SEISMIC EVALUATION

Of

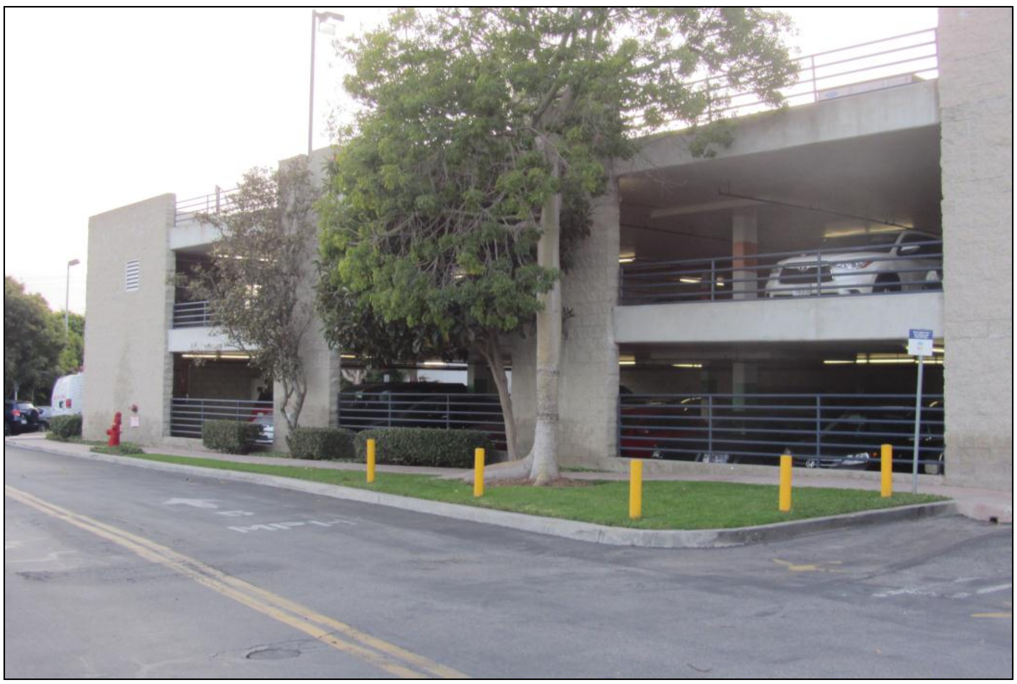
Beach Cities Health District - Parking Structure

512 N. Prospect Avenue
Redondo Beach, CA

PRIVILEGED AND CONFIDENTIAL

Prepared for:

Beach Cities Health District
514 North Prospect Avenue
Redondo Beach, CA



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0.0 EXECUTIVE SUMMARY

The objective of this report is to present the results of the seismic evaluation of the 3-level parking structure located at 512 North Prospect Avenue on the Beach Cities Health District Campus in Redondo Beach.

The parking structure has three (3) levels of parking, was constructed circa 1990 and designed to the 1985 edition of the Uniform Building Code (UBC).

The parking decks are constructed of two-way reinforced concrete slabs spanning to reinforced concrete columns at the interior and reinforced masonry walls at the perimeter. The columns and walls are continuous to the foundation. The foundation system consists of shall spread and strip footings.

The expected seismic performance of the structure was determined by a site review, review of available structural drawings, dynamic analyses and a general seismic hazard analysis for the region.

The methodology of ASCE 41-17, Seismic Evaluation and Retrofit of Existing Buildings, was used to evaluate the seismic performance. The results indicate that the slabs and CMU walls have adequate shear and flexural strength. However, the slab-to-CMU wall connections have inadequate strength to transfer expected seismic forces with average demand-to-capacity ratio of 1.2.

Recommended structural enhancements have been developed to improve seismic performance. The enhancements include adding new steel angles to underside of slab at CMU walls at select locations of roof and 2nd parking levels.

