# Seismic Evaluation Summary

**1717 4th Street**

Santa Monica, California

Englekirk
STRUCTURAL ENGINEERS

February 7, 2020

Job No. 19-L173

## TABLE OF CONTENTS

# 1.0 INTRODUCTION

## 1.1 Project Description

This report summarizes the evaluation for the existing building located at 1717 4th, Santa Monica, CA 90401. The site is located as shown in Figure 1.1.

The report presents the technical basis for the Systematic Seismic (Tier 3) Evaluation requested by the Square Mile Capital Management LLC. The report identifies the potential seismic deficiencies per ASCE 41-13 in accordance with City of Santa Monica Ordinance 2537. These potential seismic deficiencies are discussed in greater detail in Section 5 of this report.

## 1.2 Information Reviewed

Provided for review was a copy of the existing structural record drawings prepared by Englekirk and Sabol Consulting Structural Engineers Inc., dated October 20th, 1988.

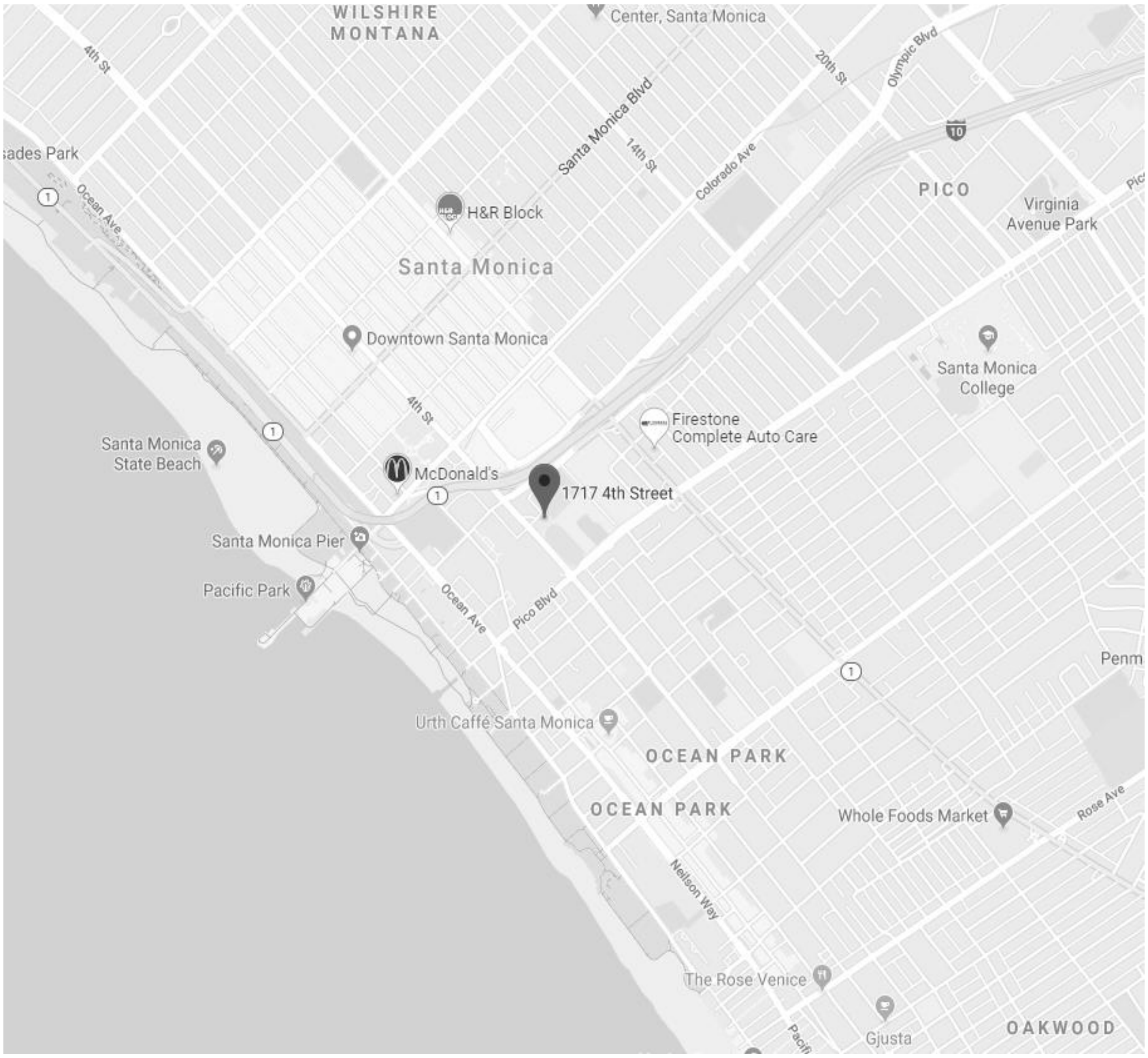


**Figure 1.1: Site Location**

# 2.0 BUILDING DESCRIPTION

## 2.1 General Building Description

1717 4th Street is a 3-story steel moment frames (SMF) building with the setbacks in West and South-West direction of the building.

## 2.2 Vertical System

Based upon a review of the record structural drawings, the building's vertical load resisting system consists of steel beams and columns supporting a concrete over metal deck floor system. A representative framing plan is presented in Figure 2.1.

The 3-story SMF building is supported on a concrete podium at Level 1. The concrete podium supporting the structure was not evaluated as it is beyond the scope of the evaluation and the City of Santa Monica Ordinance 2537.

## 2.3 Lateral System

The lateral force resisting system consists of pre-Northridge steel moment resisting frames. Two are located along the North-South direction along grids 18 and 22. The remaining steel moment resisting frames are located along the East-West direction along grids E and M.

The arrangement of the steel moment frames is shown in Figure 2.1. The building is classified as Building Type S1: Steel Moment Frames with Stiff Diaphragms. It is our understanding that the building was constructed in 1989, therefore, is not considered as a benchmark building per ASCE 41-13.

Loads are transferred from the moment frames to the foundations through the supporting concrete podium and reinforced concrete columns.

