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City of Oxnard

Public Works Integrated Master Plan

WASTEWATER

PROJECT MEMORANDUM 3.5
CONDITION ASSESSMENT

REVISED FINAL DRAFT
September 2017

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PREFACE

The analysis and evaluations contained in these Project Memorandum (PM) are based on data and information available at the time of the original date of publication, December 2015. After development of the December 2015 Final Draft PMs, the City continued to move forward on two concurrent aspects: 1) advancing the facilities planning for the water, wastewater, recycled water, and stormwater facilities; and 2) developing Updated Cost of Service (COS) Studies (Carollo, 2017) for the wastewater/collection system and the water/distribution system. The updated 2017 COS studies contain the most recent near-term Capital Improvement Projects (CIP). **The complete updated CIP based on the near-term and long-term projects is contained in the Brief History and Overview of the City of Oxnard Public Works Department's Integrated Planning Efforts: May 2014 – August 2017 section.**

At the time of this Revised PWIMP, minor edits were also incorporated into the PMs. Minor edits included items such as table title changes and updating reports that were completed after the December 2015 original publication date.

City of Oxnard

Public Works Integrated Master Plan

WASTEWATER

PROJECT MEMORANDUM 3.6
SEISMIC ASSESSMENT

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1.0 INTRODUCTION

The purpose of the structural assessment of the Oxnard Wastewater Treatment Plant (OWTP) structures was to:

- Establish the anticipated level of performance for each structure during a seismic event.
- Recommend retrofit strategies to meet established performance objectives when deficiencies are identified.
- Evaluate the structure condition to assess the total level of effort required to increase the remaining useful life.

The structural assessment considered two elements when developing recommendations; the structure's resilience or ability to withstand earthquake forces, and the overall condition.

The OWTP structures were categorized building-type or water-retaining structures. *The American Society of Civil Engineers Standard: Seismic Evaluation and Retrofit of Existing Buildings* (ASCE 31-06) provided the methodology adopted for evaluating the building's seismic resiliency. Two basic steps from the standard were used for this assessment; Tier 1 screening, and Tier 2 evaluation. Seismic assessment of existing water-retaining structures was performed using the analysis methods outlined in *American Concrete Institute: Seismic Design of Liquid-Containing Concrete Structures and Commentary* (ACI 350.3-06).

Tier 1 screening, Tier 2 assessments of the buildings, and seismic assessment of the water-retaining structures at the Oxnard Wastewater Treatment Plant (OWTP) resulted in the identification and evaluation of structural and non-structural seismic vulnerabilities. Seismic assessment was completed for a total of eighteen buildings and eight water-retaining structures.

Based on Tier 1 assessment, each building had three possible recommendations:

1. Replacement.
2. Retrofit of non-structural components.
3. Tier 2 analysis.

Recommendation of replacement was based on the results of the: condition of the building, seismic assessment of the building, and plant process considerations. As a result of the Tier 1 screening assessment;

- Eight of the eighteen assessed buildings were recommended for replacement.
- Four buildings required retrofit of non-structural components only.
- Six had deficiencies that required Tier 2 analysis to better understand the associated risk.

One of those six buildings recommended for further analysis is proposed to be replaced as a result of condition assessment bringing the number of buildings recommended for replacement to nine. Tier 2 evaluation was completed for five buildings. Based on the Tier 2 results, structural and/or non-structural retrofits were recommended for all five buildings. Summarizing, nine buildings were recommended for replacement, four buildings require retrofit of non-structural elements, and five buildings require both structural and non-structural retrofits.

Based on the preliminary seismic findings of the eight water-retaining structures:

- Six were recommended for structural retrofits.
- One was recommended for replacement.
- One for pre-stressing evaluation.

All water-retaining structures were also recommended for further concrete condition testing that was completed as a separate task. The concrete testing was completed by V&A in March 2015. In general, the concrete condition for the water-retaining structures was assessed to be fair and concrete coating and/or concrete repair is recommended for the water-retaining structures.

Along with the seismic assessment, the condition assessment and plant process considerations, four water-retaining structures were recommended for replacement. Project Memo 3.7.1 Alternatives Analysis outlines the cost estimates associated with the structural/non-structural retrofits of the buildings, and retrofits and concrete coating/concrete repairs of the water-retaining structures.

1.1 Project Memorandums (PMs) Used for Reference

The findings outlined in this PM are made in concert with recommendations and analyses from other related PMs:

- PM 3.1 - Wastewater System - Background Summary.
- PM 3.5 - Wastewater System - Condition Assessment.
- PM 3.7.1 - Wastewater System - Traditional OWTP Assessment - Upgrade in Place.

1.2 Other Reports Used for Reference

Other documents were used in developing the seismic assessment in this PWIMP. Please see the Reference Section of Appendix A and Appendix B for details on these additional documents.

2.0 BACKGROUND

In June 2014, the City of Oxnard (Oxnard) engaged Carollo Engineers to perform a seismic evaluation of the Oxnard Wastewater Treatment Plant (OWTP).

In order to assess the seismic performance of a building, the performance objective must first be identified. The performance objective of a building is comprised of three components: the level of safety of the building occupants during and after a seismic event, the cost of restoring the building to its pre-event condition, and the length of time the building is removed from service, i.e. not occupiable. A preliminary ASCE 31-06 Tier 1, i.e., screening assessment that identified potential structural and non-structural seismic vulnerabilities of the buildings as they relate to Oxnard seismic performance objectives during the subject earthquake events was completed in October 2014. During the course of completing the Tier 1 assessment, ASCE 31-06 was updated to ASCE 41-13. Deficiencies identified in Tier 1 were further evaluated, and components that require seismic retrofit were identified using the Tier 2 procedures of ASCE 41-13.

Water retaining structures (i.e. non-building type structures) were evaluated for seismic structural vulnerabilities and tested for the concrete condition. Refer to Figure 1 for the preliminary and detailed evaluation process for buildings and water-retaining structures.

3.0 SUMMARY OF FINDINGS

Results of the preliminary screening of the buildings and water-retaining structures, and results of the detailed evaluation of the buildings are shown in Tables 1 and 2, respectively. Results of concrete testing for the water-retaining structures are shown in Table 3. Appendix A is the detailed report on the approach, methodology, assessment results, and recommendations based on preliminary assessment of the buildings and water-retaining structures. Appendix B is the detailed report on the approach, methodology, assessment results, and recommendations based on detailed Tier 2 evaluation of the buildings. Appendix C includes the Tier 1 structural and non-structural checklists. Appendix D includes the final report outlining the procedures and results of the concrete testing conducted by V&A for the water-retaining structures.

