

## Los Angeles Municipal Code

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### DIVISION 88

#### EARTHQUAKE HAZARD REDUCTION IN EXISTING BUILDINGS

(Division 88 Added by Ord. No. 159,068, Eff. 7/29/84, Oper. 1/29/85.)

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**SEC. 91.8801. PURPOSE.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

The purpose of this division is to promote public safety and welfare by reducing the risk of death or injury that may result from the effects of earthquakes on unreinforced masonry bearing wall buildings constructed before 1934. Such buildings have been widely recognized for their sustaining of life hazardous damage as a result of partial or complete collapse during past moderate to strong earthquakes.

The provisions of this division are minimum standards for structural seismic resistance established primarily to reduce the risk of loss of life or injury and will not necessarily prevent loss of life or injury or prevent earthquake damage to an existing building which complies with these standards. This division shall not require existing electrical, plumbing, mechanical or fire-safety systems to be altered unless they constitute a hazard to life or property.

This division provides systematic procedures and standards for identification and classification of unreinforced masonry bearing wall buildings based on their current use. Priorities, time periods and standards are also established under which these buildings are required to be structurally analyzed and anchored. Where the analysis determines deficiencies, this division requires the building to be strengthened or demolished.

**SEC. 91.8802. SCOPE.**

The provisions of this division shall apply to all buildings constructed or under construction prior to October 6, 1933, or for which a building permit was issued prior to October 6, 1933, which on the effective date of this ordinance have unreinforced masonry bearing walls as defined herein.

**EXCEPTION:** This division shall not apply to detached one- or two-family dwellings and detached apartment houses containing less than 5 dwelling units and used solely for residential purposes.

**SEC. 91.8803. DEFINITIONS.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

For purposes of this division, the applicable definitions in CBC Sections 1602 and 1613 and the following shall apply:

**ESSENTIAL BUILDING** is any building housing a hospital or other medical facility having surgery or emergency treatment areas, fire or police stations, municipal government disaster operation and communication centers.

**HIGH-RISK BUILDING** is any building not classified as an essential building having an occupant load, as determined by CBC Section 1004.1, of 100 occupants or more.

**EXCEPTION:** A high-risk building shall not include the following:

1. Any building having exterior walls braced with masonry cross walls or wood-frame cross walls spaced less than 40 feet (12 192 mm) apart in each story. Cross walls shall be full-story height with a minimum length of 1 1/2 times the story height.
2. Any building used for its intended purpose, as determined by the Department, for less than 20 hours per week.

**HISTORICAL BUILDING** is any building designated as an historical building by an appropriate federal, state or City jurisdiction.

**LOW-RISK BUILDING** is any building not classified as an essential building having an occupant load as determined by CBC Section 1004.1 of less than 20 occupants.

**MEDIUM-RISK BUILDING** is any building not classified as a high-risk building or an essential building having an occupant load as determined by CBC Section 1004.1 of 20 occupants or more.

**UNREINFORCED MASONRY BEARING WALL** is a masonry wall having all the following characteristics:

1. Provides the vertical support for a floor or roof.
2. The total superimposed load is over 100 pounds per linear foot (1.5 kN/m).
3. The area of reinforcing steel is less than 50 percent of that required by CBC Section 2106.1.

**SEC. 91.8804. RATING CLASSIFICATIONS.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

The rating classifications as exhibited in [Table No. 88-A](#) are hereby established and each building within the scope of this division shall be placed in one rating classification by the Department. The total occupant load of the entire building as determined by CBC Section 1004.1 shall be used to determine the rating classification.

**EXCEPTIONS:**

1. For the purpose of this division, portions of buildings constructed to act independently when resisting seismic forces may be placed in separate rating classifications.
2. For the purpose of this division, to establish the rating classification of a building containing one or more artist in residence spaces, as defined in Section [91.8501](#) of this Code, the occupant load of each artist in residence space shall be one for each space less than 2,000 square feet (186 m<sup>2</sup>) in area and two for each space 2,000 square feet (186 m<sup>2</sup>) or more in area.

**SEC. 91.8805. GENERAL REQUIREMENTS.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

The owner of each building within the scope of this division shall cause a structural analysis to be made of the building by a civil or structural engineer or architect licensed by the state of California, and if the building does not meet the minimum earthquake standards specified in this division, the owner shall cause it to be structurally altered to conform to such standards or cause the building to be demolished.

The owner of a building within the scope of this division shall comply with the requirements set forth above by submitting to the Department for review within the stated time limits:

1. Within 270 days after the service of the order, a structural analysis. Such analysis, which is subject to approval by the Department, shall demonstrate that the building meets the minimum requirements of this division, or
2. Within 270 days after the service of the order, the structural analysis and plans for the proposed structural alterations of the building necessary to comply with the minimum requirements of this division, or
3. Within 120 days after service of the order, plans for the installation of wall anchors in accordance with the requirements specified in Section [91.8808.3](#), or
4. Within 270 days after the service of the order, plans for the demolition of the building.

After plans are submitted and approved by the Department, the owner shall obtain a building permit, and commence and complete the required construction or demolition within the time limits set forth in [Table No. 88-B](#). These time limits shall begin to run from the date the order is served in accordance with Sections [91.8806.1](#) and [91.8806.2](#).

Owners electing to comply with Item 3 are also required to comply with Items 2 and 4, provided, however, that the 270 day period provided for in Items 2 and 4 and the time limits for obtaining a building permit, commencing construction and completing construction for complete structural alterations or building demolition set forth in [Table No. 88-B](#) shall be extended in accordance with [Table No. 88-C](#). Each such extended time limit, except the time limit for commencing construction, shall begin to run from the date the order is served in accordance with Section [91.8806.2](#). The time limit for commencing construction shall commence to run from the date the building permit is issued.

**SEC. 91.8806. ADMINISTRATION.** (Amended by Ord. No. 171,175, Eff. 7/25/96.)

**91.8806.1. Service of Order.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

When the Department determines that a building is within the scope of this division, the owner shall comply with Section [91.8805](#). If the owner does not comply, the Department shall issue an order, as provided in Section [91.8806.2](#), to the owner of each building with the minimum time periods for service of such orders set forth in [Table No. 88-C](#). The minimum time period for the service of such orders shall be measured from the effective date of this division. The Department shall, upon receipt of a written request from the owner, order a building to comply with this division prior to the normal service date for such building as set forth in this section.

**91.8806.2. Contents of Order.** The order shall be in writing and shall be served either personally or by certified or registered mail upon the owner as shown on the last

equalized assessment, and upon the person, if any, in apparent charge or control of the building. The order shall specify that the building has been determined by the Department to be within the scope of this division and, therefore, is required to meet the minimum seismic standards of this division. The order shall specify the rating classification of the building and shall be accompanied by a copy of Section [91.8805](#), which sets forth the owner's alternatives and time limits for compliance.

