

PROCEDURES FOR THE APPLICATION OF ASCE 41-17 TO EXISTING BUILDINGS

A. PURPOSE

ASCE 41-17 is one of the design standards referenced in the Los Angeles Building Code (LABC) and the Los Angeles Existing Building Code (LAEBC) for seismic evaluation and retrofit of existing buildings. It is intended to serve as a tool for both mandatory and voluntary seismic retrofit requirements. According to LABC and LAEBC, ASCE 41-17 is permitted only with procedures established by the Los Angeles Department of Building and Safety (LADBS). This information bulletin provides clarifications and procedures for the use of ASCE 41-17 to perform seismic evaluation and retrofit of existing buildings.

The Engineer of Record using ASCE 41-17 shall assume the responsibility that the design meets the standards and shall evaluate each structure using sound engineering judgement with additional criteria as warranted by the unique features to each structure, upon approval by the LADBS.

B. APPLICATION OF ASCE 41-17

1. General Requirements

a. Compliance With Full Seismic Forces

Where compliance requires the use of **Full** Seismic Forces, the seismic evaluation or design shall be based on 100% of the values in the LABC. Alternatively, use of ASCE 41-17 is permitted, using a Tier 3 procedure and the two-level performance objective in Table 303.3.1 of LAEBC for the applicable risk category.

[BS] TABLE 303.3.1
 PERFORMANCE OBJECTIVES FOR USE IN ASCE 41 FOR COMPLIANCE WITH FULL SEISMIC FORCES

RISK CATEGORY (Based on CBC Table 1604.5)	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-1N EARTHQUAKE HAZARD LEVEL	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-2N EARTHQUAKE HAZARD LEVEL
I	Life Safety (S-3)	Collapse Prevention (S-5)
II	Life Safety (S-3)	Collapse Prevention (S-5)
III	Damage Control (S-2)	Limited Safety (S-4)
IV	Immediate Occupancy (S-1)	Life Safety (S-3)

b. Compliance With Reduced Seismic Forces

Where compliance permits the use of **Reduced** Seismic Forces, the seismic evaluation or design shall be based on 75% of the values in the LABC. Alternatively, use of ASCE 41-17

is permitted, using a Tier 3 procedure and the two-level performance objective in Table 303.3.2 of LAEBC for the applicable risk category with modifications as noted below. The BSE-1E and BSE-2E earthquake hazard shall be determined in accordance with procedures defined in ASCE 41-17. To account for the possible underestimation of the earthquake forces, the forces for the BPOE level shall be scaled up to be a minimum 75% of the forces for BPON level. For example, the BSE-1E forces shall be no less than 75% of the BSE-1N forces, and the BSE-2E forces shall be no less than 75% of the BSE-2N forces.

[BS] TABLE 303.3.2
PERFORMANCE OBJECTIVES FOR USE IN ASCE 41 FOR COMPLIANCE WITH REDUCED SEISMIC FORCES

RISK CATEGORY (Based on CBC Table 1604.5)	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-1E EARTHQUAKE HAZARD LEVEL	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-2E EARTHQUAKE HAZARD LEVEL
I	Life Safety (S-3) See Note a	Collapse Prevention (S-5)
II	Life Safety (S-3) See Note a	Collapse Prevention (S-5)
III	Damage Control (S-2) See Note a	Limited Safety (S-4) See Note b
IV	Immediate Occupancy (S-1)	Life Safety (S-3) See Note c

2. Additions, Alterations and Change in Occupancy

Additions to any building or structure shall be evaluated and designed based on the **Full** Seismic Forces. When ASCE 41-17 is used, the analysis shall use a Tier 3 procedure and the two-level performance objective in Table 303.3.1 for the applicable risk category.

Alterations to any building or structure shall be evaluated and designed based on the **Reduced** Seismic Forces, provided the reduced seismic load is not less than the original building permitted seismic loads. When ASCE 41-17 is used, the analysis shall use a Tier 3 procedure and the two-level performance objective in Table 303.3.2 for the applicable risk category with amendments as noted in this document.

When it is proposed to change the use and/or occupancy of a building to a higher Risk Category as specified in Table 1604.5 of LABC, the entire building shall be upgraded to meet the Code requirements per **Full** Seismic Forces, or alternatively ASCE 41-17 shall be permitted using the performance objectives in Table 303.3.1 for the applicable risk category.

A project that involves Mandatory Retrofit work only per Ordinance No. 183,893, with or without non-structural tenant improvements, shall not be considered as alterations per LAEBC Section 503, and may be analyzed per Section 3 below. However, where Mandatory Retrofit work is combined with Additions, Alterations, or Change of Occupancy as defined in Section 502, 503, and 506, additional structural requirements and increase in seismic hazards may be triggered.

3. Voluntary Seismic Improvements

Voluntary Seismic improvements are permitted as long as the requirements of LAEBC Section 203.13 are satisfied.

4. Mandatory Retrofit

Non-Ductile Concrete Retrofit Ordinance (183,893) and LABC Section 9508.2 require the strength of the lateral-force resisting system to meet or exceed 75% of the base shear specified in the current LABC seismic provisions. Alternatively, use of ASCE 41-17 is permitted, using a Tier 3 procedure and the two-level performance objective in Table 303.3.2 of LAEBC for the applicable risk category with amendments as noted in this document. See Information Bulletin P/BC 2020-152 for additional information and requirements.