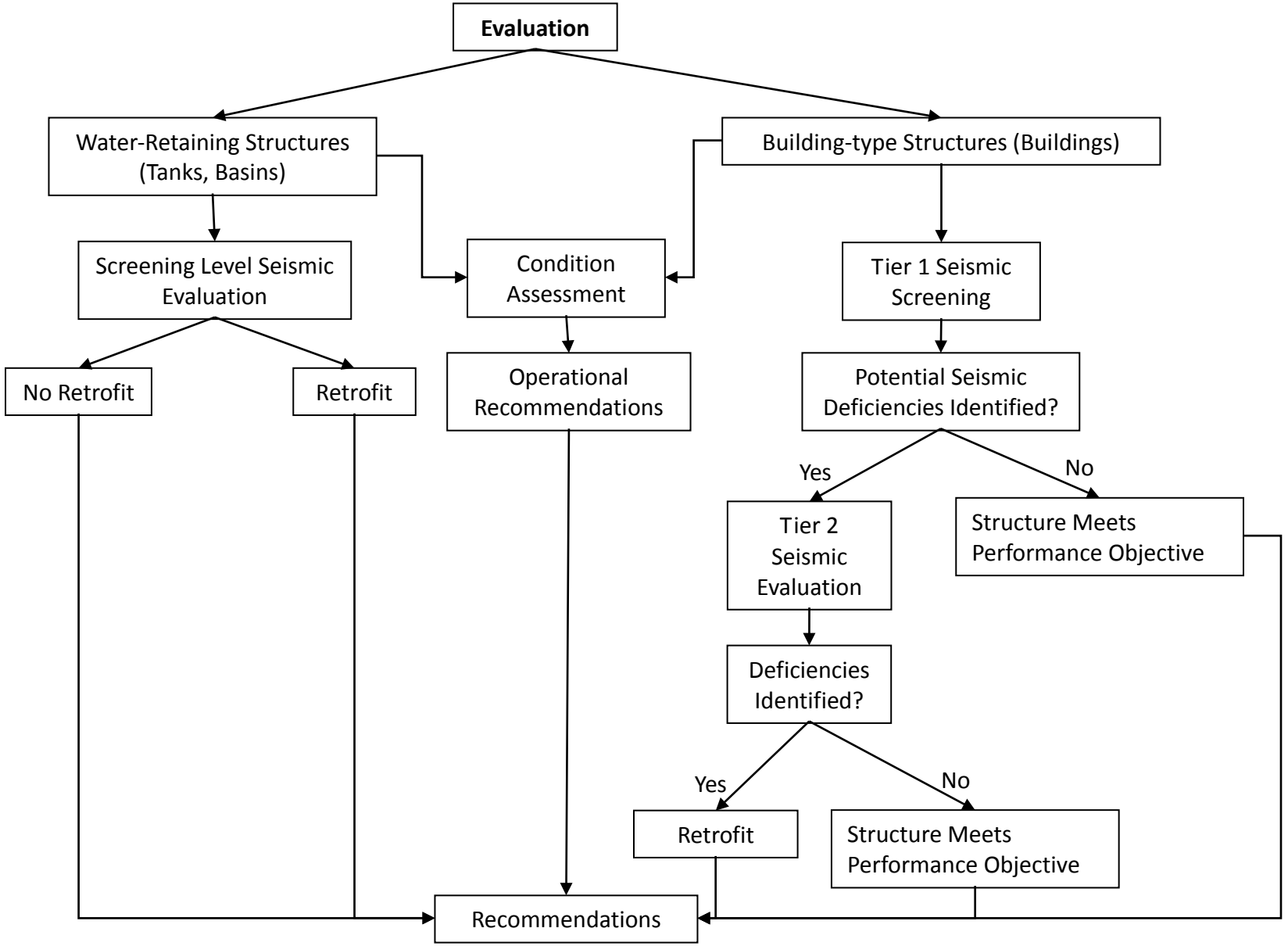

Figure 1 Evaluation Process for Buildings and Water-Retaining Structures

Table 1 shows of the twenty-six structures presented in this memorandum, eight buildings showed significant deterioration of the structural elements and, therefore, were recommended to be replaced. Four buildings required retrofit of non-structural components only, and six buildings were recommended for Tier 2 evaluation. Structural retrofits, replacement, and further concrete testing were recommended for the eight water-retaining structures.

Table 1 Summary of Assessment- Preliminary Screening of Buildings and Water-Retaining Structures Tier 1 Evaluation
Public Works Integrated Master Plan
City of Oxnard

Structure	Recommendation
Primary Sedimentation	Replace
Main Electrical / Main Switchgear Building	Replace
Digester Control Building	Replace
Operations Center/Plant Control Center Building	Replace
Effluent Pumping Station	Replace
Generator/Co-Generation Building	Replace
Storage-Vacuum Filter Building	Replace
Storage-Butler Building	Replace
Headworks Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components(2)
Grit Screenings Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components(2)
Blower Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components(2)
North Area Electrical Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components(2)
Solids Processing Building	Tier 2 Evaluation(2)
Maintenance Building	Tier 2 Evaluation(2)
Collection System Maintenance Building	Tier 2 Evaluation(2)
Chemical Handling Facilities	Tier 2 Evaluation(2)
16 kW Switchgear/Effluent Electrical Building	Tier 2 Evaluation(1)
Administration Building	Tier 2 Evaluation(2)
Activated Sludge Tanks/Aeration Basin	Structural Retrofit & Perform Concrete Testing(2)
Secondary Sedimentation Basin	Structural Retrofit & Perform Concrete Testing(2)
Flow Equalization Basin	Structural Retrofit & Perform Concrete Testing(2)
Primary Clarifier Tanks	Structural Retrofit & Perform Concrete Testing(2)
Gravity Thickeners	Replace
Digester Nos. 1, 2 and 3	Evaluate Pre-stressed Reinforcement & Perform Concrete Testing(1)
DAF Tanks	Structural Retrofit & Perform Concrete Testing(2)
Chlorine Contact Tank	Structural Retrofit & Perform Concrete Testing(2)

Notes:
(1) Structure is proposed to be replaced based on condition assessment and plant considerations.
(2) See Tables 2 and 3 for Tier 2 evaluation, and concrete testing results, respectively.

Of the ten buildings recommended for Tier 2 evaluation, the 16 kW Switchgear/Effluent Electrical Building is proposed to be replaced due to operational considerations and was not further evaluated. Table 2 presents the ASCE 41-13 Tier 2 findings. There are nine buildings listed in Table 2. Five were evaluated using the Tier 2 structural evaluation methodology. Non-structural elements of all nine buildings were reevaluated using the ASCE 41-13 Tier 2 methodology. In general, where the Tier 1 screening identified potential deficiencies the detailed Tier 2 evaluation found the buildings met the project performance objective. The deficient non-structural components identified in Tier 1 screening required retrofit to minimize risk of injury, reduce emergency repairs, and down time as a result of a seismic event.

Table 2 Summary of Assessment-Detailed Evaluation of Buildings Tier 2 Evaluation
Public Works Integrated Master Plan
City of Oxnard

Structure	Recommendation	
	Structural Components	**Non-Structural Components**
Headworks Building	Tier 2 Not Required(1)	Retrofit Recommended
Grit Screening Building	Tier 2 Not Required(1)	Retrofit Recommended
Blower Building	Tier 2 Not Required(1)	Retrofit Recommended
North Area Electrical Building	Tier 2 Not Required(1)	Retrofit Recommended
Solids Processing Building	No Deficiencies	Retrofit Recommended
Chemical Handling Facilities	Retrofit Recommended: wall-to-diaphragm connection	Retrofit Recommended
Maintenance Building	Retrofit Recommended: wall-to-diaphragm connection	Retrofit Recommended
Collection System Maintenance Building	Retrofit Recommended: wall-to-diaphragm connection	Retrofit Recommended
Administration Building	No Deficiencies	Retrofit Recommended

Note:
(1) No structural Deficiencies Identified in Preliminary Screening (Tier 1).

The concrete condition for the water-retaining structures is good to fair. Structural retrofits, and concrete coating and/or concrete repair of the water-retaining structures will increase the remaining service life. Table 3 outlines the results of the concrete testing for the water-retaining structures.