**91.8806.3. Appeal From Order.** The owner or person in charge or control of the building may appeal the Department's initial determination that the building is within the scope of this division to the Board of Building and Safety Commissioners. Such appeal shall be filed with the Board within 60 days from the service date of the order described in Section [91.8806.2](#). Any such appeal shall be decided by the Board no later than 60 days after the date that the appeal is filed. Such appeal shall be made in writing upon appropriate forms provided therefor by the Department, and the grounds thereof shall be stated clearly and concisely. Each appeal shall be accompanied by a filing fee as set forth in [Table No. 4-A](#) of [Division 4 of Article 8 of Chapter IX](#) of the Los Angeles Municipal Code.

Appeals or requests for slight modifications from any other determinations, orders or actions by the Department pursuant to this division shall be made in accordance with the procedures established in Section [98.0403.2](#) of the Los Angeles Municipal Code.

**91.8806.4. Recordation.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) At the time that the Department serves the aforementioned order, the Department shall file with the Office of the County Recorder a certificate stating that the subject building is within the scope of this division. The certificate shall also state that the owner thereof has been ordered to structurally analyze the building and to structurally alter or demolish it when the Department determines the building is not in compliance with this division.

If the building is either demolished, found not to be within the scope of this division, or is structurally capable of resisting minimum seismic forces required by this division as a result of structural alterations or an analysis, the Department shall file with the Office of the County Recorder a certificate terminating the status of the subject building as being classified within the scope of this division.

**91.8806.5. Enforcement.** If the owner or other person in charge or control of the subject building fails to comply with any order issued by the Department pursuant to this division within any of the time limits set forth in Section [91.8805](#), the Department may order that the entire building or a portion thereof be vacated and that the building or a portion thereof remain vacated until such order has been complied with. If compliance with such order has not been accomplished within 90 days after the date the building has been ordered vacated or such additional time as may have been granted by the Board, the Superintendent may order its demolition in accordance with the provisions of Section [91.8903](#) of this Code.

**SEC. 91.8807. HISTORICAL BUILDINGS.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

Qualified historical buildings shall comply with the requirements of [Division 84](#) and the California Historical Building Code established under Part 8, Title 24 of the California Code of Regulations.

**SEC. 91.8808. ANALYSIS AND DESIGN.** (Amended by Ord. No. 171,175, Eff. 7/25/96.)

**91.8808.1. General.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

Every structure within the scope of this division shall be analyzed and constructed to resist minimum total lateral seismic forces assumed to act non concurrently in the direction of each of the main axes of the structure in accordance with the following formula:

$$V = IKCSW \quad (8-1)$$

The value of *IKCS* need not exceed the values set forth in [Table No. 88-D](#) based on the applicable rating classification of the building.

**91.8808.2. Lateral Forces on Elements of Structures.** (Amended by Ord. No. 172,592, Eff. 6/28/99, Oper. 7/1/99.)

Parts or portions of structures shall be analyzed and designed for lateral loads in accordance with Sections [91.8808.1](#) and 91.1630 of this Code, but not less than the value from the following formula:

$$F_p = IC_pSW_p \quad (8-2)$$

For the provisions of this section, the product of *IS* need not exceed the values as set forth in [Table No. 88-E](#).

**EXCEPTION:** Unreinforced masonry walls in buildings not having a Rating Classification I may be analyzed in accordance with Section [91.8809](#).

The value of *C<sub>p</sub>* need not exceed the values set forth in [Table No. 88-F](#).

**91.8808.3. Anchorage and Interconnection.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

Anchorage and interconnection of all parts, portions and elements of the structure shall be analyzed and designed for lateral forces in accordance with [Table No. 88-F](#) of this Code and Formula (8-2) as modified by [Table No. 88-E](#). Minimum anchorage of masonry walls to each floor or roof shall resist a minimum force of 200 pounds per linear foot (2.92 kN/m) acting normal to the wall at the level of the floor or roof.

**91.8808.4. Level of Required Repair.** Alterations and repairs required to meet the provisions of this division shall comply with all other applicable requirements of this Code unless specifically provided for in this division.

**91.8808.5. Required Analysis.**

**91.8808.5.1. General.** Except as modified herein, the analysis and design relating to the structural alteration of existing structures within the scope of this division shall be in accordance with the analysis specified in [Division 16](#) of this Code.

In addition, the compatibility of the roof diaphragm stiffness with the out-of-plane stability of the unreinforced masonry bearing walls of the story immediately below the roof system shall be verified in accordance with the provisions of Section [91.8811](#).

**EXCEPTION:** Buildings with rigid concrete or steel and concrete roof diaphragms shall use the *h/t* values for “all other buildings” in [Table No. 88-G](#).

**91.8808.5.2. Continuous Stress Path.** A complete, continuous stress path from every part or portion of the structure to the ground shall be provided for the required horizontal forces.

**91.8808.5.3. Positive Connections.** All parts, portions or elements of the structure shall be interconnected by positive means.

## **91.8808.6. Analysis Procedure.**

**91.8808.6.1. General.** Stresses in materials and existing construction utilized to transfer seismic forces from the ground to parts or portions of the structure shall conform to those permitted by the Code and those materials and types of construction specified in Section [91.8809](#).

**91.8808.6.2. Connections.** Materials and connectors used for interconnection of parts and portions of the structure shall conform to the Code. Nails may be used as part of an approved connector.

**91.8808.6.3. Unreinforced Masonry Walls.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.) Except as modified here, unreinforced masonry walls shall be analyzed as specified in the applicable parts of CBC Sections 2106 and 2107 to withstand all vertical loads as specified in [Division 16](#) of this Code in addition to the seismic forces required by this division.

Substantial changes in wall thickness or stiffness shall be considered in the analysis for out-of-plane and in-plane wall stability, and the wall shall be restrained against out-of-plane instability by anchorage and bracing to the roof or floor diaphragm in accordance with LAMC Section [91.8808.3](#).

**EXCEPTION:** Variations in wall stiffness caused by nominal openings such as windows and exit doors need not be considered. The 50 percent increase in the seismic force factor for shear walls as specified in CBC Section 2106.5.1 may be omitted in the computation of seismic loads to existing shear walls.

No allowable tension stress will be permitted in unreinforced masonry walls. Walls not capable of resisting the required design forces specified in this division shall be strengthened or shall be removed and replaced.

### **EXCEPTIONS:**

1. Unreinforced masonry walls in buildings not classified as a Rating Classification I pursuant to [Table No. 88-A](#) may be analyzed in accordance with LAMC Section [91.8809](#).

2. Unreinforced masonry walls which carry no design loads other than their own weight may be considered as veneer if they are adequately anchored to new supporting elements.

## **91.8808.7. Combination of Vertical and Seismic Forces.**

**91.8808.7.1. New Materials.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.) All new materials introduced into the structure to meet the requirements of this section, which are subjected to combined vertical and horizontal forces, shall comply with CBC Section 1605.