1.0 INTRODUCTION

1.1 General

The objective of this report is to present the results of the seismic evaluation of the 3-level parking structure located at 512 North Prospect Avenue on the Beach Cities Health District Campus in Redondo Beach. Figure 1.1 shows the location of the structure on an aerial view of the site.

The structure was visited by *Nabih Youssef Associates* (NYA) staff to observe the general condition of the visible portions of the structural system. A general review of the structural elements was performed during the site visit to develop an understanding of the structure's construction.

The expected seismic performance was determined by a site review of the structure, review of available structural and architectural drawings, a general seismic hazard analysis for the region, and linear dynamic analyses.

The methodology of ASCE 41-17, Seismic Evaluation and Retrofit of Existing Buildings, was used to evaluate the seismic performance of the building. ASCE 41-17 is a nationally recognized standard for the seismic evaluation and retrofit of buildings.

This evaluation of the structural system represents the opinion of *NYA* based on the available information.

1.2 Scope of Work

The following tasks outline the scope of work for the structural evaluation:

1) Review existing structural and architectural drawings and prior engineering/repair reports made available by the Client.
2) Perform limited walk-through and visually confirm, to the extent possible, that the provided construction documents generally correspond with the actual conditions.
3) Perform Tier 1 evaluation to identify potential seismic deficiencies.
4) Develop a computer model of the parking structure and perform linear dynamic analyses to assess its seismic performance.
5) Develop professional opinion of the adequacy of the parking structure based on prevailing seismic performance standards.
6) Develop conceptual strengthening approach to address identified seismic deficiencies, as necessary.
7) Prepare a written report summarizing the results of the site visit, structural evaluation, and conceptual strengthening including sketches of plans and details.

1.3 Evaluation References

The following documents and available information were examined in the evaluation:

- Structural drawings for South Bay Hospital Parking Garage, as prepared by Albert G. Presky & Associates (C87050.06), dated March 3, 1989.
- Seismic Evaluation and Retrofit of Existing Buildings, ASCE/SEI 41-17, 2017.

Figure 1.1 – Aerial View

2.0 BUILDING DESCRIPTION

2.1 General

The parking structure is located east of the south tower (1968 Addition) and northeast of the medical office building (510 Prospect). The garage has three (3) levels of parking, was constructed circa 1990 and designed to the 1985 edition of the Uniform Building Code (UBC).

2.2 Gravity System

The gravity framing system typically consists of the following:

- The parking decks are typically constructed 11″ thick two-way reinforced concrete slabs with limited areas of 13″ thick slabs.
- The concrete slabs span to interior concrete columns with drop panels and reinforced masonry walls/piers along the perimeter.
- The columns and walls/piers are continuous to the foundation.
- The foundation system consists of shallow isolated spread footings supporting columns and continuous strip footings supporting masonry walls. A 4″ thick reinforced concrete slab-on-grade forms the lowest parking level.

2.3 Lateral System

The seismic system of the building typically consists of the following:

- The concrete slab parking decks act as structural diaphragms to distribute seismic inertial forces to the perimeter reinforced masonry walls/piers.

3.0 FIELD OBSERVATIONS

3.1 General

Several site visits were made by Nabih Youssef Associates staff to observe the condition and characteristics of the garage. Observation was limited to the visible areas of the structure.

3.2 Structural Observations

- In general, the garage appeared to be in good condition; there were no signs of significant structural cracking, spalling or deterioration of the structural framing.
- No permanent offset of the garage that would indicate structural distress was observed.
- The configuration of the structure was in general conformance with the original structural drawings. No significant structural alterations were observed.

4.0 BUILDING PERFORMANCE IN EARTHQUAKES

A detailed evaluation of the parking structure was performed, including three-dimensional linear dynamic analyses. The criteria used to evaluate the performance of the building, the analysis procedures and results are discussed in the following sections.