Table 3 Summary of Concrete Testing and Assessment Public Works Integrated Master Plan City of Oxnard		
	Results	
Structure	Concrete Condition	Recommendation
Flow Equalization Basin	Good, with minor cracks throughout basin	Repair areas of damaged/cracked concrete Apply corrosion inhibitor to concrete surfaces
Chlorine Contact Tank	Good, with minor cracks throughout basin	Plan to remove and replace existing coating in the next 10 years
Activated Sludge Tanks/Aeration Basin	Good, with moderate cracks throughout basin	Repair/seal cracks
Secondary Sedimentation Basin	Good, with moderate cracks throughout basin	Repair/seal cracks
Primary Clarifier Tanks	Fair, with moderate evidence of deterioration	Repair areas of damaged/cracked concrete Coat interior surfaces of tank with 100% epoxy or polyurethane coating

4.0 CONCLUSION

Based on the Tier 1 screening results and operational considerations, nine buildings were recommended for replacement. Structural and/or non-structural retrofits were recommended for nine buildings. With four of the eight water-retaining structures proposed to be replaced per seismic and operational considerations, structural retrofit, concrete coating and/or concrete repairs were recommended for the remaining four water-retaining structures. Project Memo 3.7.1 Alternatives Analysis presents the cost estimates associated with the structural and non-structural retrofits and concrete coating/concrete repairs. The estimated additional cost associated with retrofitting the buildings and retrofit and repairs for the water-retaining structures is approximately $26.4 million dollars.

APPENDIX A – PRELIMINARY STRUCTURAL SEISMIC ASSESSMENT OF BUILDING-TYPE AND WATER-RETAINING STRUCTURES

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APPENDIX A - PRELIMINARY STRUCTURAL SEISMIC ASSESSMENT OF BUILDING-TYPE AND WATER-RETAINING STRUCTURES

1.0 INTRODUCTION

In June 2014, the City of Oxnard (Oxnard) engaged Carollo Engineers to perform a seismic evaluation of the Oxnard Wastewater Treatment Plant (OWTP). The purpose of the evaluation is to identify potential structural and nonstructural seismic vulnerabilities of the structures as they relate to Oxnard seismic performance objectives during design earthquake events. Refer to Figure 1 for the OWTP site map.

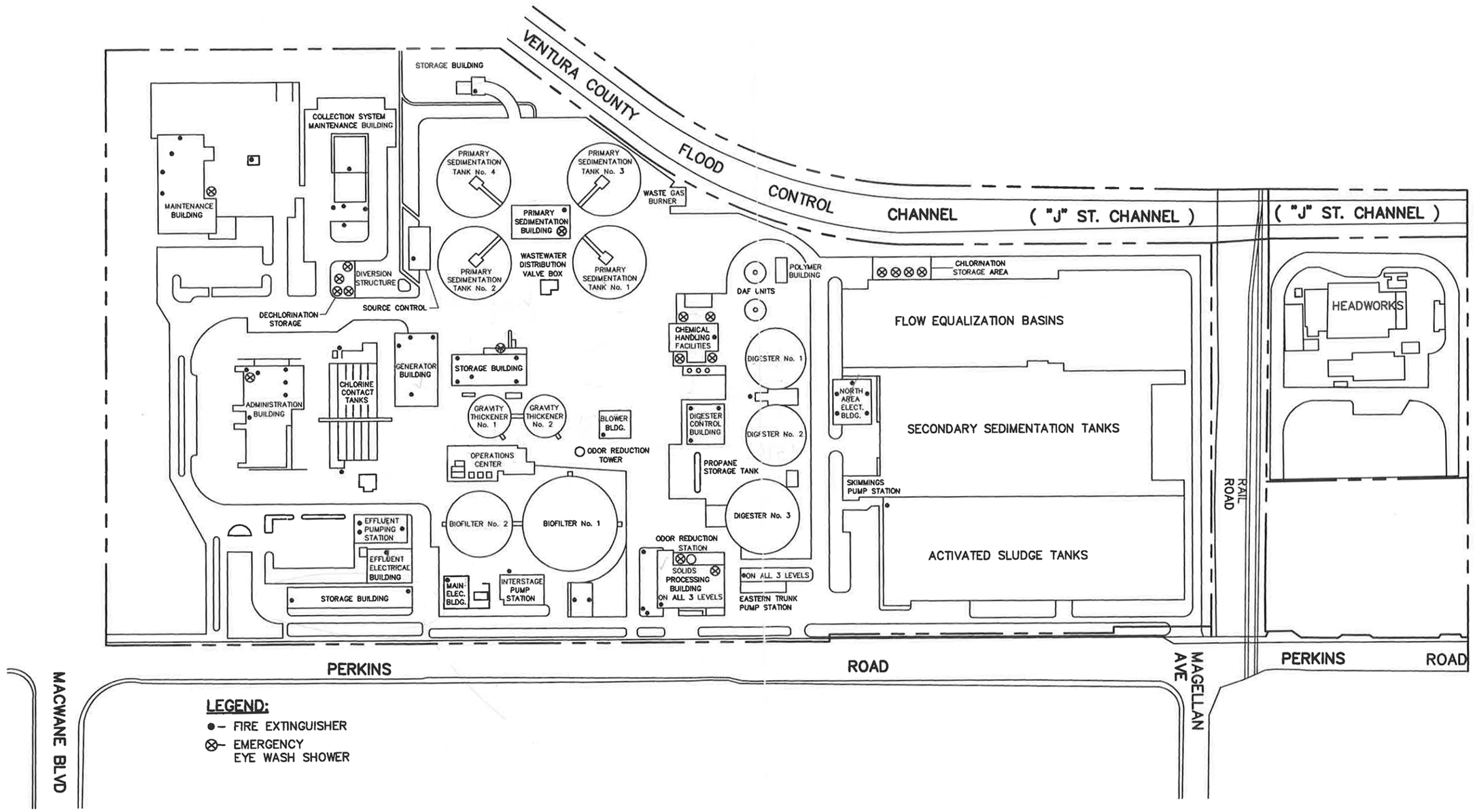
2.0 APPROACH

Preliminary seismic assessments of the existing building-type structure were performed using the *American Society of Civil Engineers Standard: Seismic Evaluation and Retrofit of Existing Buildings* (ASCE 31-06) Tier 1 evaluation procedures. This standard is commonly used as a way to evaluate anticipated seismic performance of existing buildings and the Tier 1 phase is the initial screening step. The purpose of Tier 1 step is to efficiently identify potential deficiencies or the need for additional investigation to properly evaluate the facility. For this assessment, the following three probabilistic scenario events were considered to determine if the existing structures meet an Immediate Occupancy performance level:

- 50 percent probability of exceedance in 50 years (72-year return period).
- 20 percent probability of exceedance in 50 years (225-year return period).
- 10 percent probability of exceedance in 50 years (474-year return period).

The three probabilistic scenarios represent a maximum Seismic Hazard Level of Basic Safety Earthquake (BSE)-1E. Based on the three probabilistic scenarios, buildings are expected to experience little damage from relatively frequent, low to moderate earthquakes (50%/50 years and 20%/50 years), but more damage and potential economic loss from more severe and infrequent earthquake (10%/50 years). Therefore, each scenario evaluates a different level of robustness of the building.

The performance level of a structure can be described in terms of the safety of the building occupants during and after a seismic event, the cost of restoring the building to its pre-event condition, and the length of time the building is removed from service, i.e. not occupiable. The Immediate Occupancy performance level was used to match the overall study objectives of determining the baseline plant operability after each of the three seismic events. ASCE 31-06 defines the Immediate Occupancy performance level as: “the post-earthquake damage state in which a structure remains safe to occupy, essentially retains its



OWTP SITE MAP

FIGURE 1

CITY OF OXNARD

PM NO. 3.6 APPENDIX – SEISMIC ASSESSMENT

PUBLIC WORKS INTEGRATED MASTER PLAN

CITY OF OXNARD CALIFORNIA

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pre-earthquake strength and stiffness." As part of the Tier 1 screening, ASCE 31 Structural Checklists, along with Nonstructural Checklists, for the buildings shown in Table 1 were completed. An inventory of the specific structures and/or components evaluated is provided in Table 1, including the memorandum section in which the structure's assessment results can be found.

