STRUCTURAL RETROFIT DESIGN GUIDELINES

1.0 INTRODUCTION

The purpose of this document is to provide structural design guidelines for Ordinance No. 17-1011 and chapters 13.36 and 13.40 of the City of West Hollywood Municipal Code establishing seismic strengthening requirements for two categories of existing buildings. The minimum provisions of the Ordinance are intended to promote public welfare and safety by reducing the risk of death or injury that may result from the effects of earthquakes on older existing Non-Ductile Concrete and Pre-Northridge Steel Moment Frame Buildings. These buildings may contain known deficiencies that create a risk of collapse. Adherence to these minimum standards will improve the performance of these buildings during earthquakes and reduce, but not necessarily prevent, the loss of life, injury or earthquake-related damage.

2.0 ORDINANCE SCOPE

The Ordinance applies to all existing Concrete Buildings built under Building Code standards enacted before the 1979 Uniform Building Code and all buildings utilizing a Steel Moment Frame built under Building Code standards enacted before December 1995 (Steel Moment Frame buildings may be considered exempt if shown to meet the 1997 Uniform Building Code (UBC), the 1994 UBC September errata, or a more recent Building Code).

Once a building is found to be within the scope of the Ordinance, the evaluation and seismic Retrofit of the building shall include ALL seismic lateral-force-resisting elements that are present in the current building. This includes but is not limited to ALL diaphragms, shear transfer connections, chords/collectors, lateral resisting elements, and foundations.

> Exception: For wood structures over concrete podiums, the design professional shall demonstrate through analysis that no Major Deficiency exists in the podium level in order to be excluded from the Ordinance. If the building is found to be included in the Ordinance, only the podium Major Deficiencies will need to be mitigated per these guidelines.

2.1 Exclusions

The Ordinance does not apply to any of the following structure types:

a. Concrete Buildings where all floor/roof diaphragms behave as flexible and consist of bare metal deck, plywood, or wood sheathing.

b. Single Story Concrete Buildings, unless the lateral system contains concrete moment frame elements.

c. Wood structures over concrete podiums, unless the podium contains a Major Deficiency as specified in the Ordinance.
d. Unreinforced Masonry Buildings previously strengthened with Steel Moment Frames.
e. Residential Wood-framed building utilizing Steel Moment Frames.
f. Residential common interest developments as that term is defined in the West Hollywood Municipal Code section 19.90.020.

2.2 Scope and Exclusion Clarifications

Further scope and exception clarifications shall be as follows:

a. Buildings adjacent to targeted buildings with insufficient seismic separation per ASCE 41 Section 7.2.13 which are not identified in the scope above are excluded from the requirements of the Ordinance.
b. Buildings with steel lateral resisting system elements encased in concrete, shall be excluded from the Non-Ductile Concrete Ordinance, however these buildings are subject to the Pre-Northridge Steel Moment Frame Ordinance.
c. For buildings composed of a combination of lateral systems (Mixed Vertical or Mixed Horizontal), one of which is included in the Ordinance, the building shall be excluded if it is determined that summations of all of the concrete and/or Steel Moment Frame Story shear capacity is less than 10% of the total Story shear capacity for all floors.
d. The Ordinance does not require existing electrical, plumbing, mechanical or fire-alarm systems to be altered to comply with the current Building Code unless they constitute a hazard to life or property as determined by the Building Official.
e. Historical buildings shall also comply with the provisions of these guidelines. At the Building Official's discretion, modifications to the standards set forth in this Chapter may be permitted when such modifications are consistent with the provision of the California Historical Building Code.
f. Alterations made to the structure to mitigate Major Deficiencies, as part of Phase 1, shall not affect the existing lateral load elements by increasing any demand-to-capacity ratio by more than 10% unless the existing elements are shown to be capable of resisting the increased demand. In addition, the mitigation of the Major Deficiencies shall not create additional structural deficiencies or make the existing structural deficiencies more severe.
g. Non-structural improvements are not within the scope of this Ordinance.

2.3 Design Professional

A Registered Civil or Structural Engineer Licensed in the State of California shall complete an investigation of the existing construction and structural analysis if the building is targeted by the Ordinance. If the building does not meet the minimum standards, the building shall be structurally altered to conform to the standards.

3.0 DEFINITIONS

The following are definitions included in these Seismic Design Guidelines:

ASCE 41 is the American Society of Civil Engineers *Seismic Standard – Seismic Evaluation and Retrofit of Existing Buildings [ASCE 41-17] - 2017 edition.*

Basis of Design is a document that outlines how the design professional will be interpreting the code as well as summarizing the analysis and possible Retrofit approach that will be used to satisfy the requirements of the Ordinance. This document is not intended go beyond the provisions currently listed in the code and seismic Ordinance language.

Benchmark Building is a building designed and constructed or evaluated to a specific Performance Level using an acceptable code or standard listed in ASCE 41.

