BergerABAM

Evaluation Report

Salem Central Public Library

Submitted to

City of Salem, Oregon

A14.0170.00

February 14, 2014

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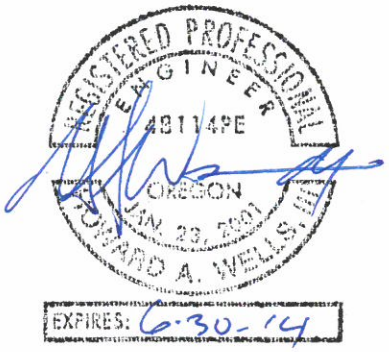

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EVALUATION REPORT

City of Salem
Salem Central Public Library

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EXECUTIVE SUMMARY

This report documents a seismic structural and nonstructural assessment of City of Salem Central Library, which includes the main library building, the auditorium, and the adjacent parking garage. This report indicates descriptions, evaluations, and upgrade recommendations. The evaluations were performed in accordance with the checklists produced by the American Society of Civil Engineers (ASCE) in ASCE 31-03 *Seismic Evaluation of Existing Buildings*. This report is based on an ASCE 31-03 Tier 1 evaluation. Structural upgrades are based in part on the analysis procedures of ASCE 41-06 *Seismic Rehabilitation of Existing Buildings.* Before implementation of any seismic upgrade scheme, a complete ASCE 31-03 Tier 2 evaluation should be performed.

Three major components were considered in this seismic evaluation: the Library, the Auditorium, and the Parking Garage. While the Library and the Parking Garage require major seismic upgrades the Auditorium requires better out-of-plane attachments for the walls. The seismic upgrade for each component, along with the type of work involved, can be summarized as follows.

- Auditorium: estimated cost $75,000
  - Reinforce anchorage of the roof to the concrete walls.
- Library: estimated cost $5.224 million
  - Add new reinforced concrete shearwalls at four locations.
  - Add new micro-pile foundations to support the new concrete shearwalls.
  - Add collector elements at elevated levels in order to get seismic load to the new concrete shearwalls.
  - Reinforce the connections of elevated levels to existing concrete walls and piers.
  - Reinforce the connection of the composite metal deck to existing concrete waffle slabs and concrete walls.
  - Reinforce the connection of the metal roof deck to existing concrete waffle slabs and concrete walls.
  - Reinforce the connections of precast concrete spandrel beams to the structure.
- The Parking Garage: estimated cost $1.098 million
  - Add new reinforced concrete shearwalls.

- Add collector elements at elevated levels in order to get seismic load to the new and existing concrete shearwalls.

- Reinforce the connections of precast concrete spandrel beams to the structure.

The costs listed above are direct construction costs only. See Appendix B, Direct Construction Cost Summary for a list of other cost categories to be included when considering the total project development cost.

Construction of these upgrades will likely disrupt the daily function of the facility and could make portions of each facility off-limits during construction.

1.0 INTRODUCTION

1.1 General

BergerABAM has been retained by the City of Salem to conduct building evaluations for the Salem Central Public Library campus. The facility includes three separate building structures: the Library building structure, the Auditorium building structure, and the adjacent Parking Garage structure. The purpose of this study is to evaluate the expected seismic performance of the existing buildings, and to determine the cost to rehabilitate the buildings to a life safety level of seismic performance.

Our evaluations of the existing buildings are based on visual observations, numerical calculations, and the review of the original design documents. Evaluation criteria from the ASCE 31-03 *Seismic Evaluation of Existing Buildings* and the ASCE 41-06 *Seismic Rehabilitation of Existing Buildings* were used, in part, as the basis of our structural assessment.

Observations, analyses, conclusions, and recommendations contained in this report reflect our best judgment. Concealed problems with the construction of the buildings may exist that were not revealed through this review. BergerABAM, therefore, is unable to warrant or guarantee the condition of the existing construction of the buildings.

1.2 Scope

The purpose of this study is to evaluate the expected seismic performance of the existing buildings, identify areas where structural and nonstructural improvements can or should be made, and evaluate their significance. Included in this work is estimated costs itemized for each structural element needed for the rehabilitation of the buildings.

Seismic condition assessments were conducted on all three existing building structures. The assessments were conducted in compliance with ASCE 31-03 Tier 1 standards. ASCE 41-06 *Seismic Rehabilitation of Existing Buildings* and a three-dimensional (3D) finite element computer program (ETABS®) were used to analyze the Library structure for proposed upgrades. Hand calculations were used to evaluate the Auditorium and the Parking Garage.

This report is intended to assist the City of Salem with determining the feasibility of rehabilitating the Salem Central Public Library building structures.

2.0 CONTENTS OF REPORT

This report presents the geotechnical and seismic design criteria and then describes each building in terms of its location, age, size, construction, and other general information. It also includes summaries of the buildings' structural and nonstructural systems, findings of the evaluation, and recommendations for changes to improve each building's seismic performance.

The appendices include cost estimates, proposed renovation drawings, site photographs, and ASCE 31-03 Tier 1 checklists and supporting calculations.

Appendix E of the report contains the team's findings about the existing conditions of each building in terms of the criteria contained in five checklists found in ASCE 31-03 *Seismic Evaluation of Existing Buildings*: the Basic and Supplemental Structural Checklist, the Geologic Site Hazards and Foundations Checklist, and the Basic and Intermediate Nonstructural Component Checklists.

3.0 GEOTECHNICAL AND SEISMIC DESIGN CRITERIA

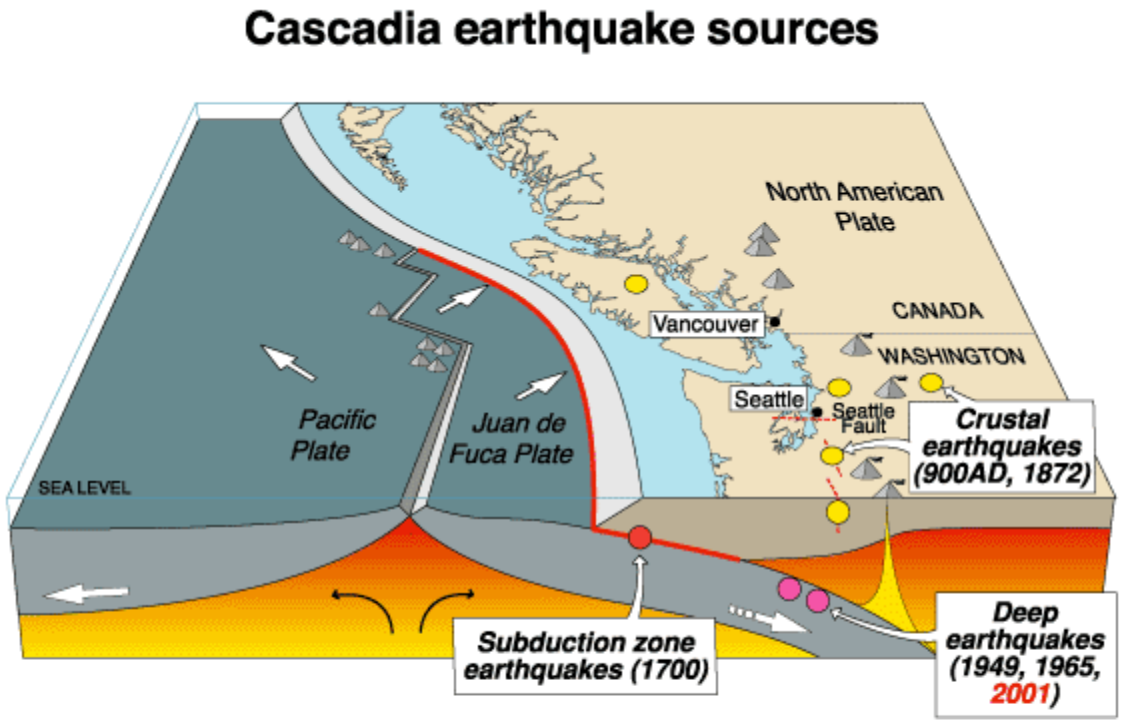
3.1 Geotechnical Data

At the time of this report, no geotechnical report was available. During the ASCE 31 analysis, no calculations were required that necessitated assumptions for the bearing capacity of the existing soil conditions. The existing drawings did list allowable soil bearing pressures used for the original design of the structure.

For the ASCE 31 evaluation to be complete, a licensed geotechnical engineer will be required to evaluate the site for the conditions listed in the Geologic Site Hazards and Foundations check lists that are located in Appendix E of this report. In particular, the potential geologic site hazards, such as liquefaction, surface fault rupture, and deterioration of foundation elements must be identified.

3.2 Regional Seismic Geology

There are three seismic source zones for earthquakes in the Pacific Northwest. These zones are illustrated in Figure 1 and include subduction zone interface, subduction zone intraplate, and crustal sources.



Source	Affected area	Max. Size	Recurrence
Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

Figure 1. Potential Seismic Source Zones for the Pacific Northwest (USGS, 2004)

The fault between the North American and the Juan de Fuca plate is the Cascadia Subduction Zone Interface and is a potential seismic source for the site. This source is at a depth of 6 to 12 miles and is located approximately beneath the coastline of western Oregon, Washington, and British Columbia. A typical subduction zone interface earthquake has a potential moment magnitude of 9.0. This type of earthquake's recurrence interval is approximately 500 to 600 years, based on historical and geologic information. The last known earthquake occurred in 1700 and indicates that the subduction zone is active.

Deep Cascadia Subduction Zone intraplate faults are also a potential seismic source. The Cascadia Subduction Zone intraplate source lies approximately directly beneath the site at a depth of 25 to 30 miles. Three earthquakes in recent history have been attributed to

this source. In 1949, 1965, and 2001 earthquakes with moment magnitudes of 7.1, 6.0, and 6.8, respectively, were observed. It is estimated that the intraplate source is capable of generating an earthquake with a maximum moment magnitude of 7.5 with an approximate return interval of 20 to 40 years.

Crustal sources are relatively shallow faults within the North American Plate and are generally considered within a certain distance from the site. This distance is commonly chosen as 60 miles. Crustal sources located more than 60 miles from the site are typically not capable of generating significant levels of shaking. There are numerous faults within 60 miles of the site, but there is much uncertainty in the classification of these sources, as only limited geological exploration has been conducted on most of the sources.

The historical seismicity for the region indicates that there have been five earthquakes with a magnitude greater than 5.0 since 1841. The largest recorded earthquake to affect the region was from the Cascadia Subduction Zone Interface. Other notable regional earthquakes were from crustal sources; the 1962 M5.5 Portland/Vancouver earthquake and the 1993 M5.6 Scotts Mill earthquake.

3.3 Level of Seismicity and Soil Type

To evaluate the buildings, ASCE 31-03 requires a classification of the site into one of three levels of seismicity: low, moderate, or high. These levels define a degree of expected earthquake hazard and are based on response acceleration values mapped by the United States Geological Survey (USGS). ASCE 31-03 uses a seismic recurrence period of a 2 percent chance of exceedance in 50 years, which is an average recurrence interval of 2,500 years.

A geotechnical evaluation was not performed as part of this evaluation. See Section 3.2 for information about regional seismic geology. ASCE 31-03 allows a soil Site Class D to be assumed in the absence of specific geotechnical information. Site Class D is defined as stiff soil with the following characteristics.

- 600 ft./sec. < v_s < 1,200 ft/sec, where v_s is the average shear wave velocity, or
- 15 < N < 50, where N is the average Standard Penetration Test blow count, or
- 1,000 psf < s_u < 2,000 psf, where s_u is the average undrained shear strength of the upper 100 feet of soils at the site.

For determination of the site seismicity, a Site Class D was assumed. The response acceleration values are shown in Table 1 and were obtained from USGS data for the site based on latitude and longitude (USGS report may be found in Appendix E of this report). For the purpose of the Tier 1 evaluation of the three building structures, these values indicate that the building is located in a region of high seismicity.

Table 1 - USGS Seismic Hazard Data for the Salem Library

Seismic Design Parameter	Value
Peak Ground Acceleration (PGA)	0.318
SDS (Design short period spectral response acceleration)	0.626
SD1 (Design spectral response acceleration at one-second period)	0.391

3.4 Seismic Performance Level

The desired performance level for the City of Salem Central Library campus buildings is Life Safety, which is a level of building performance that includes damage to both structural and nonstructural components during a design earthquake, such that partial or total structural collapse does not occur, and the overall risk of life-threatening injury as a result of structural and nonstructural damage is expected to be low.

4.0 CITY OF SALEM CENTRAL PUBLIC LIBRARY

The City of Salem's Central Public Library is located at 585 Liberty Street SE in Salem, Oregon, and shares a campus with Salem City Hall. The original library building was constructed in 1970 and currently serves Salem's 135,000 residents 53 hours a week. The Library campus is located on a sloped landscape. Modifications were made to the building in 1990 to add 38,100 square feet to the Library structure. Also in 1990, a 5,020-square-foot Auditorium and a 90,384-square-foot multistory Parking Garage were constructed.

City of Salem Central Public Library

A series of building improvements occurred between 1996 and 2010; however, it does not appear the building structure was altered.

The original design and construction documents provided for the library are dated March 1970 and the expansion project documents are dated November 1989. Both sets of plans included architectural and structural drawings showing site plans, floor plans, building elevations, sections, details, and schedules. The existing drawings provided

were reviewed and compared for consistency with the as-built construction by performing a site visit of the facility.

On 26 November 2013, two BergerABAM engineers performed a walkthrough of the facility to verify as-built conditions and to perform a site visit consistent with requirements for the preparation of an ASCE 31, Tier 1 Seismic Evaluation. While on site, BergerABAM personnel met with the City of Salem Engineering Program Manager, Mr. Allen Dannen, PE, to discuss existing building functions and known renovations or alterations that would be useful information for preparation of the seismic evaluation report. The site visit covered the Library (lower floor, main floor, second floor and roof), the Auditorium, and the Parking Garage. The perimeters of all three buildings were observed. During the site visit, field notes were recorded to include observations of any structural seismic deficiencies and a photographic inventory of over 500 photographs was collected.

4.1 Library Building

4.1.1 General Building Description

The Library is a three-story building approximately 38 feet tall from the ground to top of the roof parapet on the north side of the building. The grade slopes from an elevation of 177 feet on the north side of the building to an elevation of 189 feet(+) on the south side of the building. The lower floor is at an elevation of 177 feet, the main floor is at an elevation of 189 feet, the second floor is at an elevation of 201 feet 6 inches and the roof varies between 213 feet 6 inches to 214 feet 10 inches. The total area of the original structure is 52,278 square feet, which includes a 21,576-square-foot lower level, a 21,576-square-foot main level, and a 9,576-square-foot second level. During the 1990 expansion, a total of 38,100 square feet was added to the building. This upgrade added 10, 850 square feet to both the lower floor and main floor and 16,720 square feet to the second floor. The total area of the Library today is approximately 91,148 square feet, which includes a 32,426-square-foot lower level, a 38,296-square-foot main floor, and a 20,426-square-foot second floor.

4.1.1.1 Structural System Description

The original library building constructed in 1970 sits on shallow spread footings. Typically, the lower level slab is 5 inches thick and on grade. Framing for all other levels consists of a 14-inch deep, cast-in-place reinforced concrete waffle slab with reinforced concrete columns and walls. The lateral-force-resisting system includes the original exterior 20-inch by 7-foot concrete piers in addition to the 8-inch and 10-inch-thick reinforced concrete walls of both the elevator shaft and the south stair well. For the lower floor only, the 12-inch-thick retaining walls act as lateral-force-resisting elements. The retaining walls are located on the east, west and south sides of the building. The north side of the lower floor daylights to a plaza. The roof is composed of built-up roofing and gravel over a 14-inch cast-in-place reinforced concrete waffle slab.

According to original construction documents, all columns and walls are doweled into shallow spread footings.

The 1990 expansion also sits on shallow spread footings. The framing consists of steel columns and beams, 3-1/2-inch normal weight concrete over 2-inch formed-steel metal decking, and reinforced concrete walls. The columns are attached to the spread footings via four 1-inch-diameter anchor bolts. Reinforced 12-inch concrete retaining walls are doweled into shallow spread footings. The lower floor is composed of a 5-inch thick concrete slab on grade. The roof structure is composed of 1 1/2-inch metal decking over steel beams. No additional lateral force resisting elements were constructed in 1990. To resist lateral forces, the 1990 expansion relies on the 8-inch, 10-inch and 12-inch reinforced concrete exterior walls, the 8-inch and 10-inch-thick walls of the south stairwell, and the 20-inch by 7-foot exterior columns of the original building.

4.1.1.2 Nonstructural Systems Description

The exterior of the original building constructed in 1970 consists of reinforced concrete walls, precast sills, and glazing. To the best of our knowledge, the glazing is neither laminated annealed nor laminated heat-strengthened safety glass. Furthermore, the glazing attachment to concrete does not allow for relative displacement. Precast concrete fascia is used along the entire exterior of the roofline. The acoustical ceilings are dropped and suspended from the waffle slab system.

The exterior of the 1990 expansion area of the main building consists of reinforced concrete walls, precast spandrels, and glazing. To the best of our knowledge, the glazing is neither laminated annealed nor laminated heat-strengthened safety glass. There is a large circular skylight in the 1990 expansion area of the south side of the building that creates a light-well through the second floor.

Large book stacks, shelving units, and storage racks over 4 feet 6 inches in height can be found throughout the building. The building also contains a coffee shop with miscellaneous equipment on the lower level. There are several refrigerators, vending machines, wall-mounted televisions, and display cabinets found throughout the building.

Photographs of the interiors and the exteriors of the building are included in Appendix D.

4.1.2 Building Type

By ASCE 31 definitions, the main building was evaluated as a C2-type building: Concrete Shear Walls with Stiff Diaphragms. The floor and roof framing of this building type consists of cast-in-place concrete slabs, concrete beams, one-way joists, two-way waffle joists, or flat slabs. Floors are supported on concrete columns or bearing walls. Lateral forces are resisted by cast-in-place concrete shear walls. In older construction, shear walls are lightly reinforced but often extend throughout the building. In more recent construction, shear walls occur in isolated locations and are more heavily

reinforced with boundary elements and closely spaced ties to provide ductile performance. The diaphragms consist of concrete slabs and are stiff relative to the walls. Foundations consist of concrete spread footings, mat foundations, or deep foundations.

4.1.3 List of Assumptions

The following assumptions were made regarding the seismic performance of the Library building. The assumptions are made because of a lack of information provided by structural documentation and to outline standard practice of evaluating lateral force-resisting systems.

- Concrete strength is f'c = 4,000 psi and 3,000 psi, depending on the component.
- Normal weight reinforced concrete weighs 150 pcf
- Rebar strength fy = 60ksi

4.1.4 Findings

The library building has been evaluated for a Life Safety performance objective for the Design Earthquake as defined in ASCE 31-03 *Seismic Evaluation of Existing Buildings.* Based on the procedures of ASCE 31, the following deficiencies in the building's lateral-force-resisting system and nonstructural components were identified.

4.1.4.1 General Basic and Supplemental Structural Checklists (3.7.9 and 3.7.9S):

- A Weak Story occurs at the second floor because there is a significant reduction in the number of lateral load resisting elements and the capacity of those elements, from the main level to the second level directly above.

- A Soft Story occurs at the second floor because the stiffness of the lateral-force-resisting system of the main level is 70 percent more than the stiffness of the second story. Because of large openings and irregularities, the diaphragm is unable to redistribute seismic inertial forces to shearwalls throughout the building.

- At the main floor, the estimated distance between the story center of mass and the story center of rigidity is approximately 35 feet, and twenty percent of the building width in the north-south direction is approximately 33 feet. Thus, the building may have inherent torsional issues.

- For loading in the east-west direction and using the ASCE 31 Tier 1 evaluation procedure, the shear stress in the concrete shear walls on the second floor exceeds allowable limits.

- Based on the original construction drawings, the ratio of the horizontal reinforcing steel area to gross area of concrete for the shear walls is less than the recommended 0.0025.

- The 24-inch by 24-inch reinforced columns spanning from top to bottom of the building structure have insufficient shear reinforcement to develop the maximum

probable moment capacity (Mpr). The computed capacity of the existing (E) column is only 54 percent of the maximum shear demand of 92 kips.

4.1.4.2 Basic and Intermediate Non-Structural Component Checklists (3.9.1 and 3.9.2):

Inadequately attached non-structural elements can cause significant damage in the building, resulting in very expensive repairs and rendering it inoperable for an extended period of time after the earthquake. In addition, falling contents are often harmful to the building occupants during an earthquake, with the young and elderly being particularly vulnerable to casualty and sometimes fatality.

- The stairs do not appear to have slip connections to accommodate differential story drift. This may cause an unintended load path for seismic demands.

- The precast concrete fascia panels on the exterior of the roof of the original building are anchored at 7 feet 6 inches on center. The precast concrete fascia panels on the exterior of the 1990 expansion part of the building are anchored where the steel framing meets the concrete panels at roughly 8 feet on center. It is unclear from the plans how the relocated window/wall system on the north side of the building is attached to the main structure. Further investigation would be required to verify adequate anchorage.

- Tall contents in the building consist of unbraced book stacks, shelving units, file cabinets, lockers, and other miscellaneous furniture with a height-to-width or a height-to-depth ratio greater than 3-to-1 on all levels of the Library. These can pose a toppling hazard during an earthquake.

- There appears to be inadequate lateral bracing of the fire suppression system, including both sprinkler heads and piping, along with areas where the impact of sprinkler pipes with other unbraced nonstructural elements could result in unreliable performance. Inadequately braced fire sprinkler piping has performed poorly in past earthquakes, rendering systems unusable when most needed.

- Gas piping throughout the building does not appear to have flexible couplings, which could lead to a pipe fracture in an earthquake. This can cause a fire hazard during a seismic event, often causing more damage to the building and its contents than from structural damage alone.

- Anchorage supports on many of the pumps in the mechanical room show signs of corrosion. There is also surface corrosion on steel pipes in the mechanical room area of the building.

- The hot water heater in the mechanical room is not braced for lateral support.

- Piping from the hot water heater to the floor above does not have flexible couplings.

- There appears to be no lateral bracing of the integrated suspended ceiling system in many areas throughout the Library.
- The light fixtures in the suspended grid ceiling are not supported independently of the ceiling suspension system.
- There are several pieces of equipment weighing over 20 pounds attached to ceilings or walls that are not laterally braced.
- Glass from original building does not appear to be safety glass except in panes over five feet in dimension. Safety glass is required at egress areas. In addition, the connection of glass to structure does not allow for the differential displacements expected.

4.1.5 Recommendations

Because of the deficiencies described above, the library building does not meet the Life Safety performance objective of an ASCE 31 Tier 1 seismic evaluation. To achieve a Life Safety performance level for this building, the following strengthening scheme is proposed. Before any structural upgrades are performed, a complete Tier 2 seismic evaluation of the structure is required. See the Proposed Renovation Drawings in Appendix E.

4.1.5.1 Structural

- Provide new concrete shearwalls from the ground to the roof level.
- Provide new concrete foundations with micro-piles to support the new concrete shearwalls and allow them to resist the lateral seismic loads.
- Provide new collector elements throughout the elevated floors and roof to help distribute the seismic demands to the new concrete shearwalls.
- Improve connectivity of the existing concrete slabs to the existing concrete walls and piers.
- Reinforce the connections of the existing steel beams to the existing concrete piers at the second level.
- Strengthen the connectivity of the existing composite metal deck and metal roof deck to the existing concrete slabs and walls.
- Reinforce the concrete diaphragm around the stair opening in the slab on the second level.

4.1.5.2 Nonstructural

- Provide slip connections in stairs spanning between floors to prevent damage during the design-level earthquake.
- Further analysis should be conducted on the precast concrete panels along the exterior of the roof level to ensure that the anchorage scheme meets current seismic code. If it is determined that the anchors are insufficient, additional anchors should be installed to ensure that panels do not break free from building during the design-level earthquake.
- Tall narrow contents in the building, including book stacks, storage shelving, and equipment over 4 feet in height and with a height-to-depth or height-to-width ratio greater than 3-to-1, should be anchored to the floor slab or adjacent structural walls. Existing book stacks do not appear to have brackets to allow anchorage to the structure. The existing stacks will require a retrofit or new book stacks with anchor points will be needed.
- Provide lateral bracing and flexible couplings for all fluid, gas, and fire suppression piping.
- Brace fire suppression piping per NFPA-13.
- Remove corrosion on nonstructural elements. Protect nonstructural elements from future corrosion.
- The hot water heater in the mechanical room should be braced to the wall or anchored to the floor.
- The ladder in the mechanical room should be braced, anchored to the floor, or stored somewhere where it does not present a potential falling hazard while not in use.
- Provide lateral bracing for the suspended ceiling system throughout the entire building.
- Provide lateral bracing for the light fixtures in the suspended ceiling system independent of the ceiling system bracing.
- Brace equipment weighing over 20 pounds that is attached to ceilings, walls, or other supports four feet above the floor level.
- Provide safety glass where required. Replace window systems to allow for differential displacements.

4.2 Auditorium Building

4.2.1 General Description

The Auditorium was constructed in 1990 as part of the City of Salem Central Library Expansion project. The total area of the circular structure is 5,020 square feet. Typical exterior walls are 8-inch-thick cast-in-place reinforced concrete. The main level is on grade and the roof is at a maximum height of 20 feet above grade. The interior of the Auditorium is open, with very few partition walls.

4.2.1.1 Structural System Description

The 8-inch-thick exterior walls make up the lateral-force-resisting system of this building. The roof framing consists of 1 1/2-inch metal deck over steel open web joist and steel beams. The non-composite metal deck roof system is flexible compared to the walls. There are four tube steel columns supporting the roof system. The main floor is slab on grade. The structural elements sit on shallow foundations and, according to original construction documents, all columns and walls are doweled into the spread footings.

