welfare by reducing the risk of earthquake-induced damage to existing wood-framed residential buildings. The voluntary minimum standards contained in this Chapter shall substantially improve the seismic performance of these residential buildings but will not necessarily prevent all earthquake damage. When fully followed, these standards will strengthen the portion of the structure that is most vulnerable to earthquake damage.

Prior to 1960, most wood frame residential buildings were built with raised wood floors supported by short wood stud walls known as cripple walls. These cripple walls are typically braced with weak seismic materials such as portland cement plaster or horizontal wood siding. In addition, wood frame buildings built under building codes in effect prior to July 1938 were not required to be bolted to their foundations. Recent earthquakes have shown that if a building has weak cripple walls or is unbolted, it may fall off its foundation even in moderate earthquakes. Fallen buildings have collapsed, caught fire or needed extensive repairs to restore their occupancy.

This Chapter sets prescriptive standards for strengthening of underfloor enclosures that shall be permitted by the Superintendent of Building without requiring plans or calculations prepared by an architect or an engineer. This Chapter also provides a design standard for the use of alternate materials or an alternate method of construction in lieu of the prescriptive standards. Construction documents for strengthening using alternate materials or methods shall be prepared by an architect or engineer.

**9201.2 Scope.** The provisions of this Chapter may be applied to light wood frame Group R, Division 1 and Division 3 Occupancies with no more than four dwelling units when they contain one or more of the structural weaknesses specified in Section 9203.1.

The provisions of this Chapter do not apply to the buildings or elements thereof, listed below. These buildings or elements require analysis by an engineer or architect in accordance with Chapter 16 or other approved standards to determine appropriate strengthening.

1. Buildings with a lateral force resisting system using poles or columns embedded in the ground.
2. Cripple walls that exceed four feet (1234 mm) in height.
3. Buildings exceeding three stories in height and any three-story building with cripple wall studs exceeding 14 inches (360 mm) in height.
4. Buildings, or portions thereof, constructed on a concrete slab on grade or constructed on or into a slope steeper than three horizontal to one vertical.
5. Buildings where the Superintendent of Building determines that conditions exist that are beyond the scope of the requirements of this Chapter.

The standard details approved by the Superintendent of Building and these prescriptive provisions are not intended to be the only acceptable strengthening methods permitted. Alternate details and methods shall be permitted when approved by the Superintendent of Building. Qualified Historical Buildings shall be permitted to use alternate building regulations or deviations from this Chapter in order to preserve their original or restored architectural elements and features. See Chapter 84 for these standards.

**9201.3 Alternative Design Procedures.** When analysis by an engineer or architect is required or provided for a building within the scope of this Chapter, such analysis shall be in accordance with all requirements of this Code except as provided in this Chapter. The design shall provide strengthening for any structural weakness listed in

Section 9203 that is at least equivalent to that provided by the prescriptive requirements of this Chapter with respect to strength, deflection, and capacity. The Superintendent of Building may require that sufficient evidence be submitted to substantiate such equivalence. The base shear may be determined in accordance with the following:

### SECTION 9202 c DEFINITIONS

For the purpose of this Chapter, in addition to the applicable definitions, symbols and notations in this Code, certain additional terms are defined as follows:

**ADHESIVE ANCHOR** is a fastener placed in hardened concrete or masonry that derives its holding strength from a chemical adhesive compound placed between the wall of the hole and the embedded portion of the anchor.

**ANCHOR SIDE PLATE** is a metal plate or plates used to connect a sill plate to the side of a concrete or masonry stem wall.

**CRIPPLE WALL** is a wood-framed stud wall extending from the top of the foundation to the underside of the lowest floor framing.

**EXPANSION ANCHOR** is a mechanical fastener placed in hardened concrete or assembled masonry, designed to expand in a self-drilled or pre-drilled hole of a specified size and engage the sides of the hole in one or more locations to develop shear and/or tension resistance to applied loads without grout, adhesive or drypack.

**PERIMETER FOUNDATION** is a foundation system which is located under the exterior walls of a building.

**SNUG-TIGHT** is as tight as an individual can torque a nut on a bolt by hand using a wrench with a 10-inch (254 mm) long handle and the point at which the full surface of the plate washer is contacting the wood member and slightly indents the wood surface.