Building Code is the Building Code of the City of West Hollywood which includes the 2019 edition of the California Building Code (CBC), California Existing Building Code (CEBC), and California Historical Building Code (CHBC) with 2020 Los Angeles County amendments

Concrete Building is a building having concrete floors and/or roofs, either with or without beams, and a lateral resisting system composed of concrete walls and/or concrete frames with or without Masonry infills, or any combination thereof. Lift-slab building shall be considered as part of the concrete building with or without a concrete lateral resisting system.

Design Criteria is a document that outlines the design professional's alternative analysis or Retrofit approach and methodology to satisfy the design intent and performance objective of the Ordinance. This document is intended to be used when the code and seismic Ordinance language does not address the proposed analysis or Retrofit approach or methodology.

Historical Building is a building designated as a "qualified historical building" as defined in Part 8, Title 24 of the California Code of Regulations.

Major Deficiencies are deficiencies that are considered to be some of the most critical to the performance of the targeted structure during a seismic event. Major Deficiencies are defined as:

Load Path Deficiency – occurs when a structure does not contain a complete, well-defined load path, including structural elements and connections, which serves to transfer inertial forces associated with the mass of all elements of the building to the foundation.

For the purposes of determining compliance with Phase 1 of the seismic Ordinance, the engineer shall confirm that there is a lateral-force-resisting system that forms a load path between the foundation and all diaphragm levels and that ties all portions of the building together. Load path connections between both diaphragms and foundations and the vertical elements of the lateral-force-resisting system must be complete and sufficiently strong to meet the Ordinance Retrofit Performance Objectives. Alternatively, these load path connections shall be complete and sufficiently strong to resist the maximum load that can be delivered to them.

Weak or Soft Story Deficiencies – occurs when the sum of the shear strengths of the seismic-force-resisting system in any Story in each direction is less than 80% of the strength in the adjacent Story above OR when the stiffness of the seismic-force-resisting system in any Story is less than 70% of the seismic-force-resisting system in an adjacent Story above or less than 80% of the average seismic-force system stiffness of the three Stories above.

Where a Story does not meet the Weak or Soft Story Deficiency Definitions, additional linear dynamic or nonlinear analysis procedures may be performed to determine compliance with Phase 1 of the seismic Ordinance. The engineer may evaluate the Weak or Soft Story and show the Story vertical elements meet the strength and stiffness/deformations limits required by the Ordinance Retrofit Performance Objectives. Alternatively, where an ASCE 41 Nonlinear Dynamic Procedure (NDP) is performed, the engineer may demonstrate center of mass drift response between the defined Weak or Soft Story and its adjacent Story above does not exceed a relative difference of more than 40%.

Vertical Irregularity Deficiency – occurs when all vertical elements in the seismic-force-resisting system are not continuous to the foundation.

For purposes of determining compliance with Phase 1 of the seismic Ordinance, the engineer shall confirm the elements and connections supporting the discontinuous seismic-force-resisting system are sufficiently strong to meet the Ordinance Retrofit Performance Objectives using force-controlled criteria. Alternatively, the supporting elements and connections shall meet the Retrofit Performance Objective based on the maximum load that can be delivered to them. In addition, the engineer shall verify the connecting drag and diaphragm for its ability to transfer the load from the discontinuous element to the lower resisting element using force-controlled criteria.

Torsion Deficiency – occurs when the estimated distance between the Story center of mass and the Story center of rigidity is more than 20% of the building width in either plan direction.

Where a Story does not meet the Torsion Deficiency Definition, additional linear dynamic or nonlinear analysis procedures may be performed to determine compliance with Phase 1 of the seismic Ordinance. The engineer may evaluate the Story not meeting the Torsion Definition and show the defined Story vertical elements meet the strength and stiffness/deformations limits required by the Ordinance Retrofit Performance Objectives. Alternatively, for those floors not meeting the Torsion Deficiency Definition and where an ASCE 41 Nonlinear Dynamic Procedure (NDP) is performed, the engineer may demonstrate the maximum Story drift at one end of the structure transverse to an axis is less than 1.4 times the average of the Story drifts at the two ends of the structure.

Captive Column Deficiency – occurs when there are columns at a level with height/depth ratio less than 50% of the normal height/depth ratio of the typical columns at that level.

For elements not meeting the Captive Column Deficiency Definition additional analysis may be performed to determine compliance with Phase 1 of the seismic Ordinance. The engineer may demonstrate the Captive Column elements meet the strength and stiffness/deformations limits required by the Ordinance Retrofit Performance Objectives using force-controlled criteria. Alternatively, the engineer may show the Captive Column is flexure controlled.

Masonry Infill is the unreinforced or reinforced masonry wall construction within a reinforced concrete or steel frame.

Mixed Vertical System is a building containing a vertical combination of different building types. An example of a mixed vertical system is a wood light frame structure over a one-story concrete shear wall structure at the base.