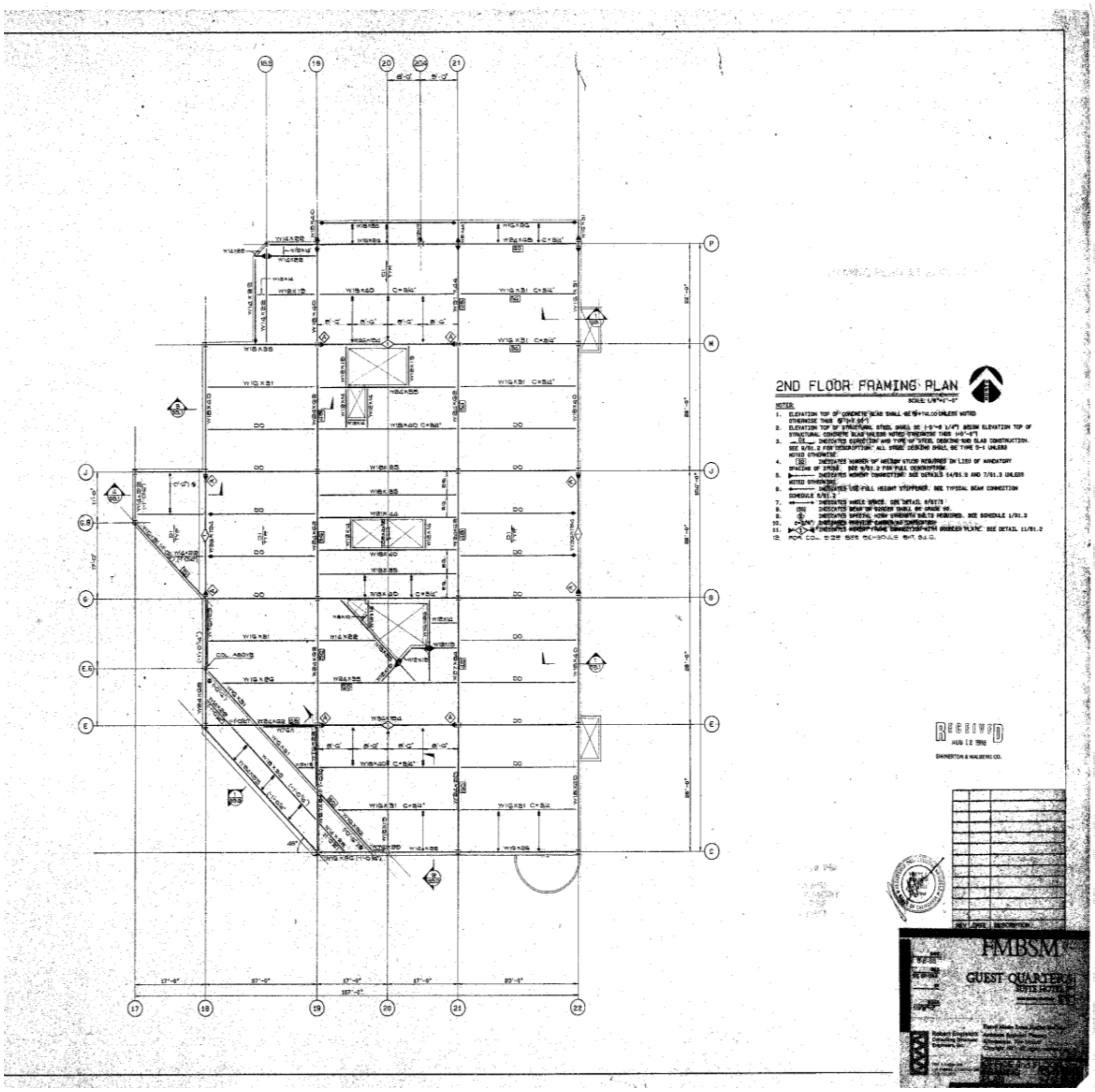


**Figure 2.1 Typical Floor Framing Plan**

# 3.0 SEISMIC EVALUATION METHODOLOGY

## 3.1 City of Santa Monica Ordinance Provisions for Steel Moment Resisting Frame Structures

The City of Santa Monica Ordinance 2537 has indicated that the welded connections and non-ductility of the steel connecting elements introduce poor performance of these type of buildings in seismic event. The deficiencies in the lateral force resisting system beam-column connections could experience damage and possible connection failures. This Ordinance requires minimum standards for these types of buildings built under building code standards enacted before January 1,1996 and intended to improve the performance during earthquakes and reduce, but not necessarily prevent, the loss of life, injury or earthquake-related damage. Furthermore, the ordinance demands compliance with the mandatory seismic retrofit requirements within the time limits allowed.

Ordinance 2537 specifies the building in question shall meet the following criteria:

- Structural analysis and identification of all structural deficiencies in accordance with ASCE 41 is required.
- Meet or exceed the strength and stiffness requirements of alteration, repair, retrofit, replacement or addition of structural elements and their connections.
- Shall cause the building to be retrofitted if any of the major deficiencies is/are identified. Retrofit work to mitigate the major deficiencies shall not impact the existing lateral load elements by increasing any demand-to-capacity ratio by more than ten percent unless the existing elements are shown to be capable of resisting the increased demand.
- Meet or exceed the structural performance level for the associate earthquake hazard levels based on Risk Category as defined in ASCE 41 as follows:

| 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 |

## 3.2 ASCE 41 – Tier 3 Systematic Seismic Evaluation

ASCE 41-13 Seismic Evaluation and Retrofit of Existing Buildings Tier 3 Systematic Evaluation was employed as the evaluation method. The Tier 3 procedure for non-linear static evaluation was implemented to evaluate potential seismic deficiencies of the building. Given the building's lateral-force-resisting system described in Section 2.0, the building is classified as a Type S1 structure in accordance with ASCE 41 Table 3-1. To perform the evaluation, a three-dimensional finite element model was created using structural analysis and design software PERFORM 3D, as shown in Figure 3.1.