Table 1 List of Facilities
Public Works Integrated Master Plan
City of Oxnard

Structure/Component	Type	Section
Headworks Building	Building	5.1
Grit Screenings Building	Building	5.2
Primary Sedimentation	Building	5.3
Main Electrical / Main Switchgear Building	Building	5.4
Blower Building	Building	5.5
North Area Electrical Building	Building	5.6
Digester Control Building	Building	5.7
Solids Processing Building	Building	5.8
Operations Center/Plant Control Center Building	Building	5.9
Effluent Pumping Station	Building	5.10
Generator/Co-Generation Building	Building	5.11
Maintenance Building	Building	5.12
Collection System Maintenance Building	Building	5.13
Chemical Handling Facilities	Building	5.14
Storage-Vacuum Filter Building	Building	5.15
Storage-Butler Building	Building	5.16
16 kW Switchgear/Effluent Electrical Building	Building	5.17
Administration Building	Building	5.18
Activated Sludge Tanks /Aeration Basin	Water-retaining Structure	5.19
Secondary Sedimentation Basin	Water-retaining Structure	5.20
Flow Equalization Basin	Water-retaining Structure	5.21
Primary Clarifier Tanks	Water-retaining Structure	5.22
Gravity Thickeners	Water-retaining Structure	5.23
Digester Nos. 1, 2 and 3	Water-retaining Structure	5.24
DAF Tanks	Water-retaining Structure	5.25
Chlorine Contact Tank	Water-retaining Structure	5.26

The seismic evaluation of the water-retaining concrete structures listed in Table 1, such as basins and tanks, was performed in accordance with *American Concrete Institute: Seismic Design of Liquid-Containing Concrete Structures and Commentary* (ACI 350.3-06).

3.0 SUMMARY OF FINDINGS

In general, the plant history reflects the evolution of the seismic codes, and older structures have more seismic deficiencies. Of the twenty six structures presented in this memorandum, eighteen were buildings, and eight were water-retaining structures.

For buildings with seismic concerns identified by Tier 1 checklists, if to remain, a Tier 2 evaluation may be recommended. Of the eighteen buildings, eight show significant deterioration to the structural elements and, therefore, were not recommended for a Tier 2 evaluation. It is recommended that those buildings be replaced. Only non-structural deficiencies were identified for four buildings, therefore, retrofit of those non-structural components is recommended. The remaining buildings were determined to be nonconforming for the Immediate Occupancy performance level for the specified seismic events and, are therefore, recommended for further Tier 2 evaluation. Table 2 lists all of the structures evaluated and their associated recommendations. Non-structural checklists reveal concerns that, when addressed, will improve safety of personnel during an earthquake. In general, there are many instances pertaining to building content and furnishing, as well as rigid piping connections, which may rupture perform well in an earthquake.

For the water-retaining structures, six of the eight structures were recommended for structural retrofits, one structure was recommend for replacement, and one structure was recommended for pre-stressing evaluation. In addition, all water-retaining structures were also recommended for further concrete condition testing.

4.0 SEISMIC ASSESSMENT METHODOLOGY

4.1 Building Structures

The seismic evaluation of the building structures at the OWTP was performed in accordance with ASCE 31-06 Tier 1 analysis procedures. Existing structural systems were determined by review of original design drawings for each building. The as-built condition of the structural system was verified through observation during a walk-through of each building. The buildings were evaluated for Immediate Occupancy performance in accordance with ASCE 31-06 Tier 1 analysis procedures to match the overall study objectives determining the baseline plant operability after a seismic event.

Table 2 **Summary of Assessment** **Public Works Integrated Master Plan** **City of Oxnard**	
Structure/Component	**Recommendation**
Headworks Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components
Grit Screenings Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components
Primary Sedimentation	Replace
Main Electrical / Main Switchgear Building	Replace
Blower Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components
North Area Electrical Building	No Structural Deficiencies Identified/ Retrofit Non-Structural Components
Digester Control Building	Replace
Solids Processing Building	Tier 2 Evaluation
Operations Center / Plant Control Center Building	Replace
Effluent Pumping Station	Replace
Generator / Co-Generation Building	Replace
Maintenance Building	Tier 2 Evaluation
Collection System Maintenance Building	Tier 2 Evaluation
Chemical Handling Facilities	Tier 2 Evaluation
Storage-Vacuum Filter Building	Replace
Storage-Butler Building	Replace
16 kW Switchgear / Effluent Electrical Building	Tier 2 Evaluation
Administration Building	Tier 2 Evaluation
Activated Sludge Tanks / Aeration Basin	Structural Retrofit & Concrete Testing
Secondary Sedimentation Basin	Structural Retrofit & Concrete Testing
Flow Equalization Basin	Structural Retrofit & Concrete Testing
Primary Clarifier Tanks	Structural Retrofit & Concrete Testing
Gravity Thickeners	Replace
Digester Nos. 1, 2 and 3	Evaluate Pre-stressed Reinforcement & Concrete Testing
DAF Tanks	Structural Retrofit & Concrete Testing
Chlorine Contact Tank	Structural Retrofit & Concrete Testing

The Tier 1 structural analysis procedures are based on structural checklists, which allow for an overall preliminary assessment of the building's lateral force resisting system. The

structural checklists are comprised of the Geologic and Foundation checklist and building type specific checklists. The building type is determined based on the building's lateral force resisting system (e.g. concrete shear wall, steel moment frame, etc.) as defined in ASCE 31-06. For each building type, there are two levels of structural checklists, "Life Safety" and "Immediate Occupancy." Depending on the level of seismicity for an earthquake event (e.g. low, moderate, or high) and the level of performance (e.g. Life Safety or Immediate Occupancy), the use of the different checklists is triggered. The level of seismicity is based on the Seismic Design Category, which is based on the seismic design parameters such as the design short-period spectral response acceleration and the design spectral response acceleration at 1-sec period. The level of seismicity for the Oxnard WTP was determined to be high.

Using these checklists and the "Quick Check" analysis procedures outlined in the ASCE 31-06 Tier 1 procedure, the buildings' structural lateral force resisting components were evaluated for compliance or noncompliance. Summaries of the structural seismic assessment results for each building are found in Section 5. Based on the results of the structural seismic assessment, overall condition assessment, and plant process assessment, Tier 2 evaluation or replacement of the building was recommended. Where non-compliant items were identified, buildings that were proposed to remain with repairable deterioration were recommended for further evaluation. The Tier 2 evaluation is in Appendix B.

4.2 Nonstructural Components

The seismic evaluation of the nonstructural components at the OWTP was performed in accordance with ASCE 31-06 Tier 1 analysis procedures. Lack of seismic anchorage and restraint of nonstructural items, such as architectural, mechanical, and electrical components, including process piping and equipment, were observed during the walk-through. The condition of nonstructural items was reviewed for Immediate Occupancy retention performance in accordance with ASCE 31-06 Tier 1 analysis procedures. ASCE 31-06 defines Immediate Occupancy for nonstructural components as "post-earthquake damage state in which nonstructural components are damaged but building access and life safety systems…generally remain available and operable, provided that power is available."

The Tier 1 nonstructural analysis procedures use a checklist that evaluates these elements. Depending on the level of seismicity for an earthquake event (e.g. low, moderate, or high) and the level of performance (e.g. Hazard Reduced, Life Safety, Immediate Occupancy, or Operational), the use of the different checklists is triggered.

Using these checklists as a guide, with our judgment, the nonstructural components were evaluated for compliance or noncompliance. Summaries of the nonstructural seismic assessment results for each structure are found in Section 5. In buildings that are proposed to remain, non-compliant non-structural elements should be retrofit. Retrofit requirements are discussed in Appendix B.