**UNREINFORCED MASONRY** includes adobe, burned clay, concrete or sand-lime brick, hollow clay or concrete block, hollow clay tile, rubble, cut stone and unburned clay masonry walls in which the area of reinforcement is less than 50 percent of the minimum steel ratios required for reinforced masonry.

### SECTION 9203 c STRUCTURAL WEAKNESSES

**9203.1 General.** For the purpose of this Chapter, structural weaknesses shall be as specified below.

1. Sill plates or floor framing which are supported directly on the ground without an approved foundation system.
2. A perimeter foundation system which is constructed of wood posts supported on isolated pad footings.
3. Perimeter foundation systems that are not continuous.

**EXCEPTIONS:** A. Existing single-story exterior walls not exceeding 10 feet (3084 mm) in length forming an extension of floor area beyond the line of an existing continuous perimeter foundation.

B. Porches, storage rooms and similar spaces not containing fuel-burning appliances.

4. A perimeter foundation system which is constructed of unreinforced masonry.
5. Sill plates which are not connected to the foundation or are connected with less than what is required by Section 9204.3.1.
6. Cripple walls that are not braced in accordance with the requirements of Section 9204.4 and Table 92-A.

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## SECTION 9204 c STRENGTHENING REQUIREMENTS

### 9204.1 General.

**9204.1.1 Scope.** The structural weaknesses noted in Section 9203 shall be strengthened in accordance with the requirements of this section. Strengthening work shall be allowed to include both new construction and alteration of existing construction. Except as provided herein, all strengthening work and materials shall comply with the applicable provisions of this Code. Alternate methods of strengthening shall be allowed provided such systems are designed by an engineer or architect and approved by the Superintendent of Building.

**9204.1.2 Condition of Existing Wood Materials.** All existing wood materials which will be a part of the strengthening work shall be in a sound condition and free from defects which substantially reduce the capacity of the member. Any wood material found to contain fungus infection shall be removed and replaced with new material. Any wood material found to be infested with insects or to have been infested shall be strengthened or replaced with new materials to provide a net dimension of sound wood at least equal to its undamaged original dimension.

**9204.1.3 Floor Joists Not Parallel to Foundations.** Floor joists framed perpendicular or at an angle to perimeter foundations shall be restrained by either a nominal two-inch (51 mm) wide continuous rim joist or a nominal two-inch (51 mm) wide full depth blocking between alternate joists in one- and two-story buildings, and between each joist in three-story buildings. Blocking for multistory buildings must occur at each joist space above a braced cripple wall panel.

Existing connections at the top edge of an existing rim joist or blocking need not be verified. The bottom edge connection to either the foundation sill plate or top plate of a cripple wall shall be verified unless a supplemental connection is provided. The minimum existing bottom edge connection shall consist of 8d toe nails spaced six inches (152 mm) apart for a continuous rim joist or three 8d toe nails per block. When this minimum bottom edge connection is not present, or is not verified, a supplemental connection shall be provided.

When an existing continuous rim joist or the minimum existing blocking does not occur, new 1c inch (29 mm) wood structural panel blocking installed tightly between floor joists and nailed with 10d common nails at four inches on center to the sill or wall top plate shall be provided at the inside face of the cripple wall. In lieu of 1c inch (29 mm) wood structural panel blocking, tight fitting, full or near full depth two inches nominal width (51 mm) lumber blocking shall be allowed provided it does not split during installation. New blocking is not required where it will interfere with vents or plumbing which penetrates the wall.

**9204.1.4 Floor Joists Parallel to Foundations.** Where existing floor joists are parallel to the perimeter foundations, the end joist shall be located over the foundation and, except for required ventilation openings, shall be continuous and in continuous contact with any existing foundation sill plate or top plate of the cripple wall. Existing connections at the top edge connection of the end joist need not be verified; however, the bottom edge connection to either the foundation sill plate or the top plate of a cripple wall shall be verified unless a supplemental connection is provided. The minimum bottom edge connection shall be 8d toe nails spaced six inches (152 mm) apart. If this minimum bottom edge connection is not present or is not verified, a supplemental connection shall be provided.

**9204.1.5 Supplemental Connections.** Supplemental connections shall provide sufficient strength to transfer the seismic forces. Framing anchors of minimum 18 gauge steel and 12 approved fasteners may be considered to meet this requirement when spaced 32 inches (813 mm) on center for one story buildings, 24 inches (610 mm) on center for two story buildings and 16 inches (406 mm) on center for three story buildings.