**91.8808.7.2. Existing Materials.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.) When stresses in existing lateral force-resisting elements are due to a combination of dead and live loads plus seismic loads, the allowable working stress specified in the Code may be increased 100 percent. However, no increase will be permitted in the stresses allowed in LAMC Section [91.8809](#), and the stresses in members due only to seismic and dead loads shall not exceed the values permitted by CBC Section 1605.

**91.8808.7.3. Allowable Reduction of Bending Stress by Vertical Load.** In calculating tensile fiber stress due to seismic forces required by this division, the

maximum tensile fiber stress may be reduced by the full direct stress due to vertical dead loads.

**91.8808.8. Irregular Features.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

All structures having any of the irregular features described in Table 12.3-1 or Table 12.3-2 of ASCE-7 shall be designated to meet the additional requirements of those sections referenced in the tables.

**SEC. 91.8809. MATERIALS OF CONSTRUCTION.** (Amended by Ord. No. 171,175, Eff. 7/25/96.)

**91.8809.1. General.** All materials permitted by this Code, including their appropriate allowable stresses and those existing configurations of materials specified herein, may be utilized to meet the requirements of this division.

**91.8809.2. Existing Materials.**

**91.8809.2.1. General.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) Unreinforced masonry walls analyzed in accordance with this section may provide vertical support for roof and floor construction and resistance to lateral loads.

All units of both bearing and nonbearing walls shall be laid with full shoved mortar joints; all head, bed and wall (collar) joints shall be solidly filled with mortar; and the bonding of adjacent wythes of multiwythe walls shall be as follows:

The facing and backing shall be bonded so that not less than 4 percent of the wall surface of each face is composed of headers extending not less than four inches (102 mm) into the backing. The distance between adjacent full-length headers shall not exceed 24 inches (610 mm) either vertically or horizontally. In walls in which a single header does not extend through the wall, headers from the opposite sides shall overlap at least four inches (102 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least four inches (102 mm).

Wythes of walls not bonded as described above shall be considered as veneer. The veneer wythe shall not be included in the effective thickness used in calculating the height-to-thickness ratio and the shear capacity of the wall.

Tension stresses due to seismic forces normal to the wall may be neglected if the wall does not exceed the height-to-thickness ratio in [Table No. 88-G](#) and the in-plane shear stresses due to seismic loads as set forth in [Table No. 88-J](#).

If the wall height-to-thickness ratio exceeds the specified limits, the wall may be supported by vertical bracing members designed in accordance with [Division 16](#) of this Code. The deflection of such bracing member at design loads shall not exceed one tenth of the wall thickness.

**EXCEPTION:** The wall may be supported by flexible vertical bracing members designed in accordance with Section [91.8808.2](#) if the deflection at design loads is not less than one quarter or more than one third of the wall thickness.

All vertical bracing members shall be attached to floor and roof construction for their design loads independently of required wall anchors. Horizontal spacing of vertical bracing members shall not exceed one half the unsupported height of the wall or 10 feet (3048 mm).

The wall height may be measured vertically to bracing elements other than a floor or roof. Spacing of the bracing elements and wall anchors shall not exceed six feet (1829

mm). Bracing elements shall be detailed to minimize the horizontal displacement of the wall by components of vertical displacements of the floor or roof.

**91.8809.2.2. Veneer.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) Veneer shall be anchored with approved anchor ties conforming to the required design capacity specified in Section [91.1403.4.3](#) and placed at a maximum spacing of 24 inches (610 mm).

**EXCEPTION:** Existing veneer anchor ties may be acceptable provided the ties are in good condition and conform to the minimum size, maximum spacing and material requirements specified in the provisions of the Los Angeles Building Ordinances in effect prior to October 6, 1933. Said provisions specified that veneer anchor ties shall be corrugated galvanized iron strips not less than one inch (25 mm) in width, eight inches (203 mm) in length and  $\frac{1}{16}$  inch (1.6 mm) in thickness and shall be located and laid in every alternate course in the vertical height of the wall at a spacing not to exceed 17 inches (432 mm) on center horizontally. As an alternate, said provisions specified that such ties may be laid in every fourth course vertically at a spacing not to exceed nine inches (229 mm) on center horizontally.

The existence and condition of existing veneer anchor ties shall be verified as follows:

1. An approved testing laboratory shall verify the location and spacing of the ties and shall submit a report to the Department for approval as a part of the structural analysis.
2. The veneer in a selected area shall be removed to expose a representative sample of ties (not less than four) for inspection by the Department.

**91.8809.2.3. Existing Roof, Floors, Walls, Footings and Wood Framing.** Existing materials, including wood shear walls utilized in the described configuration, may be used as part of the lateral load-resisting system, provided that the stresses in these materials do not exceed the values shown in [Table No. 88-H](#).

**91.8809.3. Strengthening of Existing Materials.** New materials, including wood shear walls, may be utilized to strengthen portions of the existing seismic resisting system in the described configurations, provided that the stresses do not exceed the values shown in [Table No. 88-I](#).

**91.8809.4. Alternate Materials.** Alternate materials, designs and methods of construction may be approved by the Department in accordance with the provisions of [Article 8, Chapter IX](#) of the Los Angeles Municipal Code.

**91.8809.5 Minimum Acceptable Quality of Existing Unreinforced Masonry Walls.**

**91.8809.5.1. General Provisions.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) All unreinforced masonry walls utilized to carry vertical loads and seismic forces parallel and perpendicular to the wall plane shall be tested as specified in this section. All masonry quality shall equal or exceed the minimum standards established herein or shall be removed and replaced by new materials. Alternate methods of testing may be approved by the Department. The quality of mortar in all masonry walls shall be determined by performing in-place shear tests or by testing eight-inch (203 mm) diameter cores.

The vertical wall joint between wythes (collar joints) shall be inspected at the test location after the in-place shear tests, and an estimate of the percentage of wythe-to-wythe mortar coverage shall be reported along with the results of the in-place shear tests.

Where the exterior face is veneer, the type of veneer, its thickness and its bonding and/or ties to the structural wall masonry shall also be reported.

Alternative methods of testing may be approved by the Department. Nothing shall prevent pointing with mortar of all the masonry wall joints before the tests are first made. Prior to any pointing, the mortar joints must be raked and cleaned to remove loose and deteriorated mortar. Mortar for pointing shall be Type S or N except masonry cements shall not be used. All preparation and mortar pointing shall be done under the continuous inspection of a registered deputy inspector. At the conclusion of the inspection, the inspector shall submit a written report to the licensed engineer or architect responsible for the seismic analysis of the building setting forth the result of the work inspected. Such report shall be submitted to the Department for approval as part of the structural analysis.

All testing shall meet Department-approved testing method parameters (including rate of load application) and shall be performed in accordance with the requirements specified in this section by a testing agency approved by the Department.

An accurate record of all such tests and their location in the building shall be recorded and these results shall be submitted to the Department for approval as part of the structural analysis.