4.3 Water-retaining Structures

The seismic evaluation of the water-retaining concrete structures listed in Table 1, such as basins and tanks, was performed in accordance with ACI 350.3-06. During a seismic event, these structures will experience hydrostatic, hydrodynamic and in some cases, soil loads.

The structures were divided into two structure type categories: basins and tanks. The major structural components of the oldest and newest structure in each structure type category were evaluated for seismic performance in order to envelope the anticipated performance of all water-retaining structures. Summaries of the seismic assessment results for each structure are found in Section 5.

5.0 SEISMIC ASSESSMENT RESULTS

All of the buildings were analyzed for Immediate Occupancy in accordance with ASCE 31-06 Tier 1 analysis procedures. For structural elements, it should be noted that a more detailed structural analysis may result in revised conclusions.

The following set of design drawings were available to review.

BROWN AND CALDWELL CONSULTING ENGINEERS. 1975. *City of Oxnard-Wastewater Treatment Plant 1975 Improvements, October 1975.* Construction Drawings Prepared for City of Oxnard, California.

J.S. MURK ENGINEERS, INC. 1988. *Oxnard Wastewater Treatment Plant-Phase 1 Expansion, May 1988*. Construction Drawings Prepared for City of Oxnard, California.

MALCOLM PIRNIE. 2003. *Oxnard Wastewater Treatment Plant Headworks Project, July 2003.* Construction Drawings Prepared for City of Oxnard, California.

5.1 Headworks Building

5.1.1 Existing Structure Description

The Headworks Building is a reinforced concrete structure designed in 2003. A complete set of the design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. The building makes up a part of the Headworks Area, which also includes the Grit Screening Building. The overall dimensions of the building are 47 feet in the north-south direction and 68 feet in the east-west direction. The building is a one-story structure which houses an electrical room, utility storage room, workstations, and lunch/meeting room.

5.1.2 Structural Assessment Results Summary

Per Table 3-1 of ASCE 31-06, the Headworks Building is considered a benchmark building. A benchmark building is defined as a building “designed and constructed or evaluated in

accordance with the benchmark provisions," and "satisfies BSE-1E for the designated Performance Level." The Headworks Building was designed in accordance with the 2000 edition of the International Building Code and its latest supplements; therefore, a Tier 1 seismic evaluation is not required. However, an evaluation for its nonstructural components is still required.

5.1.3 Nonstructural Assessment Results Summary

The items listed in Table 3 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Retrofit of non-structural components is recommended for this building.

Table 3 Headworks Building: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Piping: Flexible Coupling	Fluid and gas piping does not have flexible couplings.
Building Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.

5.2 Grit Screenings Building

5.2.1 Existing Structure Description

The Grit Screenings Building is a reinforced concrete structure designed in 2003. A complete set of the design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. The building makes up a part of the Headworks Area, which also includes the Headworks Building. The overall dimensions of the building are 112 feet in the north-south direction and 31 feet in the east-west direction. There is no reference to the original seismic design parameters.

5.2.2 Structural Assessment Results Summary

All items from the structural checklist were found to be compliant. The complete checklist can be found in Appendix C. During the visual assessment, there was no significant sign of deterioration of concrete or reinforcement in any of the vertical or lateral-force-resisting elements.

5.2.3 Nonstructural Assessment Results Summary

The items listed in Table 4 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Retrofit of non-structural components is recommended for this building.

Table 4 Grit Screenings Building: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Light Fixtures:	Emergency lighting is not anchored or braced to prevent failing or swaying during an earthquake.

5.3 Primary Sedimentation

5.3.1 Existing Structure Description

The Primary Sedimentation Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1988. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions of 36 feet in the north-south direction and approximately 18 feet in the east-west direction. The roof consists of 6x14 and 4x8 timber members and 3/4-inch CDX plywood sheathing. The masonry walls are reinforced with #5 @ 32-inch o.c. vertical and #5 @ 48-inch o.c. horizontal reinforcement.

5.3.2 Structural Assessment Results Summary

The items listed in Table 5 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage and other damage to the wood members, deterioration of masonry units and mortar, and corrosion to equipment support anchorage components was noted. Due to the level of visual damage and deterioration, and results of the overall condition assessment, further Tier 2 evaluation is not recommended for this building. Replacement of this building is recommended.

5.3.3 Nonstructural Assessment Results Summary

The items listed in Table 6 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 5 Primary Sedimentation Building: Structural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Building System: Deterioration of Wood	There are signs of decay, shrinkage, and splitting in the wood members.
Building System: Masonry Units	There is visible deterioration of masonry units.
Building System: Masonry Mortar	The mortar can be easily scraped away from the joints by hand with a metal tool.
Lateral-Force-Resisting System: Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio is less than 0.002 of the wall.
Diaphragm: Cross Ties	There are no continuous cross ties between diaphragm chords.
Diaphragm: Straight Sheathing	The aspect ratio of the straight sheathing is not less than 1-1 in either direction being considered.
Diaphragm: Spans	Wood diaphragms with spans greater than 12 ft do not consist of wood structural panels.

Table 6 Primary Sedimentation Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Piping: Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Building Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Mechanical & Electrical Equipment: Electrical Equipment Bracing	Electrical equipment and associated wiring is not laterally braced.
Parapets, Cornices, Ornamentation, and Appendages: Appendages	Insufficient information available to determine whether concrete parapet is anchored per specified spacing.
Parapets, Cornices, Ornamentation, and Appendages: Concrete Parapets	Concrete parapet with height-to-thickness ratios greater than 2.5 does not have vertical reinforcement.

5.4 Main Electrical / Main Switchgear Building

5.4.1 Existing Structure Description

The Main Electrical Building is a reinforced masonry bearing walls building with a flexible diaphragm and designed in 1975. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 31 feet in the north-south direction and approximately 47 feet in the east-west direction. The roof consists W14x30 steel beams running in the north-south direction, 2x8 timber joists in the east-west direction, and ½" standard grade plywood sheathing. The masonry walls are reinforced with #5 @ 32-inch o.c. vertical and #5 @ 48-inch o.c. horizontal reinforcement.

5.4.2 Structural Assessment Results Summary

The items listed in Table 7 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage, and other damage to the wood members and corrosion to equipment support anchorage components was noted. Due to the level of visual damage and deterioration, further Tier 2 evaluation is not recommended for this building. Replacement of this building is recommended.

Table 7 Main Electrical Building: Structural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Building System: Deterioration of Wood	There are signs of decay, shrinkage, and splitting in the wood members.
Lateral-Force-Resisting System: Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio is less than 0.002 of the wall.
Connections: Wall Anchorage	Exterior masonry walls that are dependent on the diaphragm for lateral support are not anchored for out-of-plane forces at each diaphragm level. The connections do not have adequate strength to resist the connection forces.
Diaphragm: Cross Ties	There are no continuous cross ties between diaphragm chords.
Diaphragm: Diagonally Sheathed and Unblocked Diaphragms	Unblocked wood structural panel diaphragm does not have horizontal spans less than 30 feet.

5.4.3 Nonstructural Assessment Results Summary

The items listed in Table 8 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 8 Main Electrical Building: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Piping: Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Mechanical & Electrical Equipment: Electrical Equipment	Electrical Equipment is not laterally braced to the structure.

5.5 Blower Building

5.5.1 Existing Structure Description

The Blower Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1975. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 21 feet in the north-south direction and approximately 33 feet in the east-west direction. The roof consists of 2x12 timber joists with 2 by blocking, and 1/2-inch CDX grade plywood sheathing. The masonry walls are reinforced with #5 @ 40-inch o.c. each way.