The northwest portion of the Auditorium is attached to the Library. The Auditorium structural wall sits over the top of a 12-inch subgrade wall. This concrete wall supports a small area of the Library roof that is located above the second floor level and below the main roof. The Auditorium roof structure consists of 1 1/2-inch metal roof deck over steel open-web joists and steel beams.

4.2.1.2 Nonstructural Systems Description

There is no cladding or veneer on the structure. The interior ceiling has many pieces of suspended equipment along with acoustical panels. There is a suspended projection screen over the main stage area. The interior walls are gypsum board over metal studs. The HVAC ducting is suspended from the roof joists.

4.2.2 Building Type

The Auditorium was evaluated as a Type C2A building: Concrete Shear Walls with Flexible Diaphragms. These buildings are similar to C2 buildings, except that the diaphragms consist of wood sheathing on wood framing or metal deck on steel framing, Lateral forces are resisted by cast-in-place concrete shear walls. In general, shear walls in older construction are lightly reinforced but often extend throughout the building. For more recent construction however, shear walls occur in isolated locations, are more heavily reinforced with boundary elements and closely spaced ties to provide ductile performance. The diaphragms consist of wood sheathing or metal deck, have large aspect ratios and are flexible relative to the walls. Foundations consist of concrete spread footings or deep foundations.

4.2.3 List of Assumptions

The following assumptions were made regarding the seismic performance of the Auditorium. The assumptions are made because of a lack of information provided by structural documentation and to outline standard practice of evaluating lateral-force-resisting systems.

- The Library structure and the Auditorium are not seismically connected and act as separate structural systems.
- Interior partition walls do not contribute to the lateral-force-resisting system.
- Structural walls consist of the following.
    - Concrete strength of f'c = 3,000 psi
    - Normal-weight concrete weighing 150 pcf
    - Reinforcing steel strength of fy = 60 ksi

4.2.4 Findings

The Auditorium has been evaluated for a Life Safety performance objective for the design earthquake as defined in ASCE 31-03 *Seismic Evaluation of Existing Buildings.* Based on the procedures of ASCE 31, the following deficiencies in the building's lateral force resisting system and non-structural components were identified.

4.2.4.1 General Basic and Supplemental Structural Checklists (3.7.16 and 3.7.16S)

- The Library building and the Auditorium from the 1990 expansion project do not have adequate seismic joints and could result in building pounding during an earthquake. Building pounding can result in highly adverse seismic behavior in one or both building components.
- To prevent pounding, the needed clear distance is 10 inches, which is equivalent to a setback of two percent of the potential contact height of each building.
- Based on the original construction drawings, the ratio of the horizontal reinforcing steel area to gross area of concrete is less than the recommended 0.0025 for the 8-inch-thick reinforced concrete shearwalls.
- The roof diaphragm is inadequately attached to the exterior walls. The original construction drawings show the roof deck attaches to the exterior 8-inch concrete walls with a single 5/8-inch diameter by 5-inch wedge anchor at 48 inches on center. These anchors are no longer deemed appropriate for use in seismic conditions because of their unreliable performance. However, to evaluate the demand-to-capacity ratio of this attachment, anchor capacity was computed using a comparable 5/8-inch diameter, Hilti Kwik-Bolt II anchor with a 4-inch embedment depth. The computed demand is nearly 1.5 times the capacity of the anchor as computed according to the approved seismic performance report (ER-4627).
- The stirrups in the coupling beams, overhead of the primary means of egress for the Auditorium, are hooked with 90-degree bends according to the original construction drawings. Current practice forthe design of concrete coupling beams includes hooks of 135 degrees or more to develop reinforcing steel.

4.2.4.2 *Basic, Intermediate and Supplemental Nonstructural Component Checklists (3.9.1, 3.9.2 and 3.9.3)*

- There appears to be no lateral bracing for the suspended equipment or the suspended acoustical panels in the auditorium.
- The suspended light fixtures in the auditorium appear to not be laterally braced.
- The fire-suppression piping does not appear to have lateral bracing.

4.2.5 Recommendations

Because of the deficiencies described above, the Auditorium does not meet the Life Safety performance objective of ASCE 31. To achieve a Life Safety performance level, the following strengthening scheme is proposed. Before any structural upgrades are performed, a complete Tier 2 seismic evaluation of the structure is required.

4.2.5.1 *Structural*

- Reinforce the anchorage of the roof to the concrete walls.

4.2.5.2 *Nonstructural*

- Brace equipment weighing over 20 lbs that is attached to ceilings, walls, or other supports four feet above the floor level.
- Brace fire suppression piping per NFPA-13.

4.3 Parking Garage

4.3.1 General Description

The Parking Garage was constructed in 1990 as part of the City of Salem Central Library Expansion project. The total area of the structure is 90,384 square feet. The lower level is a sloping slab on grade, the middle level is sloping at 10.67 feet above the lower level and the upper level is sloping at 10.67 feet above the middle level to a maximum height of 32 feet above grade. The garage is an open design and as such does not have any mechanical exhaust systems.

4.3.1.1 *Structural System Description*

The Parking Garage sits on a shallow spread footing foundation. The garage has a 6-inch concrete slab on grade with #4 reinforcing steel at 12-inches on center each way, supported by a compacted gravel base. The elevated floor framing of the Parking Garage consists of 28-inch-deep pre-cast double-tee joists, which are supported by corbels at columns, beams and walls. The exterior gravity supports are 18-inch by 18-inch columns typically spaced at 24 feet on center The double-tees have a 3-inch topping slab with #4 reinforcing steel at 12-inches on center each way that is doweled into spandrels beams, walls, and vertical concrete columns. The lateral force resisting system consists of reinforced concrete shearwalls: 10-inch-thick concrete walls are along the exterior of the building and a 12-inch-thick full height concrete shearwall runs down the center of the

building. According to original construction documents, all columns and walls are doweled into shallow spread footings.

4.3.1.2 Nonstructural Systems Description

The exterior cladding of the building is precast concrete panels.

4.3.2 Building Type

By ASCE 31 definitions, the parking garage was evaluated as a C2-type building: Concrete Shear Walls with Stiff Diaphragms. The floor and roof framing of this building type consists of cast-in-place concrete slabs, concrete beams, one-way joists, two-way waffle joists, or flat slabs. Floors are supported on concrete columns or bearing walls. Lateral forces are resisted by cast-in-place concrete shear walls. In older construction, shear walls are lightly reinforced but often extend throughout the building. In more recent construction, shear walls occur in isolated locations, are more heavily reinforced with boundary elements and closely spaced ties to provide ductile performance. The diaphragms consist of concrete slabs, and are stiff relative to the walls. Foundations consist of concrete spread footings, mat foundations, or deep foundations.

4.3.3 List of Assumptions

The following assumptions were made regarding the seismic performance of the Parking Garage. The assumptions are made because of a lack of information provided by structural documentation and to outline standard practice of evaluating lateral force resisting systems.

- Concrete strength of f'c = 3,000 psi.
- Normal-weight concrete weighing 150 pcf.
- Reinforcing steel strength of fy = 60ksi.

4.3.4 Findings

The Parking Garage has been evaluated for a Life Safety performance objective for the design earthquake as defined in ASCE 31-03 *Seismic Evaluation of Existing Buildings.* Based on the procedures of ASCE 31, the following deficiencies in the building's lateral-force-resisting system and nonstructural components were identified.

4.3.4.1 General Basic and Supplemental Structural Checklists (3.7.16 and 3.7.16S)

- The garage does not pass the Weak Story evaluation. The strength of the lateral force-resisting system supporting the upper level is 49 percent less than the lateral-force resisting system of the middle level.

- A Soft Story occurs between the upper level and the middle level of the garage. In both the north-south and the east-west directions, the upper story has less than 70 percent of the lateral-force-resisting system stiffness of the middle story.

- The distance between the story center of mass and the story center of rigidity is greater than the recommended 20 percent. There could be substantial rotation of the

diaphragm that could lead to increased demands in the columns that were not designed to be part of the lateral-force-resisting system.

- There is some minor cracking of the concrete on all areas of the building and around a few connections of the precast panels. The concrete is also deteriorating around some of the double-tee joist connections to exterior beams.

- Collector elements are not provided at reentrant corners of the diaphragm.

- The shear stress in the concrete shear walls, calculated using the Quick Check procedure, exceeds the permissible limit for all levels of the parking garage in the N-S direction of loading. The demand-to-capacity ratios range from 1.1 to 3.5. Demand-to-capacity ratios in excess of 1.0 are considered deficient.

- Secondary components do not have the shear capacity to develop their flexural strength. The 18- by 18-inch reinforced columns do not have enough shear reinforcement to develop the maximum probable moment, Mpr, or the capacity most likely achieved by the element. The shear demand is roughly twice the existing capacity.

4.3.4.2 Basic, Intermediate and Supplemental Non-Structural Component Checklists (3.9.1, 3.9.2 and 3.9.3)

- Cladding components weighing more than 10 psfshall be anchored at a spacing equal to or less than four feet. The precast concrete panels used on the exterior of the parking garage weigh more than 10 psf and are anchored at each end, or at an approximate 24-foot spacing.

- Corrosion was observed on many connecting elements, and a few connections appeared to be damaged or compromised.

- The connections of the precast concrete panel cladding to exterior columns do not have slotted connections, and therefore do not accommodate a story drift ratio of two percent.

- There are some exterior cladding panels that have fewer than four connections for each wall panel.

4.3.5 Recommendations

Because of the deficiencies described above, the parking garage does not meet the Life Safety performance objective of ASCE 31. To achieve a Life Safety performance level, the following strengthening scheme is proposed. Before any structural upgrades are performed, a complete Tier 2 seismic evaluation of the structure is required. See the Proposed Renovation Drawings in Appendix C.

4.3.5.1 Structural

- Add new reinforced concrete shearwalls.

- Add collector elements at elevated levels in order to get seismic load to the new and existing concrete shearwalls.

- Reinforce the connections of precast concrete spandrel beams to the structure.

4.3.5.2 Non-structural

Further analysis should be conducted on the precast concrete panels along the exterior of the structure to ensure that the anchorage scheme meets current seismic code. If it is determined that the anchors are insufficient, additional anchors should be installed to ensure that panels do not break loose from the building during a design earthquake event.

Provide slip connections in anchoring brackets for the precast panel cladding.

5.0 SEISMIC UPGRADE OPINION OF PROBABLE CONSTRUCTION COST

The estimated probable construction cost for the proposed upgrades are summarized as follows:

Table 2 – Opinion of Probable Construction Cost

Component	Area	$/SF	Total
Library Main Building	91,148 sf	57.31	$5,224,000
Auditorium Building	5,020 sf	14.94	$75,000
Parking Garage	90,384 sf	12.15	$1,098,000

See Appendix B for a detailed cost analysis and important assumptions and exclusions related to this estimate.

Appendix A
References

REFERENCES

ASCE 31-03, *Seismic Evaluation of Existing Buildings*. American Society of Civil Engineers. 2003

ASCE 41-06, *Seismic Rehabilitation of Existing Buildings*. American Society of Civil Engineers. 2006

ACI 318-08, *Building Code Requirements for Structural Concrete and Commentary*. American Concrete Institute. 2008

ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures*. American Society of Civil Engineers. 2006

Appendix B
Cost Estimate

DIRECT CONSTRUCTION COST SUMMARY

Component	Area		$ / SF	Total	
01 | Library Main Building	91,148	sf	57.31	$5,224,000	
02 | Auditorium Building	5,020	sf	14.94	$75,000	
03 | Parking Garage	90,384	sf	12.15	$1,098,000	

The above estimates are for direct construction cost only. They do not include furnishings & equipment, architect and engineer design fees, consultant fees, inspection and testing fees, plan check fees, state sales tax, hazardous material testing and removal, financing costs, owners contingency nor any other normally associated project and development costs.

The above estimates assume a competitively bid project, with at least three qualified bidders in each of the major sub-trades as well as the general contractors.

The above estimates assume a construction start date of: Winter 2016. If the start of construction is delayed beyond the date above, the estimates must be indexed at a rate of 3 to 4% per year compounded.

This is a probable cost estimate based on in-progress documentation provided by the architect. The actual bid documents will vary from this estimate due to document completion, detailing, specification, addendum, etc.. The estimator has no control over the cost or availability of labor, equipment, materials, over market conditions or contractor's method of pricing, contractor's construction logistics and scheduling. This estimate is formulated on the estimators professional judgment and experience. The estimate makes no warranty, expressed or implied, that the quantities, bids or the negotiated cost of the work will not vary from the estimators opinion of probable construction cost.

The above costs are rounded to the nearest 1,000.

The estimate makes an attempt to identify other systems scope of work to support the structural seismic work. A formal study is recommended to evaluate impacts to architectural, electrical and mechanical systems. Impacts to code requirements, existing pathways, etc.. Cost identified may not necessarily or adequately cover the required work to support this structural scope of work.

Alternates	Quantity	Unit	Cost / Unit	Cost	Sub-totals	Comments
01 | Library Main Building						
Demolition						
sawcut slab on grade	256	lf	$10.00	$2,560		
remove slab on grade	768	sf	5.00	3,840		
remove windows	10,000	sf	6.00	60,000		
temp shore / barricades / protect / cleanup	91,148	sf	2.00	182,296		allowance
misc. support / cut / patch	16	sum	3,500.00	56,000		allowance
haul & disposal	1	sum	16,600.00	16,600		
Sub-total	91,148	sf	3.52	/sf	$321,296	
Earthwork						
excavate for footing, neat cut	90	cy	$150.00	$13,500		by hand
haul & disposal	90	cy	50.00	4,500		
Sub-total	91,148	sf	0.20	/sf	$18,000	
Piling						
mobilization / building access	1	sum	$10,000.00	$10,000		
100 ton micro piles	88	ea	4,000.00	352,000		premium for in bldg. work
Sub-total	91,148	sf	3.97	/sf	$362,000	
Concrete work						
formwork						
footings		sf	$0.00	$0		NIC - assume earth form
walls	6,912	sf	12.50	86,400		
r/s						
footings	11,750	lbs	0.95	11,163		
walls	39,250	lbs	0.95	37,288		
drill / dowel / core						
dowel @ sog	192	ea	25.00	4,800		
dowel to exist footings	8	lctns	2,000.00	16,000		
core elevated slab for shear wall steel	8	lctns	5,000.00	40,000		allowance
dowel shear wall to roof slab	4	lctns	2,000.00	8,000		allowance
redi-mix						
4000 psi	251	cy	105.00	26,355		
place						
footings	94	cy	25.00	2,350		
walls	157	cy	105.00	16,485		
pump / transport concrete	251	cy	75.00	18,825		
finish						
footing / slab finish	768	sf	1.00	768		
wall - break ties / patch	6,912	sf	2.25	15,552		
misc.	1	sum	25,000.00	25,000		
Sub-total	91,148	sf	3.39	/sf	$308,986	
Steel						
new collector elements	1,345	lf	125.00	168,125		bolt to underside of waffle slab
rigging	1	sum	30,000.00	30,000		
reinforce connection conc. piers to slab	44	ea	850.00	37,400		
reinforce cnnctn composite deck to wall	64	lf	100.00	6,400		main floor, verify qty
reinforce cnnctn stl beam to conc. clmn	12	ea	750.00	9,000		2nd flr
reinforce cnnctn composite deck to waffle	167	lf	100.00	16,700		2nd flr
reinforce diaphragm @ opening	128	lf	100.00	12,800		2nd flr
reinforce precast cladding cnnctns	214	lf	75.00	16,050		2nd flr, verify qty
reinforce precast beam spandrel attach.	555	lf	100.00	55,500		roof, verify qty
reinforce precast cladding cnnctns	214	lf	85.00	18,190		roof, verify qty
Sub-total	91,148	sf	4.06	/sf	$370,165	

Alternates	Quantity	Unit	Cost / Unit	Cost	Sub-totals	Comments
01 | Library Main Building - Continued						
Architectural Finishes						
remove / repair to support structural	91,148	sf	10.00	911,480		allowance
roof / cut / repair	30,450	sf	2.50	76,125		allowance
new windows	10,000	sf	58.00	580,000		
Sub-total	91,148	sf	17.20	/sf	$1,567,605	
Mechanical / Electrical						
remove / repair to support structural	91,148	sf	5.00	455,740		allowance
Sub-total	91,148	sf	5.00	/sf	$455,740	
Non-structural - **Allowances**						**A feasibility study is**
slip connections @ stairs	6	flght	10,000.00	$60,000		**recommended to evaluate**
connections in anchoring precast panels	860	lf	85.00	73,100		**/ investigate actual rqrmnts.**
anchor tall narrow contents	91,148	sf	0.00	0		NIC - shelving not bracable
lateral bracing and flexible couplings	91,148	sf	0.15	13,672		
ductwork bracing	91,148	sf	0.20	18,230		
pipework bracing	91,148	sf	0.75	68,361		
hvac equipment	91,148	sf	0.35	31,902		
remove corrosion on nonstructural elements	91,148	sf	0.20	18,230		
ceiling lateral bracing	91,148	sf	0.15	13,672		
light fixture bracing	91,148	sf	0.15	13,672		
misc. clg patch / repair for above work	91,148	sf	0.30	27,344		
Sub-total	91,148	sf	3.71	/sf	$338,183	
SUB-TOTAL 01 | Library Main Building				3,741,975	**$3,741,975**	
Estimating Contingency			15.00%	561,296		
Index To Construction Start	Winter 2016		7.12%	306,393		@ ± 4% per year
General Conditions / Insurance / Bond			9.50%	437,918		per BergerAbam
General Contractor OH & Profit			3.50%	176,665	1,482,273	per BergerAbam 39.61%
TOTAL DIRECT CONSTRUCTION COST						
01 | Library Main Building	**91,148**	**sf**	**$57.32**	**/sf**	**$5,224,248**	
02 | Auditorium Building						
Seismic Work						
reinforce precast cladding cnnctns	240	lf	75.00	18,000		roof, verify qty
arch. finishes patch / repair	240	lf	35.00	8,400		allowance
remove & replace windows	200	sf	64.90	12,980		
Sub-total	5,020	sf	7.84	/sf	$39,380	
Non-structural - Allowances						
lateral bracing and flexible couplings	5,020	sf	0.20	1,004		
ductwork bracing	5,020	sf	0.30	1,506		
pipework bracing	5,020	sf	0.85	4,267		
hvac equipment	5,020	sf	0.45	2,259		
remove corrosion on nonstructural elements	5,020	sf	0.25	1,255		
ceiling lateral bracing	5,020	sf	0.20	1,004		
light fixture bracing	5,020	sf	0.20	1,004		
misc. clg patch / repair for above work	5,020	sf	0.45	2,259		
Sub-total	5,020	sf	2.90	/sf	$14,558	

Salem Central Public Library	*Architectural Cost Consultants, LLC*	Estimate Date: R27-Jab-14
Seismic Upgrade Evaluation Report	Stanley J. Pszczolkowski, AIA	Document Date: 20-Dec-13
City of Salem, Oregon	8060 SW Pfaffle Street, Suite 110	Print Date: 27-Jan-14
BergerABAM	Tigard, Oregon 97223-8489	Print Time: 1:16 PM
Evaluation Report Probable Cost Estimate - 1.2	Phone (503) 718-0075 Fax (503) 718-0077 www.archcost.com	Constr. Start: Winter 2016

Alternates	Quantity	Unit	Cost / Unit	Cost	Sub-totals	Comments
SUB-TOTAL 02 | Auditorium Building				53,938	**$53,938**	
Estimating Contingency			15.00%	8,091		
Index To Construction Start	Winter 2016		7.12%	4,416		@ ± 4% per year
General Conditions / Insurance / Bond			9.50%	6,312		per BergerAbam
General Contractor OH & Profit			3.50%	2,547	21,366	per BergerAbam 39.61%
TOTAL DIRECT CONSTRUCTION COST 02 | Auditorium Building	**5,020**	**sf**	**$15.00 /sf**		**$75,304**	

Alternates	Quantity	Unit	Cost / Unit	Cost	Sub-totals	Comments
03 | Parking Garage						
Demolition						
sawcut slab on grade	264	lf	$6.00	$1,584		
remove slab on grade	800	sf	3.00	2,400		
temp shore / barricades	1	sum	25,000.00	25,000		
misc. support / cut / patch	14	sum	1,500.00	21,000		allowance
haul & disposal	1	sum	7,497.60	7,498		
Sub-total	90,384	sf	0.64	/sf	$57,482	
Earthwork						
excavate for footing, neat cut	94	cy	$50.00	$4,700		
haul & disposal	94	cy	12.00	1,128		
Sub-total	90,384	sf	0.06	/sf	$5,828	
Piling						
mobilization	1	sum	$3,500.00	$3,500		
100 ton micro piles	96	ea	3,000.00	288,000		
Sub-total	90,384	sf	3.23	/sf	$291,500	
Concrete work						
formwork						
footings		sf	$0.00	$0		NIC - assume earth form
walls	4,704	sf	10.00	47,040		
collector beam	2,240	sf	11.50	25,760		
spandrel beam	830	sf	11.50	9,545		
r/s						
footings	11,750	lbs	0.95	11,163		
walls	26,750	lbs	0.95	25,413		
collector beam	10,000	lbs	0.95	9,500		
spandrel beam	3,000	lbs	0.95	2,850		
drill / dowel / core						
dowel @ sog	198	ea	25.00	4,950		
core elevated slab for shear wall steel	4	lctns	5,000.00	20,000		allowance
dowel shear wall to roof slab	4	lctns	2,000.00	8,000		allowance
dowel collector beam	280	lf	50.00	14,000		allowance
dowel spandrel beam / connections	160	lf	75.00	12,000		allowance
redi-mix						
4000 psi	290	cy	105.00	30,450		
place						
footings	98	cy	25.00	2,450		
walls	107	cy	90.00	9,630		
collector beam	66	cy	115.00	7,590		
spandrel beam	19	cy	115.00	2,185		
pump / transport concrete	290	cy	30.00	8,700		
finish						
footing / slab finish	800	sf	0.65	520		
wall - break ties / patch	4,704	sf	2.25	10,584		
misc.	1	sum	5,000.00	5,000		
Sub-total	90,384	sf	2.96	/sf	$267,330	
Non-structural						
connections in anchoring precast panels	1,644	lf	100.00	$164,400		allowance
Sub-total	90,384	sf	1.82	/sf	$164,400	

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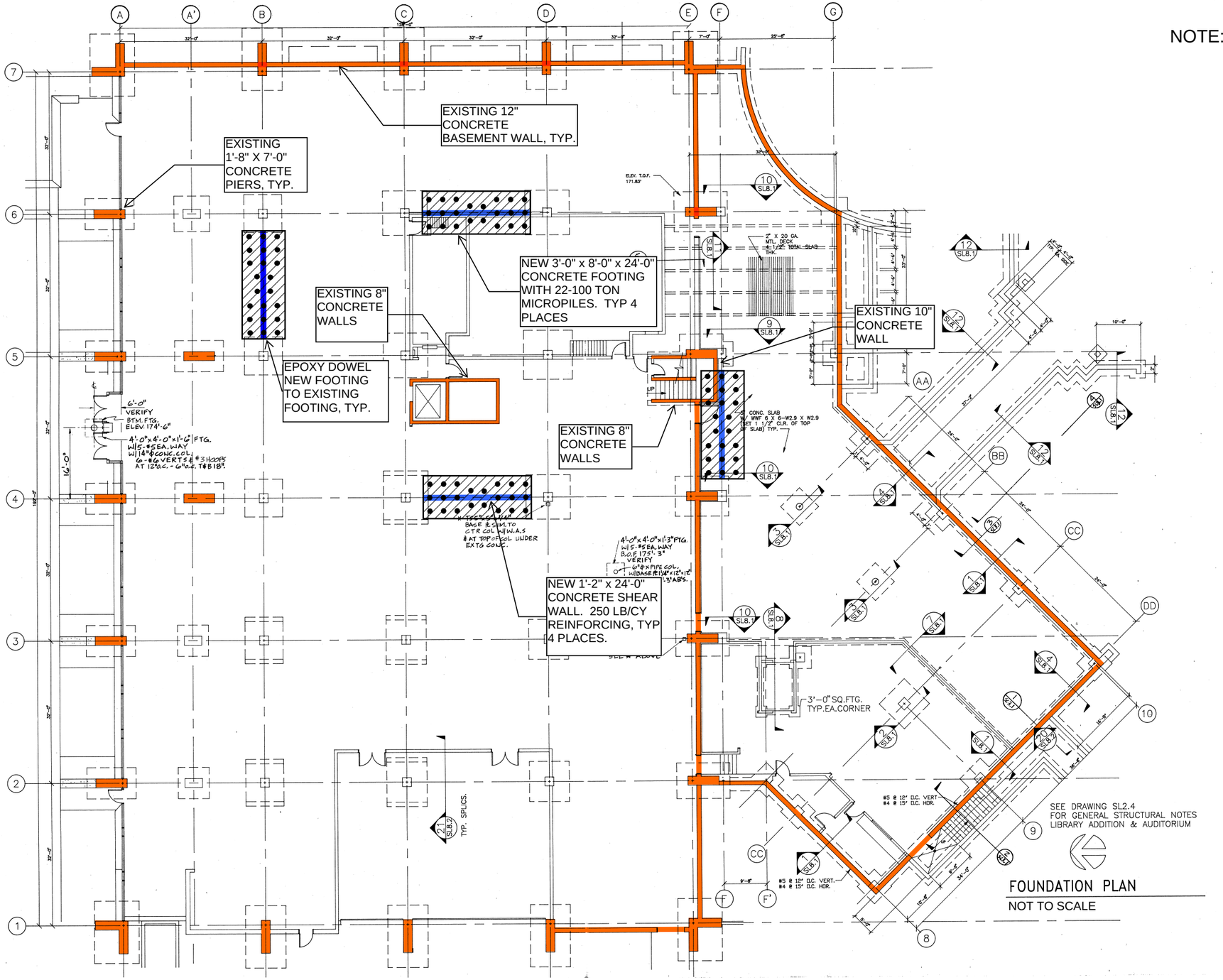
Evaluation Report Probable Cost Estimate - 1.2	Phone (503) 718-0075 Fax (503) 718-0077 www.archcost.com	Constr. Start: Winter 2016