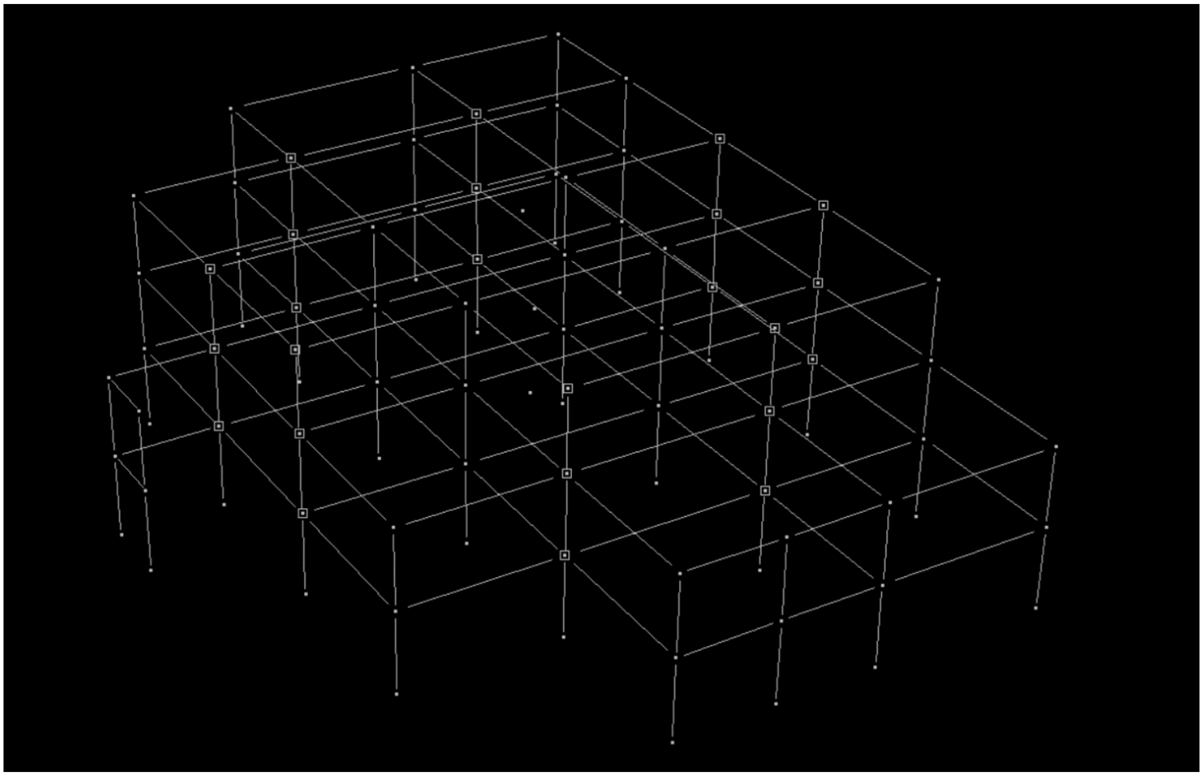

Figure 3.1 3D Structural Model of the building in Perform3D

# 4.0 SEISMICITY

## 4.1 Ground Motion Estimates for ASCE 41-13 Seismic Review

A geotechnical report was not provided for review. Site geotechnical conditions were assumed to be consistent with Site Class D (ASCE 41, Section 2.4.1.6.1), and spectral accelerations were obtained from probabilistic hazard mapping software developed by the United States Geological Survey (USGS). ASCE 41 definitions for earthquake ground motions to be assessed are paraphrased below for convenience.

BSE-2N: the 2,475-year return period earthquake ground motion, or the 150% of the Maximum Considered Earthquake ground motion for the site.

BSE-2E: the 975-year return period earthquake ground motion.

BSE-1N: two-thirds of the BSE-2N, nominally, the 475-year return period earthquake ground motion.