**EXCEPTION:** A supplemental connection is not required when:

1. The structural wood panel sheathing extends from the sill plate to the rim joist or blocking above.
2. The floor sheathing is nailed directly into the sill or top plate of the cripple wall.

**9204.1.6 Single Top Plate Ties.** When a single top plate exists in the cripple wall, all end joints in the top plate shall be tied. Ties shall be connected to each end of the discontinuous top plate and shall be equal to one of the following:

1. 3-inch by 6-inch (76 mm by 152 mm) by 0.036-inch-thick (0.9 mm) galvanized steel and nailed with six 8d nails at each end.
2. 1 2 inches (38 mm) by 12-inch (305 mm) by 0.058 inches (1.47 mm) galvanized steel nailed with six 16d nails at each end.
3. 2-inch by 4-inch by 12-inch wood blocking nailed with six 16d nails at each end.

### **9204.2 Foundations.**

**9204.2.1 New Perimeter Foundations.** New perimeter foundations shall be provided for structures with the structural weaknesses noted in Items 1 and 2 of Section 9203.1. Soil investigations or geotechnical studies are not required for this work unless the building shows signs of excessive settlement or creep.

**9204.2.2 Foundation Evaluation by Engineer or Architect.** Partial perimeter foundations or unreinforced masonry foundations shall be evaluated by an engineer or architect for the force levels noted in Formula (92-1). Test reports or other substantiating data to determine existing foundation material strengths shall be submitted for review. When approved by the Superintendent of Building, these foundation systems may be strengthened in accordance with the recommendations included with the evaluation in lieu of being replaced.

**EXCEPTION:** In lieu of testing existing foundations to determine material strengths and when approved by the Superintendent of Building, a new nonperimeter foundation system, designed for the forces noted in Formula (92-1), may be used to resist all exterior wall lateral forces.

**9204.2.3 Details for New Perimeter Foundations.** All new perimeter foundations shall be continuous and constructed according to the standards for new buildings.

**EXCEPTIONS:**

1. When approved by the Superintendent of Building, the existing clearance between existing floor joists or girders and existing grade below the floor need not comply with Section 2317.3. This exception shall not be permitted when buildings are relocated on new foundations.
2. When approved by the Superintendent of Building, and when designed by an engineer or architect, partial perimeter foundations may be used in lieu of a continuous perimeter foundation.

### **9204.3 Foundation Sill Plate Anchorage.**

**9204.3.1 Existing Perimeter Foundations.** When the building has an existing continuous perimeter foundation, all perimeter wall sill plates shall be connected to the foundation in accordance with Table 92-A and this section.

Anchors shall be installed with the plate washer installed between the nut and the sill plate. The nut shall be tightened to a snug-tight condition after curing is complete for adhesive anchors and after expansion wedge engagement for expansion anchors. The installation of nuts on all anchors shall be subject to verification by the Superintendent of Building. Torque testing shall be performed for 25 percent of all adhesive or expansion anchors. Minimum test values shall be 30 foot pounds (41 N-m) for 2-inch (12.7 mm) and 40 foot pounds (55 N-m) for 1 1/2-inch (15.9 mm) diameter anchors.

Anchor side plates shall be permitted when conditions prevent anchor installation vertically through the sill plate. Anchor side plates shall be spaced as required for adhesive or expansion anchors but only one anchor side plate is required on individual pieces of sill plate less than 32 inches (813 mm) in length. Wood structural panel shims shall be used on sill plates for single plate anchor side plates when the foundation stem wall is from 3/16 inch (4.8 mm) to 3/4 inch (19 mm) wider than the sill plate. The shim length shall extend a minimum of two inches (50.8 mm) past each end of the anchor side plate. Two plate anchor side plates shall be used when the total thickness of the required shim exceeds 3/4 inch (19 mm).

All anchor side plates which use lag or wood screws shall pre-drill the sill plate to prevent splitting as required by Sections 2337.1.2 and 2339.1.2. Lag or wood screws shall be installed in the center of the thickness of the existing sill plate.

Expansion anchors shall not be used in unreinforced masonry or concrete or masonry grout of poor quality. Adhesive anchors shall be required when expansion anchors will not tighten to the required torque or their installation causes surface cracking of the foundation wall.