Alternates	Quantity	Unit	Cost / Unit	Cost	Sub-totals	Comments
SUB-TOTAL 03 | Parking Garage				786,540	**$786,540**	
Estimating Contingency			15.00%	117,981		
Index To Construction Start	Winter 2016		7.12%	64,402		@ ± 4% per year
General Conditions / Insurance / Bond			9.50%	92,048		per BergerAbam
General Contractor OH & Profit			3.50%	37,134	311,565	per BergerAbam 39.61%
TOTAL DIRECT CONSTRUCTION COST 03 | Parking Garage	**90,384**	**sf**	**$12.15**	**/sf**	**$1,098,105**	

Appendix C
Proposed Renovation Drawings



FOUNDATION PLAN
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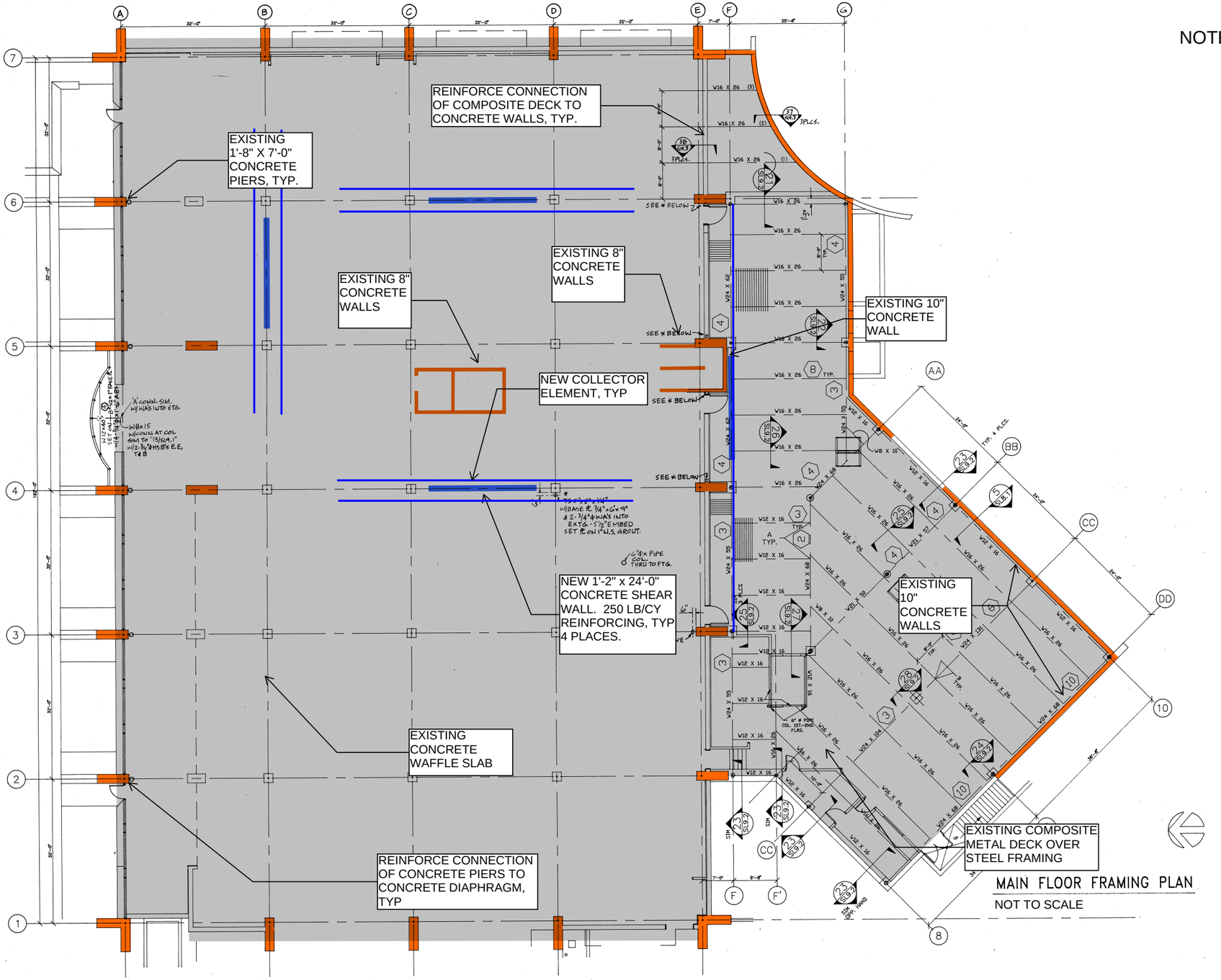

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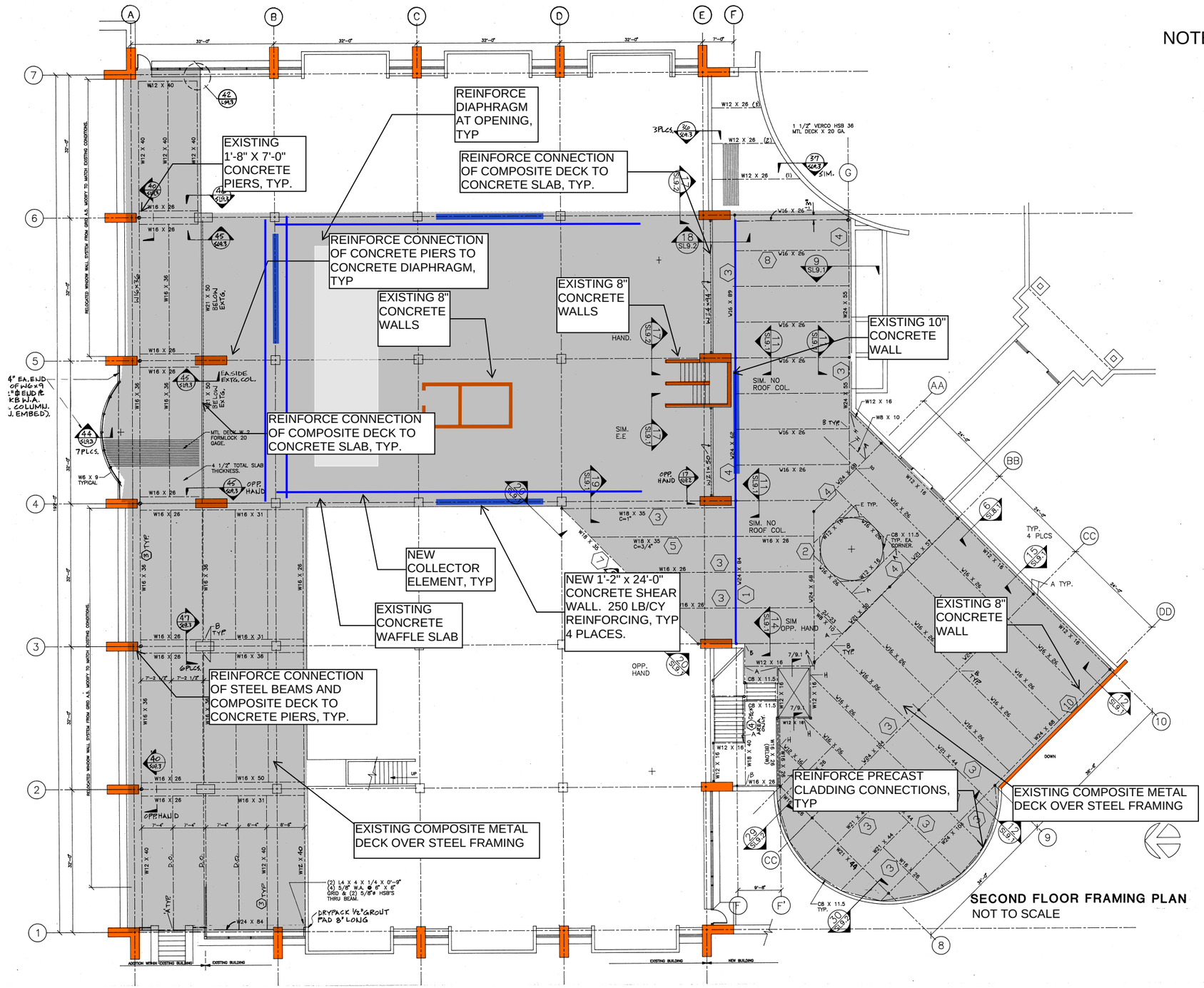

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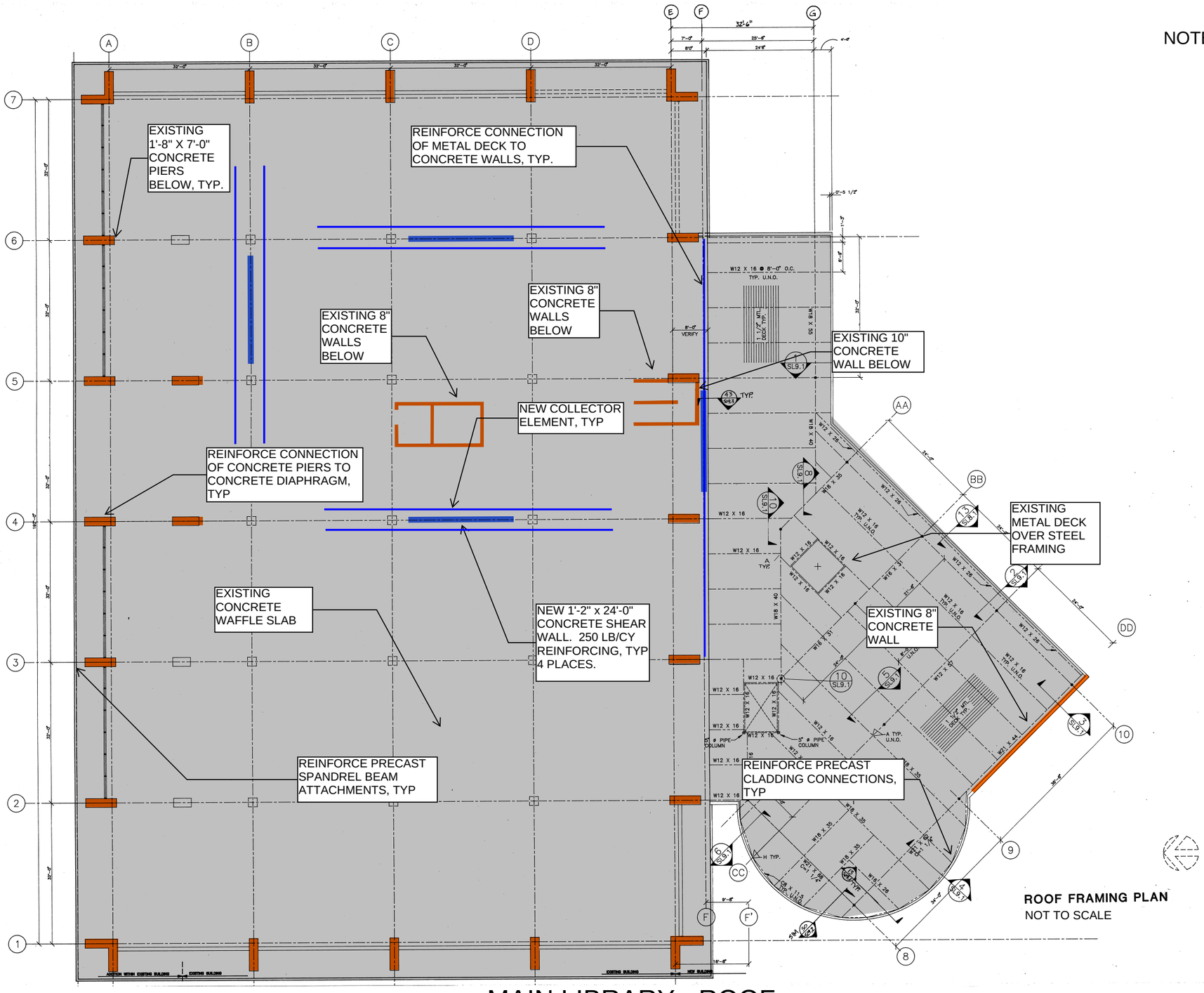

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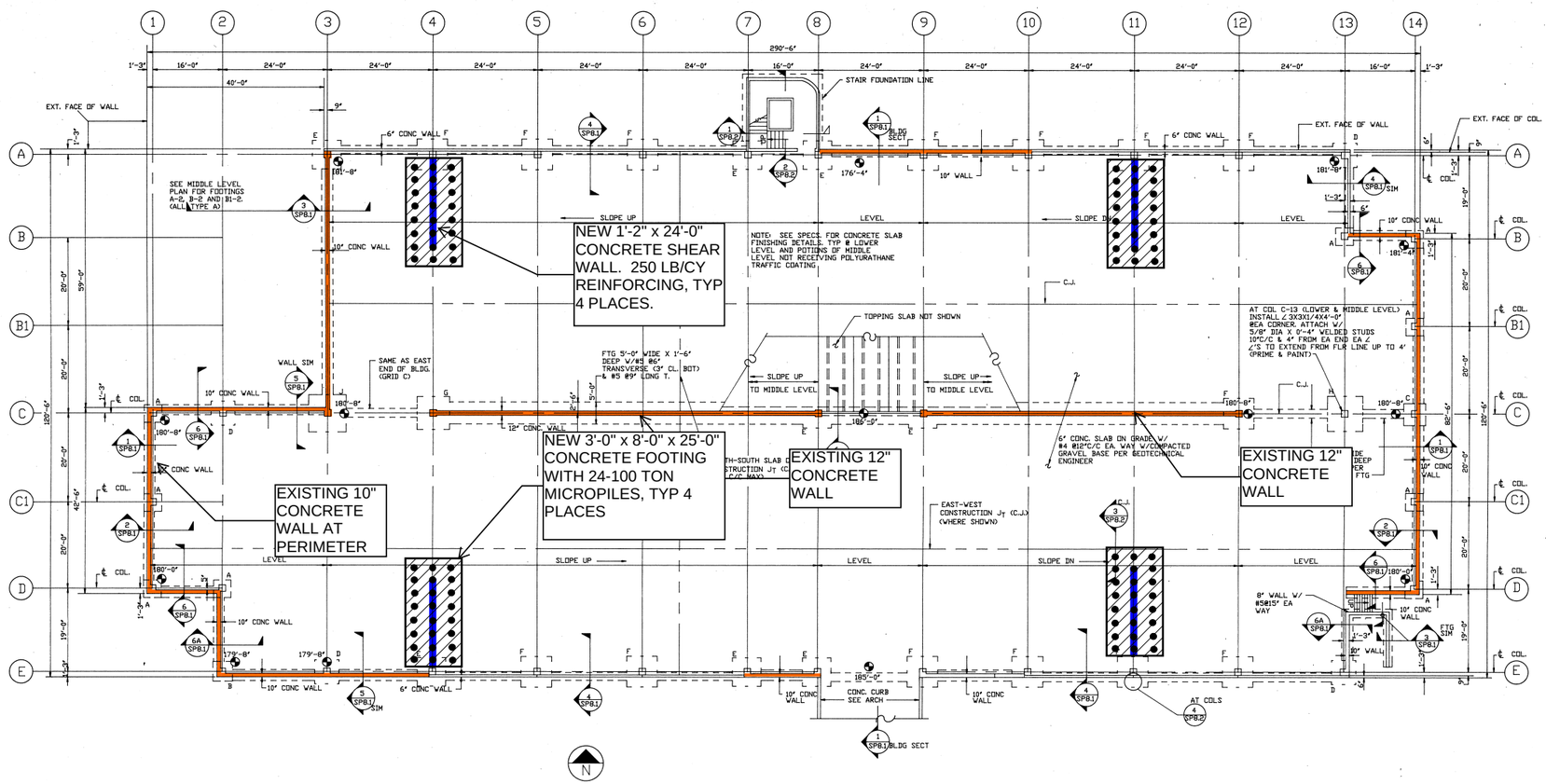

LOWER LEVEL FRAMING PLAN
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PARKING GARAGE - LOWER FLOOR

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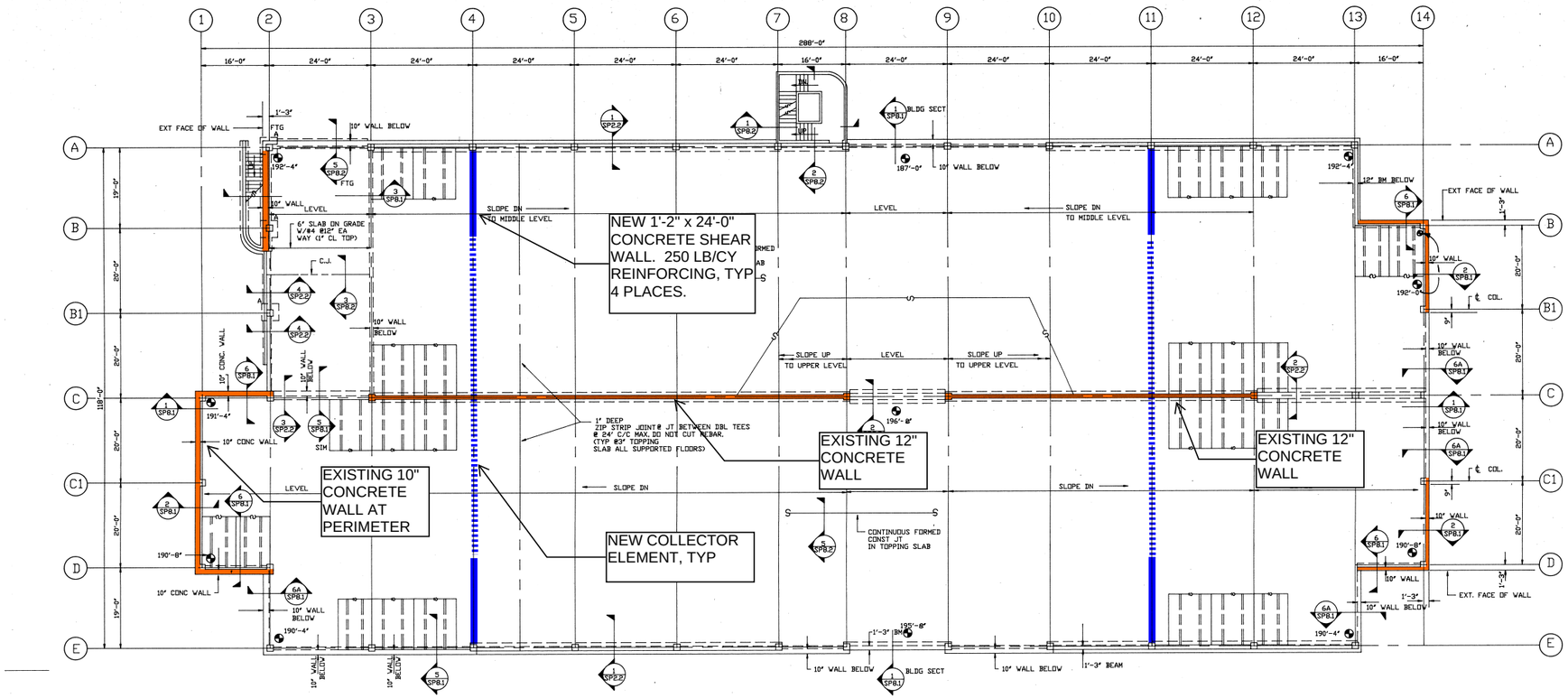

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MIDDLE LEVEL FRAMING PLAN
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PARKING GARAGE - MIDDLE LEVEL

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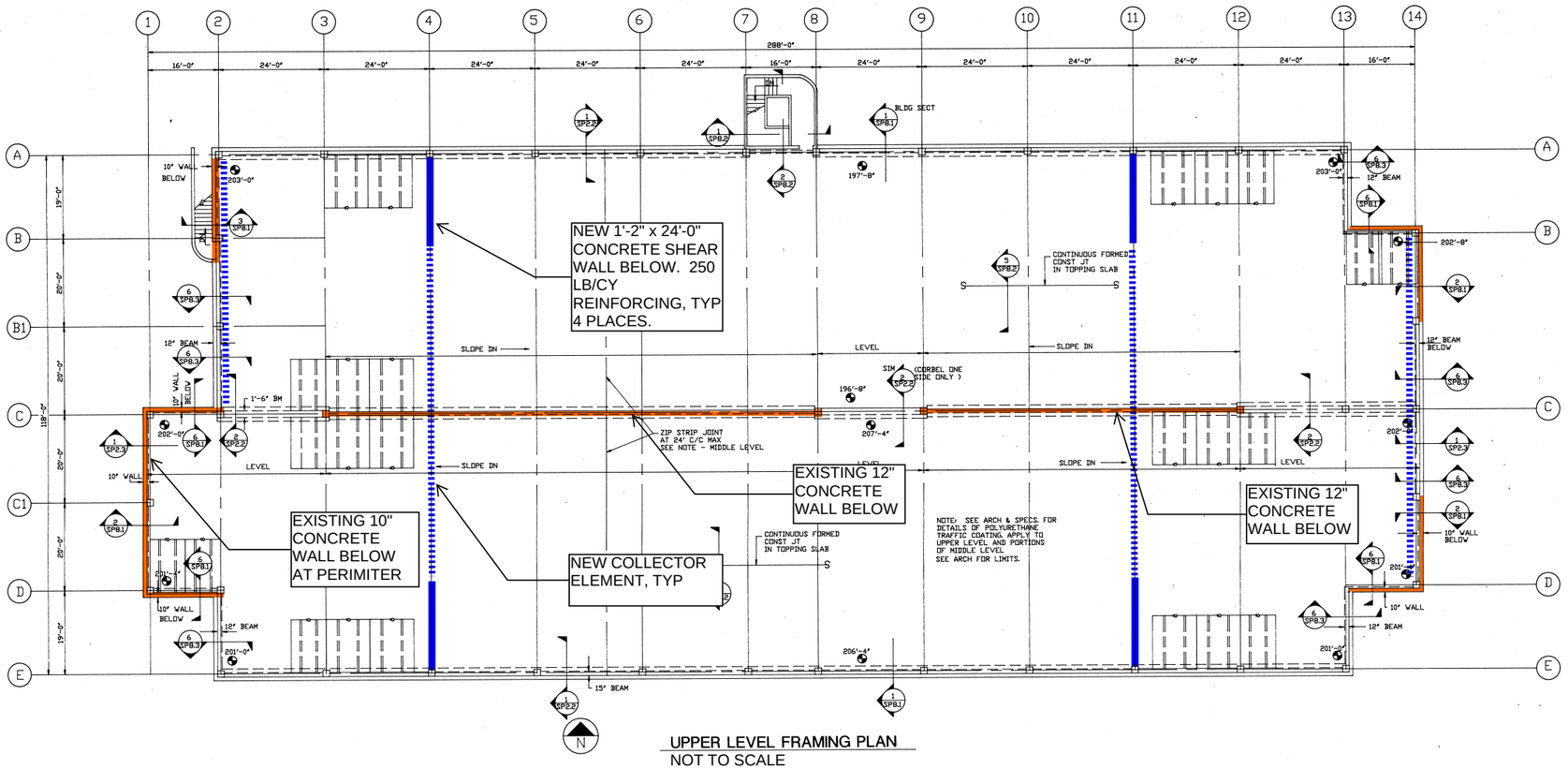

UPPER LEVEL FRAMING PLAN
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PARKING GARAGE - UPPER FLOOR

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7 OF 7

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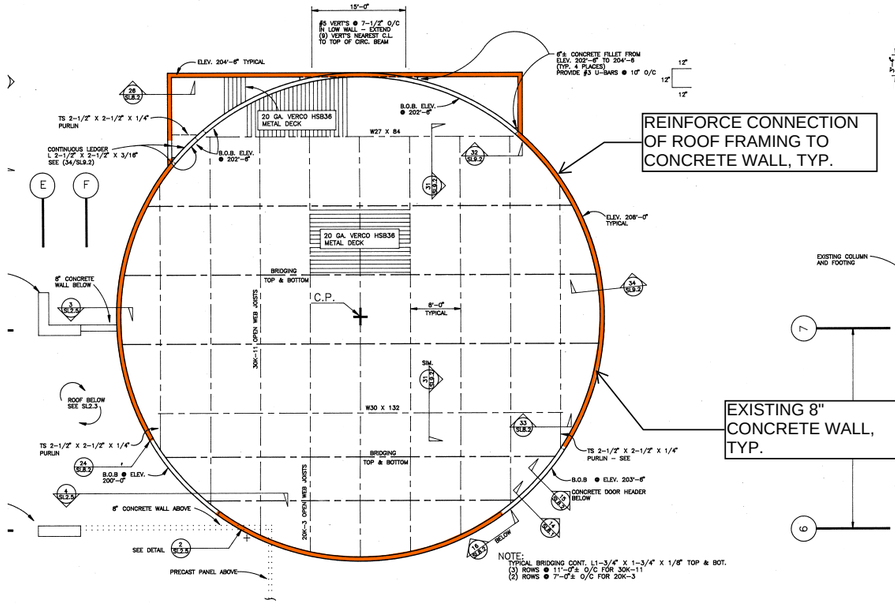
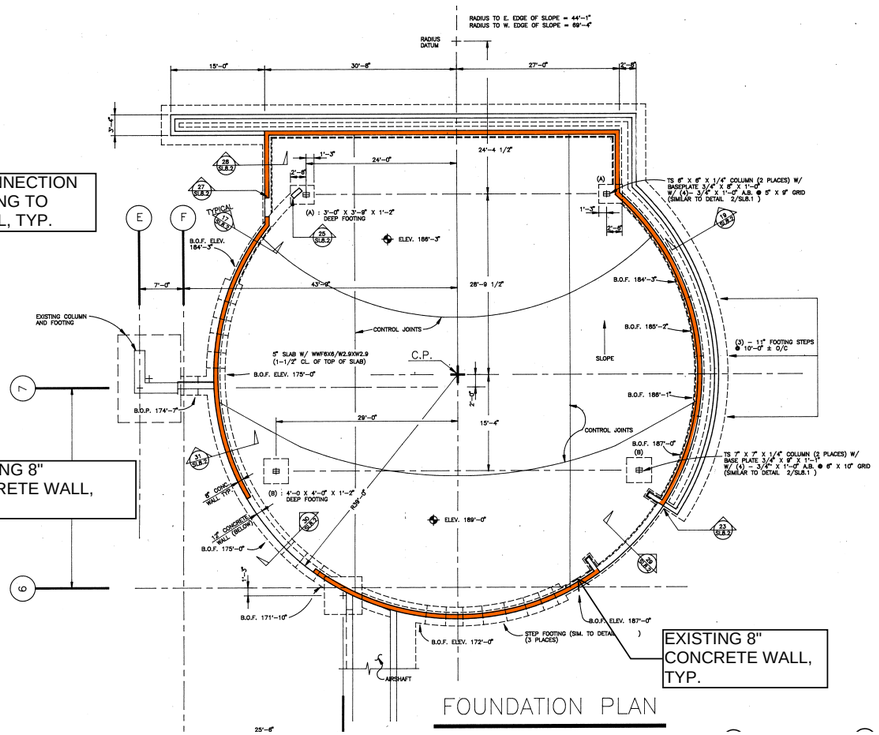


ROOF FRAMING PLAN

NOT TO SCALE



FOUNDATION PLAN

NOT TO SCALE

AUDITORIUM

BergerABAM
700 NE Multnomah Street, Suite 900
Portland, Oregon 97232
(503) 872-4100 Fax: (503) 872-4101

PROJECT NUMBER: A14.0170.01

DRAWING SCALE: AS SHOWN
DRAWN BY: DAW
APPROVED BY: HAW
DATE: 12/20/2013

NO.	REVISION	DATE.