**91.8809.5.2. Number and Location of Tests.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

The minimum number of tests shall be as follows:

1. At each of both the first and top stories, not less than two per wall line or line of wall elements providing a common line of resistance to lateral forces.
2. At each of all other stories, not less than one per wall element providing a common line of resistance to lateral forces.
3. In any case, not less than one per 1,500 square feet (139.4 m<sup>2</sup>) of wall surface and a total of eight.

The shear tests shall be taken at locations representative of the mortar conditions throughout the entire building, taking into account variations in workmanship at different building height levels, variations in weathering of the exterior surfaces and variations in the condition of the interior surfaces due to deterioration caused by leaks and condensation of water and/or by the deleterious effects of other substances contained within the building. Where the higher h/t ratios allowed in Footnotes Nos. 4 and 5 of [Table No. 88-G](#) are to be used, the in-place shear tests taken at the top story shall be included in the 80 percent of the shear tests used to determine the minimum mortar shear strength.

The exact test or core location shall be determined at the building site by the licensed engineer or architect responsible for the seismic analysis of the subject building.

**91.8809.5.3. In-Place Shear Tests.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) The bed joints of the outer wythe of the masonry shall be tested in shear by laterally displacing a single brick relative to the adjacent bricks in that wythe. The mortar in the opposite head joint of the brick to be tested shall be removed and cleaned prior to testing. The minimum quality mortar in 80 percent of the shear tests shall not be less than the total of 30 psi (206.9 kPa) plus the axial stress in the wall at the point of the test. The shear stress

shall be based on the gross area of both bed joints and shall be that shear stress at which movement of the masonry is first measured or at which cracking first appears.

An internal caliper, graduated in 0.001 of an inch (0.025 mm) increments shall be used to measure movement of the masonry unit. A hydraulic jack equipped with a pressure gauge graduated in increments of 50 psi (345 kPa) or less shall be used. The jack load shall be applied at a rate not exceeding 5,000 pounds (22 240 N) per minute.

The test shall be conducted by a minimum of two technicians. Load and displacement readings shall be recorded at the following intervals:

1. At a caliper reading of 0.001 inch (0.025 mm);
2. At first visually observed sign of movement or cracking of the mortar or masonry unit;
3. At a caliper reading of 0.02 inch (0.51 mm); and
4. The ultimate load on the unit.

The masonry unit to be tested shall not be located adjacent to a bond course in a brick wall laid in common bond. Tests to evaluate the mortar quality of structural walls shall not be conducted in masonry veneer.

Walls with mortar values which are consistently low and do not meet the minimum quality values specified in this section shall be entirely pointed per U.B.C. Standard 21-8 except that the depth of joint penetration shall be 1-1/2 inch (38 mm) in lieu of the 3/4 inch (19 mm) specified.

**91.8809.5.4. Core Tests.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) A minimum number of mortar test specimens equal to the number of required cores shall be prepared from the cores and tested as specified herein. The mortar joint of the outer wythe of the masonry core shall be tested in shear by placing the circular core section in a compression testing machine with the mortar bed joint rotated 15 degrees from the axis of the applied load. The mortar joint tested in shear shall have an average ultimate stress of 20 psi (138 kPa) based on the gross area. The average shall be obtained from the total number of cores made. If test specimens cannot be made from cores taken, the shear value shall be reported as zero.

**91.8809.6. Testing of Shear Bolts.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) One fourth of all new shear bolts and dowels embedded in unreinforced masonry walls shall be tested by a registered deputy building inspector using a torque calibrated wrench to the following minimum torques:

1/2-inch-diameter bolts or dowels – 40 foot-pounds.

5/8-inch-diameter bolts or dowels – 50 foot-pounds.

3/4-inch-diameter bolts or dowels – 60 foot-pounds.

For SI: 1 inch = 25.4 mm, 1 foot-pound = 1.356 Nm

No bolts exceeding 3/4-inch (19.1 mm) shall be used. All nuts shall be installed over malleable iron or plate washers when bearing on wood and heavy cut washers when bearing on steel.

**91.8809.7. Determination of Allowable Stresses for Design Methods Based on Test Results.**

**91.8809.7.1. Design Shear Values.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) Design seismic in-plane shear stresses shall be substantiated by tests performed as specified in Section [91.8809.5.3](#) and [91.8809.5.4](#).

Design stresses shall be related to test results obtained in accordance with [Table No. 88-J](#). Intermediate values between 3 and 10 psi (20.7 kPa and 69 kPa) may be interpolated.

**91.8809.7.2. Design compression and tension values.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) Compression stresses for unreinforced masonry having a minimum design shear value of three psi (20.7 kPa) shall not exceed 100 psi (690 kPa). Design tension values for unreinforced masonry shall not be permitted.

**91.8809.8.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) Five percent of the existing rod anchors utilized as all or part of the required wall anchors shall be tested in pullout by an approved testing laboratory. The minimum number tested shall be four per floor, with two tests at walls with joists framing into the wall and two tests at walls with joists parallel to the wall. The test apparatus shall be supported on the masonry wall at a minimum distance of the wall thickness from the anchor tested. The rod anchor shall be given a preload of 300 pounds (136 kg) prior to establishing a datum for recording elongation. The tension test load reported shall be recorded at  $\frac{1}{8}$ -inch (3.2 mm) relative movement of the anchor and the adjacent masonry surface. Results of all tests shall be reported. The report shall include the test results as related to the wall thickness and joist orientation. The allowable resistance value of the existing anchors shall be 40 percent of the average of those tested anchors having the same wall thickness and joist orientation.

**91.8809.9.** Qualification tests for devices used for wall anchorage shall be tested with the entire tension load carried on the enlarged head at the exterior face of the wall. Bond on the part of the device between the enlarged head and the interior wall face shall be eliminated for the qualification tests. The resistance value assigned the device shall be 20 percent of the average of the ultimate loads.

**SEC. 91.8810. INFORMATION REQUIRED ON PLANS.** (Amended by Ord. No. 171,175, Eff. 7/25/96.)

**91.8810.1. General.** In addition to the seismic analysis required elsewhere in this division, the licensed engineer or architect responsible for the seismic analysis of the building shall determine and record the information required by this section on the approved plans.

**91.8810.2. Construction Details.** (Amended by Ord. No. 172,592, Eff. 6/28/99, Oper. 7/1/99.) The following requirements, with appropriate construction details, shall be made part of the approved plans:

1. All unreinforced masonry walls shall be anchored at the roof and ceiling levels by tension bolts through the wall as specified in [Table No. 88-I](#), or by an approved equivalent at a maximum anchor spacing of six feet (1829 mm). Anchors installed in accordance with Section [91.8114](#) of this Code shall be accepted as conforming to this requirement.

All unreinforced masonry walls shall be anchored at all floors and ceiling with tension bolts through the wall or by existing rod anchors at a maximum anchor spacing of six feet (1829 mm). All existing rod anchors shall be secured to the joists to develop the required forces. The Department may require testing to verify the adequacy of the embedded ends of existing rod anchors. Tests, when required, shall conform to Section [91.8809.8](#).