5.5.2 Structural Assessment Results Summary

All items from the structural checklist were found to be compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

5.5.3 Nonstructural Assessment Results Summary

The items listed in Table 9 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Retrofit of non-structural components is recommended for this building.

Table 9 Blower Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Light Fixtures: Emergency Lighting Anchorage	Emergency lighting is not anchored or braced to prevent failing or swaying during an earthquake.
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.

5.6 North Area Electrical Building

5.6.1 Existing Structure Description

The North Area Electrical Building is a reinforced concrete shearing walls building with a stiff diaphragm designed in 1988. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 42 feet in the north-south direction and approximately 55 feet in the east-west direction. The roof consists W16x36 and W14x22 steel beams running in the east-west direction, and a steel deck with 2-1/2-inch concrete topping. The 8-inch concrete walls are reinforced with #5 @ 12-inch o.c. each way.

5.6.2 Structural Assessment Results Summary

All items from the structural checklist were found to be compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. During the visual assessment, there was no significant sign of deterioration of concrete or reinforcement in any of the vertical or lateral-force-resisting elements.

5.6.3 Nonstructural Assessment Results Summary

The items listed in Table 10 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Retrofit of non-structural components is recommended for this building.

Table 10 North Area Electrical Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Contents and Furnishing: Tall Narrow Contents	Contents more than 4 ft high with a height-to-depth or height-to-wide ratio or great than 3-to-1 (such as file cabinets) are not anchored to the structure or each other.
Piping: Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawers Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.

5.7 Digester Control Building

5.7.1 Existing Structure Description

The Digester Control Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1975. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 37 feet in the north-south direction and approximately 46 feet in the east-west direction. The roof consists of W16x31 steel beams running in the north-south direction, 2x8 timber joists in the east-west direction with 2 by blocking, and 1/2-inch CDX grade plywood sheathing. The masonry walls are reinforced with #5 @ 32-inch o.c. vertical and #5 @ 48-inch o.c. horizontal reinforcement.

5.7.2 Structural Assessment Results Summary

The items listed in Table 11 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage, and other damage to the wood members, deterioration of the masonry units, and corrosion to equipment support anchorage components was noted. Due to the level of visual damage and deterioration, further Tier 2 evaluation is not recommended for this building. Replacement of this building is recommended.

Table 11 Digester Control Building: Structural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Building System: Deterioration of Wood	There are signs of decay, shrinkage, and splitting in the wood members.
Building System: Masonry Units	There is visible deterioration of masonry units.
Lateral-Force-Resisting System: Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio is less than 0.002 of the wall.
Connections: Wood Ledger	Unable-To-Determine: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers.
Diaphragm: Cross Ties	There are no continuous cross ties between diaphragm chords.
Diaphragm: Diagonally Sheathed and Unblocked Diaphragms	Unblocked wood structural panel diaphragm does not have horizontal spans less than 30 feet.

5.7.3 Nonstructural Assessment Results Summary

The items listed in Table 12 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 12 Digester Control Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Equipment mounted on vibration isolators are not equipped with restraints or snubbers.

5.8 Solids Processing Building

5.8.1 Existing Structure Description

The Solids Processing Building is a three-story reinforced masonry bearing walls building with a stiff diaphragm designed in 1988. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 92 feet in the north-south direction and approximately 84 feet in the east-west direction. The roof consists of 8-inch reinforced concrete floor slab. The masonry walls are reinforced with #5 @ 24-inch o.c. vertical and #4 @ 24-inch o.c. horizontal reinforcement.

5.8.2 Structural Assessment Results Summary

The items listed in Table 13 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Further Tier 2 evaluation is recommended for this building.

Table 13 Solids Processing Building: Structural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Lateral –Force-Resisting System: Shear Stress Check	The shear stress in the reinforced masonry shear walls is greater than 70 psi.
Lateral –Force-Resisting System: Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio is less than 0.002 of the wall.
Connections: Girder/Column Connection	There is not a positive connection utilizing plates, connection hardware, or straps between the girder and column support.
Diaphragm: Openings at Exterior Masonry Shear Walls	Diaphragm opening immediately adjacent to exterior masonry shear walls are greater than 8 feet long.

5.8.3 Nonstructural Assessment Results Summary

The items listed in Table 14 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 14 Solids Processing Building: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Light Fixtures: Independent Support	Light fixtures in suspended grid ceiling are not supported independently of the ceiling suspension system by a minimum of two wires.
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Equipment mounted on vibration isolators are not equipped with restraints or snubbers.
Piping: Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping are not anchored and braced to the structure to prevent breakage.

5.9 Operations Center / Plant Control Center Building

5.9.1 Existing Structure Description

The Operations Center is a reinforced masonry bearing walls building with a flexible diaphragm designed pre-1975. It was expanded to include a corridor as part of the 1975 Wastewater Treatment Plant Improvements Project, however original design drawings were not available for review. Therefore, certain information regarding the lateral-force-resisting system could not be determined. There is no reference to the original seismic design parameters. It has since been renamed as the Plant Control Center.

The building has overall dimensions approximately 90 feet in the north-south direction and approximately 50 feet in the east-west direction. From the expansion drawings, it was determined that the existing roof is a built up roof with ½" plywood. Any other information on the lateral-force-resisting system (wall thickness, reinforcement, etc.) is not available.

5.9.2 Structural Assessment Results Summary

Although some items on the structural checklist are considered compliant, due to insufficient information available on the structure, this structure is considered non-compliant for the Immediate Occupancy performance level. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage and other damage to the wood members, and deterioration of the masonry units was noted. In order to further evaluate this building, destructive and non-destructive testing is necessary to document the building construction. Due to the level of visual damage and deterioration, and lack of design or record drawings, further Tier 2 evaluation is not recommended for this building. Replacement of this building is recommended.

5.9.3 Nonstructural Assessment Results Summary

The items listed in Table 15 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

5.10 Effluent Pumping Station

5.10.1 Existing Structure Description

The Effluent Pump Station is a reinforced masonry bearing walls building with a flexible diaphragm designed pre-1975. It was expanded to include a below grade access structure as part of the 1975 Wastewater Treatment Plant Improvements Project, however original drawings were not available for review. Therefore, information regarding the lateral-force-resisting system could not be determined. There is no reference to the original seismic design parameters.

Table 15 Operations Center: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Piping: Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Light Fixtures: Lens Covers	Lens covers on light fixtures are not supplied with safety devices.
Contents and Furnishings: Fall-Prone Contents	Equipment, stored items, or other contents weighing more than 20 lbs whose center of mass is more than 4 ft above the floor level are not braced or restrained.
Parapets, Cornices, Ornamentation, and Appendages: Appendages	Insufficient information available to determine whether concrete parapet is anchored per specified spacing.

5.10.2 Structural Assessment Results Summary

Although some items on the structural checklist are considered compliant due to visual assessment, due to insufficient information available on the structure, this structure is considered non-compliant for the Immediate Occupancy performance level. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage, and other damage to the wood members, deterioration of the masonry units and mortar, and significant wall cracks were noted. In order to further evaluate this building, destructive and non-destructive testing is necessary to document the building construction. Due to the level of damage and deterioration and lack of record drawings, further Tier 2 evaluation is not recommended for this building. Replacement of this building is recommended.

5.10.3 Nonstructural Assessment Results Summary

The items listed in Table 16 below were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 16 Effluent Pumping Station: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Piping Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Ducts: Duct Bracing	Rectangular ductworks exceeding 6 square feet in cross-sectional area are not braced.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Equipment mounted on vibration isolators are not equipped with restraints or snubbers.

