City of Santa Monica®

# Building and Fire Life Safety Commission Report

**Meeting Date: November 3, 2016**

To: Building and Fire Life Safety Commission

From: Ron Takiguchi, PE, Building Officer

**Subject: Information and Discussion of the Updates to Technical Standards of the Seismic Retrofit Provisions of Article VIII of the Santa Monica Municipal Code and Recommendations to City Council on the Technical Standards**

## Recommended Action

Staff recommends that the Building and Fire Life Safety Commission approve the proposed technical standards of the seismic retrofit provisions of Article VIII of the Santa Monica Municipal Code, and the administrative procedures related to the technical provisions to implement the Seismic Retrofit Program.

## Executive Summary

Seismic safety in the construction of buildings has always been a primary concern of the City of Santa Monica. The City has had numerous updates to the Municipal Code related to seismic strengthening provisions and seismic retrofit requirements most

prominently since the City Council adopted the Seismic Safety Element of the General Plan in 1975. The current seismic retrofit provisions in the Municipal Code were passed by City Council on June 8, 1999 and these are the standards which the City applies to seismic retrofit design today.

Since 1999, organizations such as the American Society of Civil Engineers (ASCE) have updated their standards related to the seismic evaluation of existing buildings and minimum load design criteria. The City has determined that there are buildings that have not achieved seismic retrofit and there remains a risk with these buildings that are potentially seismically vulnerable. City staff undertook efforts to determine the scope of the risk by determining the number of buildings in the City that may be seismically vulnerable. Upon completing the survey of hazardous buildings, staff realized that implementing a fully required Seismic Retrofit Program is critically necessary together with the updates to the technical standards.

Staff requests that the Commission provide input to the proposed updates to the technical seismic standards. Staff also requests that the Commission provide an approval of the technical updates with a recommendation to the City Council.

## Discussion

### Introduction

The January 17, 1994 Northridge Earthquake was a foreboding reminder of the destructive power of earthquakes and the threat to Santa Monica. Although the City of Santa Monica did not experience occurrences of injury or death related to failed buildings in the Northridge Earthquake, many buildings in the City sustained substantial damage

where these buildings had to be condemned or demolished. As earthquake faults are rampant in the Southern California region, and the City of Santa Monica has a fault running through the City, the threat of earthquakes to the City is very real. Further, the top experts in seismology have predicted that a major earthquake in the Southern California region is a high probability in the near future.

The need to strengthen Santa Monica's older buildings at-risk is critical for the continuance of building occupancy and even more critically for the protection of residents, business operators, visitors and tourists to the City. The path to achieving resiliency in older buildings is through the seismic strengthening of buildings and an active Seismic Retrofit Program.

Background

The 1999 seismic retrofit standards contain seismic retrofit provisions for specific potentially seismically vulnerable buildings. The building types are:

- Unreinforced Masonry Bearing Wall Buildings (URM);
- Concrete or Reinforced Masonry Wall Buildings with Flexible Diaphragms (Concrete Tilt-Up);
- Soft, Weak, Open-Front Walls in Light, Wood-Frame Buildings (Soft Story);
- Non-Ductile Concrete Buildings;
- Welded Steel Moment Frame Buildings;
- Cripple Wall, Sill Plate Anchorage in Single-Family Dwellings (Brace and Bolts).

Except for voluntary provisions for single-family cripple wall, sill-plate anchorage, the Municipal Code requires mandatory seismic retrofit for all hazardous building types. The

mandatory provisions have resulted in some buildings being fully retrofitted. However, since the standards of the 1999 ordinance were not accompanied by noticing provisions to owners of buildings-at-risk, there are many buildings that remain unretrofitted.

State Law and State Building Standards

Currently there are no State or Federal Laws that requires the seismic retrofit of any hazardous building. The Unreinforced Masonry Building Law of 1986 based on California Senate Bill 547 (Alquist) required local jurisdictions to inventory unreinforced masonry buildings and establish mitigation programs. The mitigation programs however did not necessary require mandatory retrofit. Chapter 34 of the California Building Code had provisions for existing structures but not the requirement for mandatory retrofit. Although there are many publications and standards on seismic evaluation and retrofit, none are codified in building standards law.

As a result of the lack of a national or statewide seismic retrofit standard, many jurisdictions developed their own standards. In some cases, jurisdictions such as the City of Los Angeles worked with advisory groups such as the Structural Engineers Association of Southern California (SEAOSC) in developing their ordinances for Unreinforced Masonry Buildings with their Division 88 standard and for Concrete Tilt-Up with their Division 95 standard. The City of Los Angeles worked again with SEAOSC in the development of their recent standards for required retrofit of Soft Story Buildings and Non-Ductile Concrete Buildings.