Mixed Horizontal System is a building containing a horizontal combination of different building types in either direction. An example of a mixed horizontal system is an interior core concrete shear wall building with exterior lines of Steel Moment Frames.

Ordinance – City of West Hollywood Ordinance no. 17-1011 establishing strengthening requirements for existing Non-Ductile Concrete and Pre-Northridge Steel Moment Frame Buildings

Owner or Building Owner is the individual(s), agent, firm, corporation, or entity having legal possession, equitable interest in the property, or rights to sanction evaluation or Retrofit of a building.

Phase 2 Deficiencies are All Deficiencies listed in ASCE 41 that are applicable to the building type that are not already included as Major Deficiencies.

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

Steel Moment Frame is a frame capable of resisting horizontal forces caused by the steel members (beams and column) and joints resisting forces primarily by flexure.

Story is as defined in the Building Code, but includes any basement or underground space of a building with cripple walls exceeding four feet in height.

4.0 DOCUMENT DELIVERY PROCESS

The following sections are intended to explain/clarify the document delivery process of the Ordinance including compliance timeframes, deliverable expectations, peer review requirements, and appeals process. It is noted that the Ordinance is set up in a 2-phase approach. The first phase is intended to address Major Deficiencies, as defined by the Ordinance, in the targeted buildings. These Major Deficiencies are known to have the largest seismic risk and are therefore prioritized. The second phase is intended to address the remainder of the building's seismic deficiencies.

4.1 Time Period for Compliance

The following table summarizes the phases and intermediate milestones required by the Ordinance. It is noted that the evaluation and Retrofit process is a multi-year process. As such, the design professional and Owner are encouraged to meet with the Building Official prior to submittal of Retrofit plans to develop a project schedule with relevant milestones and clearly identifying the selection of design standards for the duration of the project.

Table 4-1: Time Period for Compliance

	Phase 1: Engineering Report & Major Deficiency Mitigation[a,b]				Phase 2: Complete Retrofit[d]		
Phase	Submit Engineering Report & Determine All Structural Deficiencies	Submit Retrofit Plans for Major Deficiency Mitigation	Obtain Building Permit & Commence Construction	Complete Major Deficiency Mitigation Construction[c]	Submit Retrofit Plans	Obtain Building Permit & Commence Construction	Complete Construction
Milestone	3 Years from notice to the Owner	5 Years from notice to the Owner	7 Years from notice to the Owner	10 Years from notice to the Owner	13 Years from notice to the Owner	15 Years from notice to the Owner	20 Years from notice to the Owner

Table Footnotes:

a. All buildings within the scope of the Ordinance are required to submit an engineering report and determine all structural deficiencies. Buildings that do not contain any of the Major Deficiencies as defined in the Ordinance are not required to submit Major Deficiency plans or complete construction in Phase 1, but shall provide Retrofit plans and complete construction within the time limits provided in Phase 2.
b. Phase 1 Retrofit plans must indicate preliminary phase 2 Retrofit extents. Minimum Phase 2 scoping requirements are provided in Section 4.2.1 B.
c. Completion of Phase 1 may be extended by 3 years if retrofit plans in accordance with the scope of the Phase 2 are designed, approved, permitted, and constructed within Phase 1.
d. The Building Code version governing Phase 1 shall be permitted to be utilized in Phase 2.

4.2 Deliverables

The following sections addressed the expected deliverables for each delivery phase.

4.2.1 Phase 1 Deliverables

A. Phase 1: Engineering Report & Determination of ALL Structural Deficiencies (3 years from notice to comply):

1. Screening Form – a form available on the city website. Identifies the general parameters of the buildings and summarizes Building Types and the building Major Deficiencies.
2. Feasibility Study:
    a. As-Built documents – Submit all as-built documents, including drawings (original or re-constructed as-builts), available testing, and investigation.
    b. ASCE 41 Tier 1 Evaluation Checklists per Chapter 17 – Summary Data Sheet and ALL Structural Checklists for ALL structural deficiencies with

appropriate scope and hazard. Must be submitted regardless of Tier 1/Tier 2 restrictions.

c. Structural analysis calculations and associated computer models – Provide a two-step structural analysis of entire Retrofit scope of work. Step one shall clearly demonstrate how Major Deficiencies in the building will be addressed in Phase 1 of the Ordinance by analysis or retrofit. See Section 2.2.f and 3.0 for additional clarifications. Step 2 shall demonstrate how ALL structural deficiencies in the building will be addressed in Phase 2 of the Ordinance by analysis or retrofit. For complex analysis/Retrofit scopes it is recommended that the design professional submit a Basis of Design to the Building Official for review and approval. For Historical Buildings a Basis of Design shall be submitted to the Building Official for review and approval (see section 5.2.3).
d. Conceptual Retrofit Extents - a series of building plan sketches identifying the locations of new or strengthened elements of the lateral-force-resisting system that are expected to mitigate all deficiencies, clearly identifying the Phase 1 and Phase 2 scope. This may be omitted if all Retrofit Plan documents (see Section B below) are submitted at this stage.