**EXCEPTION:** Walls need not be anchored to ceiling systems that, because of their low mass and/or relative location with respect to the floor or roof systems, would not impose significant normal forces on the wall and cause out-of-plane wall failures.

At the roof and all floor levels, the anchors nearest the building corners shall be combination shear and tension anchors located not more than two feet (610 mm) horizontally from the inside corners of the walls.

When access to the exterior face of the masonry wall is prevented by proximity of an existing building, wall anchors conforming to Items 5 and 7 in [Table No. 88-I](#) may be used.

Alternative devices to be used in lieu of tension bolts for masonry wall anchorage shall be tested as specified in Section [91.8809.9](#).

2. Diaphragm chord stresses of horizontal diaphragms shall be developed in existing materials or by addition of new materials.

3. Where trusses and beams other than rafters or joists are supported on masonry, independent secondary columns shall be installed to support vertical loads of the roof or floor members.

4. (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.) Parapets and exterior wall appendages not capable of resisting the forces specified in this division shall be removed, stabilized or braced to ensure that the parapets and appendages remain in their original position.

The maximum height of an unbraced, unreinforced masonry parapet above the lower of either the level of tension anchors or roof sheathing shall not exceed one and one half times the thickness of the parapet wall. If the required parapet height exceeds this maximum height, a bracing system designed for the force factors specified in Table Nos. [88-E](#) and [88-F](#) for walls shall support the top of the parapet. Parapet corrective work must be performed in conjunction with the installation of tension roof anchors.

5. All deteriorated mortar joints in unreinforced masonry walls shall be pointed with Type S or N mortar. Prior to any pointing, the wall surface must be raked and cleaned to remove loose and deteriorated mortar. All preparation and pointing shall be done under the continuous inspection of a registered deputy inspector certified to inspect masonry or concrete. At the conclusion of the project, the inspector shall submit a written report to the Department setting forth the portion of work inspected.

6. Repair details of any cracked or damaged unreinforced masonry wall required to resist forces specified in this division.

**91.8810.3. Existing Construction.** The following existing construction information shall be made a part of the approved plans:

1. The type and dimensions of existing walls and the size and spacing of floor and roof members.

2. The extent and type of existing wall anchorage to floors and roof.

3. The extent and type of parapet corrections which were performed in accordance with Section [91.8114](#) of this Code.

4. Accurately dimensioned floor plans and masonry wall elevations showing dimensioned openings, piers, wall thickness and heights, and veneer and anchorages.

5. The location of cracks or damaged portions of unreinforced masonry walls requiring repairs.

6. The type of interior wall surfaces and ceilings, and if reinstalling or anchoring existing plaster is necessary.

7. The general condition of the mortar joints and if the joints need pointing.

8. The location of the shear tests shall be shown on the floor plans and building wall elevations, and the complete test report shall be reproduced on the approved plans.

**SEC. 91.8811. DESIGN CHECK – COMPATIBILITY OF ROOF DIAPHRAGM STIFFNESS TO UNREINFORCED MASONRY WALL OUT-OF-PLANE STABILITY.** (Amended by Ord. No. 171,175, Eff. 7/25/96.)

**91.8811.1. General.** (Amended by Ord. No. 171,939, Eff. 4/15/98.) The requirements of this section are in addition to the requirements of Sections [91.8808](#) and [91.8809](#). The relative stiffness and strength of a diaphragm governs the amount of amplification of the seismic ground motion by the diaphragm and, therefore, a diaphragm stiffness and strength-related check of the out-of-plane stability of unreinforced masonry walls anchored to wood diaphragms shall be made. This section contains a procedure for the evaluation of the out-of-plane stability of unreinforced masonry walls anchored to wood diaphragms that are coupled to shear-resisting elements.

**91.8811.2. Requirements for Terms.** (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.) The requirements for the terms used in this Division shall be defined as follows:

**CROSS WALL** is a wood-framed wall having a height-to-length ratio of:

1. Two to one for wood structural panels.
2. One to one for gypsum board, gypsum lath, cement plaster or diagonal sheathing.

The total strength of all cross walls located within any 40-foot (12 192 mm) length of diaphragm measured in the direction of the diaphragm span shall not be less than 30 percent of the strength of the diaphragm in the direction of consideration.

**DEMAND-CAPACITY RATIO (DCR)** is a ratio of the following:

1. **Demand** = lateral forces due to 33 percent of the weight of the diaphragm and the tributary weight of the walls and other elements anchored to the diaphragm.
2. **Capacity** = diaphragm total shear strength in the direction under consideration as determined using the values in [Table No. 88-K](#) or [Table No. 88-L](#).

**91.8811.3. Notations.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

$D$  = depth of diaphragm, in feet (mm), measured perpendicular to the diaphragm span.

$h/t$  = height-to-thickness ratio of an unreinforced masonry wall. The height shall be measured between wall anchorage levels and the thickness shall be measured through the wall cross section.

$L$  = span of diaphragm between masonry shear walls or steel frames.

$V_c$  = total shear capacity of cross walls in the direction of analysis immediately below the diaphragm level being investigated as determined by using [Tables Nos. 88-K](#) and [88-L](#).

$v_u$  = maximum shear strength in pounds per foot for a diaphragm sheathed with any of the materials given in [Tables Nos. 88-K](#) and [88-L](#).

$W_d$  = total dead load of the diaphragm plus the tributary weight of the walls anchored to the diaphragm, the tributary ceiling and partitions and the weight of any other permanent building elements at the diaphragm level under investigation.

**91.8811.4. Design Check Procedure.** (Added by Ord. No. 171,939, Eff. 4/15/98.)

**91.8811.4.1. General.** The demand-capacity ratio (DCR) for the building under investigation shall be calculated using the following equations:

$$DCR = 0.33W_d/2v_uD \quad (11-3)$$

or

$$DCR = 0.33W_d/(2v_uD + V_c) \quad (11-4)$$

**91.8811.4.2. Diaphragm Deflection.** The calculated DCR shall be to the left of the curve in [Figure No. 88-A](#). Where the calculated DCR is outside (to the right of) the curve, the diaphragm deflection limits are exceeded, and cross walls may be used to reduce the deflection.

**91.8811.4.3. Unreinforced Masonry Wall Out-of-Plane Stability.** The DCR shall be calculated discounting any cross walls. If the DCR corresponding to the diaphragm span is to the right of the curve in [Figure No. 88-A](#), the region within the curve at and below the intersection of the diaphragm span with the curve may be used to determine the allowable h/t values per [Table No. 88-G](#).

**SEC. 91.8812. VIOLATIONS.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

Notwithstanding any other provision of this Code to the contrary, it shall be unlawful for any person, firm, or corporation to maintain, use, or occupy any building within the scope of this division which does not meet the minimum earthquake standards specified in this division.