## Existing Santa Monica Seismic Retrofit Standards

The 1999 City of Santa Monica seismic retrofit standards had basis from several sources since formal required retrofit standards were not prevalent in 1999. The 1999 standards have the requirement to analyze and retrofit structures to one-hundred percent (100%) of current building code. This requirement is more stringent that the California Existing Building Code of seventy-five percent (75%) of current code. In discussing the 100% requirement with building owners, many of them realized the significant effect of this requirement and in several cases, the retrofitting of the building was deferred.

In the process leading to the updates to the City of Santa Monica retrofit requirements, staff needed to understand the full scope of the seismic retrofit issue. This meant that the total number of buildings that are considered Potentially Seismically Vulnerable Buildings had to be determined. Staff and consulting services identified buildings Citywide using a combination of City zoning maps, permit records, visual identification, and examination of the building structural plans.

## Potentially Seismically Vulnerable Buildings

A building that may be considered Potentially Seismically Vulnerable is due to a combination of a building's age, its type of construction, and its lateral load resisting force elements. A building that is Potentially Seismically Vulnerable does not mean that collapse or failure is imminent in a seismic event, nor does it mean that the building is unsafe, it only speaks for the characteristics and its inherent lateral resistance system.

The identification of Potentially Seismically Vulnerable buildings resulted in the following counts:

| Potentially Seismically Vulnerable Buildings Type | Retrofitted Number of Buildings with Work Completed | Unretrofitted Work Incomplete Work Never Initiated | Total per Building Type |
|---|---|---|---|
| Unreinforced Masonry Buildings | 61* (111) | 210* (160) | 271 |
| Concrete Tilt-Up Buildings | 10 | 29 | 39 |
| Soft-Story Buildings | 494* (975) | 1,848* (1,367) | 2,342 |
| Non-Ductile Concrete Buildings | 9 | 73 | 82 |
| Steel Moment Frame Buildings | 8 | 71 | 79 |
| Overall Total Number | **582*** (1,113) | **2,231*** (1,700) | **2,813** |

The total number of Potentially Seismically Vulnerable Buildings identified is 2,813. Of this total, 582 are considered retrofitted and 2,231 are either not retrofitted or will require further analysis.

Because of current methods of seismic evaluation and retrofit standards, staff is recommending that URM Buildings that previously completed retrofit, but have masonry walls over eleven-feet in height to analyze for building compliance to determine if previous retrofit work is safe. Similarly, three and four story Soft Story Buildings with previous approved retrofit work will have to analyze the entire story above the weak story for lateral load behavior. The numbers with the asterisk in the table signifies the number of buildings

that had previous retrofit work that was approved. However, some buildings in this category will require re-analysis due to conditions of the building.

Updates to the City of Santa Monica Seismic Retrofit Standards

The total number of Potentially Seismically Vulnerable Buildings enabled Building and Safety staff to execute next steps in updating the technical standards. Following discussions with SEAOSC's Existing Buildings Committee and examination of other California jurisdictions with retrofit standards, staff is recommending a regional approach to Santa Monica's updates to the seismic retrofit standards. Standards similar to the City of Los Angeles are proposed as well as standards from the City of West Hollywood and the California/International Existing Building Code.

In summary, all of Santa Monica's standards will take the approach to apply 75% of current building code for the lateral load resisting analysis and design. The application of the standards being:

| Potentially Seismically Vulnerable Buildings Type | Technical Standard | Mandatory or Voluntary Program |
|---|---|---|
| Unreinforced Masonry Buildings | CA Existing Bldg Code Appendix Chp A1 | Mandatory |
| Concrete Tilt-Up Buildings | Int'l Existing Bldg Code Appendix Chp A2 | Mandatory |
| Soft-Story Buildings | City of Los Angeles ASCE 7 | Mandatory |

| | | |
|---|---|---|
| Non-Ductile Concrete Buildings | City of Los Angeles<br>ASCE 41 | Mandatory |
| Steel Moment Frame Buildings | City of West Hollywood<br>ASCE 41 | Mandatory |
| Single-Family Brace and Bolts | CA Existing Bldg Code<br>Appendix Chp A3 | Voluntary |

In brief summary of the technical requirements of each of the standards for each building type are:

URM Buildings – California Existing Building Code, Appendix Chapter A1

- $S_{D1}$ Elements of Table A1-A

**[BS] TABLE A1-A**
**ELEMENTS REGULATED BY THIS CHAPTER**

| BUILDING ELEMENTS | $S_{D1}$ | | | |
|---|---|---|---|---|
| | $\geq 0.067_g < 0.133_g$ | $\geq 0.133_g < 0.20_g$ | $\geq 0.20_g < 0.30_g$ | $> 0.30_g$ |
| Parapets | X | X | X | X |
| Walls, anchorage | X | X | X | X |
| Walls, *h/t* ratios | | X | X | X |
| Walls, in-plane shear | | X | X | X |
| Diaphragms[a] | | | X | X |
| Diaphragms, shear transfer[b] | | X | X | X |
| Diaphragms, demand-capacity ratios[b] | | | X | X |

a. Applies only to buildings designed according to the general procedures of Section A110.
b. Applies only to buildings designed according to the special procedures of Section A111.