Exception: For buildings previously retrofitted utilizing the Benchmark Buildings path to compliance, the Feasibility Study shall consist of a report documenting verification of the items listed in Section 5.1.1.

It is noted that the Engineering Report referenced in the Ordinance is the combination of the Screening Form and Feasibility Study.
If it is determined that the building meets the criteria of the Ordinance in its existing condition and therefore does not require a seismic retrofit, the City will issue a "Letter of Compliance" based on approved Engineering Report. When this occurs, a building that does not have available as-built drawings (or where the analysis relies testing) will require the Material Testing and Condition Assessment Program specified in Section 4.2.1B be submitted and approved before City issues "Letter of Compliance."

For buildings that are found to be outside the scope of the Ordinance, the City will issue a "Letter of Exemption" based on approved Screening Form.

B. Phase 1: Submit Retrofit Plans for Major Deficiency Mitigation (5 years from notice to comply):

1. Material Testing and Condition Assessment Program (MTCAP) Results – submit MTCAP results for entire building. It is recommended that the engineer review the test locations and condition assessment locations with the city prior to executing the program. Program may be submitted earlier if desired (recommended). See Appendix A for requirements.
2. Geotechnical / Geological Report (as required) – Submit geotechnical/ geological report including, but not limited to, geological data, seismicity data,

and foundation recommendations. Program may be submitted earlier if desired (recommended). See Appendix B for requirements.

3. Structural design calculations and associated computer models:
   a. Tier 2 – Where Tier 2 design is used to comply with Phase 1 scope, design calculations may be limited to the mitigation of all Major Deficiencies. See 2.2f and 3.0 for additional clarifications.
   b. Tier 3 – Where Tier 3 design is used to comply with Phase 1 scope, design calculations may be limited to the mitigation of all Major Deficiencies. It is noted that Tier 3 requires full building analysis with Phase 1 Retrofit only. See Section 2.2.f and 3.0 for additional clarifications. For complex analysis or Retrofit scopes, it is recommended that the design professional submit a Basis of Design for City review prior to submission of construction documents and associated design calculations.
   c. Tier 2 or Tier 3 – If Retrofit scheme previously submitted under Section A Feasibility Study has changed, an updated Feasibility Study is required.
4. Construction Documents – Submit construction documents associated with retrofitting all Major Deficiencies (Phase 1 Scope). Identify schematically in the construction documents the extents of ALL deficiencies to be retrofitted in the future phase (Phase 2). Design professional shall consider constructability of future phase 2 scope when detailing phase 1 scope.

C. Phase 1: Major Deficiency Retrofit Building Permit (7 years from notice to comply):

1. Approved MTCAP Results.
2. Approved Geotechnical / Geological Report.
3. Approved Construction Documents (Phase 1 scope) – Approval of construction documents is contingent on the approval of MTCAP Results and Geotechnical / Geological Report.
4. Obtain Building Retrofit Permit (Phase 1 scope).

D. Phase 1: Complete Major Deficiency Construction (10 years from notice to comply):

1. Construction Start - Construction must begin no later than 1 year after the building permit is issued (Phase 1).
2. Construction Stops/Pauses – Construction must not stop/pause for more than 180 days at any given time (Phase 1).
3. Construction Completion/Closeout – Upon Completion of construction and final inspection (Phase 1) the Building Official will provide written documentation (Letter of Compliance) indicating the phase 1 Retrofit scope has been completed.

4.2.2 Phase 2 Deliverables

A. Phase 2: Submit Retrofit Plans for Remaining Structural Deficiencies (13 years from notice to comply):

1. As-Built Documents – Submit all as-built documents, including drawings, available testing, and investigation (include phase 1 documents).
2. Material Testing and Condition Assessment Program (MTCAP) Results – Submit original MTCAP along with any additional results as applicable to the phase 2 scope.
3. Geotechnical / Geological Report (as required) – Submit original Geotechnical / Geological report along with any additional results as applicable to the phase 2 scope.
4. Structural design calculations and associated computer models - Submit design used to comply with Phase 2 scope. Calculations shall include the evaluation and mitigation for all deficiencies. For complex analysis or Retrofit scopes, it is recommended that the design professional submit a Basis of Design for city review prior to submission of full design to the city.
5. Construction Documents – Submit construction documents associated with retrofitting all deficiencies (Phase 2 Scope).

B. Phase 2: Remaining Deficiency Retrofit Building Permit (15 years from notice to comply):

1. Approved MTCAP Results (as applicable).
2. Approved Geotechnical / Geological Report (as applicable).
3. Approved Construction Documents (Phase 2 scope) – Approval of construction documents is contingent on the approval of MTCAP Results and Geotechnical / Geological Report (as applicable).
4. Obtain Building Retrofit Permit (Phase 2 scope).