CITY OF SALEM
EVALUATION REPORT

SALEM CENTRAL PUBLIC LIBRARY

SHEET NUMBER
S-08
8 OF 8

Appendix D
Site Photographs

MAIN BUILDING AND AUDITORIUM – PHOTOS OF EXTERIOR

Photo 1 - West Wall of Building

Photo 2 - West Wall of Building, Mezzanine Level Children's Reading Area

MAIN BUILDING AND AUDITORIUM – PHOTOS OF EXTERIOR

Photo 3 - West Wall of Main Building, Mezzanine Level Children's Reading Area

Photo 4 - Southwest Corner of Main Building

Photo 5 - South Wall of Main Building

Photo 6 - South Entrance to Main Building

MAIN BUILDING AND AUDITORIUM – PHOTOS OF EXTERIOR

Photo 7 - Intersection of Main Building and Auditorium at South Side of Main Building

Photo 8 - Northwest Corner of Building

Photo 9 - North Side of Building

Photo 10 - North Side of Building

MAIN BUILDING AND AUDITORIUM – PHOTOS OF EXTERIOR

Photo 11 - North Side of Building

Photo 12 - Northeast Corner of Building

Photo 13 - East Side of Building

Photo 14 - East Side of Building

Photo 15 - East Side of Building

Photo 16 - East Side of Building – Shows Intersection of Auditorium with Main Building

Photo 17 - East Side of Building – Auditorium Exterior Walls

Photo 18 - Southeast Side of Building

MAIN BUILDING AND AUDITORIUM – PHOTOS OF EXTERIOR

Photo 19 - Southeast Side of Building

Photo 20 - West Side of Auditorium

Photo 21 - Intersection of Auditorium and Main Building at Roof Level

Photo 22 - Auditorium Roof Looking Southeast from Main Building Roof

Photo 23 - Interior of Main Library Building

Photo 24 - Shows Inadequately Braced Book Stacks

Photo 25 – Inadequately Braced Book Stacks

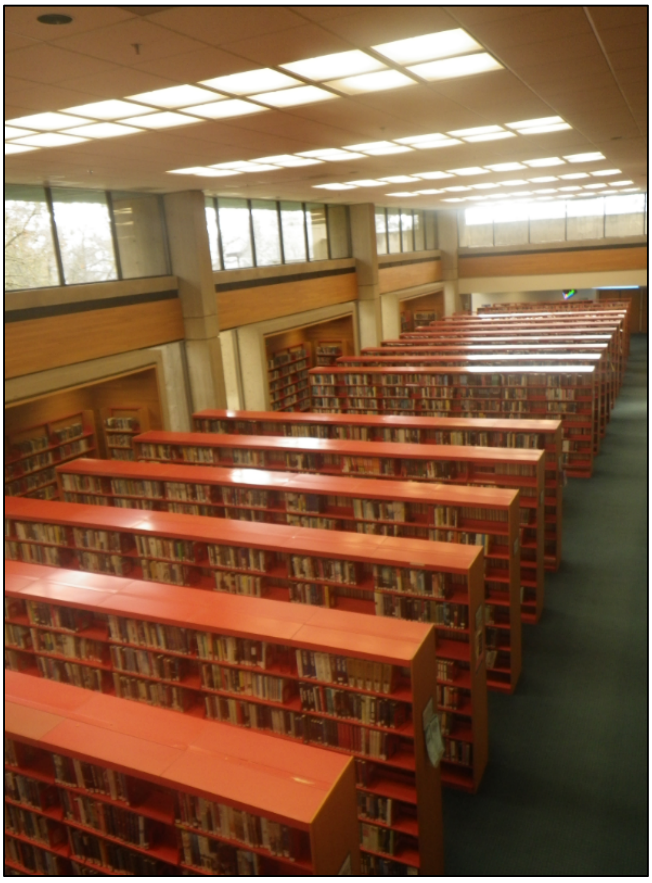


Photo 26 - View of the Main Level from the Second Story

Photo 27 - View of the Main Level from the Second Story

Photo 28 - Inadequately Braced Shelves

Photo 29 - Unbraced Suspended Ceiling System and Piping

Photo 30 – Inadequately Braced Light Fixtures in Suspended Grid Ceilings

Photo 31 - Inadequately Braced Suspended Equipment

Photo 32 – Inadequately Braced Suspended Equipment

Photo 33 - Inadequately Braced Suspended Piping Systems

Photo 34 - Inadequately Braced Shelves

Photo 35 - Inadequately Braced Shelves

Photo 36 – Inadequately Braced Shelves

Photo 37 - Inadequately Braced Lockers

Photo 38 – Inadequately Braced Shelves

Photo 39 – Inadequately Braced Ladder

Photo 40 - Inadequately Braced Mechanical Equipment

Photo 41 - Inadequately Braced Mechanical Equipment

Photo 42 - Inadequately Braced Mechanical Equipment

Photo 43 - Inadequately Braced Mechanical Equipment

Photo 44 - Inadequately Braced Mechanical Equipment

Photo 45 - Inadequately Braced Suspended Mechanical Equipment

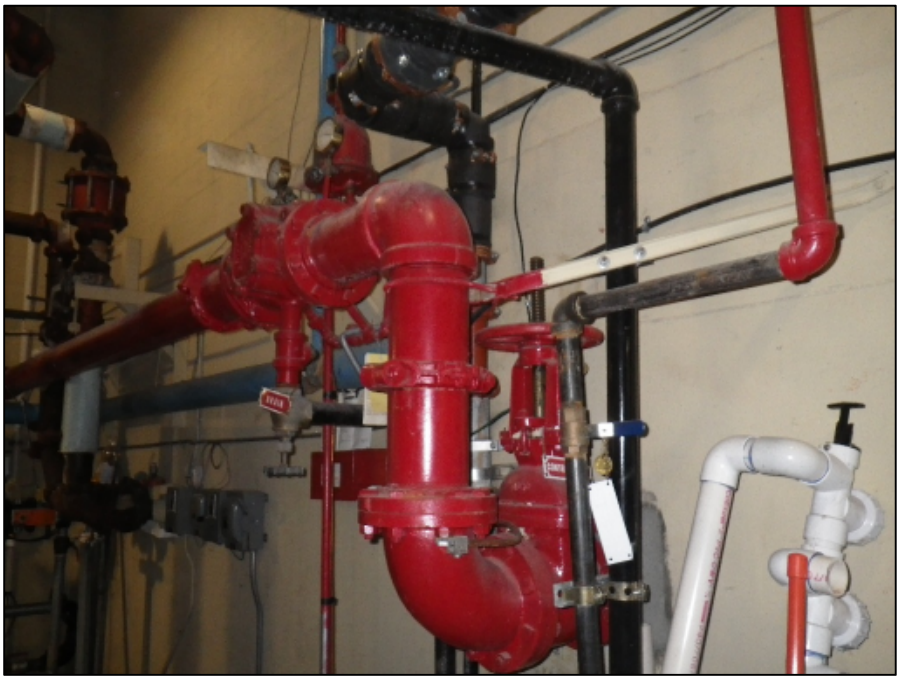


Photo 46 - Inadequately Braced Suspended Mechanical Equipment

Photo 47 - Inadequately Braced Mechanical Equipment

Photo 48 - Inadequately Braced Suspended Mechanical Equipment

Photo 49 - Inadequately Braced Suspended Mechanical Equipment

Photo 50 - Inadequately Braced Cabinets

Photo 51 - Adequately Braced Water Main Line

Photo 52 - Inadequately Braced Shelves

MAIN BUILDING AND AUDITORIUM – PHOTOS OF INTERIOR

Photo 53 - Interior of Auditorium

PARKING GARAGE PHOTOS

Photo 54 - Upper Level Looking West

Photo 55 - Upper Level Looking West

PARKING GARAGE PHOTOS

Photo 56 - North Side of Parking Garage

Photo 57 - North Side of Parking Garage (SE Corner)

PARKING GARAGE PHOTOS

Photo 58 - East Side of Parking Garage (SE Corner)

Photo 59 - Parking Garage Looking North (NE Corner)

PARKING GARAGE PHOTOS

Photo 60 - Southwest Corner of Parking

Photo 61 - West Side of Parking Garage

PARKING GARAGE PHOTOS

Photo 62 - West Side of Parking Garage

Photo 63 - North Side of Parking Garage

Photo 64 - Northwest corner of Parking Garage

Photo 65 - Northwest corner of Parking Garage

PARKING GARAGE PHOTOS

Photo 66 - Interior of Parking Garage

Photo 67 - Interior of Parking Garage

PARKING GARAGE PHOTOS

Photo 68 - Interior of Parking Garage

Photo 69 - Interior of Parking Garage

Photo 70 - Interior of Parking Garage

Photo 71 - Interior of Parking Garage

Photo 72 - Interior of Parking Garage

Photo 73 - Interior of Parking Garage

PARKING GARAGE PHOTOS

Photo 74 - Interior of Parking Garage

Photo 75 - Interior of Parking Garage

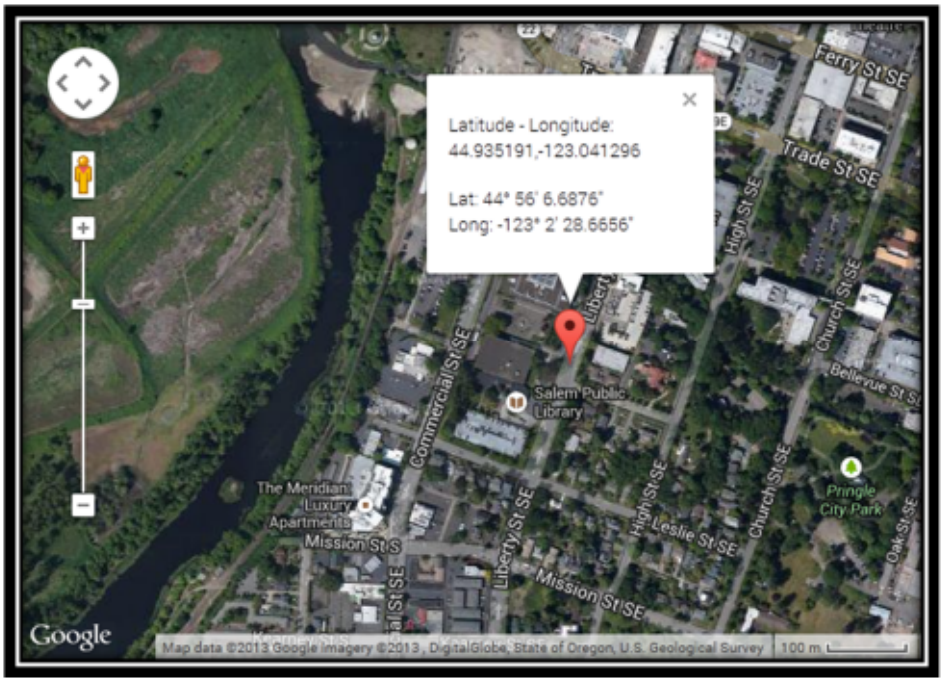
PARKING GARAGE PHOTOS

Photo 76 - Interior of Parking Garage

Appendix E
ASCE 31-03 Tier 1 Checklists

Seismic Design

Address: 585 Liberty Street SE, Salem, OR 97301-3513



Conterminous 48 States
2003 NEHRP Seismic Design Provisions
Latitude = 44.935191
Longitude = -123.04129600000002
Spectral Response Accelerations Ss and S1
Ss and S1 = Mapped Spectral Acceleration Values
Site Class B - Fa = 1.0 ,Fv = 1.0
Data are based on a 0.01 deg grid spacing

Period (sec)	Sa (g)
0.2	0.795 (Ss, Site Class B)
1.0	0.341 (S1, Site Class B)

Conterminous 48 States
2003 NEHRP Seismic Design Provisions
Latitude = 44.935191
Longitude = -123.04129600000002
Design Spectral Response Accelerations SDs and SD1
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class D - Fa = 1.182 ,Fv = 1.717

Period (sec)	Sa (g)
0.2	0.626 (SDs, Site Class D)
1.0	0.391 (SD1, Site Class D)

Conterminous 48 States
2003 NEHRP Seismic Design Provisions
Latitude = 44.935191
Longitude = -123.04129600000002
Spectral Response Accelerations SMs and SM1
SMs = Fa x Ss and SM1 = Fv x S1
Site Class D - Fa = 1.182 ,Fv = 1.717

Period (sec)	Sa (g)
0.2	0.940 (SMs, Site Class D)
1.0	0.586 (SM1, Site Class D)

<u>Salem Central Public Library ASCE 31-03 Seismic Evaluation Checklists</u>: MAIN BUILDING

3.7.9 Basic Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

3.7.9S Supplemental Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

3.8 Geologic Site Hazards and Foundations Checklist

3.9.1 Basic Nonstructural Component Checklist

3.9.2 Intermediate Nonstructural Component Checklist

3.7.9 Basic Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier I Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	Building System
☒	☐	☐	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1) **COMMENTS:**
☐	☐	☒	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3) **COMMENTS:**
☐	☒	☐	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1) **COMMENTS:** By inspection, the second level is a weak story. There is a significant reduction in both the number and length of lateral-force-resisting elements.
☐	☒	☐	SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2) **COMMENTS:** The stiffness of the lateral-force-resisting system at the second level is less than 70% the stiffness of the lateral-force-resisting system at the main level. This is obvious due to two factors, 1) There is a large open air space and 2) there is a significant reduction in stiff lateral-force-resisting elements between levels.
☒	☐	☐	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3) **COMMENTS:**
☒	☐	☐	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4) **COMMENTS:**

☒ ☐ ☐ MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

COMMENTS:

☐ ☒ ☐ TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.6)

COMMENTS: At the main level, the estimated distance between the story center of mass and the story center of rigidity is approximately 35 feet. 20% of the building width in the N-S direction is approximately 33 feet. It appears that the building may have inherent torsional issues.

☒ ☐ ☐ DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

COMMENTS:

☐ ☐ ☒ POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used. (Tier 2: Sec. 4.3.3.5)

COMMENTS:

☒ ☐ ☐ CONCRETE WALL CRACKS: All Existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.9)

COMMENTS:

C NC N/A **Lateral-Force-Resisting System**

☐ ☐ ☒ COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical-load-carrying system. (Tier 2: Sec. 4.4.1.6.1)

COMMENTS:

☒ ☐ ☐ REDUNDANCY: The number of lines of moment frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

COMMENTS:

☐ ☒ ☐ SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the greater of 100 psi or $2\sqrt{f'c}$ for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.1)

COMMENTS: The demand-to-capacity ratio is greater than 1.0 (DCR = 1.44) for the second level only, in the E-W direction of loading.

☐ ☒ ☐ REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18 inches for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.2

COMMENTS: Based on original construction drawings, rebar in the horizontal direction is less than the recommended 0.0025. Rebar in the vertical direction appears to be sufficient. For the 8" south stairwell walls, the plans show the horizontal rebar spaced at 20" O.C. which is larger than the 18" maximum rebar spacing.

C	NC	N/A	**Connections**
☒	☐	☐	TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)

COMMENTS:

☒ ☐ ☐ FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)

COMMENTS:

3.7.9S Supp. Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragm

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

C	NC	N/A	Lateral-Force-Resisting System
☐	☒	☐	DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of Sections 4.4.1.5.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy (Tier 2: Sec. 4.4.1.6.2) **COMMENTS:** The 24" x 24" reinforced columns do not have enough horizontal reinforcement to resist the shear demand when the maximum moment, Mpr is applied. The shear demand is roughly 92 kips and the (E) column capacity, with #3 @ 16" O.C., is 50 kips.
☐	☐	☒	FLAT SLABS: Flat slabs/plates not part of the lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety and Immediate Occupancy. (Tier 2: 4.4.1.6.3) **COMMENTS:**
☐	☐	☒	COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than d/2 and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.3) **COMMENTS:**
☐	☐	☒	OVERTURNING: All shear walls shall have aspect ratios less than 4-to-1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.4) **COMMENTS:**
☐	☐	☒	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5) **COMMENTS:**
☒	☐	☐	REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.6) **COMMENTS:**
☒	☐	☐	WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 inches. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.7)

COMMENTS:

C	NC	N/A	Diaphragms
☒	☐	☐	DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. (Tier 2: Sec. 4.5.1.1)

COMMENTS:

☒	☐	☐	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

COMMENTS:

☐	☐	☒	PLAN IRREGULITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

COMMENTS:

☐	☐	☒	DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

COMMENTS:

C	NC	N/A	Connections
☐	☐	☒	UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. (Tier 2: Sec. 4.6.3.10)

COMMENTS:

3.8 Geologic Site Hazards and Foundations Checklist

Geologic Site Hazards and Foundations Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

Geologic Site Hazards

C	NC	N/A	
☐	☐	☐	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 feet under the building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.7.1.1)
			COMMENTS: Could not be verified.
☒	☐	☐	SLOPE FAILURE: The building site shall be sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or shall be capable of accommodating any predicted movements without failure. (Tier 2: Sec. 4.7.1.2)
			COMMENTS:
☐	☐	☐	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site is not anticipated. (Tier 2: Sec. 4.7.1.3)
			COMMENTS: Could not be verified.

Condition of Foundations

C	NC	N/A	
☒	☐	☐	FOUNDATION PERFORMANCE: There shall be no evidence of excessive foundation movement such as settlement or heave that would affect the integrity or strength of the structure. (Tier 2: Sec. 4.7.2.1)
			COMMENTS:
☐	☐	☐	DETERIORATION: There shall not be evidence that foundation elements have deteriorated due to corrosion, sulfate attack, material breakdown, or other reasons in a manner that would affect the integrity or strength of the structure. (Tier 2: Sec. 4.7.2.2)
			COMMENTS: Could not be verified.

Capacity of Foundations

C	NC	N/A	
☐	☐	☒	POLE FOUNDATIONS: Pole foundations shall have a minimum embedment depth of 4 feet for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.7.3.1)
			COMMENTS:
☒	☐	☐	OVERTURNING: The ratio of the horizontal dimension of the lateral-force-resisting system at the foundation level to the building height (base/height) shall be greater than $0.6S_a$. (Tier 2: Sec. 4.7.3.2)
			COMMENTS:
☒	☐	☐	TIES BETWEEN FOUNDATION ELEMENTS: The foundation shall have ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Class A, B, or C. (Section 3.5.2.3.1, Tier 2: Sec. 4.7.3.3)
			COMMENTS:
☐	☐	☒	DEEP FOUNDATIONS: Piles and piers shall be capable of transferring the lateral forces between the structure and the soil. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.7.3.4)
			COMMENTS:
☒	☐	☐	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another shall not exceed one story in height. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.7.3.5)
			COMMENTS:

3.9.1 Basic Nonstructural Component Checklist

This Basic Nonstructural Component Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	**Partitions**
☐	☐	☒	UNREINFORCED MASONRY: Unreinforced Masonry or hollow clay tile partitions shall be braced at spacing equal to or less than 10 feet in levels of low or moderate seismicity and 6 feet in levels of high seismicity. (Tier 2: Sec. 4.8.1.1)

COMMENTS: According to original construction drawings, the 8" concrete block walls located in both the mechanical room area and loading dock area have vertical reinforcement (#4 @ 4'-0" O.C.) and are doweled into the footing below by #4 @ 4'-0" O.C. and into the waffle slab above by #8 @ 4'-0" O.C.

C	NC	N/A	**Ceiling Systems**
☒	☐	☐	SUPPORT: The integrated suspended ceiling system shall not be used to laterally support the tops of gypsum board, masonry, or hollow clay tile partitions. Gypsum board partitions need not be evaluated where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.3.1)

COMMENTS:

C	NC	N/A	**Light Fixtures**
☒	☐	☐	EMERGENCY LIGHTING: Emergency lighting shall be anchored or braced to prevent falling during an earthquake. (Tier 2: Sec 4.8.3.1)

COMMENTS:

C	NC	N/A	**Cladding and Glazing**
☐	☒	☐	CLADDING ANCHORS: Cladding components weighing more than 10 psf shall be mechanically anchored to the exterior wall framing at a spacing equal to or less than 4 feet. A spacing of up to 6 feet is permitted where only Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.1)

COMMENTS: The precast concrete fascia panels on the exterior of the roof of the original building are anchored at 7'-6" O.C. The precast concrete fascia panels on the exterior of the 1990 expansion part of the building are anchored where the steel framing meets the concrete panels at roughly 8'-0" O.C. It is unclear from the plans how the relocated window/wall system on the north side of the building is attached to the main structure. Further investigation would be required to verify adequate anchorage.

☒	☐	☐	DETERIORATION: There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)

COMMENTS:

☐ ☐ ☒ CLADDING ISOLATION: For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a story drift ratio of 0.02. Panel connection detailing for a story drift ratio of 0.01 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.3)

COMMENTS:

☐ ☐ ☒ MULTI-STORY PANELS: For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02. Panel connection detailing for a story drift ratio of 0.01 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.4)

COMMENTS:

☐ ☐ ☒ BEARING CONNECTIONS: Where bearing connections are required, there shall be a minimum of two bearing connections for each wall panel. (Tier 2: Sec. 4.8.4.5)

COMMENTS

☒ ☐ ☐ INSERTS: Where inserts are used in concrete connections, the inserts shall be anchored to reinforcing steel or other positive anchorage. (Tier 2: Sec. 4.8.4.6)

COMMENTS:

☒ ☐ ☐ PANEL CONNECTIONS: Exterior cladding panels shall be anchored out-of-plane with a minimum of 4 connections for each wall panel. Two connections per wall panel are permitted where only the Basic Nonstandard Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)

COMMENTS:

C NC N/A **Masonry Veneer**

☐ ☐ ☒ SHELF ANGLES: Masonry veneer shall be supported by shelf angles or other elements at each floor 30 feet or more above ground for Life Safety and at each floor above the first floor for Immediate Occupancy. (Tier 2: Sec. 4.8.5.1)

COMMENTS:

☐ ☐ ☒ TIES: Masonry veneer shall be connected to the back-up with corrosion-resistant ties. The ties shall have a spacing equal to or less than 24 inches with a minimum of one tie for every 2-2/3 square feet. A spacing of up to 36 inches is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.5.2)

COMMENTS:

☐ ☐ ☒ WEAKENED PLANES: Masonry veneer shall be anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)

COMMENTS:

☐ ☐ ☒ DETERIORATION: There shall be no evidence of deterioration, damage, or corrosion in any part of the connection elements. (Tier 2: Sec. 4.8.5.4)

COMMENTS:

C	NC	N/A	**Parapets, Cornices, Ornamentation, and Appendages**

☐ ☐ ☒ URM PARAPETS: There shall be no laterally unsupported unreinforced masonry parapets or cornices with height-to-thickness ratios greater than 1.5. A height to thickness ratio of up to 2.5 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.1)

COMMENTS:

☒ ☐ ☐ CANOPIES: Canopies located at building exits shall be anchored to the structural framing at a spacing of 6 feet or less. An anchorage spacing of up to 10 feet is permitted where only Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)

COMMENTS:

C	NC	N/A	**Masonry Chimneys**

☐ ☐ ☒ URM CHIMNEYS: No unreinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface up to three times the least dimension of the chimney is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.9.1)

COMMENTS:

C	NC	N/A	**Stairs**

☐ ☐ ☒ URM WALLS: Walls around stair enclosures shall not consist of unbraced hollow clay tile or unreinforced masonry with a height-to-thickness ratio greater than 12-to-1. A height-to-thickness ratio of up to 15-to-1 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.10.1)

COMMENTS:

☐ ☐ ☒ STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure shall not rely on shallow anchors in concrete. Alternatively, the stair details shall be capable of accommodating the drift calculated using the Quick Check procedure of Section 3.5.3.1 without including tension in the anchors. (Tier 2: Sec. 4.8.10.2)

COMMENTS:

C NC N/A

Building Contents and Furnishing

☐ ☒ ☐ TALL NARROW CONTENTS: Contents over 4 feet in height with a height-to-depth or height-to-width ratio greater than 3-to-1 shall be anchored to the floor slab or adjacent structural walls. A height-to-depth or height-to width ratio of up to 4-to-1 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.11.1)

COMMENTS: Unbraced shelving units, file cabinets, lockers and other miscellaneous furniture with a height-to-width or a height-to-depth ratio greater than 3-to-1 are present on all levels of the Main Building.