4.1 Evaluation Criteria

The parking structure was evaluated using the methodology of ASCE 41-17, *Seismic Evaluation and Retrofit of Existing Buildings*, a national standard that provides guidelines for relating engineering limit states to expected damage/performance. The Basic Performance Objective for Existing Buildings (BPOE), as defined by ASCE 41-17, was the performance criteria used in the assessment. The BPOE, or objectives close to it, has been used for characterizing seismic performance in other standards and regulations. The BPOE accepts a lower level of safety and a higher risk of collapse than would that provided by similar standards for new buildings. Building meeting the BPOE are expected to experience little damage from relatively frequent, moderate earthquakes but significantly more damage and potential economic loss from the more severe and infrequent earthquakes that could affect them.

The BPOE incorporates a two (2) tier procedure to evaluate seismic performance. Table 4.1 summarizes the criteria.

Table 4.1 – Basic Performance Objective for Existing Buildings

Earthquake Hazard Level	**Structural Performance Level**
BSE-1E (20/50 – 225 yr)	Life Safety
BSE-2E (5/50 – 975 yr)	Collapse Prevention

The design response spectral accelerations for the BSE-1E and BSE-2E seismic hazard levels for the site, assuming soil type D, is provided in Table 4.2.

Table 4.2 –Design Response Spectral Acceleration for BSE-1E & BSE-2E

Spectral Acceleration	BSE-1E	BSE-2E
S_{XS}	0.817g	1.407g
S_{X1}	0.454g	0.880g

4.2 Analysis Approach

A Tier 1 evaluation was initially performed to screen for potential deficiencies. Results identified insufficient shear strength of the reinforced masonry walls/piers as a potential deficiency. A Tier 3 evaluation using the linear dynamic procedure (LDP) of ASCE 41-17 was performed.

A three-dimensional computer model of the parking structure was developed using ETABS 2017, developed by Computers & Structures, Inc. The model included all elements that significantly contribute to the lateral force resistance of the garage: these include the concrete slab parking decks, and reinforced masonry walls/piers. The concrete slab parking decks were assumed to behave as semi-rigid diaphragms. The concrete columns were included in the model to provide vertical support to the concrete slabs. The seismic base of the garage was assumed to be at the first parking level. Figure 4.1 shows a plot of the ETABS model.

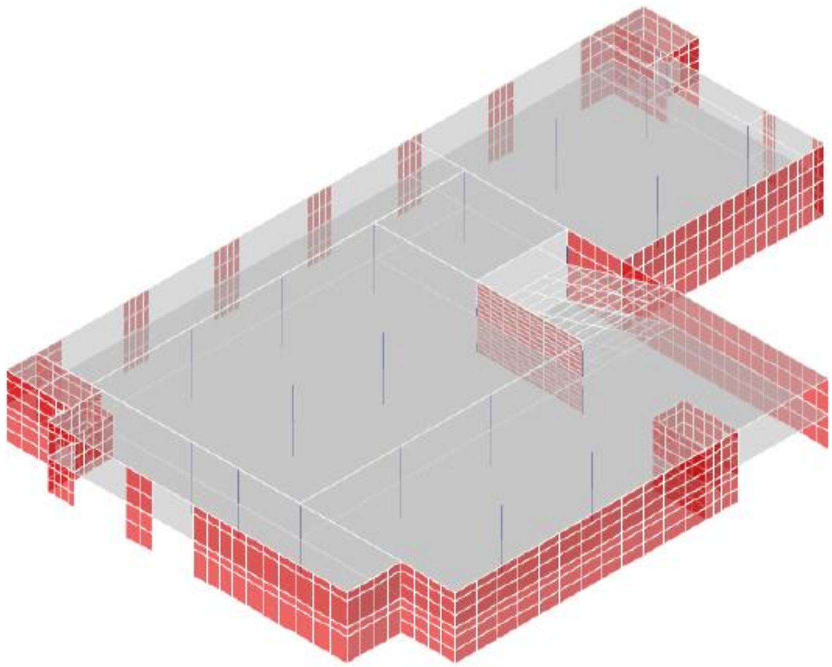


Figure 4.1 – Plot of ETABS model

The material properties for concrete and masonry were provided on the original structural drawings and used in the model.

