

Mandatory Wood Frame Soft-story Retrofit Program

STRUCTURAL DESIGN GUIDELINES

The purpose of this information bulletin is to provide structural design guidelines to strengthen deficiencies in wood frame soft-story buildings per Division 93, Los Angeles Municipal Code (Ordinance [183983](#) and Ordinance [184081](#)). This new revision of the code mandates a standard for earthquake hazard reduction in existing wood-frame buildings with soft, weak, or open-front walls.

I. Definitions

OPEN-FRONT WALL LINE is an exterior wall line, without vertical elements of the lateral force-resisting system, which requires tributary seismic forces to be resisted by diaphragm rotation or excessive cantilever beyond parallel lines of shear wall. Diaphragms that cantilevered more than 25% of the distance between lines of lateral force resisting elements from which the diaphragm cantilevers and exterior balconies of 6 feet or more in width shall be considered excessive.

RETROFIT is an improvement of the lateral force system by alteration of existing structural elements or addition of new structural elements.

SOFT WALL LINE is a wall line, the lateral stiffness of which is less than what is required by story drift limitations or deformation compatibility requirements of this division. In lieu of the engineering analysis required by this division to determine whether a wall line's lateral stiffness is less than the aforementioned story drift limitations or deformation compatibility requirements, a soft wall line may be defined as a wall line in a story where the wall stiffness is less than 70% of the stiffness of the exterior wall above for the direction under consideration.

STORY STRENGTH is the total strength of all seismic-resisting elements sharing the same story shear in the direction under consideration.

WALL LINE is any length of a wall along a principal axis of the building used to provide resistance

WEAK WALL LINE is a wall line at the ground floor where the wall strength is less than 80% of the strength of the wall above in the direction under consideration.

II. Design Methods

A. Analysis and Design Requirements. The retrofit shall meet the strength and stiffness in conformance to the 2014 LABC except as modified under section 9309. The lateral-load-path analysis shall include the resisting elements and connections from the wood diaphragm immediately above any soft, weak, or open wall lines and down to the foundation. Stories above the weak wall line shall be considered in the analysis but need not be modified.

1. Design base shear.

- a) The design base shear shall be 75 percent of the value specified ASCE 7-10 section 12.8.1.
- b) The value of Response Modification Factor, R , used in any direction shall not exceed the value at any story above, in the same direction.

(1) R need not be less than 3.5, provided the structural systems are not cantilevered column systems and the strengthened structure will not have vertical irregularities of either type 1a, 1b, 5a or 5b listed in ASCE 7-10, "Vertical Structural Irregularities" Table 12.3-2.

(2) If using R greater than 3.5, the existing lateral system shall be verified to comply with specifications of other lateral systems listed in ACSE 7-10, table 12.2-1.

(3) The deflection amplification factor C_d value shall be 3 and overstrength factor, Ω_0 , shall be 3 which is consistent with the R value of 3.5 as specified in the seismic provisions of ASCE 7-10 for the lateral resisting system. Cantilever Column systems shall still use the values corresponding to the system.

2. Lateral Vertical Systems.

- a) Strengthening systems with concrete walls or masonry walls, or steel braced frames shall not be permitted. The use of and/or strengthening of existing masonry or concrete walls is permitted provided the whole story is analyzed.

- b) Steel Moment Frame:

(1) Steel OMF is not permitted in SDC "D", "E" and "F".*

(2) Steel IMF is not permitted in SDC "E" and "F".*

*For exceptions: see Steel Moment Frame Design Information Bulletin, P/BC 2008-098 or ASCE 7-10 Table 12.2-1

3. **Horizontal Structural Irregularities in Buildings.** Structures with 3 or more stories having horizontal structural irregularities shall be altered to meet the additional requirements of ASCE 7-10 per table 12.3-1 only if they are located in the area of Retrofit.
4. **Vertical distribution of seismic forces** over the height of the structure shall be based on ASCE 7-10 section 12.8.3.
5. **Additional Anchorage Requirements for Buildings on Hillsides.** Where a building or a portion thereof is constructed on or into a slope steeper than 33% slope, the lateral-force-resisting system, at and below the base level diaphragm, shall also be analyzed for the effects of concentrated lateral loads caused at the building base from the hillside conditions and must comply with the provisions of Division 94.
6. **Story Drift Limitations**
 - a) The calculated story drift shall not exceed the allowable deformation compatible with all vertical load-resisting elements and 0.025 times the story height.
 - b) In lieu of verifying the stiffness of the floor with the new strengthening system(s) is greater than 70% of the stiffness of the floor above, limit the drift to 2% of the story height.
7. **P-delta effects.** The stress analysis of cantilevered columns shall use a buckling factor of safety of 2.1 for the direction normal to the axis of the beam.
8. Consider 10 psf for partition loads per ASCE 7-10 chapter 12.
9. Account for weight of exterior walls in stories above the soft wall line.
10. **Horizontal Diaphragms.**
 - a) Diaphragms that cantilever more than 25% of the distance between lines of lateral-load-bearing elements from which the diaphragm cantilevers shall be designed for shear transfer.
 - b) Limit diaphragm ratio to 3:1.
11. **Ties and continuity.** Design all the elements in the lateral load path to transfer seismic loads from diaphragm to the foundation.
12. **Collector elements.**
 - a) Design collectors and drag struts.
 - b) Size and spacing of all existing elements in the shear path used in shear transfer calculations shall be clearly identified in the plans as "To Be Verified in Field during construction".