5.11 Generator / Co-Generation Building

5.11.1 Existing Structure Description

The Generator Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1975. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 52 feet in the north-south direction and approximately 105 feet in the east-west direction. The roof consists of W21x44 steel beams with a metal deck in the Generator Room and 2x8 timber joists with 2 by blocking, and 1/2-inch CDX grade plywood sheathing in the Control Room. The masonry walls are reinforced with #6 @ 24-inch o.c. vertical and #5 @ 32-inch o.c. horizontal reinforcement.

5.11.2 Structural Assessment Results Summary

The items listed in Table 17 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage, and other damage to the wood members, deterioration of the masonry units, and corrosion to equipment support anchorage components was noted. Further Tier 2 evaluation is not recommended for this structure. Replacement of this building is recommended.

Table 17 Generator Building: Structural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Building System: Deterioration of Wood	There are signs of decay, shrinkage, and splitting in the wood members.
Building System: Masonry Units	There is visible deterioration of masonry units.
Lateral-Force-Resisting System: Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio is less than 0.002 of the wall.
Diaphragm: Cross Ties	There are no continuous cross ties between diaphragm chords.
Diaphragm: Diagonally Sheathed and Unblocked Diaphragms	Unblocked wood structural panel diaphragm does not have horizontal spans less than 30 feet.

5.11.3 Nonstructural Assessment Results Summary

The items listed in Table 18 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

5.12 Maintenance Building

5.12.1 Existing Structure Description

The Maintenance Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1977. Record drawings were not available for review. Therefore, information regarding the lateral-force-resisting system could not be determined. There is no reference to the original seismic design parameters.

5.12.2 Structural Assessment Results Summary

Although some items on the structural checklist are considered compliant by visual assessment, due to insufficient information available on the structure, this structure is considered non-compliant for the Immediate Occupancy performance level. The complete checklist can be found in Appendix C. During the visual assessment, deterioration of wood members was noted. Further Tier 2 evaluation is recommended for this building.

5.12.3 Nonstructural Assessment Results Summary

The items listed in Table 19 below were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 18 Generator Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Parapets: Urm Parapets	There is a laterally unsupported unreinforced masonry parapet with a height-to-thickness ratio greater than 1.5
Piping Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Ducts: Duct Bracing	Rectangular ductworks exceeding 6 square feet in cross-sectional area, are not braced.
Mechanical and Electrical Equipment: Electrical Equipment Bracing	Electrical equipment and associated wiring is not laterally braced to the structural system.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Equipment mounted on vibration isolators are not equipped with restraints or snubbers.
Parapets: Urm Parapets	Parapets are not reinforced and anchored to the structural system at a spacing less than 10 feet.

Table 19 Maintenance Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage or corrosion in the anchorage or supports of mechanical and electrical equipment.
Piping Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.

5.13 Collection System Maintenance Building

5.13.1 Existing Structure Description

The Collection System Maintenance Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1988. A partial set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. The building is currently used as a maintenance building and houses staff offices and does not serve its original purpose. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 45 feet in the north-south direction and approximately 134 feet in the east-west direction. The roof consists of timber joists with 2 by blocking, and 1/2-inch CDX grade plywood sheathing. The masonry walls are reinforced with #5 @ 32-inch o.c. vertical and #5 @ 48-inch o.c. horizontal reinforcement. Complete information pertaining to the lateral force resisting system was not provided in the set of drawings available, therefore, some structural items were found to be non-compliant.

5.13.2 Structural Assessment Results Summary

The items listed in Table 20 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Further Tier 2 evaluation is recommended for this building.

Table 20 Collection System Maintenance Building: Structural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Connections: Wood Ledgers	The connection between the wall panels and the diaphragm induces cross-grain bending or tension in the wood legers.
Lateral –Force-Resisting System: Shear Stress Check	Unable-to-Determine: The shear stress in the reinforced masonry shear walls shall be less than 70 psi.
Lateral –Force-Resisting System: Reinforcing Steel	Unable-to-Determine: The total vertical and horizontal reinforcing steel ratio of the shear walls is less than 0.002.
Lateral –Force-Resisting System: Proportions	Unable-to-Determine: The height-to-thickness ratio of the shear walls shall be less than 30.
Diaphragm: Straight Sheathing	Straight-sheathed diaphragm does not have an aspect ratio of less than 2-to-1.
Diaphragm: Diagonally Sheathed and Unblocked Diaphragms	Unblocked wood structural panel diaphragm does not have horizontal spans less than 30 feet.

5.13.3 Nonstructural Assessment Results Summary

The items listed in Table 21 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

5.14 Chemical Handling Facilities

5.14.1 Existing Structure Description

The Chemical Handling Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1988. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. The building is currently used as the electrical shop and does not serve its original purpose. There is no reference to the original seismic design parameters.

The building has overall dimensions approximately 45 feet in the north-south direction and approximately 134 feet in the east-west direction. The roof consists of timber joists with 2 by blocking, and 1/2-inch CDX grade plywood sheathing. The masonry walls are reinforced with #5 @ 32-inch o.c. vertical and #5 @ 48-inch o.c. horizontal reinforcement. Complete information pertaining to the lateral force resisting system was not provided in the set of drawings available, therefore, some structural items were found to be non-compliant.

Table 21 Collection System Maintenance Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Light Fixtures: Emergency Lighting Anchorage	Emergency lighting is not anchored or braced to prevent failing or swaying during an earthquake.
Piping Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Ducts: Duct Bracing	Rectangular ductworks exceeding 6 square feet in cross-sectional area are not braced.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Equipment mounted on vibration isolators are not equipped with restraints or snubbers.

5.14.2 Structural Assessment Results Summary

The items listed in Table 22 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. Further Tier 2 evaluation is recommended for this building.

Table 22 Chemical Handling Facilities: Structural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Connections: Wood Ledgers	The connection between the wall panels and the diaphragm induces cross-grain bending or tension in the wood legers.
Lateral –Force-Resisting System: Reinforcing Steel	The total vertical and horizontal reinforcing steel ratio is less than 0.002 of the wall.
Lateral –Force-Resisting System: Proportions	The height-to-thickness ratio of the shear walls is not less than 30.
Diaphragm: Straight Sheathing	Straight-sheathed diaphragm does not have an aspect ratio of less than 2-to-1.

5.14.3 Nonstructural Assessment Results Summary

The items listed in Table 23 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 23 Chemical Handling Facilities: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Building Contents and Furnishing: Tall Narrow Contents	Contents over 4 feet in height with a height-to-depth ratio greater than 3-to-1 are not anchored to the floor slab or adjacent walls.
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Piping Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible coupling.
Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.

5.15 Storage-Vacuum Filter Building

5.15.1 Existing Structure Description

The Storage-Vacuum Filter Building is a reinforced masonry bearing walls building with a flexible designed pre-1975. Record drawings were not available for review. Therefore, information regarding the lateral-force-resisting system could not be determined. There is no reference to the original seismic design parameters.

5.15.2 Structural Assessment Results Summary

Although some items on the structural checklist are considered compliant by visual assessment, due to insufficient information available on the structure, this structure is considered non-compliant for the Immediate Occupancy performance level. The complete checklist can be found in Appendix C. During the visual assessment, significant sign of deterioration, shrinkage and other damage to the wood members, deterioration of the masonry units and mortar, and significant wall cracks were noted. Due to the level of

damage and deterioration and lack of record drawings, further Tier 2 evaluation is not recommended for this building. Replacement of this building is recommended.

5.15.3 Nonstructural Assessment Results Summary

The items listed in Table 24 below were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 24 Storage-Vacuum Filter Building: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Building Contents and Furnishing: Tall Narrow Contents	Contents over 4 feet in height with a height-to-depth ratio greater than 3-to-1 are not anchored to the floor slab or adjacent walls.
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Piping Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Piping: Flexible Couplings	Fluid, gas, and fire suppression piping does not have flexible couplings.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Ducts: Duct Bracing	Rectangular ductworks exceeding 6 square feet in cross-sectional area are not braced.
Mechanical and Electrical Equipment: Heavy Equipment Anchorage	Equipment weighing over 100 lbs is not anchored to the structure or foundation.