LDP consists of performing modal spectral analysis using linearly elastic response spectra that are not modified to account for anticipated nonlinear response. The procedure produces displacements that approximate maximum displacements expected during the design earthquake, but internal forces exceed those that the building can sustain because of anticipated inelastic response of components and elements. These forces are evaluated using acceptance criteria that include modification factors.

4.3 Discussion of Results

Modal analyses were performed to determine the dynamic characteristics of the building. The results indicate that the lateral force resisting elements are well distributed and provide a regular response. Figures 4.2 through 4.4 show plots of the fundamental mode shapes. Table 4.3 summarizes the fundamental periods.

Dynamic analyses were performed to establish likely earthquake demand on individual structural components and global response. The demands on individual components were evaluated using ASCE 41-17 acceptance criteria for Life Safety and Collapse Prevention performance.

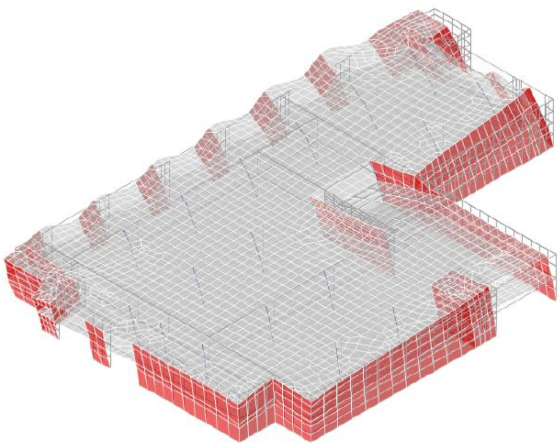


Figure 4.2 – N-S Translational Mode

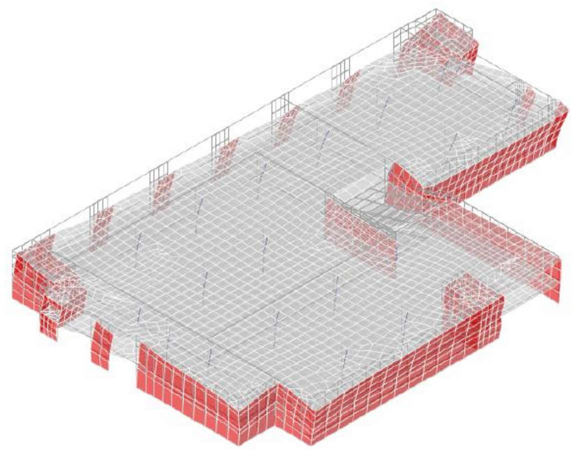


Figure 4.3 – E-W Translational Mode

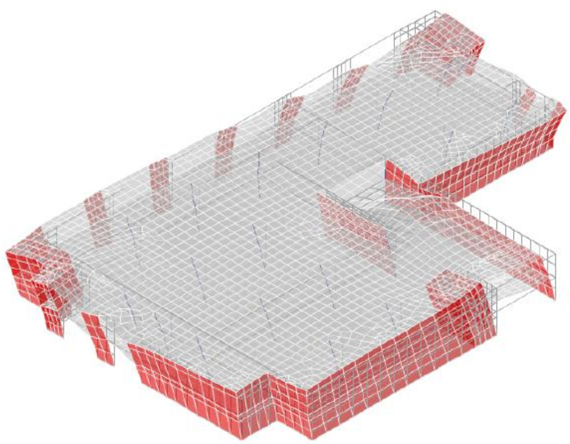


Figure 4.4 – Torsional Mode

Table 4.3 Fundamental Periods

Fundamental Mode	Period (sec.)
N-S	0.14
E-W	0.11
Torsion	0.10

The results of the analysis indicate that the slabs and CMU walls have adequate shear and flexural strength. However, the results also indicate that the slab-to-CMU wall connections have inadequate strength to transfer expected seismic forces with average demand-to-capacity ratio (DCR) of 1.2.