C NC N/A **Mechanical and Electrical Equipment**

☒ ☐ ☐ EMERGENCY POWER: Equipment used as part of an emergency power system shall be mounted to maintain continued operation after an earthquake. (Tier 2: Sec. 4.8.12.1)

COMMENTS:

☒ ☐ ☐ HAZARDOUS MATERIAL EQUIPMENT: HVAC or other equipment containing material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)

COMMENTS:

☐ ☒ ☐ DETERIORATION: There shall be no evidence of deterioration, damage, or corrosion in any of the anchorage or supports of mechanical or electrical equipment. (Tier 2: Sec. 4.8.12.3)

COMMENTS: There is corrosion on the anchorage supports of many pumps in the mechanical room. There is also significant corrosion on steel pipes in the mechanical room area of the building.

☐ ☒ ☐ ATTACHED EQUIPMENT: Equipment weighing over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be braced. (Tier 2: Sec. 4.8.12.4)

COMMENTS: There are several pieces of equipment weighing over 20 lb. that are either attached to the ceilings or to walls that are not laterally braced. There are many areas throughout the entire building where the duct and piping, including the suspended ceiling system itself, does not appear to have lateral bracing which means that it could sway during an earthquake causing damage on impact with other adjacent items or may result in falling hazards to human life.

C NC N/A **Piping**

☐ ☒ ☐ FIRE SUPPRESSION PIPING: Fire suppression piping shall be anchored and braced in accordance NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)

COMMENTS: There appears to be inadequate lateral bracing of both sprinkler heads and piping, along with areas where the impact of sprinkler pipes and other unbraced nonstructural elements could result in unreliable performance. Fire sprinkler piping has performed poorly in past earthquakes, rendering systems unusable when most needed.

C	NC	N/A	
☐	☒	☐	FLEXIBLE COUPLINGS: Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)

COMMENTS: Gas pipes do not appear to have flexible couplings which could lead to a fracture in an earthquake event.

C	NC	N/A	**Hazardous Materials Storage and Distribution**
☒	☐	☐	TOXIC SUBSTANCES: Toxic and hazardous substances stored in breakable containers shall be restrained from falling by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 4.8.15.1)

COMMENTS:

3.9.2 Intermediate Nonstructural Component Checklist

This Intermediate Nonstructural Component Checklist shall be completed where required by Table 3-2. The Basic Nonstructural Component Checklist shall be completed prior to completing this Intermediate Nonstructural Component Checklist.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	Ceiling Systems
☒	☐	☐	LAY-IN TILES: Lay-in tiles used in ceiling panels located at exits and corridors shall be secured with clips. (Tier 2: Sec. 4.8.2.2)
			COMMENTS:
☐	☒	☐	INTEGRATED CEILINGS: Integrated suspended ceilings at exits and corridors or weighing more than 2 pounds per square foot shall be laterally restrained with a minimum of four diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 feet. (Tier 2: Sec. 4.8.2.4)
			COMMENTS: There appears to be no lateral bracing in many areas throughout the building.
☐	☐	☒	SUSPENDED LATH AND PLASTER: Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forces for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)
			COMMENTS: It is under our impression that the suspended lath and plaster ceilings shown on the plans for the original building construction in 1970 were removed and replaced during the 1990 expansion upgrade.

C	NC	N/A	Light Fixtures
☐	☒	☐	INDEPENDENT SUPPORT: Light fixtures in suspended grid ceilings shall be supported independently of the ceiling suspension system by a minimum of two wires at diagonally opposite corners of the fixtures. (Tier 2: Sec. 4.8.3.2)
			COMMENTS: The light fixtures in the suspended grid ceiling are not supported independently of the ceiling suspension system.

C	NC	N/A	Cladding and Glazing
☐	☒	☐	GLAZING: Glazing in curtain walls and individual panes over 16 square feet in area, located up to a height of 10 feet above an exterior walking surface, shall have safety glazing. Such glazing located over 10 feet above exterior walking surface shall be laminated annealed or laminated heat-strengthened safety glass or other glazing system that will remain in the frame when glass is cracked. (Tier 2: Sec. 4.8.4.8)
			COMMENTS: Glass from original building does not appear to be safety glass. In addition, the connection of glass to structure does not allow for relative displacement.

C	NC	N/A	Parapets, Cornices, Ornamentation, and Appendages
☒	☐	☐	CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)

COMMENTS

☒	☐	☐	APPENDAGES: Cornices, parapets, signs, and other appendages that extend above the highest point of anchorage to the structure or cantilever from exterior wall faces and other exterior wall ornamentation shall be reinforced and anchored to the structural system at a spacing equal to or less than 10 feet for Life Safety and 6 feet for Immediate Occupancy. This requirement need not apply to parapets or cornices compliant with Section 4.8.8.1 or 4.8.8.3. (Tier 2: Sec. 4.8.8.4)

COMMENTS:

C	NC	N/A	Masonry Chimneys
☐	☐	☒	ANCHORAGE: Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)

COMMENTS:

C	NC	N/A	Mechanical and Electrical Equipment
☐	☐	☒	VIBRATION ISOLATORS: Equipment mounted on vibration isolators shall be equipped with restraint or snubbers. (Tier 2: Sec. 4.8.12.5)

COMMENTS:

C	NC	N/A	Ducts
☐	☐	☒	STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)

COMMENTS:

Supporting Calculations

Roof Loads (psf) - Main Building

	Flr. Mass
Insulation	1
5-Ply Felt and Gravel	6
Slab/Joist System (14" Waffle Slab + 3" concrete cover)	105
Suspended Ceiling	3
Mechanical and Electrical	8
Fire Sprinklers	1
Reinforced Concrete Columns	17
Exterior Walls	33
Miscellaneous	4
Dead Load	**178**
Live Load	**20**

Roof Loads (psf) - 1990 Wing Addition

	Flr. Mass
Roofing (Metal deck + insullation)	4
Steel Framing	15
Suspended Ceiling	3
Exterior Walls	40
Mechanical and Electrical	5
Fire Sprinklers	1
Miscellaneous	2
Dead Load	**70**
Live Load	**20**

Floor Loads (psf) - Main Building - Second Level

	Flr. Mass
Flooring	5
Slab/Joist System (14" waffle + 3" concrete cover)	105
Partitions/ non-bearing walls	10
Mechanical and Electrical	5
Fire Sprinklers	1
Reinforced Concrete Columns	36
Exterior Walls	50
Miscellaneous	5
Dead Load	**217**
Live Load (Library - Stacks)	**150**

Floor Loads (psf) - Main Building - Main Level

	Flr. Mass
Flooring	5
Slab/Joist System (14" waffle + 3" concrete cover)	105
Partitions/ non-bearing walls	10
Mechanical and Electrical	10
Fire Sprinklers	1
Reinforced Concrete Columns	28
Exterior Walls	40
Miscellaneous	5
Dead Load	**204**
Live Load (Library - Stacks)	**150**

Floor Loads (psf) - 1990 Wing Addition - Second Level

	Flr. Mass
Deck (metal decking + concrete)	54
Steel Framing	20
Partitions/ non-bearing walls	10
Mechanical and Electrical	5
Fire Sprinklers	1
Columns	1
Exterior Walls	50
Miscellaneous	4
Dead Load	**145**
Live Load (Lirary - Stacks)	**20**

Floor Loads (psf) - 1990 Wing Addition - Main Level

	Flr. Mass
Deck (metal decking + concrete)	54
Steel Framing	20
Partitions/ non-bearing walls	10
Mechanical and Electrical	5
Fire Sprinklers	1
Columns	1
Exterior Walls	35
Miscellaneous	4
Dead Load	**130**
Live Load (Lirary - Stacks)	**20**

Roof Level

Location	plf	total linear ft	Weight, lbs
Roof Precast-Panels	525	710	372,750
Exterior Walls			
North Side of Building	550	196	107,800
West Side of Building	1,500	130	195,000
South Side of Building	550	196	107,800
East Side of Building	1,500	130	195,000
Interior Walls			
8" Concrete Wall	660		
10" Concrete Wall	825		
		Total Floor Weight =	978,350
		Total Floor psf=	32

Second Level

Location	plf	total linear ft	Weight, lbs
Exterior Walls			
North Side of Building	950	196	186,200
West Side of Building	2,150	42	90,300
South Side of Building	950	65	61,750
East Side of Building	2,150	130	279,500
Interior Walls			
8" Concrete Wall	1,300		
10" Concrete Wall	1,625		
Concrete Rail			
		Total Floor Weight =	617,750
		Total Floor psf=	47

Main Level

Location	plf	total linear ft	Weight, lbs
Exterior Walls			
North Side of Building	980	196	192,080
West Side of Building (Open Area)	3,250	90	292,500
West Side of Building (Mezz Area)	2,000	40	80,000
South Side of Building	980	196	192,080
East Side of Building	2,000	130	260,000
Interior Walls			
8" Concrete Wall	1,225		
10" Concrete Wall	1,530		
		Total Floor Weight =	1,016,660
		Total Floor psf=	40

Main Building

Roof Level

Location	psf	total sf	Weight, lbs
1970 Original Building	178	30,745	5,472,610
1990 Wing Addition	70	8,300	581,000
		Total Floor Weight (lbs) =	**6,053,610**

Second Level

Location	psf	total sf	Weight, lbs
1970 Original Building	217	13,225	2,869,825
1990 Wing Addition	145	8,300	1,203,500
		Total Floor Weight (lbs), DL=	**4,073,325**
		Live Load (25% x 150psi x Total SF = 12,000), lbs =	**450,000**
		Σ =	**4,523,325**

Main Level

Location	psf	total sf	Weight, lbs
1970 Original Building	204	25,640	5,230,560
1990 Wing Addition	130	8,300	1,079,000
		Total Floor Weight (lbs) =	**6,309,560**
		Live Load (25% x 150psi x Total SF = 20,000), lbs =	**750,000**
		Σ =	**7,059,560**

Total Building Weight, Dead Load =	16,436	kips
Live Load (25% x 150psi x Total SF = 32,000) =	1,200	kips
Σ =	**17,636**	**kips**

Building Period (T)

$T = (C_t)(h_n)^{\beta}$

C_t =	0.020	(For all other framing systems)
hn =	38	ft
β =	0.75	(For all other framing systems)
T =	0.306	seconds

Story Shear Forces (V)

$V=CS_aW$

C =	**1.1**	(From ASCE 31 Table 3-4)
W =	**17,636**	kips (From mass take off calculations spreadsheets)
S_{D1} =	0.391	g
$S_a = S_{D1}/T$	1.277	g

S_a shall not exceed S_{DS} Therefore:

S_{DS} =	0.626	g

therefor:

S_a =	**0.626**	g

Seismic Shear:

V =	0.689	*W	kips
V =	**12,144**		**kips**

Shear Wall Area for Shear Stress in Concrete Shear Walls Quick Calc (3.5.3.3):

N-S Direction of Loading

Location	Length, ft	Area, sf
Main Level		
20" Ext. Column	112	187
12" Wall	156	156
10" Wall	198	165
8" Wall	85	57
∑ =	551	**564**

Location	Length, ft	Area, sf
Second Level		
20" Ext. Column	91	152
12" Wall	27	27
10" Wall	0	0
8" Wall	70	47
∑ =	188	**225**

Location	Length, ft	Area, sf
Roof Level		
20" Ext. Column	112	187
12" Wall	27	27
10" Wall	0	0
8" Wall	70	47
∑ =	209	**260**

E-W Direction of Loading

Location	Length, ft	Area, sf
Main Level		
20" Ext. Column	70	117
12" Wall	180	180
10" Wall	205	171
8" Wall	58	39
∑ =	513	**506**

Location	Length, ft	Area, sf
Second Level		
20" Ext. Column	0	0
12" Wall	27	27
10" Wall	10	8
8" Wall	20	13
∑ =	57	**49**

Location	Length, ft	Area, sf
Roof Level		
20" Ext. Column	70	117
12" Wall	27	27
10" Wall	10	8
8" Wall	20	13
∑ =	127	**165**

Story Shear Forces in Concrete Shear Walls (3.5.2.2):

$$F(x) = \frac{(w_x h_x)^k}{\sum_{i=1}^{n}(w_i h_i)^k} V \qquad V_j = \sum_{i=j}^{n} F_x$$

Story	h_x	w_x (kips)	$h_x w_x^k$	Cv	F_x (kips)
Roof	38	6,054	230,052	0.519	6,307
Second Level	26	4,523	117,598	0.265	3,224
Main Level	13.5	7,060	95,310	0.215	2,613
		∑ =	442,960	1.000	12,144

Shear Stress in Concrete Shear Walls (3.5.3.3):

Determined as follows:

$$vj^{avg} = \frac{1}{m}\left(\frac{V_j}{A_w}\right)$$

m = Component modification factor: Taken from table 3-7
Vj = story shear
Aw = Sum of horizontal cross-section areas of walls

Limit shear stress to greater of: 100psi or $2\sqrt{f'c}$

$$2\sqrt{f'c} = 2 \times \sqrt{4000\ psi} = 126\ psi$$

126 psi **CONTROLS** 0.126 ksi **CONTROLS**

N-S Direction

Story	A_w (in^2min)	V_j (kips)	m	v_j^{avg} (ksi)	DCR	Less than?
Roof	37,488	6,307	4.0	0.04	0.33	**OKAY**
Second Level*	32,448	9,531	4.0	0.07	0.53	**OKAY**
Main Level	81,264	12,144	4.0	0.04	0.30	**OKAY**

E-W Direction

Story	A_w (in^2min)	V_j (kips)	m	v_j^{avg} (ksi)	DCR	Less than?
Roof	23,808	6,307	4.0	0.07	0.53	**OKAY**
Second Level*	7,008	9,531	4.0	0.18	1.44	**NOT GOOD**
Main Level	72,888	12,144	4.0	0.04	0.33	**OKAY**

$$* \ v_j avg = \frac{3{,}224\ kips}{A_{w\ (2nd\ Level)}} + \frac{6{,}307\ kips}{A_{w\ (Roof)}}$$

Note: All of the columns supporting the roof do not support the 2nd level.

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Project Salem Library
Subject 1 Main Bldg. Floor Weights

Sheet ____ of ____
Job Number A14.0170.00
Designer EMG
Date 12-2013

Floor Weights (Waffle system)~

* Assume 14" waffle + 3" topping = 17" total thk.
* 2½' x 2½' voids
* Filled around columns (punching shear)

→ determine Avg. psf:

64' x 64' grid section = 4,096 s.f.
voids = 6.25 s.f.

total concrete s.f. = 4,096 s.f.
− 6.25 s.f. (84 voids x 4 grids) = 2,100 s.f.
≅ 2,000 s.f. x 17" thick
≅ 2,833 c.f. concrete

total weight = 2,833 c.f. (150 p.c.f)
= 424,950#/4,096 s.f. = **105 psf**

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Project Salem Library
Subject Main Bldg. Ext. Wall Weights

Sheet ____ of ____
Job Number A14.0170.00
Designer CMG
Date 12-2013

Exterior Walls - Roof Pre-cast panels 6" thick ~ (GENERAL)

concrete w_t = 150 pcf

(6"/12")(7 ft) = 3.5 sf (150 pcf) = **525 plf** ←

Exterior Walls - North side of building ~

(measured between grid lines)

Roof

4 ft (10" concrete wall @ top) = 3.33 sf.
4 ft (window → 8 psf)

3.33 sf (150 pcf) = 500 plf
4 ft (8 psf) = 32 plf
550 plf ←

2nd. Level

1.5 ft (window → 8 psf)
[3 ft (1 ft) + 3.5 ft (10" concrete wall)] = 6 sf
5 ft (window → 8 psf)

1.5 ft (8 psf) = 12
6 sf (150 pcf) = 900 plf
5 ft (8 psf) = 40 plf
950 plf ←

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Project Salem Library
Subject Main. Bldg. Ext. Wall Weights

Sheet ____ of ____
Job Number A14.0170.00
Designer CMG
Date 12/2013

Ext. Wall Weights N. Side of Bldg. cont.) ~

Main Level

5ft (window → 8 psf)
1.75 ft (0.75 ft) + 4 ft (10" concrete wall) = 4.5 sf.
4.5 ft (window → 8 psf)

5ft (8 psf) = 40 plf
6 sf (150 pcf) = 900 plf
5 ft (8 psf) = 40 plf
980 plf ←

Ext. Wall Weights W. Side of Bldg ~

roof (Open Area - Adult Reading Room)

4 ft (10" concrete wall @ top) = 3.33 sf.
5.5 ft (window → 8 psf)
3 ft (1 ft) + 3.5 ft (10" concrete wall) = 6 sf

3.33 sf (150 pcf) = 500 plf
5.5 ft (8 psf) = 45 plf
6 sf (150 pcf) = 900 plf
1,500 plf ←

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Project Salem Library
Subject Main Bldg. Ext. Wall Weights

Sheet _____ of _____
Job Number A14.0170.00
Designer CMG
Date 12-2013

Ext. Wall Weights W. Side of Bldg cont.) ~

Main. Level (Open Area - Adult Reading Room)

124 ft (8" concrete wall) = 16 sf.
24 ft (1" wood panneling = 2.5psf)
6 ft (10" concrete wall) = 5 sf.

16 sf (150 plf) = 2,400 plf
24 ft (2.5 psf) = 60 plf
5 sf (150 plf) = 750 plf
3250 plf ←

Ext. Wall Weights E. Side of Bldg. ~ (@ west side @ 2nd Level area only)

Roof

4ft (10" concrete wall @ top) = 3.33 sf.
4ft (window → 8psf)

3.33 sf (150 pcf) = 500 plf
4 ft (8 psf) = 32 plf
550 plf ←

2nd. Level

1.5 ft (window → 8psf)
6 sf (window ledge)
12 ft (8" concrete wall) = 8 sf
12 ft (1" wood panneling = 2.5 sf.)

(next pg.)

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Project Salem Library

Subject Main Bldg
Ext. Wall Weights

Sheet _____ of _____

Job Number A14.0170.00

Designer CMG

Date 12-2013

Ext. Wall Weights E. Side of Bldg. cont.) (+ west side @ Mezz. Level)

2nd Level (cont.)

1.5 ft (8 psf) = 12 plf
6 sf (150 pcf) = 900 plf
8 sf (150 pcf) = 1,200 plf
12 ft (2.5 sf) = 30 plf

2,150 plf ←

Main Level

12 ft (8" concrete wall) = 8 sf.
12 ft (1" wood panneling = 2.5psf)
6 ft (10" concrete wall) = 5 sf.

8 sf (150 pcf) = 1,200 plf
12 ft (2.5 psf) = 30 plf
5 sf (150 pcf) = 750 plf

2,000 plf ←

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Project Salem Library

Subject Main Bldg. Column Weights

Sheet _____ of _____

Job Number A14.0170.00

Designer CMG

Date 12-2013

Main Bldg. Roof -

TRIB = 6.6 ft

(24" x 24") x 11 = 44 sf

(20" x 48") x 3 = 20 sf

(20" x 7') x 15 = 176 sf

Σ = 240 sf.

TRIB = 13 ft

(24" x 24") x 4 = 16 sf

(20" x 7') x 11 = 130 sf

Σ = 146 sf.

Total W_T = [(6.6 ft)(240 sf) + 13 ft(146 sf)](150 pcf)

= 522,300 #

Total Roof S.F. ≅ 30,745

∴ PSF = 522,300#/30,745 s.f. = **17 psf**

Main Bldg. - 2nd Level -

TRIB = 13 ft

(24" x 24") x 11 = 44 sf.

(20" x 48") x 3 = 20 sf

(20" x 7') x 15 = 176 sf

≅ 240 sf.

Total W_T = 13 ft(240 sf)(150 pcf) = 468,000 #

Total Mezz. Level S.F. ≅ 13,225

∴ PSF = 468,000#/13,225 s.f. = **36 psf**

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Project Salem Library

Subject Main Bldg Column Weights

Sheet _____ of _____

Job Number A14.0170.00

Designer CMG

Date 12-2013

Main Bldg. - Main Level -

TRIB. = 12 ft.

* columns same as FOR ROOF

Total W_T = [12 ft (240 s.f.) + 13 ft. (146 s.f.)] (150 pcf)

= 716,700 #

Total Main Floor S.F. = 25,640

∴ PSF = 716,700 # / 25,640 s.f. = **28 psf**

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Project Salem Library

Subject Main Building Quick Checks

Sheet _____ of _____

Job Number A14.0170.00

Designer CMG

Date 12-2013

Quick check for reinforcing steel~

20"x 7'-0" exterior columns

(V) steel: 4(#8) + 5(#8) = 9(0.79 in²) = 7.11 in² (controls)

concrete: 20" x 84" = 1680 in²

ratio = 0.00423 > 0.0015 ∴ OK

(H) steel: #3 @ 16" O.C. = 2(0.11 in²) = 0.22 in²

Concrete: 16" x 20" = 320 in²

ratio = 0.0006875 < 0.0025 ∴ N.G.

10" Exterior Wall

(V) Steel: 4(#4) + 5(#6) = 4(0.2) + 5(0.44) = 3 in²

Concrete: 60" x 10" = 600 in²

ratio = 0.005 > 0.0015 ∴ OK

(H) Steel: 2(#4) = 2(0.2) = 0.4 in²

Concrete: 15" x 12" = 180 in²

ratio = 0.0022 < 0.0025 ∴ N.G.

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Project Salem Library
Subject Main Building Quick Checks

Sheet _____ of _____
Job Number A14.0770.00
Designer CMG
Date 12-2013

Quick check for reinforcing steel (cont.) ~

12" Exterior Walls

(V) Steel: $2(\#4) = 2(0.2) = 0.4\ in^2$

Concrete: $12" \times 10" = 120\ in^2$

ratio = $0.0033 > 0.0015$ ∴ OK

(H) Steel: $2(\#4) = 0.4\ in^2$

Concrete: $18" \times 10" = 180\ in^2$

ratio = $0.0022 < 0.0025$ ∴ N.G.

8" Interior Walls (1970 bldg - elevator shaft)

(V) Steel: #5 @ 15" O.C.
#8 @ 12" O.C.
#4 @ 12" O.C. ← controls $= 2(0.2) = 0.4\ in^2$

concrete: $12" \times 8" = 96\ in^2$ ratio = $0.0042 > 0.0015$ ∴ OK

(H) Steel: #4 @ 12" O.C.
#4 @ 20" O.C. ← N.G. > 18" O.C.

$2(0.2) = 0.4\ in^2$

Concrete: $12" \times 8" = 96\ in^2$

ratio = $0.004167 > 0.0025$ ∴ OK

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Project Salem Library
Subject Main Building Quick Checks
Sheet ____ of ____
Job Number A14.0170.00
Designer CMG
Date 12-2013

Check deflection compatability of exterior columns ~

TRIB = 32' x 32' = 1,024 sf.

Total Load = 1.2D + 1.0L = 1.2(204 psf) + 1.0(150 psf)
= 395 psf

OR 405 kip (worst case)

→ see SP column output, $\phi = 1.0$, $f'_c = 3{,}000$ psi

(ACI 21.4.5) $M_{pr} = 634$ k-ft

(Demand) $V = \frac{2M_{pr}}{H} = \frac{2(634\text{ k-ft})}{12\text{ ft}} = 105^k$

(Capacity) ACI Eqn. 11-15 $V_s = \frac{A_v f_y d}{s}$

#3 @ 16" O.C.
$A_v = 2(\#3) = 0.22\text{ in}^2$
$f_y = 60{,}000$ psi
$d = 24" - 1.5" - \frac{1}{2}(0.79") = 22.1"$
$s = 16"$

$\therefore V_s = \frac{0.22\text{ in}^2(60{,}000\text{ psi})(22.1")}{16"} = 18.23^k$

$\phi V_s = 0.65(18.23^k) = 11.85^k$

$V_c = 2\sqrt{f'_c}\, b_w d = 2\sqrt{3{,}000\text{ psi}}(24")(22.1") = 58.1^k$

$\phi V_c = 0.65(58.1^k) = 37.7^k$

Total Shear Capacity @ $H/2 = V_c + V_s \approx 50^k < 105^k$ ∴ N.G.