C. ANALYSIS PROCEDURES

The analysis procedure used to evaluate the building shall comply with either linear static, linear dynamic, nonlinear static, nonlinear dynamic or an acceptable alternative rational analysis. Each procedure has its own limitations and is not applicable to all buildings. The procedural selection shall be based on the structural characteristics as shown in the table below.

Irregularities	Structural Characteristics ⁴		Linear Analysis		Nonlinear Analysis ⁵	
			Linear Static Procedure (LSP)	Linear Dynamic Procedure (LDP)	Nonlinear Static Procedure ¹ (NSP)	Nonlinear Dynamic Procedure (NDP)
NO	Structures w/ $T \leq 3.5T_s$		P	P	P	P
	Structures w/ $T \geq 3.5T_s$		NP	P	P	P
YES	Only any of the irregularities defined in Sect. 7.3.1.2		NP	P	P	P
	Irregularities defined in Sect. 7.3.1.1.1 or 7.3.1.1.2	$\mu_{strength}^2 < \mu_{max}^3$	NP	NP	P	P
		$^1\mu_{strength}^2 > \mu_{max}^3$			NP	P
	Irregularities defined in Sect. 7.3.1.1.3 or 7.3.1.1.4 w/ DCRs ⁴ < min(3.0 and m)		P	P	P	P
	Irregularities defined in Sect. 7.3.1.1.3 or 7.3.1.1.4 w/ DCRs ⁴ > min(3.0 and m)	$\mu_{strength}^2 < \mu_{max}^3$	NP	NP	P	P
		$^1\mu_{strength}^2 > \mu_{max}^3$			NP	P

1. NSP is permitted only if higher modes effects are not significant as defined per Sect. 7.3.2.1 (2). If higher modes are significant, the NSP shall be permitted if an LDP analysis is also performed to supplement the NSP in accordance with Sect. 7.3.2.1 (2).
2. $\mu_{strength}$ calculated in accordance with EQ. (7-31).
3. μ_{max} calculated in accordance with EQ. (7-32).
4. Demand-capacity ratios (DCRs) are the magnitude and distribution of elastic demands for existing and added primary elements and components.
5. Seismic Peer Review Panel shall be required, refer to Information Bulletin P/BC 2020-147 for additional information.

D. DATA COLLECTION, MATERIAL TESTING, AND CONDITION ASSESSMENT

As-built conditions and material properties of the building elements are required in order to properly characterize building performance in seismic analysis. In order to make sound engineering assumption and judgment, the design professional shall either obtain the existing building construction documents and test records and/or perform appropriate condition assessment and material testing to establish the properties of building structural components. A preliminary review of drawings and/or available test records shall identify primary gravity-

and lateral-force-resisting elements and systems, and their critical components and connections. When complete as-built drawings and/or prior testing records are not available, the design professional shall perform an appropriate investigation of the building gravity and lateral-load-resisting systems. Data collection, material testing, and condition assessment shall be done per Information Bulletin P/BC 2020-153 and shall be submitted to the department along with the plans and calculations.

E. ADDITIONAL REQUIREMENTS

1. Qualified Historical Buildings

Qualified historical buildings shall comply with Los Angeles Historical Building Code (LAHBC). The strength-level seismic forces used to evaluate the structure for resisting to seismic loads shall be 75 percent of the seismic forces prescribed by Sections 1609 and 1613 of the LABC. However, the seismic forces need not exceed 0.30W for Risk Categories I & II and 0.40W for Risk Categories III & IV. Alternatively, the qualified historical building shall be analyzed using ASCE 41-17, with a Tier 3 procedure and the two-level performance objective in Table 303.3.2 of 2020 LAEBC for the applicable risk category with modifications as noted in this document.

2. Risk Category

Each building and structure shall be assigned a proper risk category in accordance with LABC Section 1604.5. Both, the structural and nonstructural system of the building expected performance level shall be selected based on its assigned risk category, performance levels described in Section 2.3 and the seismic hazard levels set forth in Section 2.4.

3. Building Separation

Minimum building separation distance requirements as specified in Section 7.2.13 shall be in full compliance. Risk Category I and II buildings that do not meet the minimum separation distance requirements specified in Section 7.2.13.1, or the separation exceptions listed in Section 7.2.13.2 are required to be analyzed with an analysis method that can account for the transfer of momentum and energy between structures as they impact. The analysis method to evaluate pounding effects can be obtained by performing nonlinear response history analyses of both, structures or other procedures based on rational method of analysis that accounts for the change in dynamic response of the structures caused by the impacts in accordance with principles of mechanics and approved by the Department.

Risk Category III and IV buildings that do not meet the minimum separation distance requirements specified in Section 7.2.13.1 are required to be evaluated and retrofitted with an analysis method approved by the Department. Such analysis method should account for the pounding effects and to evaluate the potential damage to both structural and nonstructural system and to achieve a level of performance to meet Enhanced Performance Objectives.