5.0 CODE ASSESSMENT

The City of Redondo Beach does not currently have a mandatory seismic retrofit ordinance for reinforced masonry walls with stiff/rigid diaphragm. Thus, mandatory seismic upgrade would only be triggered for change of use or occupancy, or significant structural alteration/addition.

Retrofit to mitigate identified deficiencies would be strictly voluntary.

6.0 RECOMMENDATIONS

Recommended enhancements have been developed to improve the seismic performance of the parking structure. The proposed strengthening is preliminary and is intended to identify representative scope for planning, coordination, and rough order of magnitude estimate of cost.

6.1 Recommended Strengthening

The recommended strengthening consists of the following:

- Add new steel angles to underside of slab at CMU walls at select locations of roof and 2nd parking levels. Angles to be connected to slabs and walls with drilled and epoxy dowels. Figure 6.1 shows a sketch of the slab-to-wall connection detail.

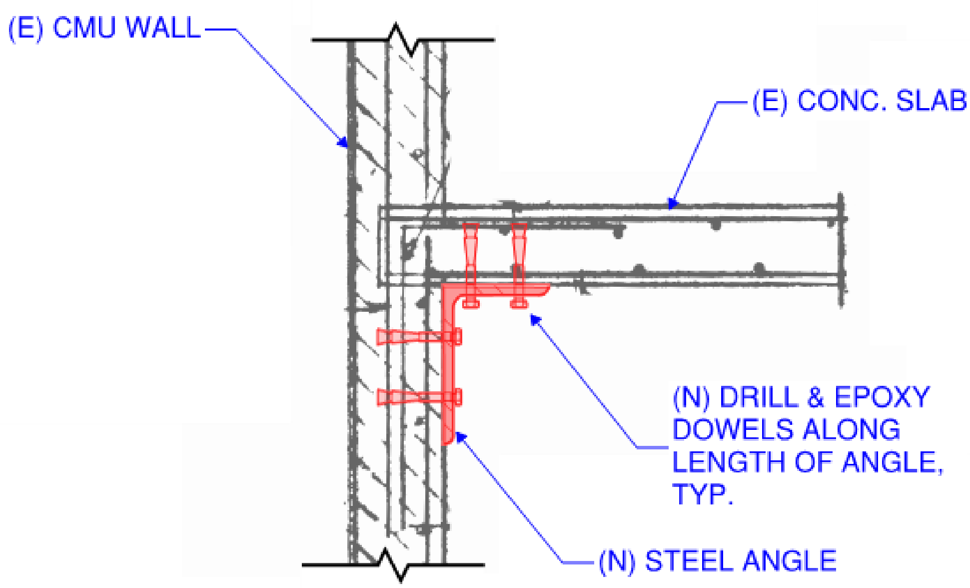
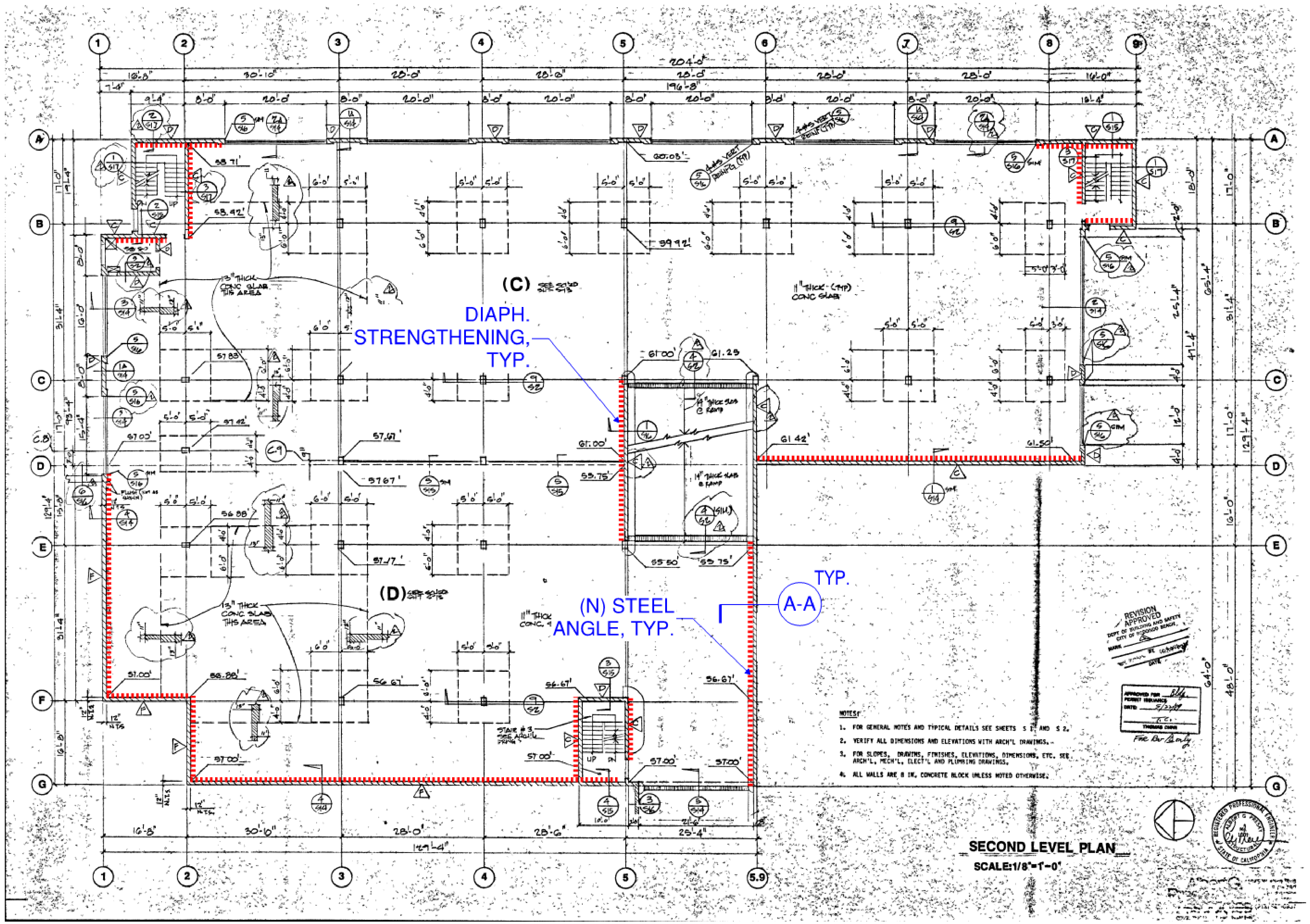
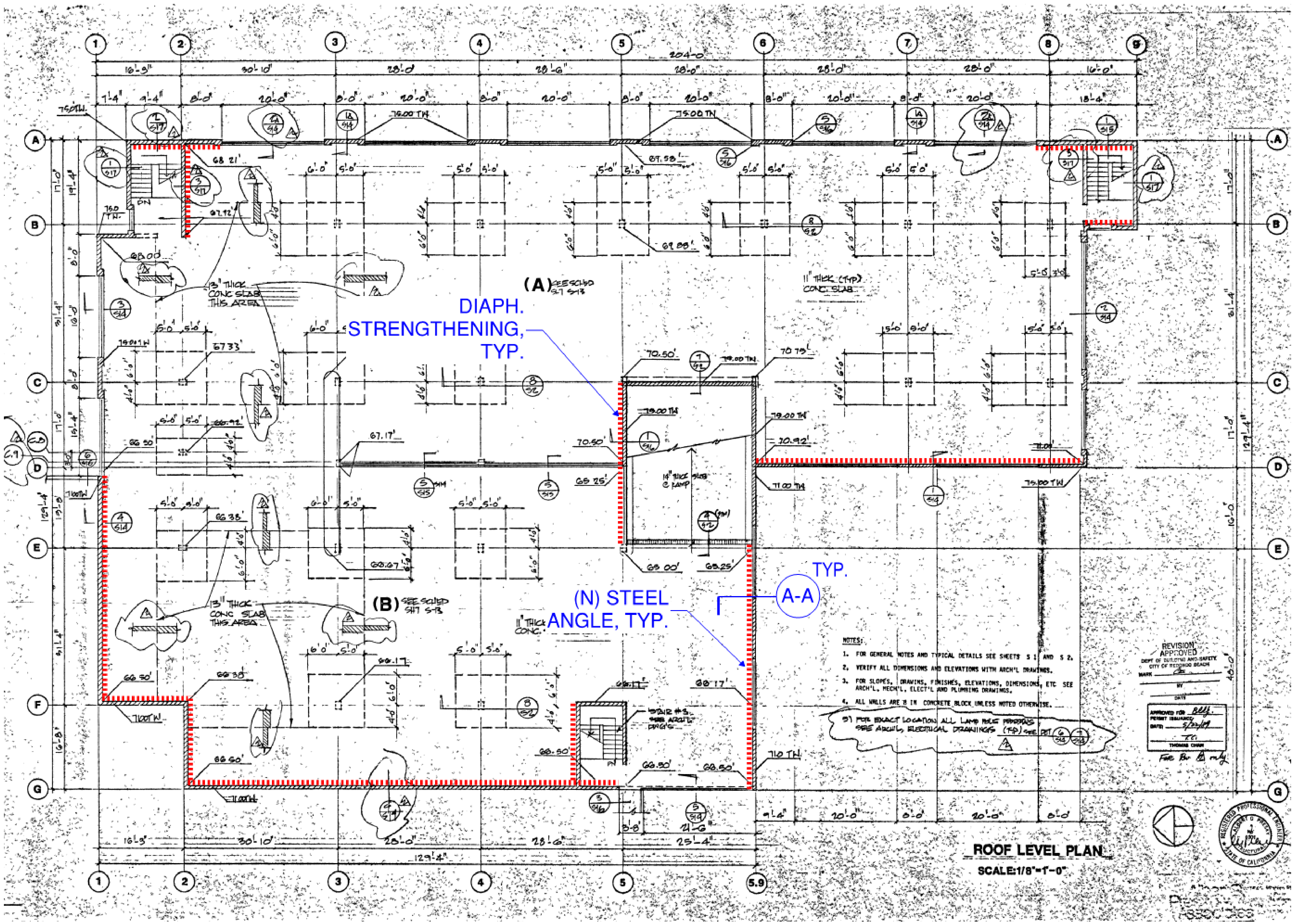


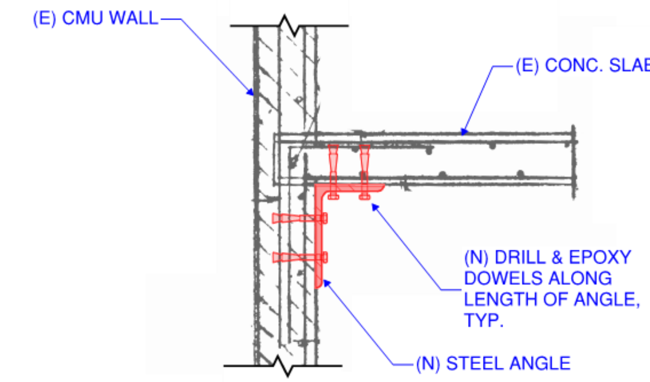
Figure 6.1 – Slab-to-CMU Wall Connection Strengthening

APPENDIX A – SEISMIC STRENGTHENING SKETCHES



2nd Parking Level Plan





SECTION A-A

Roof Parking Level Plan