BSE-1E: the 225-year return period earthquake ground motion.

Spectral accelerations were obtained from the USGS for the Basic Safety Earthquake-1 (BSE-1E) hazard levels and Basic Safety Earthquake-2 (BSE-2E) hazard levels. The ordinates required for the Basic Performance Objectives for Existing Buildings (BPOE) are illustrated in Figure 4.1. The BSE-2E hazard level corresponds to an earthquake with an average return period of 975 years or 5% probability of exceedance in 50 years. BSE-2E spectral accelerations are used to verify that the building satisfies Collapse Prevention performance objectives. The BSE-1E hazard level corresponds to an earthquake with an average return period of 225 years or 20% probability of exceedance in 50 years.BSE-1E spectral accelerations are used to verify that the building satisfies Life Safety performance objectives.

| | ASCE41-13 | | |
|---|---|---|---|
| | BSE-1E | BSE-2E | |
| | 225yrs RP | 975yrs RP | |
| β (damping) | 5.0 | 5.0 | % |
| x | 20 | 5 | yrs |
| $S_{XS,BSE-XE}$ | 0.875 | 1.465 | g |
| $S_{X1,BSE-XE}$ | 0.496 | 0.909 | g |
| $T_{0,BSE-XE}$ | 0.110 | 0.124 | s |
| $T_{S,BSE-XE}$ | 0.551 | 0.620 | s |
| $T_{L,BSE-XE}$ | 8.000 | 8.000 | s |
| $B_{1,5\%}$ | 1.00 | 1.00 | s |

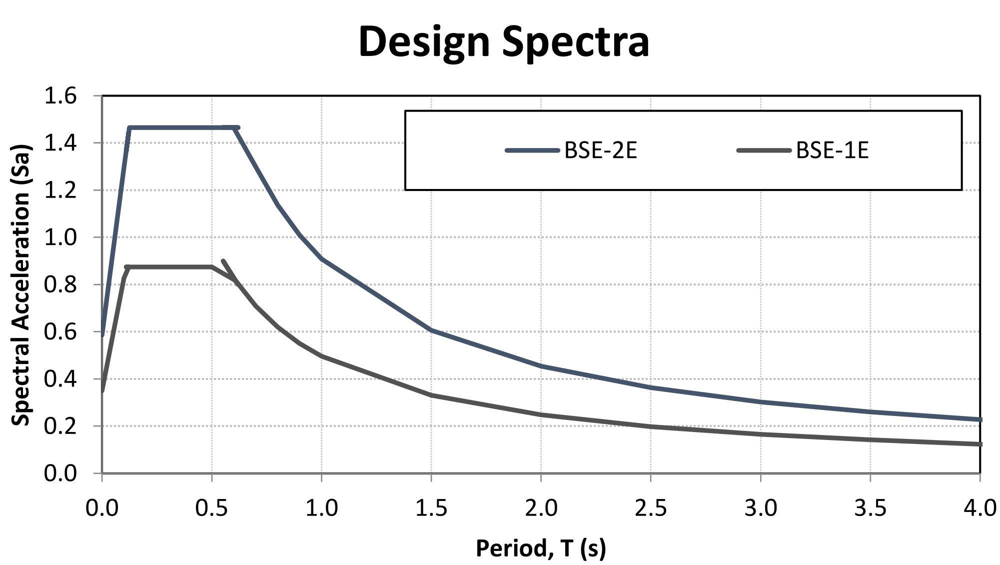


**Figure 4.1 BSE-2E & 1E Spectral Ordinates per ASCE 41-13**

# 5.0 SEISMIC EVALUATION SUMMARY

## 5.1 ASCE 41-13 Tier 3 Systematic Evaluation (BPOE)

### 5.1.1 Introduction

A systematic analysis was performed to assess potential seismic deficiencies in accordance with the requirements for BPOE of ASCE 41-13. As stated previously, a structural model was built using software PERFORM 3D, following the modeling criteria described in ASCE 41-13, Chapter 9. The model included all components of the gravity and lateral systems.