Any person who violates, causes or permits another person to violate this provision is guilty of a misdemeanor. Any person includes an owner, lessor, sublessor, manager or person in control of a building subject to this division. This term shall not include any person who is merely a tenant or other individual occupying any dwelling unit, efficiency dwelling unit, guest room or suite in a building. The legal owner of a building is that person, firm, corporation, partnership or other entity whose name or title appears on the record with the Office of the County Recorder, as well as all successors or assignees of these persons.

**EXCEPTION:** This section shall not apply to any building on which work is proceeding in compliance with the time limits set forth in this division, and/or in compliance with any extensions of time granted by the Department or the Board; or any action, order or determination made by the Department or the Board in the implementation of this division.

## **SEC. 91.8813. SPECIAL REQUIREMENTS FOR VACANT BUILDINGS.**

(Amended by Ord. No. 171,175, Eff. 7/25/96.)

**91.8813.1. General.** This section shall apply to every vacant unreinforced masonry bearing wall building within the scope of this division which has not complied with the requirements contained in this division.

**91.8813.2. Enforcement.** When the Department determines that a building is within the scope of this section, it shall notify the owner and order the owner to bring the building into compliance with the provisions of this section. Compliance with such an order shall be accomplished within the time limits set forth herein and any extensions of time granted by the Department. If the owner does not comply within such time limits, then the Department may order the demolition of the building or structure in accordance with the provisions of Section [91.8903](#).

**91.8813.3 Time for Compliance.** (Amended by Ord. No. 171,939, Eff. 4/15/98.)

1. For a one-story building with wall anchors installed pursuant to Section [91.8808](#).3, either before or within 60 days after notice is given by the Department:

Within 180 days after notice is given pursuant to this section, the owner shall submit to the Department either plans and a structural analysis for the proposed structural alterations of the building necessary to comply with the minimum requirements of this division, or an application for demolition of the building or structure.

If the owner elects to perform the proposed structural alterations, then within 270 days after notice is given pursuant to this section, the owner shall obtain the necessary permits for strengthening the building or structure; within 90 days of obtaining a permit to strengthen the building, the owner shall commence strengthening work; and within 18 months after notice is given pursuant to this section, the owner shall complete all strengthening work.

If the owner elects to demolish the building, then within 210 days after notice is given pursuant to this section, the owner shall obtain permits for the demolition of the building or structure; within 21 days of obtaining a demolition permit, the owner shall commence demolition; and within 300 days after notice is given pursuant to this section the owner shall complete the demolition of the building or structure.

2. Time for compliance for all other buildings:

Within 60 days after notice is given pursuant to this section, the owner shall submit to the Department either plans and a structural analysis for the proposed structural alterations of the building necessary to comply with the minimum requirements of this division, or an application for demolition of the building or structure.

If the owner elects to perform the necessary alterations, then within 120 days after notice is given pursuant to this section, the owner shall obtain the necessary permits for strengthening the building or structure; within 21 days of obtaining a permit, the owner shall begin work; and within 365 days after notice is given pursuant to this section, the owner shall complete all strengthening work.

If the owner elects to perform the necessary alterations, then within 120 days after notice is given pursuant to this section, the owner shall obtain the necessary permits for strengthening the building or structure; and within 120 days after obtaining the demolition permit, the owner shall complete the demolition of the building or structure.

**91.8813.4. Special Provisions for Damaged Buildings.** An unreinforced masonry bearing wall building which is damaged or partially destroyed by fire, flood, wind, earthquake or other calamity or act of God or the public enemy shall be repaired or demolished within six months of such damage or destruction.

**DEMAND-CAPACITY RATIO,  $0.33 W_D / (2V_u D)$  OR  $0.33 W_D / (2V_u D + SV_c)$   
ACCEPTABLE SPAN FOR DIAPHRAGMS (BASED ON DISPLACEMENT  
CONTROL CONCEPTS)**

**FIGURE NO. 88-A** (Added by Ord. No. 165,310, Eff. 12/31/89.)

**TABLE NO. 88-A  
RATING CLASSIFICATIONS**

<b>TYPE OF BUILDING</b>	<b>CLASSIFICATION</b>
Essential Building	I
High Risk Building	II
Medium Risk Building	III
Low Risk Building	IV

**TABLE NO. 88-B  
TIME LIMITS FOR COMPLIANCE**

<b>REQUIRED ACTION BY OWNER</b>	<b>OBTAIN BUILDING PERMIT WITHIN</b>	<b>COMMENCE CONSTRUCTION WITHIN</b>	<b>COMPLETE CONSTRUCTION WITHIN</b>
Complete Structural Alterations or Building Demolition	1 year	180 days*	3 years
Wall Anchor Installation	180 days	270 days	1 year

\*Measured from date of building permit issuance.

**TABLE NO 88-C**  
**SERVICE PROVISIONS AND EXTENDED TIME PROVISIONS\*\***  
**(Amended by Ord. No. 160,451, Eff. 11/25/85.)**

<b>Rating Occupant Classification</b>	<b>Extension of Time if Wall Anchors Load</b>	<b>Minimum Time Periods are Installed</b>	<b>Service of Order</b>
I (Highest Priority)	Any	One Year	0
II	100 or more	One Year	90 Days
III	100 or more	One Year	One Year
	More than 50, but less than 100	One Year	Two Years
	More than 19, but less than 51	One Year	Three Years
IV (Lowest Priority)	less than 20	One Year	Four Years

\*\*Buildings that have obtained a building permit for wall anchors and met the time schedule in [Table 88-B](#) for wall anchor installation may utilize the time extensions, which are permitted in [Table 88-C](#) prior to the adoption of this ordinance. (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

**TABLE NO. 88-D**  
**HORIZONTAL FORCE FACTORS BASED ON RATING CLASSIFICATION**

<b>RATING CLASSIFICATION</b>	<b>IKCS</b>
I	0.186
II	0.133
III & IV	0.100

**TABLE NO. 88-E**  
**HORIZONTAL FORCE FACTORS “IS” FOR PARTS OR PORTIONS OF**  
**STRUCTURES**

<b>RATING CLASSIFICATION</b>	<b>IS</b>
I	1.50
II	1.00
III & IV	0.75

**TABLE NO. 88-F**  
**HORIZONTAL FORCE FACTOR “C<sub>p</sub>” FOR PARTS OR PORTIONS OF**  
**BUILDINGS OR OTHER STRUCTURES <sup>1</sup>**  
**(Amended by Ord. No. 171,939, Eff. 4/15/98.)**

<b>PART OR PORTION OF BUILDINGS</b>	<b>DIRECTION OF FORCE</b>	<b>VALUE OF C<sub>p</sub></b>
Exterior bearing and nonbearing walls; interior bearing walls and partitions; interior nonbearing walls and partitions over 10 feet in height; masonry fences over 6 feet in height	Normal to flat surface	0.20
Cantilever parapet and other cantilever walls, except retaining walls.	Normal to flat surface	1.00
Exterior and interior ornamentations and appendages.	Any direction	1.00
When connected to or a part of a building: towers, tanks, towers and tanks plus contents, racks over 8 feet 3 inches in height plus contents, chimneys, smokestacks and penthouses.	Any direction	0.20 <sup>2,4</sup>
When connected to or a part of a building: rigid and rigidly mounted equipment and machinery not required for continued operation of essential occupancies. <sup>5</sup>	Any horizontal direction	0.20 <sup>3</sup>
Tanks plus effective contents resting on the ground.	Any direction	0.12
Floors and roofs acting as diaphragms.	In the plane of the diaphragm	0.12 <sup>6</sup>
Prefabricated structural elements, other than walls, with force applied at center of gravity of assembly.	Any horizontal direction	0.30
Connections for exterior panels or elements.	Any direction	2.00

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm.