**9204.3.2 Placement of Anchors.** Anchors shall be placed within 12 inches (305 mm), but not less than nine inches (229 mm), from the ends of sill plates and shall be placed near the center of the stud space closest to the required spacing. New sill plates may be installed in pieces when necessary because of existing conditions. The minimum length of new sill plate pieces shall be 30 inches (762 mm).

**EXCEPTION:** Where physical obstructions such as fireplaces, plumbing or heating ducts interfere with the placement of an anchor, the anchor shall be placed as close to the obstruction as possible, but not less than nine inches (229 mm) from the end of the plate. Center-to-center spacing of the anchors shall be reduced as necessary to provide the minimum total number of anchors required based on the full length of the wall. Center-to-center spacing shall not be less than 12 inches (305 mm).

**9204.3.3 New Perimeter Foundations.** Sill plates for new perimeter foundations shall be anchored as required by Section 1806.6.

#### **9204.4 Cripple Wall Bracing.**

**9204.4.1 General.** Exterior cripple walls, not exceeding four feet (1219 mm) in height, shall use the prescriptive bracing method listed below. Cripple walls more than four feet (1219 mm) in height require analysis by an engineer or architect in accordance with Section 1601.

**9204.4.1.1 Sheathing Requirements.** Wood structural panel sheathing shall not be less than 15/32-inch (12 mm) thick. When used, plywood panels shall be constructed of five or more plies. All wood structural panels shall be nailed with 8d common nails spaced four inches (102 mm) on center at all edges and at 12 inches (305 mm) on center at each intermediate support with not less than two nails for each stud. Nails shall be driven so that their head or crown is flush with the surface of the sheathing and shall penetrate the supporting member a minimum of 12 inch (38 mm). When a nail fractures the surface, it shall be left in place and not counted as part of the required nailing. A new 8d nail shall be located within two inches (51 mm) of the discounted nail and hand driven flush with the sheathing surface.

**EXCEPTION:** No. 6 x 12 inch (38 mm) wood screws may be used for sheathing nailing when bracing materials are installed on the interior face of studs and cement plaster or other brittle finishes are on the exterior of the sheathed wall.

All horizontal joints must occur over nominal two-inch by four-inch (51 mm by 102 mm) blocking installed with the nominal four-inch (102 mm) dimension against the face of the plywood. All vertical joints must occur over studs. Vertical joints at adjoining pieces of wood structural panels shall be centered on existing studs such that there is a minimum 1/8 inch (3.2 mm) between the panels. Nails shall be placed a minimum of 2 inch (12.7 mm) from the edges of the existing stud. When such edge distance cannot be maintained because of the width of the existing stud, a new stud shall be added adjacent to the existing and connected with 16d common nails at eight inches (206 mm) on center. A minimum of three such nails shall be provided.

**9204.4.2 Distribution and Amount of Bracing.** See Table 92-A for the distribution and amount of bracing required. Bracing for a building with three or more floor levels above cripple wall studs exceeding 14 inches (356 mm) in height must be designed in accordance with Chapter 16 of this code.

The braced panel must be at least two times the height of the cripple stud wall but not less than 48 inches (1219 mm) in width. All panels along a wall shall be nearly equal in length and shall be nearly equally spaced along the length of the wall. Braced panels at ends of walls shall be located as near the end as possible.

Where physical obstructions such as fireplaces, plumbing or heating ducts interfere with the placement of cripple wall bracing, the bracing shall then be placed as close to the obstruction as possible. The total amount of bracing required shall not be reduced because of obstructions but the required length of bracing need not exceed the length of the wall.

Underfloor ventilation openings shall be maintained in accordance with Section 2317.7. Braced panels may include underfloor ventilation openings when the height of the solid portion of the panel meets or 75 percent of the height of the cripple stud wall. When the minimum amount of bracing prescribed in Table 92-A cannot be installed due to obstructions along any wall, the bracing must be designed by an architect or engineer in accordance with Section 9201.3.

**9204.4.3 Stud Space Ventilation.** When bracing materials are installed on the interior face of studs forming an enclosed space between the new bracing and existing exterior finish, each braced stud space must be ventilated. Adequate ventilation and access for future inspection shall be provided by drilling on two-inch to three-inch (51 mm to 76 mm) diameter round hole through the sheathing nearly centered between each stud at the top and bottom of the cripple wall. Such holes should be spaced a minimum of one-inch (25 mm) clear from the sill or top plates. In stud spaces containing sill bolts, the hole shall be located on the center line of the sill bolt but not closer than one-inch (25 mm) clear from the nailing edge of the sheathing.