General Information:
==========
File Name: q:\portland\2014\a14.0170\01\engineering\cmg\report docume...\interior column 24 x 24.col
Project: Salam Library - Main Bldg
Column: Engineer: CMG
Code: ACI 318-08 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: X-axis Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 75 ksi = 1.25 f_y (PER ACI 21.4.5)
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
==========
Rectangular: Width = 24 in Depth = 24 in

Gross section area, Ag = 576 in^2
Ix = 27648 in^4 Iy = 27648 in^4
rx = 6.9282 in ry = 6.9282 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Other; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 1, phi(b) = 1, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 1.10%
Minimum clear spacing = 8.63 in

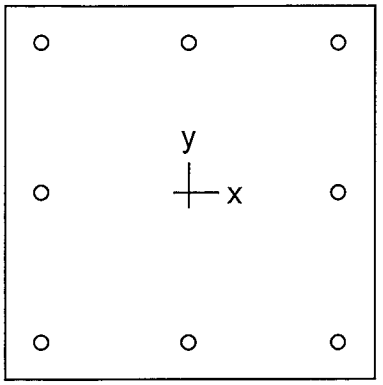
8 #8 Cover = 1.5 in

Axial Load and Corresponding Moment Capacities:
==========

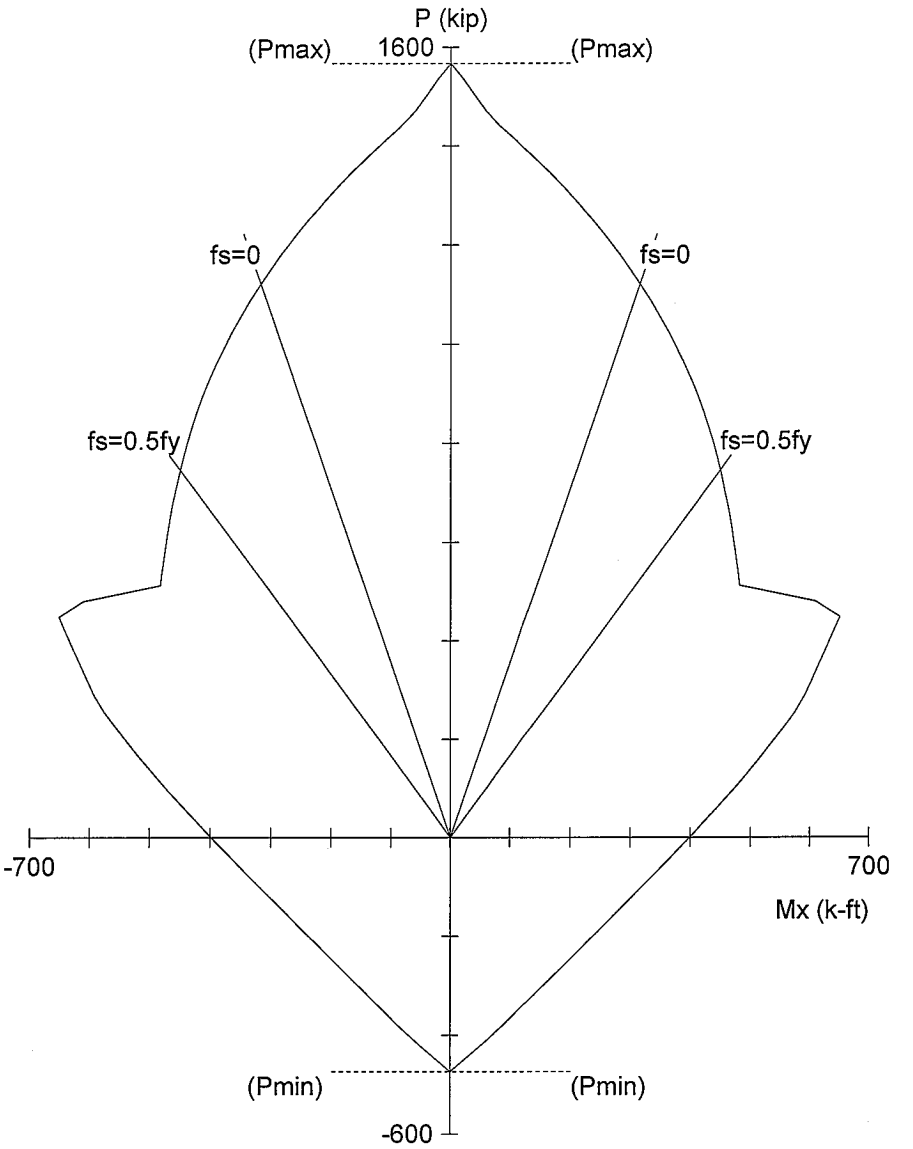
Load No.	PhiPn kip	PhiMnx k-ft	NA depth in	Dt depth in	eps_t	Phi
1	0.0	398.29	3.46	21.63	0.01577	1.000
		-398.29	3.46	21.63	0.01577	1.000
2	25.0	417.46	3.69	21.63	0.01459	1.000
		-417.46	3.69	21.63	0.01459	1.000
3	50.0	436.29	3.93	21.63	0.01350	1.000
		-436.29	3.93	21.63	0.01350	1.000
4	75.0	454.79	4.18	21.63	0.01251	1.000
		-454.79	4.18	21.63	0.01251	1.000
5	100.0	472.89	4.45	21.63	0.01160	1.000
		-472.89	4.45	21.63	0.01160	1.000
6	125.0	490.59	4.71	21.63	0.01076	1.000
		-490.59	4.71	21.63	0.01076	1.000
7	150.0	507.85	4.99	21.63	0.01000	1.000
		-507.85	4.99	21.63	0.01000	1.000
8	175.0	524.60	5.28	21.63	0.00930	1.000
		-524.60	5.28	21.63	0.00930	1.000
9	200.0	540.92	5.57	21.63	0.00865	1.000
		-540.92	5.57	21.63	0.00865	1.000
10	225.0	556.69	5.86	21.63	0.00807	1.000
		-556.69	5.86	21.63	0.00807	1.000
11	250.0	571.97	6.16	21.63	0.00752	1.000
		-571.97	6.16	21.63	0.00752	1.000
12	275.0	586.35	6.46	21.63	0.00704	1.000
		-586.35	6.46	21.63	0.00704	1.000
13	300.0	596.04	6.67	21.63	0.00672	1.000
		-596.04	6.67	21.63	0.00672	1.000
14	325.0	605.67	6.89	21.63	0.00642	1.000
		-605.67	6.89	21.63	0.00642	1.000

15	350.0	615.17	7.11	21.63	0.00613	1.000
		-615.17	7.11	21.63	0.00613	1.000
16	375.0	624.55	7.34	21.63	0.00584	1.000
		-624.55	7.34	21.63	0.00584	1.000
17	400.0	633.79	7.57	21.63	0.00557	1.000
		-633.79	7.57	21.63	0.00557	1.000

*** End of output ***



24 x 24 in



Code: ACI 318-08

Units: English

Run axis: About X-axis

Run option: Investigation

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 12/16/13

Time: 13:01:58

File: q:\portland\2014\a14.0170\01\engineering\cmg\report documents\seismic evaluation\main...\interior column 24 x 24.col

Project: Salam Library - Main Bldg

Column:

Engineer: CMG

f'c = 4 ksi	fy = 75 ksi	Ag = 576 in^2	8 #8 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 6.32 in^2	rho = 1.10%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 27648 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 27648 in^4
Beta1 = 0.85		Min clear spacing = 8.63 in	Clear cover = 1.88 in

Confinement: Other

phi(a) = 1, phi(b) = 1, phi(c) = 0.65

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Project Salem Library

Subject Main Building

Sheet _____ of _____

Job Number A14.0170.00

Designer CMG

Date 12.17.13

Check for overturning (geologic site hazard)~

$0.6 S_a = 0.6 (0.626\,g) = 0.376$

ratio base/height = $\frac{513\,ft}{38\,ft} = 13.5 >> 0.38$

∴ OK

Salem Central Public Library ASCE 31-03 Seismic Evaluation Checklists: AUDITORIUM

3.7.9A Basic Structural Checklist for Building Type C2A: Concrete Shear Walls with Flexible Diaphragms

3.7.9AS Supplemental Structural Checklist for Building Type C2A: Concrete Shear Walls with Flexible Diaphragms

3.8 Geologic Site Hazards and Foundations Checklist

3.9.1 Basic Nonstructural Component Checklist

3.9.2 Intermediate Nonstructural Component Checklist

3.7.9A Basic Structural Checklist for Building Type C2A: Concrete Shear Walls with Flexible Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier I Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	Building System
☒	☐	☐	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1) **COMMENTS:**
☐	☒	☐	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4 percent of the height of the shorter building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.1.2) **COMMENTS:** 4%*H = 10 inches. There is no clear distance provided between the Auditorium and the adjacent buildings.
☐	☐	☒	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3) **COMMENTS:**
☐	☐	☒	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1) **COMMENTS:**
☐	☐	☒	SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2) **COMMENTS:**
☐	☐	☒	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3) **COMMENTS:**

☒ ☐ ☐ VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

COMMENTS:

☐ ☐ ☒ MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

COMMENTS:

☐ ☐ ☒ DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose. (Tier 2: Sec. 4.3.3.1)

COMMENTS:

☒ ☐ ☐ DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

COMMENTS:

☐ ☐ ☒ POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used. (Tier 2: Sec. 4.3.3.5)

COMMENTS:

☒ ☐ ☐ CONCRETE WALL CRACKS: All Existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.9)

COMMENTS:

C NC N/A **Lateral-Force-Resisting System**

☒ ☐ ☐ REDUNDANCY: The number of lines of moment frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

COMMENTS:

☒ ☐ ☐ SHEAR STRESS CHECK: The shear stress in the concrete columns, calculated using the Quick Check procedure of Section 3.5.3.2, shall be less than the greater of 100 psi or $2\sqrt{f'c}$ for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.1)

COMMENTS:

☐ ☒ ☐ REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18 inches for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.2)

COMMENTS: Based on original construction drawings, rebar in the horizontal direction is less than the recommended 0.0025 (ratio = 0.00208).

C	NC	N/A	**Connections**
☐	☒	☐	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 3.5.3.7. (Tier 2: 4.6.1.1)

COMMENTS: The original construction drawings show the roof deck attaching to the exterior 8" concrete walls via. (1) 5/8" Dia. x 5" wedge anchor @ 48" O.C. These anchors no longer meet current seismic code. However, to check the strength of the connection we compared the demand to the capacity of Hilti 5/8" Dia. KBII anchor bolts with a 4" embedment depth. From the ER-4627 report, the allowable tension load = 1,335 lbs. Our calculated demand, using tributary area approach = 1,975 lbs.

☒ ☐ ☐ TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)

COMMENTS:

☒ ☐ ☐ FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)

COMMENTS:

3.7.9AS Supplemental Structural Checklist for Building Type C2A: Concrete Shear Walls with Flexible Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

C	NC	N/A	Lateral-Force-Resisting System
☐	☒	☐	COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than d/2 and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.3) **COMMENTS:** The connection of the coupling beams does not include hooks of 135 degrees or more. According to the original construction drawings, all hooks are at 90 degree angles.
☐	☐	☒	OVERTURNING: All shear walls shall have aspect ratios less than 4-to-1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.4) **COMMENTS:**
☐	☐	☒	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5) **COMMENTS:**
☐	☐	☒	REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.6) **COMMENTS:**
☐	☐	☒	WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 inches. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.7) **COMMENTS:**

C	NC	N/A	Diaphragms
☒	☐	☐	DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. (Tier 2: Sec. 4.5.1.1) **COMMENTS:**
☒	☐	☐	CROSS TIES: There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)

COMMENTS:

☐ ☐ ☒ PLAN IRREGULITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

COMMENTS:

☐ ☐ ☒ DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)

COMMENTS:

☐ ☐ ☒ STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspet ratios less than 2-to-1 for Life Safety and 1-to-1 for Immediate Occupancy in the direction being considered. (Tier 2: Sec. 4.5.2.1)

COMMENTS:

☐ ☐ ☒ SPANS: All wood diaphragms with spans greater than 24 feet for Life Safety and 12 feet for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing. (Tier 2: Sec. 4.5.2.2)

COMMENTS:

☐ ☐ ☒ UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms shall have horizontal spans less than 40 feet for Life Safety and 30 feet for Immediate Occupancy and shall have aspect ratios less than or equal to 4-to-1for Life Safety and 3-to-1 for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)

COMMENTS:

☐ ☐ ☒ NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 feet and shall have span/depth ratios less than 4-to-1. This Statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)

COMMENTS:

☒ ☐ ☐ OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 4.5.7.1)

COMMENTS:

C	NC	N/A	Connections
☐	☐	☒	UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. (Tier 2: Sec. 4.6.3.10)

COMMENTS:

3.8 Geologic Site Hazards and Foundations Checklist

Geologic Site Hazards and Foundations Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

Geologic Site Hazards

C	NC	N/A	
☐	☐	☐	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 feet under the building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.7.1.1)
			COMMENTS: Could not be verified.
☒	☐	☐	SLOPE FAILURE: The building site shall be sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or shall be capable of accommodating any predicted movements without failure. (Tier 2: Sec. 4.7.1.2)
			COMMENTS:
☐	☐	☐	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site is not anticipated. (Tier 2: Sec. 4.7.1.3)
			COMMENTS: Could not be verified.

Condition of Foundations

C	NC	N/A	
☒	☐	☐	FOUNDATION PERFORMANCE: There shall be no evidence of excessive foundation movement such as settlement or heave that would affect the integrity or strength of the structure. (Tier 2: Sec. 4.7.2.1)
			COMMENTS:
☐	☐	☐	DETERIORATION: There shall not be evidence that foundation elements have deteriorated due to corrosion, sulfate attack, material breakdown, or other reasons in a manner that would affect the integrity or strength of the structure. (Tier 2: Sec. 4.7.2.2)
			COMMENTS: Could not be verified.

Capacity of Foundations

C	NC	N/A	
☐	☐	☒	POLE FOUNDATIONS: Pole foundations shall have a minimum embedment depth of 4 feet for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.7.3.1)

COMMENTS:

☒	☐	☐	OVERTURNING: The ratio of the horizontal dimension of the lateral-force-resisting system at the foundation level to the building height (base/height) shall be greater than $0.6S_a$. (Tier 2: Sec. 4.7.3.2)

COMMENTS:

☒	☐	☐	TIES BETWEEN FOUNDATION ELEMENTS: The foundation shall have ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Class A, B, or C. (Section 3.5.2.3.1, Tier 2: Sec. 4.7.3.3)

COMMENTS:

☐	☐	☒	DEEP FOUNDATIONS: Piles and piers shall be capable of transferring the lateral forces between the structure and the soil. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.7.3.4)

COMMENTS:

☐	☐	☒	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another shall not exceed one story in height. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.7.3.5)

COMMENTS:

3.9.1 Basic Nonstructural Component Checklist

This Basic Nonstructural Component Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	
			Partitions
☐	☐	☒	UNREINFORCED MASONRY: Unreinforced Masonry or hollow clay tile partitions shall be braced at spacing equal to or less than 10 feet in levels of low or moderate seismicity and 6 feet in levels of high seismicity. (Tier 2: Sec. 4.8.1.1)
			COMMENTS:
			Ceiling Systems
☐	☐	☒	SUPPORT: The integrated suspended ceiling system shall not be used to laterally support the tops of gypsum board, masonry, or hollow clay tile partitions. Gypsum board partitions need not be evaluated where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.3.1)
			COMMENTS:
			Light Fixtures
☒	☐	☐	EMERGENCY LIGHTING: Emergency lighting shall be anchored or braced to prevent falling during an earthquake. (Tier 2: Sec 4.8.3.1)
			COMMENTS:
			Cladding and Glazing
☐	☐	☒	CLADDING ANCHORS: Cladding components weighing more than 10 psf shall be mechanically anchored to the exterior wall framing at a spacing equal to or less than 4 feet. A spacing of up to 6 feet is permitted where only Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.1)
			COMMENTS:
☒	☐	☐	DETERIORATION: There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)
			COMMENTS:
☒	☐	☐	CLADDING ISOLATION: For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a story drift ratio of 0.02. Panel connection detailing for a story drift ratio of 0.01 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.3)
			COMMENTS:

☐ ☐ ☒ MULTI-STORY PANELS: For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02. Panel connection detailing for a story drift ratio of 0.01 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.4)

COMMENTS:

☐ ☐ ☒ BEARING CONNECTIONS: Where bearing connections are required, there shall be a minimum of two bearing connections for each wall panel. (Tier 2: Sec. 4.8.4.5)

COMMENTS

☒ ☐ ☐ INSERTS: Where inserts are used in concrete connections, the inserts shall be anchored to reinforcing steel or other positive anchorage. (Tier 2: Sec. 4.8.4.6)

COMMENTS:

☐ ☐ ☒ PANEL CONNECTIONS: Exterior cladding panels shall be anchored out-of-plane with a minimum of 4 connections for each wall panel. Two connections per wall panel are permitted where only the Basic Nonstandard Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)

COMMENTS:

C NC N/A **Masonry Veneer**

☐ ☐ ☒ SHELF ANGLES: Masonry veneer shall be supported by shelf angles or other elements at each floor 30 feet or more above ground for Life Safety and at each floor above the first floor for Immediate Occupancy. (Tier 2: Sec. 4.8.5.1)

COMMENTS:

☐ ☐ ☒ TIES: Masonry veneer shall be connected to the back-up with corrosion-resistant ties. The ties shall have a spacing equal to or less than 24 inches with a minimum of one tie for every 2-2/3 square feet. A spacing of up to 36 inches is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.5.2)

COMMENTS:

☐ ☐ ☒ WEAKENED PLANES: Masonry veneer shall be anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)

COMMENTS:

☐ ☐ ☒ DETERIORATION: There shall be no evidence of deterioration, damage, or corrosion in any part of the connection elements. (Tier 2: Sec. 4.8.5.4)

COMMENTS:

C	NC	N/A	Parapets, Cornices, Ornamentation, and Appendages
☒	☐	☐	URM PARAPETS: There shall be no laterally unsupported unreinforced masonry parapets or cornices with height-to-thickness ratios greater than 1.5. A height to thickness ratio of up to 2.5 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.1)

COMMENTS:

☐	☐	☒	CANOPIES: Canopies located at building exits shall be anchored to the structural framing at a spacing of 6 feet or less. An anchorage spacing of up to 10 feet is permitted where only Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)

COMMENTS:

C	NC	N/A	Masonry Chimneys
☐	☐	☒	URM CHIMNEYS: No unreinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface up to three times the least dimension of the chimney is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.9.1)

COMMENTS:

C	NC	N/A	Stairs
☒	☐	☐	URM WALLS: Walls around stair enclosures shall not consist of unbraced hollow clay tile or unreinforced masonry with a height-to-thickness ratio greater than 12-to-1. A height-to-thickness ratio of up to 15-to-1 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.10.1)

COMMENTS:

☐	☒	☐	STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure shall not rely on shallow anchors in concrete. Alternatively, the stair details shall be capable of accommodating the drift calculated using the Quick Check procedure of Section 3.5.3.1 without including tension in the anchors. (Tier 2: Sec. 4.8.10.2)

COMMENTS: In the 1990 expansion area of the main building, which includes the Auditorium area, the stairs do not appear to have slip connections to accommodate building drift

C	NC	N/A	Building Contents and Furnishing
☒	☐	☐	TALL NARROW CONTENTS: Contents over 4 feet in height with a height-to-depth or height-to-width ratio greater than 3-to-1 shall be anchored to the floor slab or adjacent structural walls. A height-to-depth or height-to width ratio of up to 4-to-1 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.11.1)

COMMENTS:

C	NC	N/A	Mechanical and Electrical Equipment
☒	☐	☐	EMERGENCY POWER: Equipment used as part of an emergency power system shall be mounted to maintain continued operation after an earthquake. (Tier 2: Sec. 4.8.12.1)
			COMMENTS:
☒	☐	☐	HAZARDOUS MATERIAL EQUIPMENT: HVAC or other equipment containing material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)
			COMMENTS:
☒	☐	☐	DETERIORATION: There shall be no evidence of deterioration, damage, or corrosion in any of the anchorage or supports of mechanical or electrical equipment. (Tier 2: Sec. 4.8.12.3)
			COMMENTS:
☐	☒	☐	ATTACHED EQUIPMENT: Equipment weighing over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be braced. (Tier 2: Sec. 4.8.12.4)
			COMMENTS: There appears to be no lateral bracing for the suspended equipment or the suspended acoustical panels in the auditorium.
C	NC	N/A	**Piping**
☐	☒	☐	FIRE SUPPRESSION PIPING: Fire suppression piping shall be anchored and braced in accordance NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)
			COMMENTS: The fire suppression piping did not appear to have lateral bracing.
☐	☐	☐	FLEXIBLE COUPLINGS: Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)
			COMMENTS: Could not be verified.
C	NC	N/A	**Hazardous Materials Storage and Distribution**
☐	☐	☒	TOXIC SUBSTANCES: Toxic and hazardous substances stored in breakable containers shall be restrained from falling by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 4.8.15.1)
			COMMENTS:

3.9.2 Intermediate Nonstructural Component Checklist

This Intermediate Nonstructural Component Checklist shall be completed where required by Table 3-2. The Basic Nonstructural Component Checklist shall be completed prior to completing this Intermediate Nonstructural Component Checklist.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	Ceiling Systems
☐	☐	☒	LAY-IN TILES: Lay-in tiles used in ceiling panels located at exits and corridors shall be secured with clips. (Tier 2: Sec. 4.8.2.2) **COMMENTS:** There are no suspend ceiling systems at exits or corridors
☐	☐	☒	INTEGRATED CEILINGS: Integrated suspended ceilings at exits and corridors or weighing more than 2 pounds per square foot shall be laterally restrained with a minimum of four diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 feet. (Tier 2: Sec. 4.8.2.4) **COMMENTS:** There are no suspend ceiling systems at exits or corridors
☐	☐	☒	SUSPENDED LATH AND PLASTER: Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forces for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4) **COMMENTS:**

C	NC	N/A	Light Fixtures
☐	☒	☐	INDEPENDENT SUPPORT: Light fixtures in suspended grid ceilings shall be supported independently of the ceiling suspension system by a minimum of two wires at diagonally opposite corners of the fixtures. (Tier 2: Sec. 4.8.3.2) **COMMENTS:** The suspended light fixtures in the auditorium appear to not be laterally braced.

C	NC	N/A	Cladding and Glazing
☐	☐	☐	GLAZING: Glazing in curtain walls and individual panes over 16 square feet in area, located up to a height of 10 feet above an exterior walking surface, shall have safety glazing. Such glazing located over 10 feet above exterior walking surface shall be laminated annealed or laminated heat-strengthened safety glass or other glazing system that will remain in the frame when glass is cracked. (Tier 2: Sec. 4.8.4.8) **COMMENTS:** Could not be verified.

C	NC	N/A	Parapets, Cornices, Ornamentation, and Appendages
☐	☐	☒	CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)

COMMENTS

☒	☐	☐	APPENDAGES: Cornices, parapets, signs, and other appendages that extend above the highest point of anchorage to the structure or cantilever from exterior wall faces and other exterior wall ornamentation shall be reinforced and anchored to the structural system at a spacing equal to or less than 10 feet for Life Safety and 6 feet for Immediate Occupancy. This requirement need not apply to parapets or cornices compliant with Section 4.8.8.1 or 4.8.8.3. (Tier 2: Sec. 4.8.8.4)

COMMENTS:

C	NC	N/A	Masonry Chimneys
☐	☐	☒	ANCHORAGE: Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)

COMMENTS:

C	NC	N/A	Mechanical and Electrical Equipment
☐	☐	☒	VIBRATION ISOLATORS: Equipment mounted on vibration isolators shall be equipped with restraint or snubbers. (Tier 2: Sec. 4.8.12.5)

COMMENTS:

C	NC	N/A	Ducts
☐	☐	☒	STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)

COMMENTS:

Supporting Calculations

Roof Loads (psf)

	Flr. Mass
Membrane Roof	5
Steel Framing	10
Suspended Ceiling/Acoustical	3
Mechanical and Electrical	3
Fire Sprinklers	1
Exterior Walls	61
Egress Opening Headers	5
Column (TS 7x7x1/4)	1
Miscellaneous	1
Dead Load	**90**
Live Load	**20**

Floor Loads (psf)

**Slab on grade

Total Roof SF = 4,778 sf

Total Building Weight, Dead Load =	430	kips
Live Load=	0	kips
∑ =	**430**	**kips**

Building Period (T)

$T = (C_t)(h_n)^{\beta}$

C_t =	0.020	(For all other framing systems)
hn =	20	ft
β =	0.75	(For all other framing systems)
T =	0.189	seconds

Story Shear Forces (V)

$V=CS_aW$

C =	1	(From ASCE 31 Table 3-4)
W =	**430**	kips (From mass take off calculations spreadsheets)
S_{D1} =	0.391	g
$S_a = S_{D1}/T$	2.067	g

S_a shall not exceed S_{DS} Therefore:

S_{DS} =	0.626	g

therefor:

S_a =	**0.626**	g

Seismic Shear:

V =	0.626	*W	kips
V =	**269**		**kips**

Shear Wall Area for Shear Stress in Concrete Shear Walls Quick Calc (3.5.3.3):

All Directions of Loading

Location	Length, ft	Area, sf
Roof Level		
8" Wall	123	82
	∑ =	**82**

Shear Stress in Concrete Shear Walls (3.5.3.3):

Determined as follows:

$$vj^{avg} = \frac{1}{m}\left(\frac{V_j}{A_w}\right)$$

m = Component modification factor: Taken from table 3-7
Vj = story shear
Aw = Sum of horizontal cross-section areas of walls

Limit shear stress to greater of: 100psi or $2\sqrt{f'c}$

$$2\sqrt{f'c} = 2 \times \sqrt{3000\ psi} = 109.5\ psi$$

109.5 psi **CONTROLS** or 0.1095 ksi **CONTROLS**

All Directions

Story	A_w (in^{2}min)	V_j (kips)	m	v_j^{avg} (ksi)	DCR	Less than?
Roof Level	11760	269	4.0	0.01	0.1	**OKAY**

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Project Salem Library
Subject Auditorium
Sheet ____ of ____
Job Number A14.0170.00
Designer CMG
Date 12-2013

Determine Wall W_T to Roof -

TRIB = 8.75 ft

R = 39 ft ∴ $L = 2\pi r \cong$ 245 ft

18" reinforced concrete walls

8"/(8.75 ft) ≅ 6 sf (150 pcf) = 900 plf

Total W_T = [900 plf/(245 ft) + 80 ft]

= 292,500 #

Total Area = πr^2 = 4,778 sf.

∴ PSF = 292,500 #/4,778 sf = **61 psf.**

Auditorium S.F. =

$\pi R^2 = \pi(39\text{ ft})^2 = 4{,}778$ sf.

Column W_T: 7x7x1/4 = 23 plf

Total W_T/SF = 23 plf(4)(9 ft)/4,778 = < **1 psf**

Door Headers -

2x[14 ft(3ft x 1ft)] = 84 cf. (150 pcf) = 12,600 # (2)

= 25,200 #/4,778 sf.