**Notes:**

1. See Section [91.8808.2](#) for use of  $C_p$ .
2. When located in the upper portion of any building with a height to depth ratio of 5 to 1 or greater, the value shall be increased by 50 percent.
3. For flexible and flexible mounted equipment and machinery, the appropriate values for  $C_p$  shall be determined with consideration given to both the dynamic properties of the equipment and machinery and to the building and building or structure in which it is placed.
4. The  $W_p$  for storage racks shall be the weight of the racks plus contents. The value of  $C_p$  for racks over two storage support levels in height shall be 0.16 for the levels below the top two levels.
5. The design of the equipment and machinery and their anchorage is an integral part of the design and specification of that equipment and machinery. The structure to which the equipment or machinery is mounted shall be capable of resisting the anchorage forces (see also Section 13.6.5 of ASCE-7). (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)
6. Floor and roofs acting as diaphragms shall be designed for a minimum force resulting from a  $C_p$  of 0.12 applied to  $W_p$  unless a greater force results from the distribution of lateral forces in accordance with Section 12.8.3 of ASCE-7. (Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

**TABLE NO. 88-G**

**ALLOWABLE VALUE OF HEIGHT-TO-THICKNESS RATIO OF UNREINFORCED MASONRY WALLS WITH MINIMUM QUALITY MORTAR <sup>1,2</sup>**

(Amended by Ord. No. 171,939, Eff. 4/15/98.)

	BUILDINGS W/ CROSS WALLS AS DEFINED BY SECTION <a href="#">91.8803</a>	ALL OTHER BUILDINGS
Walls of One-story Buildings	13 - 16 <sup>3,4,5</sup>	13
First-Story Wall of Multi-story Buildings	16	15
Walls in Top Story of Multi-story Buildings	9 - 14 <sup>3,4,5</sup>	9
All Other Walls	16	13

1. Minimum quality mortar shall be determined by laboratory testing in accordance with Section [91.8809.5](#) of this Code.
2. This table is not applicable to buildings of Rating Classification I. Walls of buildings within Rating Classification I shall be analyzed in accordance with Section [91.8808.6](#) of this Code.
3. The minimum mortar shear strengths required in Footnotes 4 and 5 shall be that shear strength without the effect of axial stress in the wall at the point of the test.

4. The larger height-to-thickness ratio may be used where mortar shear tests in accordance with Section 91.8809.5.3 of this Code establish a minimum mortar shear strength of not less than 100 psi (690 kPa) or where the tested mortar shear strength is not less than 60 psi (414 kPa) and a visual examination of the vertical wythe-to-wythe wall joint (collar joint) indicates not less than 50 percent mortar coverage.

5. Where a visual examination of the collar joint indicates not less than 50 percent mortar coverage and the minimum mortar shear strength when established in accordance with Section 91.8809.5.3 of this Code is greater than 30 psi (207 kPa) but less than 60 psi (414 kPa), the allowable height-to-thickness ratio may be determined by linear interpolation between the larger and smaller ratios in direct proportion to the mortar shear strength.

**TABLE NO. 88-H**  
**VALUES FOR EXISTING MATERIALS**  
 (Amended by Ord. No. 171,939, Eff. 4/15/98.)

<b>EXISTING MATERIALS OR CONFIGURATION OF MATERIALS <sup>1</sup></b>	<b>ALLOWABLE VALUES</b>
1. HORIZONTAL DIAPHRAGMS	
(a) Roofs with straight sheathing and roofing applied directly to the sheathing.	100 lbs. per foot for seismic shear.
(b) Roofs with diagonal sheathing and roofing applied directly to the sheathing.	400 lbs. per foot for seismic shear.
(c) Floors with straight tongue-and-groove sheathing.	150 lbs. per foot for seismic shear.
(d) Floors with straight sheathing and finished wood flooring.	300 lbs. per foot for seismic shear.
(e) Floors with diagonal sheathing and finished wood flooring.	450 lbs. per foot for seismic shear.
(f) Floors or roofs with straight sheathing and plaster applied to the joist or values for items 1(a) and 1(c) rafters. <sup>2</sup>	Add 50 lbs. per foot to the allowable values for items 1(a) and 1(c).
2. SHEAR WALL Wood stud walls with lath and plaster	100 lbs. per foot each side for seismic shear.
3. PLAIN CONCRETE FOOTINGS	$f' = 1500$ psi unless otherwise shown by tests
4. DOUGLAS FIR WOOD	Allowable stress same as No. 1 D.F. <sup>3</sup>
5. REINFORCING STEEL	$f' = 18,000$ lbs. per square inch maximum
6. STRUCTURAL STEEL	$f' = 20,000$ lbs. per square inch maximum

For SI: 1 pound per foot = 0.0146 N/m, 1 pound per square inch (psi) = 6.895 kPa.

**Notes:**

- <sup>1</sup> Material must be sound and in good condition.
- <sup>2</sup> The wood lath and plaster must be reattached to existing joists or rafters in a manner approved by the Department.
- <sup>3</sup> Stresses given may be increased for combinations of loads as specified in Section [91.8808.7.2](#) of this Code.

**TABLE NO. 88-I**  
**ALLOWABLE VALUES OF NEW MATERIALS USED IN CONJUNCTION**  
**WITH EXISTING CONSTRUCTION**

(Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

NEW MATERIALS OR CONFIGURATION OF MATERIALS <sup>1</sup>	ALLOWABLE VALUES
1. HORIZONTAL DIAPHRAGMS	
Plywood sheathing applied directly over existing straight sheathing with ends of plywood sheets bearing on joists or rafters and edges of plywood located on center of individual sheathing boards.	Same as specified in CBC Table 2306.3.1 for blocked diaphragms.
2. SHEAR WALLS	
a. Plywood sheathing applied directly over existing wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing.	Same as values specified in CBC Table 2306.4.1 for shear walls.
b. Dry wall or plaster applied directly over existing wood studs.	75 percent of the values specified in CBC Table 2306.4.5.
c. Dry wall or plaster applied to plywood sheathing over existing wood studs.	33 1/3 percent of the values specified in CBC Table 2306.4.5.
3. SHEAR BOLTS	
Shear bolts and shear dowels embedded a minimum of eight inches into unreinforced masonry walls. Bolt centered in a 2-1/2 inch-diameter hole with drypack or an approved non-shrink grout around circumference of bolt or dowel. <sup>1,3</sup>	133 percent of the values for plain solid masonry specified in <a href="#">Table No. 88-M</a> . No values larger than those given for 3/4 inch bolts shall be used.
4. TENSION BOLTS	
Tension bolts and tension dowels extending entirely through unreinforced masonry secured	1200 lbs. per bolt or dowel.