When existing blocking occurs within the stud space, additional ventilation holes shall be placed above and below the blocking or the existing block shall be removed and a new nominal two-inch (51 mm) by four-inch (102 mm) block installed with the nominal four-inch (102 mm) dimension against the face of the plywood. For stud heights less than 18 inches (457 mm) only one ventilation hole need be provided.

**9204.4.4 Existing Underfloor Ventilation.** Existing underfloor ventilation shall not be reduced without providing equivalent new ventilation as close to the existing as possible. New sheathing may be installed around existing vent openings in braced panels when the length of the panel is increased a distance equal to the length of the vent opening or one stud space minimum.

**EXCEPTION:** For residential buildings with a post and pier foundation system where a new continuous perimeter foundation system is being installed, ventilation shall be provided in accordance with this Code.

### SECTION 9205 c QUALITY CONTROL

**9205.1 Inspection by the Department.** All work shall be subject to inspection by the Superintendent of Building including, but not limited to:

1. Placement and installation of new adhesive or expansion anchors or anchor side plates installed in existing foundations.
2. Placement of required blocking and framing anchors.
3. Installation and nailing of new cripple wall bracing.

The torque testing of sill plate anchors per Section 9204.3.1 shall be performed by the building inspector.

**9205.2 Special Inspection.** Special inspection is not required for sill plate anchors installed in existing foundations regulated by the provisions of this Chapter. Any work may be subject to special inspection when required by the Superintendent of Building or when so designated by the architect or engineer of record.

**9205.3 Structural Observation.** Structural observation is not required for work done under the prescriptive provisions of this Chapter. When construction documents for strengthening are prepared by an architect or engineer and alternate materials or methods are used, structural observation shall be provided as required in Section 1702.



**9205.4 Engineer's or Architect's Statement.** When an alternative design is provided per Section 9201.3, the responsible engineer or architect shall place the following statement on the approved plans:

1. I am responsible for this building's seismic strengthening design for the underfloor cripple walls and sill bolting in compliance with the minimum seismic resistance standards of Chapter 92 of the Los Angeles Building Code.

or when applicable:

2. The Registered Deputy Inspector, required as a condition of the use of structural design stresses requiring continuous inspection, will be responsible to me as required by Section 1701.1 of the Los Angeles Building Code.

TABLE 92-A C SILL PLATE ANCHORAGE AND CRIPPLE WALL BRACING<sup>1,2,3</sup>

Number of Stories above Cripple Walls	Minimum Sill Plate Connection and Maximum Spacing	Amount of Wall Bracing
One Story	Adhesive or expansion anchors shall be ½-inch (12.7 mm) minimum diameter spaced at six feet (1829 mm) maximum center to center.	Each end and not less than 50% of the wall length.
Two Story	Adhesive or expansion anchors shall be ½-inch (12.7 mm) minimum diameter spaced at four feet (1219 mm) maximum center to center; or 5/8 inch (15.9 mm) spaced at six feet maximum center to center.	Each end and not less than 70% of the wall length.
Three Story	Adhesive or expansion anchors shall be ½-inch minimum (12.7 mm) diameter spaced at two feet eight inches (813 mm) maximum center to center; or 5/8-inch minimum (15.9 mm) diameter spaced at four feet (1219 mm) maximum center to center.	100% of the wall length.

<sup>1</sup> Plate washers for use with adhesive or expansion anchors shall be two-inch (51 mm) by two-inch (51 mm) by 3/16-inch (4.8 mm) for ½-inch (12.7 mm) diameter anchors and 2½-inch (64 mm) by 2½-inch (64 mm) by 1/4-inch (6 mm) for 5/8 inch (15.9 mm) diameter anchors.

<sup>2</sup> Existing sill plate anchor bolts shall be permitted to provide all or a portion of the sill plate connection requirement if:

- the anchor bolt is cast in concrete and in sound condition, and;
- the diameter size and maximum spacing meets or exceeds the requirements of Table 92-A, and;
- a new plate washer conforming to footnote 1 is installed, and;
- the sill plate is connected to a snug tight condition and torque tested per Section 9204.3.1.

<sup>3</sup> Anchor side plates shall be permitted when conditions prevent anchor installation vertically through the sill plate.

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