= **5 psf**

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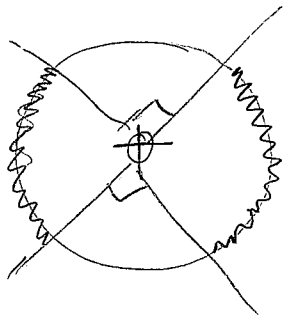
Project Salem Library
Subject Auditorium
Sheet ____ of ____
Job Number A14.0170.00
Designer CMG
Date 12-2013

Shear Stress check ~

* since auditorium is circular, treat length of shear wall to resist shear forces as you would in a pipe.



$= \frac{1}{2}(2\pi r) = \pi r$

~> this situation is worst case scenario

$\therefore L_{8" wall} = \pi r = \pi(39\,ft) = 122.5\,ft$

Reinforcing concrete ~

8" shear walls

(V) steel: #5 @ 15" O.C. = $0.31\,in^2$

concrete: $15" \times 8" = 120\,in^2$

ratio = $0.00258 > 0.0015$ ∴ OK

(H) steel: #4 @ 12" O.C. = $0.2\,in^2$

concrete: $12" \times 8" = 96\,in^2$

ratio = $0.00208 < 0.0025$ ∴ N.G.

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Sheet _____ of _____
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Flexible Diaphragm Connection forces

From ASCE 31-03, For W27x84 connection

3.5.3.7 $T_c = 0.9 S_{DS} w_p A_p$

$S_{DS} = 0.626\,g$

$w_p = 8" \times 150\,pcf = 100\,psf$

$A_p \cong 8.75\,ft \times 4 = 35\,sf$.
(worst case)

$\therefore T_c = 0.9(0.626)(100\,psf)(35\,sf)$

$T_c = 1,972\,\#$

→ AB's used are KB-1, from Hilti ESR report for KB-2 Expansion Anchors

$T_{AL} = 1,335\,\#$

$T_c > T_{AL} \therefore$ N.G.

TABLE 3—CARBON STEEL KWIK BOLT-II ALLOWABLE TENSION AND SHEAR VALUES (in pounds), NORMAL-WEIGHT CONCRETE[1,2]

ANCHOR DIAMETER (inch)	ANCHOR DEPTH (inches)	f'_c = 2,000 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Tension			Tension			Tension			Tension		
		With Sp. Insp.	Without Sp. Insp.	Shear	With Sp. Insp.	Without Sp. Insp.	Shear	With Sp. Insp.	Without Sp. Insp.	Shear	With Sp. Insp.	Without Sp. Insp.	Shear
1/4	$1^1/_8{}^3$	245	120	400	300	150	400	350	175	400	430	215	400
	2	525	265	400	550	280	400	590	295	400	625	315	400
	$3^3/_4$	625	315	400	625	315	400	625	315	400	625	315	400
3/8	$1^5/_8{}^3$	500	250	925	605	300	975	710	355	1,025	800	400	1,025
	$2^1/_2$	1,125	565	1,100	1,210	605	1,100	1,290	645	1,100	1,450	725	1,100
	$4^1/_4$	1,190	595	1,100	1,235	615	1,100	1,285	640	1,100	1,450	725	1,100
1/2	$2^1/_4{}^3$	860	430	1,810	960	480	1,840	1,065	530	1,840	1,625	815	1,840
	$3^1/_2$	1,750	875	1,840	2,000	1,000	1,840	2,250	1,125	1,840	2,625	1,315	1,840
	6	1,950	975	1,840	2,165	1,080	1,840	2,375	1,190	1,840	2,625	1,315	1,840
5/8	$2^3/_4{}^3$	1,425	710	2,875	1,685	845	2,875	1,950	975	2,875	2,500	1,250	2,875
	4	2,180	1,125	3,125	2,670	1,335	3,125	3,090	1,545	3,125	3,925	1,965	3,125
	7	3,000	1,500	3,125	3,250	1,625	3,125	3,500	1,750	3,125	3,925	1,965	3,125
3/4	$3^1/_4{}^3$	1,850	925	3,875	2,175	1,090	3,875	2,500	1,250	3,875	3,000	1,500	3,875
	$4^3/_4$	2,750	1,375	4,225	3,625	1,940	4,225	4,500	2,250	4,225	5,060	2,530	4,225
	8	3,750	1,875	4,225	4,625	2,315	4,225	5,500	2,750	4,225	5,925	2,965	4,225
1	$4^1/_2{}^3$	2,930	1,465	6,625	3,650	1,825	7,125	4,375	2,190	7,625	4,360	2,180	8,625
	6	3,990	1,995	8,625	5,310	2,655	8,625	6,625	3,315	8,625	7,875	3,940	8,625
	9	6,040	3,020	8,625	7,050	3,525	8,625	8,055	4,025	8,625	10,000	5,000	8,625

For SI: 1 inch = 25.4 mm, 1 psi = 6.9 kPa, 1 lb. = 4.45 N.

[1]See Table 2 footnotes.

[2]Allowable loads may be increased by $33^1/_3$ percent for short-term loading due to wind or seismic forces.

[3]Only the long-threaded style KB-II anchor installed at this embedment depth is permitted to be used to resist shear due to wind or seismic forces. Long threaded style KB-II anchors have a thread length greater than three bolt diameters.

TABLE 4—STAINLESS STEEL KWIK BOLT-II ALLOWABLE TENSION AND SHEAR VALUES (in pounds), NORMAL-WEIGHT CONCRETE[1,2]

ANCHOR DIAMETER (inch)	ANCHOR DEPTH (inches)	f'_c = 2,000 psi			f'_c = 3,000 psi			f'_c = 4,000 psi			f'_c = 6,000 psi		
		Tension			Tension			Tension			Tension		
		With Sp. Insp.	Without Sp. Insp.	Shear	With Sp. Insp.	Without Sp. Insp	Shear	With Sp. Insp.	Without Sp. Insp.	Shear	With Sp. Insp.	Without Sp. Insp.	Shear
1/4	$1^1/_8{}^3$	170	85	525	230	115	540	245	120	550	350	175	550
	2	425	210	550	500	250	550	500	250	550	520	260	550
	$3^3/_4$	520	260	550	520	260	550	520	260	550	520	260	550
3/8	$1^5/_8{}^3$	400	200	825	460	230	950	515	260	1,075	625	315	1,150
	$2^1/_2$	875	440	1,250	1,025	515	1,250	1,175	590	1,250	1,350	675	1,250
	$4^1/_4$	1,000	500	1,250	1,145	625	1,250	1,350	675	1,250	1,350	675	1,250
1/2	$2^1/_4{}^3$	800	400	1,700	1,000	500	1,740	1,200	600	1,775	1,250	625	2,085
	$3^1/_2$	1,250	625	2,085	1,625	815	2,085	2,000	1,000	2,085	2,250	1,125	2,085
	6	1,375	690	2,085	1,765	880	2,085	2,150	1,075	2,085	2,550	1,275	2,085
5/8	$2^3/_4{}^3$	1,020	510	2,625	1,250	625	2,875	1,475	735	3,125	1,800	900	3,125
	4	1,730	865	3,125	2,220	1,110	3,125	2,715	1,355	3,125	3,000	1,500	3,125
	7	2,250	1,125	3,125	2,825	1,415	3,125	3,425	1,715	3,125	3,425	1,715	3,125
3/4	$3^1/_4{}^3$	1,450	725	2,700	1,825	915	3,100	2,200	1,100	3,500	2,450	1,225	4,500
	$4^3/_4$	2,350	1,175	4,225	2,990	1,495	4,365	3,625	1,815	4,500	4,375	2,190	4,500
	8	2,750	1,375	4,500	3,500	1,815	4,500	4,250	2,125	4,500	4,800	2,400	4,500
1	$4^1/_2{}^3$	2,300	1,150	5,700	2,850	1,425	6,350	3,400	1,700	7,000	4,500	2,250	7,000
	6	3,740	1,870	7,000	4,930	2,465	7,000	6,120	3,060	7,000	6,875	3,440	7,000
	9	5,250	2,625	7,000	7,075	3,540	7,000	8,800	4,400	7,000	8,800	4,400	7,000

For SI: 1 inch = 25.4 mm, 1 psi = 6.9 kPa, 1 lb. = 4.45 N.

[1]See Table 2 footnotes.

[2]Allowable loads may be increased by $33^1/_3$ percent for short-term loading due to wind or seismic forces.

[3]Anchors installed at this embedment depth shall not be used to resist shear due to wind or seismic forces.

Salem Central Public Library ASCE 31-03 Seismic Evaluation Checklists: PARKING GARAGE

3.7.9 Basic Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

3.7.9S Supplemental Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

3.8 Geologic Site Hazards and Foundations Checklist

3.9.1 Basic Nonstructural Component Checklist

3.9.2 Intermediate Nonstructural Component Checklist

3.7.9 Basic Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier I Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	Building System
☒	☐	☐	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1) **COMMENTS:**
☐	☐	☒	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3) **COMMENTS:**
☐	☒	☐	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1) **COMMENTS:** The strength of the lateral-force-resisting system supporting the Upper Level is 49% less than the strength of the lateral-force resisting system supporting the Middle Level.
☐	☒	☐	SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2) **COMMENTS:** In both the N-S and the E-W directions, the upper story is less than 70% of the lateral-force-resisting system stiffness in the middle story.
☒	☐	☐	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3) **COMMENTS:**
☒	☐	☐	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)

COMMENTS:

☒ ☐ ☐ MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)

COMMENTS:

☐ ☒ ☐ TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.6)

COMMENTS: The distance between the story center of mass and the story center of rigidity is greater than the recommended 20%. There could be substantial rotation of the diaphragm which would lead to increased demands in the columns which were not designed to be part of the lateral-force-resisting system.

☐ ☒ ☐ DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements. (Tier 2: Sec. 4.3.3.4)

COMMENTS: There is some minor cracking of the concrete on all areas of the building and around a few connections of the pre-cast panels. The concrete is also deteriorating around some of the double-tee joist connections to exterior beams.

☐ ☐ ☒ POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used. (Tier 2: Sec. 4.3.3.5)

COMMENTS:

☒ ☐ ☐ CONCRETE WALL CRACKS: All Existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.9)

COMMENTS:

C	NC	N/A	**Lateral-Force-Resisting System**

☒ ☐ ☐ COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical-load-carrying system. (Tier 2: Sec. 4.4.1.6.1)

COMMENTS:

☒ ☐ ☐ REDUNDANCY: The number of lines of moment frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)

COMMENTS:

☐ ☒ ☐ SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the greater of 100 psi or $2\sqrt{f'c}$ for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.1)

COMMENTS: The demand-to-capacity ratio is greater than 1.0 (Range is 1.0-2.21) for all levels of the parking garage in the N-S direction of loading except for the very top level which has a demand-to-capacity ratio equal to 1.0.

☒ ☐ ☐ REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18 inches for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.2

COMMENTS: Based on original construction drawings.

C	NC	N/A	**Connections**
☒	☐	☐	TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)

COMMENTS:

☒ ☐ ☐ FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)

COMMENTS:

3.7.9S Supp. Structural Checklist for Building Type C2: Concrete Shear Walls with Stiff Diaphragm

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

C	NC	N/A	Lateral-Force-Resisting System
☐	☒	☐	DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of Sections 4.4.1.5.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy (Tier 2: Sec. 4.4.1.6.2) **COMMENTS:** The 18" x 18" reinforced columns do not have enough horizontal reinforcement to resist the shear demand when the maximum moment, Mpr is applied. The shear demand is roughly 61 kips and the capacity is 29 kips.
☐	☐	☒	FLAT SLABS: Flat slabs/plates not part of the lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety and Immediate Occupancy. (Tier 2: 4.4.1.6.3) **COMMENTS:**
☐	☐	☒	COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than d/2 and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. (Tier 2: Sec. 4.4.2.2.3) **COMMENTS:**
☐	☐	☒	OVERTURNING: All shear walls shall have aspect ratios less than 4-to-1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.4) **COMMENTS:**
☐	☐	☒	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5) **COMMENTS:**
☐	☐	☒	REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.6) **COMMENTS:**
☐	☐	☒	WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 inches. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.7)

COMMENTS:

C	NC	N/A	Diaphragms
☒	☐	☐	DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. (Tier 2: Sec. 4.5.1.1)

COMMENTS:

☐	☐	☒	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)

COMMENTS:

☐	☐	☒	PLAN IRREGULITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

COMMENTS:

☐	☐	☒	DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)

COMMENTS:

C	NC	N/A	Connections
☐	☐	☒	UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. (Tier 2: Sec. 4.6.3.10)

COMMENTS:

3.8 Geologic Site Hazards and Foundations Checklist

Geologic Site Hazards and Foundations Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

Geologic Site Hazards

C	NC	N/A	
☐	☐	☐	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 feet under the building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.7.1.1)
			COMMENTS: Could not be verified.
☒	☐	☐	SLOPE FAILURE: The building site shall be sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or shall be capable of accommodating any predicted movements without failure. (Tier 2: Sec. 4.7.1.2)
			COMMENTS:
☐	☐	☐	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site is not anticipated. (Tier 2: Sec. 4.7.1.3)
			COMMENTS: Could not be verified.

Condition of Foundations

C	NC	N/A	
☒	☐	☐	FOUNDATION PERFORMANCE: There shall be no evidence of excessive foundation movement such as settlement or heave that would affect the integrity or strength of the structure. (Tier 2: Sec. 4.7.2.1)
			COMMENTS:
☐	☐	☐	DETERIORATION: There shall not be evidence that foundation elements have deteriorated due to corrosion, sulfate attack, material breakdown, or other reasons in a manner that would affect the integrity or strength of the structure. (Tier 2: Sec. 4.7.2.2)
			COMMENTS: Could not be verified.

Capacity of Foundations

C	NC	N/A	
☐	☐	☒	POLE FOUNDATIONS: Pole foundations shall have a minimum embedment depth of 4 feet for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.7.3.1)

COMMENTS:

☒	☐	☐	OVERTURNING: The ratio of the horizontal dimension of the lateral-force-resisting system at the foundation level to the building height (base/height) shall be greater than $0.6S_a$. (Tier 2: Sec. 4.7.3.2)

COMMENTS:

☒	☐	☐	TIES BETWEEN FOUNDATION ELEMENTS: The foundation shall have ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Class A, B, or C. (Section 3.5.2.3.1, Tier 2: Sec. 4.7.3.3)

COMMENTS:

☐	☐	☒	DEEP FOUNDATIONS: Piles and piers shall be capable of transferring the lateral forces between the structure and the soil. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.7.3.4)

COMMENTS:

☐	☐	☒	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another shall not exceed one story in height. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.7.3.5)

COMMENTS:

3.9.1 Basic Nonstructural Component Checklist

This Basic Nonstructural Component Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	
			Partitions
☐	☐	☒	UNREINFORCED MASONRY: Unreinforced Masonry or hollow clay tile partitions shall be braced at spacing equal to or less than 10 feet in levels of low or moderate seismicity and 6 feet in levels of high seismicity. (Tier 2: Sec. 4.8.1.1)
			COMMENTS:
			Ceiling Systems
☐	☐	☒	SUPPORT: The integrated suspended ceiling system shall not be used to laterally support the tops of gypsum board, masonry, or hollow clay tile partitions. Gypsum board partitions need not be evaluated where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.3.1)
			COMMENTS:
			Light Fixtures
☐	☐	☒	EMERGENCY LIGHTING: Emergency lighting shall be anchored or braced to prevent falling during an earthquake. (Tier 2: Sec 4.8.3.1)
			COMMENTS:
			Cladding and Glazing
☐	☒	☐	CLADDING ANCHORS: Cladding components weighing more than 10 psf shall be mechanically anchored to the exterior wall framing at a spacing equal to or less than 4 feet. A spacing of up to 6 feet is permitted where only Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.1)
			COMMENTS: The pre-cast concrete panels used on the exterior of the parking garage are anchored at each end, or at approximately a 24'-0" spacing.
☐	☒	☐	DETERIORATION: There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)
			COMMENTS: There was corrosion on many connecting elements. A few connections appeared to be damaged.

☐ ☒ ☐ CLADDING ISOLATION: For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a story drift ratio of 0.02. Panel connection detailing for a story drift ratio of 0.01 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.3)

COMMENTS: The connections of the precast concrete panel cladding to exterior columns do not have slotted connections.

☐ ☒ ☐ MULTI-STORY PANELS: For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02. Panel connection detailing for a story drift ratio of 0.01 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.4)

COMMENTS: The connections of the precast concrete panel cladding to exterior columns do not have slotted connections.

☒ ☐ ☐ BEARING CONNECTIONS: Where bearing connections are required, there shall be a minimum of two bearing connections for each wall panel. (Tier 2: Sec. 4.8.4.5)

COMMENTS

☐ ☐ ☒ INSERTS: Where inserts are used in concrete connections, the inserts shall be anchored to reinforcing steel or other positive anchorage. (Tier 2: Sec. 4.8.4.6)

COMMENTS:

☐ ☒ ☐ PANEL CONNECTIONS: Exterior cladding panels shall be anchored out-of-plane with a minimum of 4 connections for each wall panel. Two connections per wall panel are permitted where only the Basic Nonstandard Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)

COMMENTS: There are only two connections for some of the smaller exterior precast wall panels.

C NC N/A **Masonry Veneer**

☒ ☐ ☒ SHELF ANGLES: Masonry veneer shall be supported by shelf angles or other elements at each floor 30 feet or more above ground for Life Safety and at each floor above the first floor for Immediate Occupancy. (Tier 2: Sec. 4.8.5.1)

COMMENTS:

☐ ☐ ☒ TIES: Masonry veneer shall be connected to the back-up with corrosion-resistant ties. The ties shall have a spacing equal to or less than 24 inches with a minimum of one tie for every 2-2/3 square feet. A spacing of up to 36 inches is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.5.2)

COMMENTS:

☐ ☐ ☒ WEAKENED PLANES: Masonry veneer shall be anchored to the backup adjacent to

weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)

COMMENTS:

☐ ☐ ☒ DETERIORATION: There shall be no evidence of deterioration, damage, or corrosion in any part of the connection elements. (Tier 2: Sec. 4.8.5.4)

COMMENTS:

C	NC	N/A	**Parapets, Cornices, Ornamentation, and Appendages**
☐	☐	☒	URM PARAPETS: There shall be no laterally unsupported unreinforced masonry parapets or cornices with height-to-thickness ratios greater than 1.5. A height to thickness ratio of up to 2.5 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.1)

COMMENTS:

☐ ☐ ☒ CANOPIES: Canopies located at building exits shall be anchored to the structural framing at a spacing of 6 feet or less. An anchorage spacing of up to 10 feet is permitted where only Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)

COMMENTS:

C	NC	N/A	**Masonry Chimneys**
☐	☐	☒	URM CHIMNEYS: No unreinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface up to three times the least dimension of the chimney is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.9.1)

COMMENTS:

C	NC	N/A	**Stairs**
☐	☐	☒	URM WALLS: Walls around stair enclosures shall not consist of unbraced hollow clay tile or unreinforced masonry with a height-to-thickness ratio greater than 12-to-1. A height-to-thickness ratio of up to 15-to-1 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.10.1)

COMMENTS:

☐ ☐ ☒ STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure shall not rely on shallow anchors in concrete. Alternatively, the stair details shall be capable of accommodating the drift calculated using the Quick Check procedure of Section 3.5.3.1 without including tension in the anchors. (Tier 2: Sec. 4.8.10.2)

COMMENTS:

C	NC	N/A	**Building Contents and Furnishing**
☐	☐	☒	TALL NARROW CONTENTS: Contents over 4 feet in height with a height-to-depth or height-to-width ratio greater than 3-to-1 shall be anchored to the floor slab or adjacent

structural walls. A height-to-depth or height-to width ratio of up to 4-to-1 is permitted where only the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.11.1)

COMMENTS: Unbraced shelves are present at the 1st floor in the food storage room, old museum/garage area and the library. Unbrace shelves are also present on the 2nd floor in the classrooms and conference room areas.

C	NC	N/A	**Mechanical and Electrical Equipment**
☐	☐	☒	EMERGENCY POWER: Equipment used as part of an emergency power system shall be mounted to maintain continued operation after an earthquake. (Tier 2: Sec. 4.8.12.1)

COMMENTS:

☐	☐	☒	HAZARDOUS MATERIAL EQUIPMENT: HVAC or other equipment containing material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)

COMMENTS: Could not be verified.

☐	☐	☒	DETERIORATION: There shall be no evidence of deterioration, damage, or corrosion in any of the anchorage or supports of mechanical or electrical equipment. (Tier 2: Sec. 4.8.12.3)

COMMENTS:

☐	☐	☒	ATTACHED EQUIPMENT: Equipment weighing over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be braced. (Tier 2: Sec. 4.8.12.4)

COMMENTS:

C	NC	N/A	**Piping**
☐	☐	☒	FIRE SUPPRESSION PIPING: Fire suppression piping shall be anchored and braced in accordance NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)

COMMENTS:

☐	☐	☒	FLEXIBLE COUPLINGS: Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)

COMMENTS: Gas pipe at kitchen island does not appear to have flexible coupling between 2nd floor and ground floor which could lead to a fracture in an earthquake.

C	NC	N/A	**Hazardous Materials Storage and Distribution**
☐	☐	☒	TOXIC SUBSTANCES: Toxic and hazardous substances stored in breakable containers shall be restrained from falling by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 4.8.15.1)

COMMENTS:

3.9.2 Intermediate Nonstructural Component Checklist

This Intermediate Nonstructural Component Checklist shall be completed where required by Table 3-2. The Basic Nonstructural Component Checklist shall be completed prior to completing this Intermediate Nonstructural Component Checklist.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 Evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

C	NC	N/A	Ceiling Systems
☐	☐	☒	LAY-IN TILES: Lay-in tiles used in ceiling panels located at exits and corridors shall be secured with clips. (Tier 2: Sec. 4.8.2.2)
			COMMENTS: There are no suspend ceiling systems at exits or corridors
☐	☐	☒	INTEGRATED CEILINGS: Integrated suspended ceilings at exits and corridors or weighing more than 2 pounds per square foot shall be laterally restrained with a minimum of four diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 feet. (Tier 2: Sec. 4.8.2.4)
			COMMENTS: There are no suspend ceiling systems at exits or corridors
☐	☐	☒	SUSPENDED LATH AND PLASTER: Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forces for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)
			COMMENTS:

C	NC	N/A	Light Fixtures
☐	☐	☒	INDEPENDENT SUPPORT: Light fixtures in suspended grid ceilings shall be supported independently of the ceiling suspension system by a minimum of two wires at diagonally opposite corners of the fixtures. (Tier 2: Sec. 4.8.3.2)
			COMMENTS:

C	NC	N/A	Cladding and Glazing
☐	☐	☒	GLAZING: Glazing in curtain walls and individual panes over 16 square feet in area, located up to a height of 10 feet above an exterior walking surface, shall have safety glazing. Such glazing located over 10 feet above exterior walking surface shall be laminated annealed or laminated heat-strengthened safety glass or other glazing system that will remain in the frame when glass is cracked. (Tier 2: Sec. 4.8.4.8)
			COMMENTS:

C	NC	N/A	Parapets, Cornices, Ornamentation, and Appendages
☐	☐	☐	CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)

COMMENTS: Unable to verify.

☐	☐	☒	APPENDAGES: Cornices, parapets, signs, and other appendages that extend above the highest point of anchorage to the structure or cantilever from exterior wall faces and other exterior wall ornamentation shall be reinforced and anchored to the structural system at a spacing equal to or less than 10 feet for Life Safety and 6 feet for Immediate Occupancy. This requirement need not apply to parapets or cornices compliant with Section 4.8.8.1 or 4.8.8.3. (Tier 2: Sec. 4.8.8.4)

COMMENTS:

C	NC	N/A	Masonry Chimneys
☐	☐	☒	ANCHORAGE: Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)

COMMENTS:

C	NC	N/A	Mechanical and Electrical Equipment
☐	☐	☒	VIBRATION ISOLATORS: Equipment mounted on vibration isolators shall be equipped with restraint or snubbers. (Tier 2: Sec. 4.8.12.5)

COMMENTS:

C	NC	N/A	Ducts
☐	☐	☒	STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)

COMMENTS:

Supporting Calculations

Upper Level Loads (psf) - High Side (South Side of Building)

	Flr. Mass
3" Concrete topping slab	38
28" Double Tee Joists	66
Structural Elements	58
Columns (18' x 18")	5
Miscellaneous	1
Dead Load	**168**
Live Load	**40**

Upper Level Loads (psf) - Low Side (North Side of Building)

	Flr. Mass
3" Concrete topping slab	38
28" Double Tee Joists	66
Structural Elements	64
Columns	4
Miscellaneous	1
Dead Load	**173**
Live Load	**40**

Middle Level Loads (psf) - High Side (South Side of Building)

	Flr. Mass
3" Concrete topping slab	38
28" Double Tee Joists	66
Structural Elements	62
Columns	6
Miscellaneous	2
Dead Load	**174**
Live Load	**40**

Middle Level Loads (psf) - Low Side (North Side of Building)

	Flr. Mass
3" Concrete topping slab	38
28" Double Tee Joists	66
Structural Elements	68
Columns	5
Miscellaneous	1
Dead Load	**178**
Live Load	**40**

Upper Level - High Side (South Side of Building)

Location	plf (U.N.O)	total linear ft (U.N.O.)	Weight, lbs
Exterior Walls			
Pre-Cast Panels	450	422	189,900
Interior Walls	psf	total sf	Weight, lbs
12" Concrete Wall	150	600	90,000
Exterior Walls			
10" Concrete Wall	1,250	110	137,500
Beams			
Center Corbel Beam	1,350	140	189,000
Exterior Beam	900	422	379,800
		Total Floor Weight =	986,200
		Total Floor psf=	58

Upper Level - Low Side (North Side of Building)

Location	plf (U.N.O)	total linear ft (U.N.O.)	Weight, lbs
Exterior Walls			
Pre-Cast Panels	450	390	175,500
Interior Walls	psf	total sf	Weight, lbs
12" Concrete Wall	150	1,100	165,000
Exterior Walls			
10" Concrete Wall	1,250	120	150,000
Beams			
Center Corbel Beam	1,350	140	189,000
Exterior Beam	900	390	351,000
		Total Floor Weight =	1,030,500
		Total Floor psf=	64

Middle Level - High Side (South Side of Building)

Location	plf (U.N.O)	total linear ft (U.N.O.)	Weight, lbs
Exterior Walls			
Pre-Cast Panels	450	422	189,900
Interior Walls	psf	total sf	Weight, lbs
12" Concrete Wall	150	1,000	150,000
Exterior Walls			
10" Concrete Wall	1,375	110	151,250
Beams			
Center Corbel Beam	1,350	140	189,000
Exterior Beam	900	422	379,800
		Total Floor Weight =	1,059,950
		Total Floor psf=	62

Middle Level - Low Side (North Side of Building)

Location	plf (U.N.O)	total linear ft (U.N.O.)	Weight, lbs
Exterior Walls			
Pre-Cast Panels	450	390	175,500
Interior Walls	psf	total sf	Weight, lbs
12" Concrete Wall	150	1,000	150,000
Exterior Walls			
10" Concrete Wall	1,375	170	233,750
Beams			
Center Corbel Beam	1,350	140	189,000
Exterior Beam	900	390	351,000
		Total Floor Weight =	1,099,250
		Total Floor psf=	68

Parking Garage

DEAD LOAD

Location	psf	total sf	Weight, lbs
Upper Level (High Side)	168	17,000	2,856,000
Upper Level (Low Side)	173	16,200	2,802,600
Middle Level (High Side)	174	17,000	2,958,000
Middle Level (Low Side)	178	16200	2,883,600
		∑ =	**11,500,200**

LIVE LOAD*

Location	psf	total sf	Weight, lbs
Upper Level (High Side)	40	17,000	680,000
Upper Level (Low Side)	40	16,200	648,000
Middle Level (High Side)	40	17,000	680,000
Middle Level (Low Side)	40	16200	648,000

*Per ASCE 31-03 Section 3.5.2.1, floor live load in public garages and open parking structures need not be considered.