with bearing plates on far side of wall with at least 30 square inches of area. <sup>2, 3, 4</sup>	
<b>5. COMBINATION SHEAR AND TENSION WALL ANCHORS</b>	
a. Bolts extending to the exterior face of the wall with a 2-1/2 inch round plate under the head. Install as specified for shear bolts. Spaced not closer than 12 inches on centers. <sup>1, 2, 3</sup>	600 lbs. per bolt for tension. <sup>4</sup> See Item 3 (SHEAR BOLTS) for shear values.
b. Bolts or dowels extending to the exterior face of the wall with a 2-1/2 inch round plate under the head and drill at an angle of 22-1/2 degrees to the horizontal. Installed as specified for shear bolts. <sup>1, 2, 3</sup>	1200 lbs per bolt or dowel for tension. <sup>4</sup> See Item 3 (SHEAR BOLTS) for shear values.
c. Through bolt with bearing plate for tension per Item 4. Combined with minimum eight-inch grouted section for shear per Item 3.	See Item 4 (TENSION BOLTS) for tension values. <sup>4</sup> See Item 3 (SHEAR BOLTS) for shear values.
<b>6. INFILLED WALLS</b>	
Reinforced masonry infilled openings in existing unreinforced masonry walls with keys or dowels to match reinforcing.	Same as values specified for unreinforced masonry walls.
<b>7. REINFORCED MASONRY</b>	
Masonry piers and walls reinforced per CBC Section 2106 and Section 91.2107 of this Code.	Same as values determined per CBC Section 2106.
<b>8. REINFORCED CONCRETE</b>	
Concrete footings, walls and piers reinforced as specified in <a href="#">Division 19</a> of this Code and designed for tributary loads.	Same as values specified in <a href="#">Division 19</a> of this Code.
<b>9. EXISTING FOUNDATION LOADS</b>	
Foundation loads for structures exhibiting no evidence of settlement.	Calculated existing foundation loads due to maximum dead load plus live load may be increased 25 percent for deadload, and may be increased 50 percent for dead load plus seismic load required by this division.

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm<sup>2</sup>, 1 pound = 4.45 N.

<sup>1</sup> Bolts and dowels to be tested as specified in Section [91.8809.6](#) of this Code.

<sup>2</sup> Bolts and dowels to be 1/2-inch minimum in diameter.

3. Drilling for bolts and dowels shall be done with an electric rotary drill. Impact tools shall not be used for drilling holes or tightening anchor and shear bolt nuts.

4. Allowable bolt and dowel values specified are for installations in minimum three wythe walls. For installations in two wythe walls, use 50 percent of the value specified, except that no value shall be given to tension bolts that do not extend entirely through the wall and are secured with bearing plates on the far side.

**TABLE NO. 88-J  
ALLOWABLE SHEAR STRESS FOR TESTED UNREINFORCED MASONRY  
WALLS**

<b>EIGHTY PERCENT OF TEST RESULTS IN PSI NOT LESS THAN</b>	<b>AVERAGE TEST RESULTS OF CORES IN PSI</b>	<b>SEISMIC IN-PLANE SHEAR BASED ON GROSS AREA</b>
30 plus axial stress	20	3 psi*
40 plus axial stress	27	4 psi*
50 plus axial stress	33	5 psi*
100 plus axial stress or more	67 or more	10 psi max*

\* Allowable shear stress may be increased by addition of 10% of the axial stress due to the weight of the wall directly above.

**TABLE NO. 88-K  
VALUES FOR EXISTING MATERIALS  
(Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)**

<b>EXISTING MATERIALS OR CONFIGURATION OF MATERIALS <sup>1</sup></b>	<b>ALLOWABLE VALUES</b>
<b>1. HORIZONTAL DIAPHRAGMS</b>	
a. Roofs with straight sheathing and roofing applied directly to the sheathing.	100 lbs. per foot for seismic shear.
b. Roofs with diagonal sheathing and roofing applied directly to the sheathing.	250 lbs. per foot for seismic shear.
<b>2. CROSSWALLS <sup>2,3</sup></b>	
a. Plaster on wood or metal lath.	per side: 200 lbs. per foot for seismic shear.
b. Plaster on gypsum lath.	175 lbs. per foot for seismic shear.
c. Gypsum wall board, unlocked edges.	75 lbs. per foot for seismic shear.
d. Gypsum wall board, blocked edges.	125 lbs. per foot for seismic shear.

<sup>1</sup> Materials must be sound and in good condition.

<sup>2</sup> For crosswalls, values of all materials may be combined, except the total combined value shall not exceed 300 lbs. per foot for seismic shear.

3. The cross wall aspect ratio for plaster on wood, metal, or gypsum lath and gypsum wall board shall be a maximum height to width ratio of 1:1.

**TABLE NO. 88-L  
ALLOWABLE VALUES OF NEW MATERIALS USED IN CONJUNCTION  
WITH EXISTING CONSTRUCTION**

(Amended by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

<b>NEW MATERIALS OR CONFIGURATION OF ALLOWABLE VALUES</b>	<b>NEW AND EXISTING MATERIALS <sup>1</sup></b>
1. HORIZONTAL DIAPHRAGMS	
Plywood sheathing applied directly over existing straight sheathing with ends of plywood sheets bearing on joists or rafters and edges of plywood located on center of individual sheathing boards.	225 lbs. per foot for seismic shear.
2. CROSS WALLS <sup>2,3</sup>	
a. Plywood sheathing applied directly over existing wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing.	1.33 times the values specified in CBC Table 2306.4.1 for shear walls.
b. Drywall or plaster applied directly over existing wood studs.	100 percent of the values specified in CBC Table 2306.4.5.

<sup>1</sup> Materials must be sound and in good condition.

<sup>2</sup> For cross walls, values of all materials may be combined, except the total combined value shall not exceed 300 lbs. per foot for seismic shear.

<sup>3</sup> The cross wall aspect ratio for drywall, plaster and gypsum wall board shall be a maximum height to width ratio of 1:1, and for plywood shall be a maximum height to width ratio of 2:1.

**TABLE NO. 88-M  
ALLOWABLE SHEAR ON BOLTS**

(Added by Ord. No. 179,324, Eff. 12/10/07, Oper. 1/1/08.)

<b>DIAMETER BOLT (inches)</b>	<b>EMBEDMENT (inches)</b>	<b>SOLID MASONRY (shear in pounds)</b>	<b>GROUTED MASONRY (shear in pounds)</b>
1/2	4	350	750
5/8	4	500	750
3/4	5	750	1100
7/8	6	750	1100
1	7	750	1100
1-1/8		750	1100