C. Phase 2: Complete Remaining Deficiency Construction (20 years from notice to comply):

1. Construction Start - Construction must begin no later than 1 year after the building permit is issued (Phase 2).
2. Construction Stops/Pauses – Construction must not stop/pause for more than 180 days at any given time (Phase 2).
3. Construction Completion/Closeout – Upon Completion of construction and final inspections the Building official will provide written documentation (Certificate of Compliance) indicating the phase 2 Retrofit scope has been completed.

4.2.3 Phase 1 and 2 Alternative Deliverables Path

A. Phase 1 and 2: Complete Evaluation, Design and Construction of ALL Deficiencies (13 years from notice to comply):

1. Completion of Phase 1 may be extended by 3 years if retrofit plans in accordance with the scope of both Phase 1 and Phase 2 are designed, approved, permitted, and constructed within Phase 1 timeframe. The time frame and associated deliverable requirements shall be as followed if this option is selected:
   a. 3 Years: Submit engineering report determine ALL structural deficiencies per 4.2.1 A.
   b. 5 Years: Submit Retrofit plans to mitigate ALL structural deficiencies per 4.2.1.B and 4.2.2 A. Intermediate Phase 1 design calculations not required if design calculations include full Retrofit (i.e. Phase 1+ Phase 2).
   c. 7 Years: Obtain building Retrofit permit to mitigate ALL structural deficiencies per 4.2.1 C and 4.2.2 B. Intermediate Phase 1 Retrofit plans not required if Retrofit plans include full Retrofit (i.e. Phase 1+ Phase 2).
   d. 13 Years: Complete construction of ALL structural deficiency mitigation plans per 4.2.1 D and 4.2.2 C. Upon Completion of construction and final inspections the Building official will provide written documentation (Certificate of Compliance) indicating the Phase 1 and 2 Retrofit scope has been completed.

4.3 Peer Review Requirements

A structural design peer review and/or a geotechnical/geological peer review may be required under certain circumstances. Please see Appendix D for specific conditions which require peer reviews.

4.4 Appeals

Should the Building Owner or engineer believe that the building is not part of the scope of the Ordinance for Non-Ductile Concrete or Pre-Northridge Steel Moment Frame Buildings, or if it is believed that the building already meets the Ordinance requirements, the following shall be submitted as an initial appeal:

a) Screening Form– a form available on the City website that identifies the general parameters of the buildings.

b) Should the Owner disagree with a Building Official's decision made during any milestone, the Owner may appeal the decision to the Building Board of Appeals

established in Section 105 of the Building Code. Such an appeal shall be filed with the Board within 60 days of the decision.

5.0 TECHNICAL METHOD OF COMPLIANCE

The following sections outline the technical method of compliance. This includes various technical compliance paths and associated criteria that is allowed to be used when utilizing ASCE 41. The requirements for an alternate method of compliance is also provided when this path is desired.

5.1 Technical Paths to Compliance

The evaluation and/or Retrofit shall comply with the provisions of ASCE 41. There are several parallel paths described in ASCE 41 that can be followed in order to demonstrate compliance with the Ordinance including: Benchmark Building Evaluation, Tier 1 Screening, Tier 2 Deficiency-Based Evaluation and Retrofit, and Tier 3 Systematic Evaluation and Retrofit. Depending on the building characteristics and complexity of the analysis and/or Retrofit approach, not all paths are permitted. The sections below outline the general procedures and limitations for each of the compliance paths.

5.1.1 Benchmark Building Evaluation (Previous Seismic Retrofits)

Description/Applicability: A Benchmark Building is a building that has historically provided Life-Safety performance based on the type of lateral-force-resisting system and Building Code edition that was utilized in the original design and construction or retrofit. Based on the targeted years of construction for the buildings in the scope of the Ordinance, the buildings will likely not meet the Benchmark Building criteria unless the building has undergone a seismic Retrofit after the year identified in the scope of the Retrofit Ordinance and the engineer can demonstrate that the Retrofit was completed for the entire building (i.e. not a partial voluntary seismic improvement retrofit).

General Procedure/Requirements: Where it can be demonstrated that a building has completed a previous retrofit, the building may be a candidate for meeting the Benchmark Building method of compliance, provided they were retrofitted to meet all of the requirements of the seismic code edition listed in ASCE 41 Table 3-2. ASCE 41 Section 3.3 requires the Engineer to verify items pertaining to the Retrofit as summarized below:

Existing documents - A review of the existing documents is required to confirm the lateral-force-resisting system and their detailing were intended to be designed in accordance with the applicable code provisions, See ASCE 41 Section 3.3.1.