- Quality Control: Mortar Testing, Masonry Shear Tests, Prequalified Tests Bolts

Concrete Tilt-Up Buildings – International Existing Building Code, Appendix Chap A2

- 75% of Current Building Code

Soft Story Buildings – City of Los Angeles Ordinance & ASCE 7

- Base Shear 75%
- R of 3.5 minimum
- Drift 0.025 Story Height
- P-Delta based on California Building Code
- Collectors based on California Building Code
- Considerations for Moment Frame and “Flag Pole” applications
- Soft Story Categories: Number of Stories, Number of Units
    - Category I. Buildings with three stories or more.
    - Category II. Buildings with 16 or more dwelling units.
    - Category III. Buildings containing 15 to 7 dwelling units.
    - Category IV. Buildings containing 6 or less dwelling units.

Non-Ductile Concrete Buildings – City of Los Angeles Ordinance & ASCE 41

- Base Shear 75%
- Basic Safety Objective from ASCE 41

**Table 2-1. Basic Performance Objective for Existing Buildings (BPOE)**

| | Tier 1[a] | Tier 2[a] | Tier 3 | |
|---|---|---|---|---|
| **Risk Category** | **BSE-1E** | **BSE-1E** | **BSE-1E** | **BSE-2E** |
| I & II | Life Safety Structural Performance<br>Life Safety Nonstructural Performance<br>(3-C) | Life Safety Structural Performance<br>Life Safety Nonstructural Performance<br>(3-C) | Life Safety Structural Performance<br>Life Safety Nonstructural Performance<br>(3-C) | Collapse Prevention Structural Performance<br>Nonstructural Performance Not Considered<br>(5-D) |
| III | See footnote *b* for Structural Performance<br>Position Retention Nonstructural Performance<br>(2-B) | Damage Control Structural Performance<br>Position Retention Nonstructural Performance<br>(2-B) | Damage Control Structural Performance<br>Position Retention Nonstructural Performance<br>(2-B) | Limited Safety Structural Performance<br>Nonstructural Performance Not Considered<br>(4-D) |
| IV | Immediate Occupancy Structural Performance<br>Position Retention Nonstructural Performance<br>(1-B) | Immediate Occupancy Structural Performance<br>Position Retention Nonstructural Performance<br>(1-B) | Immediate Occupancy Structural Performance<br>Position Retention Nonstructural Performance<br>(1-B) | Life Safety Structural Performance<br>Nonstructural Performance Not Considered<br>(3-D) |

[a]For Tier 1 and 2 assessments, seismic performance for the BSE-2E is not explicitly evaluated.
[b]For Risk Category III, the Tier 1 screening checklists shall be based on the Life Safety Performance Level (S-3), except that checklist statements using the Quick Check procedures of Section 4.5.3 shall be based on MS-factors and other limits that are an average of the values for Life Safety and Immediate Occupancy.

**Table C2-1. Probability of Exceedance and Mean Return Period**

| Probability of Exceedance | Mean Return Period (years) |
|---|---|
| 50%/30 years | 43 |
| 50%/50 years | 72 |
| 20%/50 years | 225 |
| 10%/50 years | 475 |
| 5%/50 years | 975 |
| 2%/50 years | 2,475 |

**Table C2-2. Performance Objectives**

| | Target Building Performance Levels | | | |
|---|---|---|---|---|
| Seismic Hazard Level | Operational Performance Level (1-A) | Immediate Occupancy Performance Level (1-B) | Life Safety Performance Level (3-C) | Collapse Prevention Performance Level (5-D) |
| 50%/50 years | a | b | c | d |
| BSE-1E (20%/50 years) | e | f | g | h |
| BSE-2E (5%/50 years) | i | j | k | l |
| BSE-2N (ASCE 7 $MCE_R$) | m | n | o | p |