13. **Deformation Compatibility.** All structural framing elements and their connections not required to be part of the lateral system, shall be designed and detailed to be adequate to maintain support of design dead and live loads when subject to expected deformation of seismic loads.

B. Alternate Design Methods:

Pursuant to Section 104.2.6, the department may approve alternate design methods that improve the entire first story seismic performance and are at least equivalent to those prescribed in Division 93. The retrofit design using alternate methods shall achieve the “life safety” objectives established by Division 93. The following are approved alternate design methods.

1. Appendix Chapter A4, 2012 International Existing Building Code. The entire weak first story must be analyze and designed.
2. ASCE 41-13, Seismic Evaluation and Retrofit of Existing Buildings,
 - a) Design to meet the Rehabilitation Objective (Section 1.4) (Life Safety Performance Level: S-3) for the BSE-1 earthquake hazard level
 - b) Retrofit strength need not exceed 1.3 times the strength of story above.
3. FEMA P-807, Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories.
 - a) The entire weak first story must be analyze and designed.
 - b) The spectral demand shall be $0.5S_{MS}$, calculated in accordance with ASCE 7-10 section 11.4 except that for sites in site class E, the value of F_a shall be taken as 1.3
 - c) Acceptable performance level shall be based on drifts corresponding to Onset of Strength Loss in the seismic force-resisting wood-frame elements.
 - d) The maximum limit probability of exceedance (POE) for evaluation or retrofit design shall be 20%.
 - e) Limit diaphragm ratio to 2:1.

III. Existing Materials

All existing components and materials shall be in sound conditions and constructed in conformance to the 2014 LABC before they can be used to resist lateral loads.

- A. **Existing shear walls** that require analysis, shall be permitted to use the values as follows:

EXISTING MATERIALS OR CONFIGURATION OF MATERIALS	ALLOWABLE VALUES
Wood stud walls with lath and plaster	100 lbs. per foot

B. **Existing Horizontal wood diaphragms** that require analysis, shall be permitted to use the values as follows:

EXISTING MATERIALS OR CONFIGURATION OF MATERIALS	ALLOWABLE VALUES
1. HORIZONTAL DIAPHRAGMS	
a. Roofs with straight sheathing and roofing applied directly to the sheathing.	100 lbs. per foot
b. Roofs with diagonal sheathing and roofing applied directly to the sheathing.	400 lbs. per foot
c. Floors with straight tongue-and-groove sheathing.	150 lbs. per foot
d. Floors with straight sheathing and finished wood flooring	300 lbs. per foot
e. Floors with diagonal sheathing and finished wood flooring.	450 lbs. per foot
f. Floors and roofs with straight sheathing and plaster applied to the joist or values for items 1 (a) and 1(c) rafters	Add 50 lbs. per foot to the allowable values for items 1(a) and 1(c)

C. For all other existing structural members, allowable design values are as follows.

EXISTING MATERIALS OR CONFIGURATION OF MATERIALS	ALLOWABLE VALUES
1. Plain or reinforced concrete footings	$f'_c = 1500$ psi unless otherwise shown by tests
2. Douglas fir wood	Allowable stress same as No. 1 D.F.
3. Reinforcing steel	$f_s = 0.4 F_y$, maximum 18 ksi
4. Structural steel	$f_b = 0.6 F_y$, maximum 20 ksi
5. Anchor Bolts	Current code values

IV. Declaration (Engineer’s or architect’s statement)

The responsible engineer or architect shall provide the following statement on the approved plans:

“I am responsible for designing this building’s seismic strengthening in compliance with the minimum regulations of the Mandatory Earthquake Hazard Reduction In Existing Wood-Frame Buildings with Soft, Weak, or Open-Front Walls (LAMC Division 93).”

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