Field Verification – Field verification shall be performed to confirm that the building was constructed in general conformance with the record drawings and that no

modifications have been made that significantly affect the expected performance of the lateral-force-resisting system, See ASCE 41 Section 3.3.2.

Condition Assessment – Field verification confirms that significant deterioration of structural materials has not occurred, See ASCE 41 Section 3.3.3.

Geologic Site Hazards –Liquefaction, slope failure, or surface fault rupture hazard shall be not be present at the site, See ASCE 41 Section 3.3.4.

Compliance: Provided the Engineer can verify the above items in accordance with the provisions of ASCE 41 Section 3.3, then the Performance Objective and Ordinance is satisfied without further evaluation.

Limitations: In addition to the requirements for Benchmark Building evaluation required in ASCE 41, it is not permitted to utilize the code edition provisions listed in ASCE 41 Table 3-2 as the criteria for a new evaluation or Retrofit for the purpose of satisfying the Ordinance.

Where it is determined that a geologic site hazard exist, Benchmarking may not be used as a path to compliance. To determine if a geologic site hazard exist a geologic study must be done per Appendix B: Geotechnical / Geological Report Requirements Section 3.0.

5.1.2 Tier 1 Screening

Description/Applicability: A Tier 1 Screening is a screening procedure that utilizes a series of quick checks to conservatively evaluate a building and determine potential seismic deficiencies based on observed building damage from past earthquakes.

General Procedure/Requirements: The engineer shall determine the lateral-force-resisting system(s) utilized in the building and corresponding building type(s) in accordance with ASCE 41 Table 3-1. A basic configuration checklist should be completed, along with the applicable checklists for each lateral-force-resisting system and performance objective per ASCE 41 Table 2-1. See ASCE 41 Chapter 5 for the specific analysis procedures and acceptance criteria. In addition On-Site Investigation and Condition Assessment shall be conducted per ASCE 41 Section 4.2.1.

Compliance: Buildings evaluated using the Tier 1 Screening procedure that do not identify any non-compliant or undetermined checklist deficiencies under the required Performance Objective shall be considered compliant with the Ordinance, except as limited below.

Limitations: It is noted that although Tier 1 Screening tends to be conservative, these simplified procedures are not adequate to evaluate large and/or complicated buildings. ASCE 41 Section 3.4.1 indicates the limitations of using Tier 1 Screening procedures based on a max number of stories for a given building type (See Table 3-4) and where

buildings are composed of more than one building type (i.e. combination(s) of lateral systems). Building that do not sufficiently fit into the building types in ASCE 41 Table 3-1, shall not be deemed compliant using the Tier 1 Screening methodology.

A Tier 1 screening is a requirement for all buildings targeted under the Ordinance per Section 4.2.1. However, it is noted that a Tier 1 is an evaluation tool and not a Retrofit criteria.

Where it is determined that a geologic site hazard exists, a Tier 1 may not be used as a path to compliance To determine if a geologic site hazard exist a geologic study must be done per Appendix B: Geotechnical / Geological Report Requirements Section 3.0.

5.1.3 Tier 2 Deficiency-Based Evaluation and Retrofit

Description/Applicability: A Tier 2 Deficiency-Based Evaluation methodology focuses on the potential deficiencies identified in Tier 1 Screening, and where available, provides a less conservative (or more detailed) procedure to evaluate the potential deficiencies. The Tier 2 Deficiency-Based Retrofit involves a building Retrofit in which the deficiencies identified in a Tier 1 Screening or Tier 2 Evaluation are mitigated and deemed to comply with the applicable Performance Objective. The scope of the Tier 2 Deficiency-Based Evaluation and Retrofit need not expand beyond the evaluation of the potential deficiencies identified in Tier 1 Screening or Tier 2 Evaluation.

General Procedure/Requirements: Utilizing the appropriate checklists and potential deficiencies identified in the Tier 1 Screening, the engineer shall evaluate the potential deficiencies according to the more detailed Tier 2 criteria reference in the checklist (where available). Potential deficiencies identified in the Tier 1 Screening that are deemed non-compliant by the engineer may be specifically mitigated (either shown through analysis to be acceptable or mitigated from retrofit), such that the deficiency can be deemed compliant or no longer applicable. For the specific analysis procedures and acceptance criteria see ASCE 41 Chapter 5. ASCE 41 Section 5.2.4 specifically indicates important Tier 2 analysis requirements. In addition, Material Testing and Condition Assessment may be required per Appendix A of this document.

Compliance: Buildings evaluated or retrofitted using the Tier 2 Deficiency-Based procedure shall be deemed to comply with the Ordinance, except as limited below.