Building Period (T)

$T = (C_t)(h_n)^{\beta}$

C_t =	0.020	(For all other framing systems)
hn =	46.5	ft
β =	0.75	(For all other framing systems)
T =	0.356	seconds

Story Shear Forces (V)

$V=CS_aW$

C =	**1.2**	(From ASCE 31 Table 3-4)
W =	**11,500**	kips
S_{D1} =	0.391	g
$S_a = S_{D1}/T$	1.098	g

S_a shall not exceed S_{DS} Therefore:

S_{DS} =	0.626	g

therefor:

S_a =	**0.626**	g

Seismic Shear:

V =	0.751	*W	kips
V =	**8,639**		**kips**

Shear Wall Area for Shear Stress in Concrete Shear Walls Quick Calc (3.5.3.3):

N-S Direction of Loading

Location	Length, ft	Area, sf
Upper Level (High Side)		
12" Wall	0	0
10" Wall	60	50
	∑ =	**50**
Upper Level (Low Side)		
12" Wall	0	0
10" Wall	45	38
	∑ =	**38**
Middle Level (High Side)		
12" Wall	0	0
10" Wall	80	67
	∑ =	**67**
Middle Level (Low Side)		
12" Wall	0	0
10" Wall	120	100
	∑ =	**100**

E-W Direction of Loading

Location	Length, ft	Area, sf
Upper Level (High Side)		
12" Wall	92	92
10" Wall	40	33
	∑ =	**125**
Upper Level (Low Side)		
12" Wall	184	184
10" Wall	40	33
	∑ =	**217**
Middle Level (High Side)		
12" Wall	92	92
10" Wall	132	110
	∑ =	**202**
Middle Level (Low Side)		
12" Wall	92	92
10" Wall	104	87
	∑ =	**179**

Story Shear Forces in Concrete Shear Walls (3.5.2.2):

$$F(x) = \frac{(w_x h_x)^k}{\sum_{i=1}^{n}(w_i h_i)^k} V \qquad V_j = \sum_{i=j}^{n} F_x$$

Story	h_x	w_x (kips)	$h_x w_x^k$	Cv	Fx (kips)
Upper Level (High Side)	32	2,856	91,392	0.37	3,160
Upper Level (Low Side)	22	2,803	61,666	0.25	2,132
Middle Level (High Side)	22	2,958	65,076	0.26	2,250
Middle Level (Low Side)	11	2,884	31,724	0.13	1,097
		∑ =	249,858	1.00	8,639

Shear Stress in Concrete Shear Walls (3.5.3.3):

Determined as follows:

$$vj^{avg} = \frac{1}{m}\left(\frac{V_j}{A_w}\right)$$

m = Component modification factor: Taken from table 3-7
Vj = story shear
Aw = Sum of horizontal cross-section areas of walls

Limit shear stress to greater of: 100psi or $2\sqrt{f'c}$

$$2\sqrt{f'c} = 2 \times \sqrt{3000\ psi} = 109.5\ psi$$

109.5 psi **CONTROLS** **or** 0.1095 ksi **CONTROLS**

N-S Direction

Story	A_w (in^{2}min)	V_j (kips)	m	v_j^{avg} (ksi)	DCR	Less than?
Upper Level (High Side)	7,200	3,160	4.0	0.11	1.00	**OKAY**
Upper Level (Low Side)	5,472	5,292	4.0	0.24	2.21	**NOT OKAY**
Middle Level (High Side)	9,648	7,542	4.0	0.20	1.78	**NOT OKAY**
Middle Level (Low Side)	14,400	8,639	4.0	0.15	1.37	**NOT OKAY**

E-W Direction

Story	A_w (in^{2}min)	V_j (kips)	m	v_j^{avg} (ksi)	DCR	Less than?
Upper Level (High Side)	18,000	3,160	4.0	0.04	0.40	**OKAY**
Upper Level (Low Side)	31,248	5,292	4.0	0.04	0.39	**OKAY**
Middle Level (High Side)	29,088	7,542	4.0	0.06	0.59	**OKAY**
Middle Level (Low Side)	25,776	8,639	4.0	0.08	0.77	**OKAY**

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Parking Garage

Pre-cast Panels @ Upper & Middle levels ~

6" thk x 6 ft = 3 sf. (150 pcf) = 450 plf

Double Tee's - 28" ⇒ span = 119", 652 plf

≈ 60' span

Total W_T = 60 ft (652 plf) = 39,120 #

Total SF = 60 ft (9.92 ft) = 595 s.f.

PSF = 39,120 #/595 sf. = 66 psf.

3" concrete topping ~

1 sf. (3"/12") (150 pcf) = 38 psf

10" wall ~

(10"/12") (150 pcf) = 125 psf.

12" wall -) 150 psf

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Floors are 10'-8" EL. Each.

	TRIB
Upper	10 ft
Middle	11 ft
Lower	11 ft

Column Weights -

(18"x18") x (150 pcf) = 340 plf.

Upper Level (High Side) ~

340 plf (10 ft) = 3,400 #
x 24 columns
= 81,600 #/17,000 s.f. = 4.8 ≈ 5 psf

Upper Level (Low Side) ~

340 plf (10 ft) x 18 columns = 61,200 #/16,200 sf = 4 psf

All other levels (High Side) ~

340 plf (11 ft) x 24 columns = 89,760 #/17,000 sf = 5.3 psf

All other levels (Low Side) ~

340 plf (11 ft) x 18 columns = 67,320 #/16,200 sf = 4.2 psf

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Check For Soft Story ~

N-S Direction

$$K_{upper} = R_F\left(\frac{10'-8''}{19'}\right) + 4R_F\left(\frac{10'-8''}{20'}\right)$$

$$= R_F(0.56) + 4R_F(0.53) = 5.4 + 4(5.75) = \underline{28.4}$$

$$K_{middle} = R_F\left(\frac{6'}{19'}\right) + 4\left(\frac{6'}{20'}\right)$$

$$= R_F(0.32) + 4(0.30) = 10 + 4(10.78) = \underline{53.12}$$

E-W Direction

$$K_{upper} = 5R_F\left(\frac{10'-8''}{16'}\right)$$

$$= 5R_F(0.67) = 5(4.33) = \underline{21.65}$$

$$K_{lower} = R_F\left(\frac{7'}{16'}\right) + 2R_F\left(\frac{7'}{24'}\right) + R_F\left(\frac{10'-8''}{16'}\right) + R_F\left(\frac{10'-8''}{24'}\right)$$

$$+ R_F\left(\frac{6'}{6'}\right) + R_F\left(\frac{6'}{16'}\right) + R_F\left(\frac{6'}{16'}\right) + 2R_F\left(\frac{4'}{24'}\right)$$

$$+ R_F\left(\frac{5'-4''}{24'}\right) + R_F\left(\frac{5'-4''}{16'}\right)$$

$$= R_F(0.44) + 2R_F(0.29) + R_F(0.67) + R_F(0.44)$$

$$+ R_F(1.0) + 2R_F(0.38) + 2R_F(0.17) + R_F(0.22) + R_F(0.33)$$

$$= 7.1 + 2(11.18) + 4.328 + 7.1 + 2.5 + 2(8.369)$$

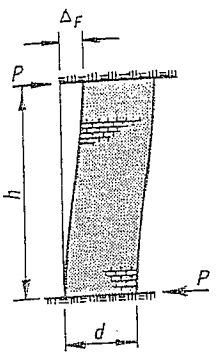
$$+ 2(19.42) + 14.9 + 9.747 = \underline{123.6}$$

STIFFENES (K)

TABLE T-1a Coefficients for Deflection and Rigidity of Walls or Piers for Distribution of Horizontal Forces

For use of Table, see Example 4-F

Fixed Wall or Pier



Δ_F = Deflection of wall or pier fixed top and bottom.

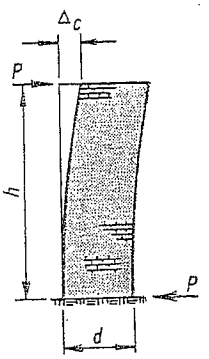
$$\Delta_F = \frac{P}{E_m t}\left[\left(\frac{h}{d}\right)^3 + 3\left(\frac{h}{d}\right)\right]$$

$$\Delta_F = 0.1\left(\frac{h}{d}\right)^3 + 0.3\left(\frac{h}{d}\right)$$

$R_F = \frac{1}{\Delta_F}$ Rigidity of fixed wall or pier.

h = actual height

Cantilever Wall or Pier



Δ_C = Deflection of cantilever wall or pier.

$$\Delta_C = \frac{P}{E_m t}\left[4\left(\frac{h}{d}\right)^3 + 3\left(\frac{h}{d}\right)\right]$$

$$\Delta_C = 0.4\left(\frac{h}{d}\right)^3 + 0.3\left(\frac{h}{d}\right)$$

$R_C = \frac{1}{\Delta_C}$ Rigidity of cantilever wall or pier.

$P = 100{,}000$ pounds; $t = 1''$; $E_m = 1{,}000{,}000$ psi

h/d	Δ_F	Δ_C	R_F	R_C	h/d	Δ_F	Δ_C	R_F	R_C	h/d	Δ_F	Δ_C	R_F	R_C
0.10	0.030	0.030	33.223	32.895	0.45	0.144	0.171	6.939	5.833	0.80	0.291	0.445	3.434	2.248
0.11	0.033	0.034	30.181	29.822	0.46	0.148	0.177	6.769	5.652	0.81	0.296	0.456	3.377	2.195
0.12	0.036	0.037	27.645	27.254	0.47	0.151	0.183	6.606	5.479	0.82	0.301	0.467	3.321	2.143
0.13	0.039	0.040	25.497	25.076	0.48	0.155	0.188	6.449	5.312	0.83	0.306	0.478	3.266	2.093
0.14	0.042	0.043	23.655	23.203	0.49	0.159	0.194	6.299	5.153	0.84	0.311	0.489	3.213	2.045
0.15	0.045	0.046	22.057	21.575	0.50	0.163	0.200	6.154	5.000	0.85	0.316	0.501	3.160	1.997
0.16	0.048	0.050	20.657	20.146	0.51	0.166	0.206	6.014	4.853	0.86	0.322	0.512	3.109	1.952
0.17	0.051	0.053	19.421	18.880	0.52	0.170	0.212	5.880	4.712	0.87	0.327	0.524	3.060	1.907
0.18	0.055	0.056	18.321	17.752	0.53	0.174	0.219	5.751	4.576	0.88	0.332	0.537	3.011	1.864
0.19	0.058	0.060	17.335	16.738	0.54	0.178	0.225	5.626	4.445	0.89	0.337	0.549	2.963	1.822
0.20	0.061	0.063	16.447	15.823	0.55	0.182	0.232	5.505	4.319	0.90	0.343	0.562	2.916	1.781
0.21	0.064	0.067	15.643	14.992	0.56	0.186	0.238	5.389	4.197	0.91	0.348	0.574	2.871	1.741
0.22	0.067	0.070	14.911	14.233	0.57	0.190	0.245	5.277	4.080	0.92	0.354	0.587	2.826	1.702
0.23	0.070	0.074	14.242	13.538	0.58	0.194	0.252	5.168	3.968	0.93	0.359	0.601	2.782	1.665
0.24	0.073	0.078	13.627	12.898	0.59	0.198	0.259	5.062	3.859	0.94	0.365	0.614	2.739	1.628
0.25	0.077	0.081	13.061	12.308	0.60	0.202	0.266	4.960	3.754	0.95	0.371	0.628	2.697	1.592
0.26	0.080	0.085	12.538	11.760	0.61	0.206	0.274	4.861	3.652	0.96	0.376	0.642	2.656	1.558
0.27	0.083	0.089	12.053	11.252	0.62	0.210	0.281	4.766	3.555	0.97	0.382	0.656	2.616	1.524
0.28	0.086	0.093	11.602	10.778	0.63	0.214	0.289	4.673	3.460	0.98	0.388	0.670	2.577	1.491
0.29	0.089	0.097	11.181	10.335	0.64	0.218	0.297	4.583	3.369	0.99	0.394	0.685	2.538	1.460
0.30	0.093	0.101	10.787	9.921	0.65	0.222	0.305	4.495	3.280	1.00	0.400	0.700	2.500	1.429
0.31	0.096	0.105	10.419	9.531	0.66	0.227	0.313	4.410	3.195	1.01	0.406	0.715	2.463	1.398
0.32	0.099	0.109	10.073	9.165	0.67	0.231	0.321	4.328	3.112	1.02	0.412	0.730	2.426	1.369
0.33	0.103	0.113	9.747	8.820	0.68	0.235	0.330	4.247	3.032	1.03	0.418	0.746	2.391	1.340
0.34	0.106	0.118	9.440	8.495	0.69	0.240	0.338	4.169	2.955	1.04	0.424	0.762	2.356	1.312
0.35	0.109	0.122	9.150	8.187	0.70	0.244	0.347	4.093	2.880	1.05	0.431	0.778	2.321	1.285
0.36	0.113	0.127	8.876	7.895	0.71	0.249	0.356	4.019	2.808	1.06	0.437	0.794	2.288	1.259
0.37	0.116	0.131	8.616	7.618	0.72	0.253	0.365	3.948	2.737	1.07	0.444	0.811	2.255	1.233
0.38	0.119	0.136	8.369	7.356	0.73	0.258	0.375	3.877	2.669	1.08	0.450	0.828	2.222	1.208
0.39	0.123	0.141	8.135	7.106	0.74	0.263	0.384	3.809	2.604	1.09	0.457	0.845	2.191	1.183
0.40	0.126	0.146	7.911	6.868	0.75	0.267	0.394	3.743	2.540	1.10	0.463	0.862	2.159	1.160
0.41	0.130	0.151	7.699	6.641	0.76	0.272	0.404	3.678	2.478	1.11	0.470	0.880	2.129	1.136
0.42	0.133	0.156	7.496	6.425	0.77	0.277	0.414	3.615	2.418	1.12	0.476	0.898	2.099	1.114
0.43	0.137	0.161	7.302	6.219	0.78	0.281	0.424	3.553	2.359	1.13	0.483	0.916	2.069	1.092
0.44	0.141	0.166	7.117	6.021	0.79	0.286	0.434	3.493	2.303	1.14	0.490	0.935	2.040	1.070

Check for Soft Story (cont.)

N-S Direction

$K_{upper} = 28.4$

$K_{middle} = 53.12$

$53.12(0.7) = 37.18 > 28.4 \therefore$ NG.

↑ 70%

E-N Direction

$K_{upper} = 21.65$

$K_{middle} = 123.6$

$123.6(0.7) = 86.52 > 21.65 \therefore$ NG.

Check For Weak Story - compare length of walls:

Upper Level -

Total length of wall = 16' + 40' + 16' + 24'(7) + 16' + 16'(2) + 20'(2)

= 328 ft

Middle Level = 16'(2) + 40' + 59' + 24' + 59' + 24'(7) + 16'(2) + 24'(2) + 24'(2) + 16' + 24' + 4' + 16'(2) + 80'

= 666 ft. (0.8) = 533 > 328

$\therefore$ N.G.

* The strength of the upper level is almost 50% less than the strength of the middle level

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Check for Torsion -

distance between story center of mass & story center of rigidity ≅ 30' (N-S)
≅ 140' (E-W)

building width ≅ 118' (N-S)
≅ 288' (E-W)

20% (118') = 24'
20% (288') = 58'

Check for reinforcing steel ~

10" Shear Wall

(V) steel: 2(#5) = 0.62 in²
concrete: 12" × 12" = 144 in²
ratio = 0.0043 > 0.0015 ∴ OK

(H) steel: 2(#4) = 0.4 in²
concrete: 12" × 12" = 144 in²
ratio = 0.0028 > 0.0025 OK

12" Shear Wall

(V) steel: 2(#5) = 0.62 in²
concrete: 12" × 12" = 144 in²
ratio = 0.0043 > 0.0015 ∴ OK

(H) steel: 2(#4) = 0.4 in²
concrete: 10" × 10" = 100 in²
ratio = 0.004 > 0.0025 OK

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Date 12/12/13

Check deflection compatibility of columns

* make sure column has sufficient shear strength to develop M_{pr}.

→ from SP column output, $\phi = 1.0$ & $f'_c = 3{,}000$ psi

(ACI 21.4.5) $M_{pr} = 1.25 M_n = 280^{k\text{-ft}}$

(Demand) $V = \frac{2M_{pr}}{H} = \frac{2(280^{k\text{-ft}})}{10.67\text{ ft}} = \underline{52.5^{k}}$

(Capacity) $V_s = \frac{A_v f_{yd}}{s}$ (Eqn. ACI 11-15)

#3 @ 12" o.c.

$A_v = 2(\#3) = 2(0.11\text{ in}^2) = 0.22\text{ in}^2$

$f_y = 60{,}000$ psi

$d = 18" - 1.5" - \frac{1}{2}(0.79") = 16.1$ in

$S = 12$ in.

$\therefore V_s = \frac{0.22\text{in}^2(60{,}000\text{ psi})(16.1")}{12"} = 17.7^{k}$

$\phi V_s = 0.65(17.7^{k}) = 11.5^{k}$

(Eqn. ACI 11-3) $V_c = 2\sqrt{f'_c}\, b_w d = 2\sqrt{3{,}000\text{psi}}\,(18")(14.6\text{ in})$

$= 28.78^{k}$

$\phi V_c = 0.65(28.78^{k}) = 18.7^{k}$

Total shear capacity of column @ $H/2 = V_c + V_s$

$= 10.4^{k} + 18.7^{k} = 29.1^{k} << 52.5^{k}$

∴ N.G.

General Information:
==========
File Name: q:\portland\2014\a14.0170\01\engineering\cmg\report documents\seismic evalua...\18x18.col
Project: Salam Library
Column:
Code: ACI 318-08
Engineer: CMG
Units: English

Run Option: Investigation
Run Axis: X-axis
Slenderness: Not considered
Column Type: Structural

Material Properties:
==========
f'c = 3 ksi
Ec = 3122.02 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85
fy = 75 ksi → 1.25fy (per ACI 21.4.5)
Es = 29000 ksi

Section:
==========
Rectangular: Width = 18 in
Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4
rx = 5.19615 in
Xo = 0 in
Iy = 8748 in^4
ry = 5.19615 in
Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Other; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 1, phi(b) = 1, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 1.95%
Minimum clear spacing = 5.63 in

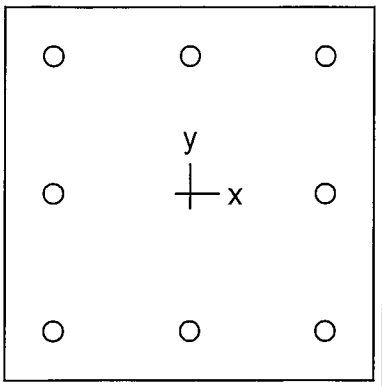
8 #8 Cover = 1.5 in

Axial Load and Corresponding Moment Capacities:
==========

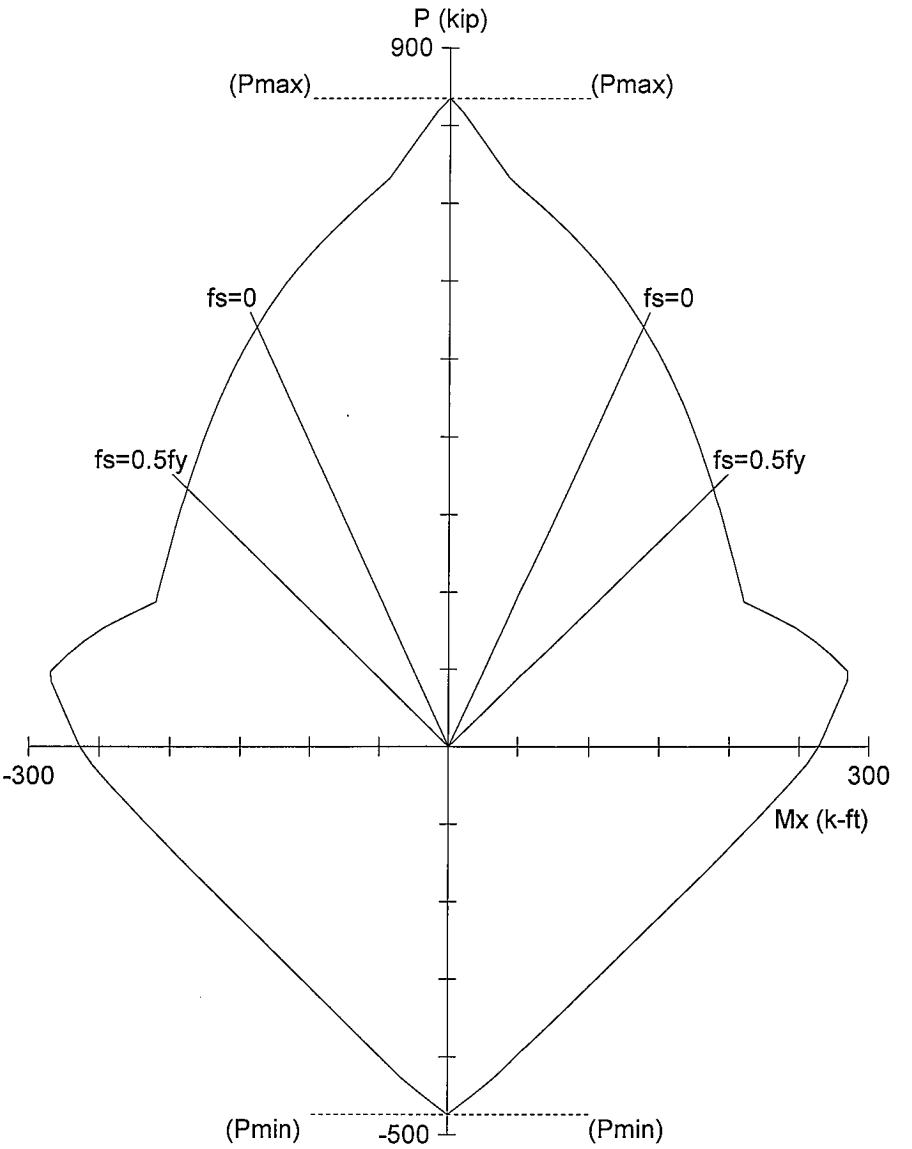
Load No.	PhiPn kip	PhiMnx k-ft	NA depth in	Dt depth in	eps_t	Phi
1	-0.0	264.00	4.91	15.63	0.00654	1.000
		-264.00	4.91	15.63	0.00654	1.000
2	25.0	270.07	5.15	15.63	0.00611	1.000
		-270.07	5.15	15.63	0.00611	1.000
3	50.0	276.10	5.39	15.63	0.00569	1.000
		-276.10	5.39	15.63	0.00569	1.000
4	75.0	282.08	5.65	15.63	0.00529	1.000
		-282.08	5.65	15.63	0.00529	1.000
5	100.0	283.26	5.95	15.63	0.00488	0.982
		-283.26	5.95	15.63	0.00488	0.982
6	125.0	268.61	6.38	15.63	0.00435	0.905
		-268.61	6.38	15.63	0.00435	0.905
7	150.0	249.96	6.97	15.63	0.00372	0.815
		-249.96	6.97	15.63	0.00372	0.815

set M_n = 280 k-ft.

*** End of output ***



18 x 18 in



Code: ACI 318-08

Units: English

Run axis: About X-axis

Run option: Investigation

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 12/16/13

Time: 13:28:19

spColumn v4.81. Licensed to: BergerABAM. License ID: 59529-1032107-4-1A81A-1E412

File: q:\portland\2014\a14.0170\01\engineering\cmg\report documents\seismic evaluation\parking garage\18x18.col

Project:

Column:

Engineer:

f'c = 3 ksi	fy = 75 ksi	Ag = 324 in^2	8 #8 bars
Ec = 3122 ksi	Es = 29000 ksi	As = 6.32 in^2	rho = 1.95%
fc = 2.55 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 5.63 in	Clear cover = 1.88 in

Confinement: Other

phi(a) = 1, phi(b) = 1, phi(c) = 0.65