### 5.1.2 Component Strength versus Acceptance Criteria

The components modeled in the lateral system shall be classified as either force-controlled or deformation-controlled elements. Per ASCE 41-13, a deformation-controlled action is defined as an action that has an allowable deformation greater than the deformation associated with the yield strength of the member. The maximum deformation is limited by the ductility capacity of the component. A force-controlled action is defined as an action that has a deformation that is not allowed to exceed the deformation associated with the yield strength of the member; members with limited ductility were considered force-controlled.

For deformation-controlled action, the acceptance criteria are defined as:

> Primary and secondary components shall have expected deformation capacities not less than maximum deformation demands calculated at target displacements; where expected deformation capacities are determined considering all coexisting forces and deformations.

For force-controlled action, the acceptance criteria are defined as:

$$YX(Q_{UF}-Q_G)+Q_G \leq Q_{CL}$$

where:

$Q_{CL}$ = Lower bound strength of the component

$Q_{UF}$ = Equivalent lateral load for force-controlled actions

$Q_G$ = Gravity load demand

$Y$ = Load factor

The *X*-factors used for the non-linear static procedure is 1.0 for the Collapse Prevention (CP) Performance Level and 1.3 for Life Safety (LS) Performance Level.

### 5.1.3 Analytical Results

Based upon the results of the non-linear static Tier 3 analysis for BPOE, the following were found per ASCE 41-13:

**Steel Columns:** The shear, axial and bending capacity in all steel columns, given by the analysis, is larger than their demand. This behavior was observed in both the Life Safety (LS, BSE-1E) and Collapse Prevention (CP, BSE-2E) Performance Levels. No deficiencies were found, and retrofitting is not required in steel columns.

**Panel Zone:** The shear stress in all panel zones, given by the analysis, is smaller than their shear capacity. This behavior was observed in both the Life Safety (LS, BSE-1E) and Collapse Prevention (CP, BSE-2E) Performance Levels. No deficiencies were found, and retrofitting is not required in Panel Zones.

**Steel Beams:** The shear stress in all steel beams, given by the analysis, is smaller than their shear capacity. Deformation capacities satisfy Life Safety (LS, BSE-1E) and Collapse Prevention (CP, BSE-2E) Performance levels. This behavior was observed in both the Life Safety (LS, BSE-1E) and Collapse Prevention (CP, BSE-2E) Performance Levels. No deficiencies were found, and retrofitting is not required in steel beams.

**Beam Connections:** The non-linear static analysis in both directions shows the sudden decrease in strength loss of overall structure. In the existing building, the failure of the beam-column fully restrained (FR) weld connections at Level 2 and Level 3 caused the abrupt decrease in the "pushover curve" therefore, results in the structure not meeting the acceptance criteria per ASCE41-13. The deficiencies were observed for both Life Safety (LS, BSE-1E) and Collapse Prevention (CP, BSE-2E) Performance Levels.

By addressing the FR welded connections at Levels 2 and 3, the deformation capacity of the FR welded connections in the both directions will increase. This will result in gradual strength loss in pushover curves and more energy dissipation. Ultimately, the overall structure would meet the required acceptance criteria specified in ASCE41-13 and intent of City of Santa Monica Ordinance 2537.

## 6.0 CONCLUSIONS

Based upon a review of the record drawings and the evaluation of the building's vertical and lateral system using ASCE 41 Tier 3 Evaluation Procedure, it is our opinion that the structural deficiencies stated in Section 5.1.3 for BPOE need to be addressed.

I am a State of California licensed structural engineer and certify that the evaluation of the building located at 1717 4th Street, Santa Monica, CA 90401 was either done by me or the bulk of work was performed under my direct supervision. I have no ownership interest in the subject property.

Mahmoud Faghihi, PE, SE, License No. S-5789
Associate Principal

cc: Eric Velazquez – Englekirk
Nilofar Doorandish – Englekirk
Prayut Patel – Englekirk