Limitations: It is noted that although the Tier 2 Deficiency-Based Evaluation and Retrofit procedure tends to be conservative, it is permitted under limited conditions. ASCE 41 Section 3.4.1 indicates the limitations of using Tier 2 Deficiency-Based Evaluation procedures based on a max number of stories for a given building type (See Table 3-4) and where buildings are composed of more than one building type (i.e. combination(s) of lateral systems). It should be noted that the Tier 2 Deficiency-Based Evaluation and Retrofit methodology prohibits non-linear analysis. In addition, complex Retrofit elements/schemes, like viscous dampers and base isolation, will require a Tier 3 analysis.

Where it is determined that a geologic site hazard exists, a Tier 2 may not be used as a path to compliance. To determine if a geologic site hazard exist a geologic study must be done per Appendix B: Geotechnical / Geological Report Requirements Section 3.0.

5.1.4 Tier 3 Systematic Evaluation and Retrofit

Description/Applicability: A Tier 3 Systematic Evaluation and Retrofit is a methodology that utilizes Linear or non-linear, static and dynamic procedures to evaluate each element of the lateral-force-resisting system and Retrofit as necessary.

General Procedure/Requirements: The Engineer shall analyze the building in accordance with ASCE 41 Chapter 6 and evaluate all lateral-force-resisting elements on an individual element basis. Elements that are determined to be overstressed or deficient based on the demand to capacity ratio requires mitigation using a Tier 3 Retrofit procedure. For the specific analysis procedures and acceptance criteria see ASCE 41 Chapter 7. In addition, Material Testing and Condition Assessment may be required per Appendix A of this document.

Compliance: Buildings evaluated using the Tier 3 procedure for the applicable performance objective shall be considered compliant with the Ordinance.

Limitations: Tier 3 evaluations are not limited by building size or complexity and both linear and nonlinear analysis procedures can be used, however, linear procedures have some limitations as indicated in ASCE 41 Section 7.3. In addition, complex Retrofit elements/schemes, like viscous dampers and base isolation, will require a Tier 3 analysis, subject to the limitations in ASCE 41 Section 15.4.1. A deficiency-based Retrofit approach is not allowed to demonstrate full compliance (Phase 2) of the Ordinance when utilizing the Tier 3 methodology.

It is noted that where a geologic hazard is found, a Tier 3 analysis is required. To determine if a geologic site hazard exist a geologic study must be done per Appendix B: Geotechnical / Geological Report Requirements Section 3.0.

5.2 Performance Objectives

The following sections describe all different seismic performance objectives required by the Ordinance, for Historic Buildings and non-historic buildings, with and without Additions, Alterations, and/or Change of Occupancy.

5.2.1 Ordinance Performance Objectives

The following table identifies the required structural performance level(s) and seismic hazard(s) for each Risk Category under the Ordinance:

Table 5.2-1: Retrofit Performance Objectives by Risk Category[1,2,3]

Compliance Method	Risk Category	Hazard/Performance Level 1	Hazard/Performance Level 2
Tier 1 & Tier 2	I & II	Deemed to Comply	BSE-2E, S-5
	III & IV	BSE-1E, S-2	BSE-2E, S-5
Tier 3	I & II	BSE-1E, S-3	BSE-2E, S-5
	III & IV	BSE-1E, S-2	BSE-2E, S-5

Table Footnotes:

1. BSE-1E and BSE-2E are seismic hazards with probability of exceedance of 20%/50yr (but no greater than 2/3MCER) and 5%/50yr (but no greater than MCER), respectively, per ASCE 41 Section 2.4.
2. Structural Performance Level per ASCE 41 Section 2.3:
   a. S-1, Immediate Occupancy, is defined as the post-earthquake damage state in which a structure remains safe to occupy and essentially retains its pre-earthquake strength and stiffness.
   b. S-2, Damage Control, is defined as the post-earthquake damage state between life safety (S-3) and immediate occupancy (S-1).
   c. S-3, Life Safety, is defined as the post-earthquake damage state in which a structure has damaged components but retains a margin against the onset of partial or total collapse.
   d. S-5, Collapse Prevention, is defined as the post-earthquake damage state in which the building is on the verge of partial or total collapse.
3. See ASCE 41 commentary C2.2.1 for further discussion of seismic hazard and performance objectives.

5.2.2 Additions, Alterations, and Change of Occupancy

When an Addition, Alteration, and/or Change of Occupancy are included as part of the Retrofit scope, the highest performance objective that is required by either Section 5.2.1 or CEBC Sections 503, 504, and 506, shall be used.

5.2.3 Historic Buildings

Historical Buildings identified to be in the scope of the Ordinance are required to comply with these Seismic Design Guidelines and the CHBC. The design professional shall submit a Basis of Design to the Building Official as part of the Phase 1 Engineering Report Deliverables (see section 4.2.1), for review and approval, describing how the performance objectives of the Seismic Design Guidelines and CHBC will be satisfied.

5.3 Alternate Methods of Compliance

Alternate procedures may be considered (e.g. ASCE 7, ATC 78, future ASCE 41 editions etc.),however, a Design Criteria must be submitted to the Building Official for review and approval prior to the submission of the Retrofit plans.