NOTES: Each cell in the above matrix represents a discrete Performance Objective.
The Performance Objectives in the matrix above can be used to represent the three specific Performance Objectives for a standard building that would be considered Risk Category I & II defined in Sections 2.2.1, 2.2.2, and 2.2.3, as follows:

| | |
|---|---|
| Basic Performance Objective for Existing Buildings (BPOE) | g and l |
| Enhanced Objectives | g and i, j, m, n, o, or p<br>l and e or f<br>g and l and a, or b<br>k, m, n, or o alone |
| Limited Objectives | g alone<br>l alone<br>c, d, e, or f |

## Steel Moment Frame Buildings – City of West Hollywood & ASCE 41

- Risk Category ASCE 41

| Risk Category | Hazard Level 1 | Hazard Level 2 |
|---|---|---|
| I & II | BSE-1E, S-3 | BSE-2E, S-5 |
| III & IV | BSE-1E, S-2 | BSE-2E, S-5 |

| | | | | |
|---|---|---|---|---|
| Steel moment frames | Primary elements | Extensive distortion of beams and column panels. Many fractures at moment connections, but shear connections remain intact. A few elements might experience partial fracture. | Hinges form. Local buckling of some beam elements. Severe joint distortion; isolated moment connection fractures, but shear connections remain intact. | Minor local yielding at a few places. No fractures. Minor buckling or observable permanent distortion of members. |
| | Secondary elements | Same as for primary elements. | Extensive distortion of beams and column panels. Many fractures at moment connections, but shear connections remain intact. | Same as for primary elements. |
| | Drift | Transient drift sufficient to cause extensive nonstructural damage. Extensive permanent drift. | Transient drift sufficient to cause nonstructural damage. Noticeable permanent drift. | Transient drift that causes minor or no nonstructural damage. Negligible permanent drift. |

Single Family Dwelling Brace and Bolts – California Existing Building Code, Appendix Chapter A3 & City of Los Angeles Plan Set A

- 75% or Greater current building code

## Administrative Proposals of the Seismic Retrofit Program

The City of Santa Monica Seismic Retrofit Program will contain administrative provisions for compliance and verification of retrofit projects. The administrative standards will apply generally to all hazardous buildings types with specific provisions for each building type.

### Time Limits for Compliance

Each category of Potentially Seismically Vulnerable Building will have time limits in which to complete retrofit requirements. The final proposed time limits are in discussion by staff relative to the number of structures of each type of building. One major consideration in the proposal of time limits is the fact that Santa Monica already has existing retrofit requirements.

The general milestones for time limit compliance are proposed to be:

- Notification by the City of Santa Monica to the building owner;
- City of Santa Monica to record notice with the County of Los Angeles Registrar/Recorder;
- Submission of a structural analysis of the building reporting either compliance or recommendation for retrofit;
- Provide the City with confirmation that the “Tenant and Occupant Advisory” notice to tenants has been provided to each tenant;
- Application for a building permit and submission of retrofit plans;
- Obtain a building permit;
- Start of construction;

- First building inspection;
- Final building inspection and approval;
- Release of recorded notice.

Appeals

Any notification to a building owner of a Potentially Seismically Vulnerable Building notice is appealable. Appeals will be heard by the Building and Fire Life Safety Commission whose decision shall be final. An application for an appeal must be submitted within sixty days from the date on the notice in which the Commission must hear the appeal within ninety days of the appeal filing. Appeals before the Commission must be of a technical nature related to the building, technical methods of compliance, existing retrofit work, equivalency requests. The Commission will not hear appeals for seismic retrofit cases related to financial hardships or non-technical matters.

Professionals Authorized to Perform Structural Evaluations, Seismic Design

The ordinance proposes to list the following professional classes and scope of work applicable to seismic retrofit:

- All types of buildings: California Licensed Civil or Structural Engineer or Registered Architect, except:
    - High-Rise Steel or Concrete Retrofit per Santa Monica's definition of High-Rise Structures above 55-feet: California Licensed Structural Engineer
    - Declaration of Dangerous Building requiring Demolition due to Imminent and Immediate Threat to Life and Safety: California Licensed Structural Engineer

Other Compliances

The proposed seismic retrofit ordinance will include other compliances in the verification of retrofit work. These include:

- Structural Observation per Chapter 17 of the California Building Code;
- Special Inspection per Chapter 17 of the California Building Code;
- Peer Review as deemed applicable by Building and Safety;
- Consulting plan check services for certain buildings or review;
- Protections for historical and landmark buildings;
- "Triggers" for other compliances: Accessibility for non-residential buildings. Multi-family dwellings 1991 and older are exempt. Seismic gas shut-off valve. Existing parking verification.

Recommendations

Staff requests that the Building and Fire Life Safety Commission approve the proposed technical standards that will be incorporated into the technical provisions of the seismic retrofit ordinance. Staff also requests that the Commission approve the administrative standards as to the technical applicability to the ordinance.