5.3.1 Minimum Document Requirements for Alternate Design Criteria

A report outlining the alternate Design Criteria shall be submitted to the Building Official for review and approval. This document shall identify how the performance objectives required by the Ordinance will be met by the proposed evaluation/Retrofit methodology. The following items should be addressed in the Design Criteria:

1. Governing code and standards.
2. Seismic analysis procedure and loading criteria.
3. Modeling assumptions and criteria.
4. Material properties.
5. Member capacities and/or acceptance criteria.
6. Analysis software used.
7. New member design methodology.

6.0 AMENDMENTS AND CLARIFICATIONS TO ASCE 41

For amendments and clarifications to ASCE 41, refer to Appendix C.

7.0 MATERIAL TESTING AND CONDITION ASSESSMENT

Minimum requirements for Material Testing and Condition Assessment when following Tier 2 and Tier 3 evaluation procedures are found in Appendix A of this design guide. Material Testing is not required where a Benchmark or Tier 1 methodology is being used to comply with the Ordinance. Refer to Section 5.1.1 and 5.1.2 in this document for Condition Assessment requirements when using Benchmark and Tier 1 methodologies.

8.0 GEOTECHNICAL/GEOLOGICAL REPORT REQUIREMENTS

In many cases a geotechnical/geological report will be required to be in compliance with the Ordinance. To determine when a geotechnical/geological report is required as well as what should be addressed in the report, refer to Appendix B.

9.0 QUALITY CONTROL AND ASSURANCE REQUIREMENTS

Special attention shall be taken during construction to ensure good quality control. See Appendix E for Quality Assurance Requirements.

10.0 DECLARATIONS AND INFORMATINO REQUIREMENTS ON PLANS

The following statements shall be placed on approved plans.

10.1 Engineer's Statement

At a minimum, the responsible engineer shall provide the following statement on the approved plans:

"I am responsible for designing this building's **[Phase 1 or Phase 2]** seismic strengthening in compliance with the minimum standards of the Mandatory Seismic strengthening Provisions for **[Non-Ductile Concrete structures (Chapter 13.36) or Pre-Northridge Steel Moment Frame Buildings (Chapter 13.40)].**"

10.2 Owners Statement

At a minimum, the Owner or Owner's representative shall provide the following statement on the approved plans:

"I _____understand the seismic evaluation and strengthening performed under this project is limited to that specified in the Mandatory Seismic Strengthening Provisions for **[Non-Ductile Concrete structures (Chapter 13.36) or Pre-Northridge Steel Moment Frame Buildings (Chapter 13.40)]** which is intended to reduce the risk under a seismic event. I understand the full building has not been evaluated nor strengthened for other potential structural deficiencies that may cause a life safety concern, injury, or property damage risk under a seismic event".

10.3 Information Requirements on Plans

The following information shall be provided on the first page of the plans:

a. Roof and floor Live Loads
b. Risk Category
c. Performance Level and Seismic Hazard Level
d. Mapped spectral response accelerations parameters, S_s and S_1
e. Site Class
f. Design spectral response acceleration parameters, S_{XS} and S_{X1}

g. Level of Seismicity
h. Seismic Force Resisting System(s)
i. Pseudo Seismic Force, V
j. Modification Factors C_1, C_2, C_m
k. Fundamental Period, T (For each primary direction)
l. Path to Compliance Method (Tier 2 or Tier 3)
m. Analysis Procedure Used (LSP, LDP, NSP, NDP)
n. Retrofit Scope Narrative
    - Phase 1: Describe Phase 1 Retrofit scope that is being approved and expected Phase 2 Retrofit that will be approved in the future.
    - Phase 2: Reference Phase 1 Retrofit drawings and describe Phase 2 Retrofit scope that is being approved.
o. Deficiencies:
    - Phase 1 – List deficiencies to be mitigated and list remaining Phase 2 Deficiencies
    - Phase 2 – List deficiencies previous mitigated in Phase 1 and list deficiencies to be mitigated
p. Reference Phase 1 Retrofit Drawings and Date (Phase 2 only)
q. Material Testing Results
r. Expected and lower-Bound material properties utilized in design
s. Knowledge Factors Used
t. Reference Geotechnical / Geological reports
u. Geotechnical - Load bearing values utilized in design
v. Geohazards - Indicate if the parcel is located within an earthquake fault zone and if it is subject to the Alquist-Priolo Act

APPENDIX

The following Appendices shall be considered part of these Seismic Design Guidelines

Appendix A – Material Testing and Condition Assessment Requirements

Appendix B – Geotechnical / Geological Report Requirements

Appendix C – Amendments and Clarifications to ASCE 41

Appendix D – Structural and Geotechnical Peer Review Requirements

Appendix E – Quality Assurance Requirements