5.16 Storage-Butler Building

5.16.1 Existing Structure Description

The two Storage-Butler Buildings are manufactured steel building systems. Butler Building A, currently known as the Storage Building, located to the north of the Collection System/Maintenance Building has significant steel deterioration and was not accessible for an interior visual assessment. Butler Building B, currently known as the second Storage Building, located east of the Effluent Pumping Station, has steel deterioration, and was accessible for both exterior and interior visual assessment. Record drawings for either

building were not available for review. Therefore, information regarding the lateral-force-resisting system could not be determined. There is no reference to the original seismic design parameters.

5.16.2 Structural Assessment Results Summary

Due to insufficient information available on Butler Building A, and lack of accessibility, this structure is considered non-compliant for the Immediate Occupancy performance level. Although some items on the structural checklist are considered compliant by visual assessment of Butler Building B, due to insufficient information available on the structure, this structure is considered non-compliant for the Immediate Occupancy performance level. The complete checklist can be found in Appendix C. During the visual assessment, significant deterioration of steel was noted. Due to the level of damage and deterioration and lack of record drawings for both buildings, further Tier 2 evaluation is not recommended for these buildings. Replacement of these buildings is recommended.

5.16.3 Nonstructural Assessment Results Summary

Due to lack of accessibility of Butler Building A, this building is considered non-compliant for the Immediate Occupancy performance level during the specified seismic events. The items listed in Table 25 were found to be non-compliant for Butler Building B for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 25 Butler Buildings: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Building Contents and Furnishing: Tall Narrow Contents	Contents over 4 feet in height with a height-to-depth ratio greater than 3-to-1 are not anchored to the floor slab or adjacent walls.
Mechanical & Electrical Equipment: Attached Equipment	Equipment weighting over 20 lbs supported 4 feet above the floor level is not mounted.
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage or supports of mechanical and electrical equipment.
Mechanical and Electrical Equipment: Heavy Equipment Anchorage	Equipment weighing over 100 lbs is not anchored to the foundation.

5.17 16 kW Switchgear Building / Effluent Electrical Building

5.17.1 Existing Structure Description

The 16-kW Switchgear Building is a part of the current Effluent Electrical Building. Record drawings were not available for review. Therefore, information regarding the lateral-force-

resisting system could not be determined. From visual assessment, the building can be assumed as a reinforced masonry bearing walls building with a flexible diaphragm. There is no reference to the original seismic design parameters.

5.17.2 Structural Assessment Results Summary

Although some items on the structural checklist are considered compliant by visual assessment, due to insufficient information available on the structure, this structure is considered non-compliant for the Immediate Occupancy performance level. The complete checklist can be found in Appendix C. If this building is to remain, further Tier 2 evaluation is recommended for this building.

5.17.3 Nonstructural Assessment Results Summary

The items listed in Table 26 below were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

Table 26 16-kW Switchgear Building: Nonstructural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Light Fixtures: Emergency Lighting Anchorage	Emergency lighting is not anchored or braced to prevent failing or swaying during an earthquake.
Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Mechanical and Electrical Equipment: Electrical Equipment Bracing	Electrical equipment and associated wiring is not laterally braced to the structure.

5.18 Administration Building

5.18.1 Existing Structure Description

The Administration Building is a wood framed building designed in 1975. A complete set of design drawings was available for review. A site visit confirmed that the drawings appear to be consistent with observed conditions. There is no reference to the original seismic design parameters.

The building has overall dimensions of 63 feet in the north-south direction and approximately 144 feet in the east-west direction. The roof consists of timber members and 1/2-inch CDX plywood sheathing. The building is used as a laboratory and office space.

5.18.2 Structural Assessment Results Summary

The items listed in Table 27 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C. During the visual assessment, damage to the wood members was noted. Further Tier 2 evaluation is recommended for this structure.

Table 27 Administration Building: Structural Deficiencies
Public Works Integrated Master Plan
City of Oxnard

Deficient Issue	Description
Building System: Deterioration of Wood	There are signs of decay, shrinkage, and splitting in the wood members.
Lateral-Force-Resisting System: Shear Stress Check	The shear stress in the shear walls is less than 1000 plf for structural panels.
Diaphragm: Straight Sheathing	The aspect ratio of the straight sheathing is not less than 2-1 in either direction being considered.

5.18.3 Nonstructural Assessment Results Summary

The items listed in Table 28 were found to be non-compliant for the Immediate Occupancy performance level during the specified seismic events. The complete checklist can be found in Appendix C.

5.19 Activated Sludge Tanks/Aeration Basin

The new Activated Sludge Tanks were built during the of the 1988 expansion project. The design structural drawings were available for review. The Activated Sludge Basin is a reinforced concrete tank with a rectangular plan. The exterior 16-inch thick basin walls are approximately 21 feet tall.

The exterior wall was analyzed using hydrostatic and hydrodynamic seismic loads. The walls will experience excessive deflection in a seismic event, however, deflection and crack control is not considered for seismic loads. The walls, however, are under-reinforced and at risk of shear failure. Therefore, structural retrofitting of these tanks is recommended. Testing of the concrete condition is also recommended to assess the feasibility of retrofitting the tanks.

5.20 Secondary Sedimentation Basin

The Secondary Sedimentation Basin was built during the 1988 expansion project. The design structural drawings were available for review. The Secondary Sedimentation Basin is a rectangular reinforced concrete tank. The exterior 14” thick basin walls are approximately 15 feet tall.

Table 28 Administration Building: Nonstructural Deficiencies Public Works Integrated Master Plan City of Oxnard	
Deficient Issue	**Description**
Hazardous Material Storage and Distribution: Toxic Substances Lateral Bracing and Anchorage	Toxic and hazardous substances stored in breakable containers not are restrained from falling by latched doors, shelf clips, wires or other methods.
Light Fixtures: Independent Support	Light fixtures in suspended grid ceiling are not supported independently of the ceiling suspension system by a minimum of two wires.
Mechanical & Electrical Equipment: Attached Equipment	Equipment weighting over 20 lbs that is attached to the walls is not mounted.
Mechanical & Electrical Equipment: Deterioration	There is evidence of deterioration, damage, or corrosion in the anchorage of mechanical equipment.
Piping: Fire Suppression Piping	Fire suppression piping is not anchored and braced in accordance with NFPA-13.
Building Contents and Furnishing: Drawers	Cabinet drawers do not have latches to keep them closed during an earthquake.
Building Contents and Furnishing: File Cabinets	File cabinets arranged in groups are not attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawers Locks	Cabinet doors and drawers do not have latches to keep them closed during an earthquake.
Mechanical & Electrical Equipment: Electrical Equipment Bracing	Electrical equipment and associated wiring is not laterally braced.

The walls were analyzed using hydrostatic and hydrodynamic seismic loads. Similar to the Aeration Basin, the walls will experience excessive deflection. The walls are under-reinforced in flexure and shear is not of a concern. Therefore, structural retrofitting of these tanks is recommended. Testing of the concrete condition is also recommended. Based on the condition of the concrete, retrofit options, such as composite fiber fabric to strengthen the walls, can be recommended.

5.21 Flow Equalization Basin

The Flow Equalization Basin was built during the 1988 expansion project. The construction details of the Flow Equalization Basin are the same as the Secondary Sedimentation Basin. Therefore, it was deicide to assume that it will behave in a similar manner in a seismic event and it will have the same concerns as the structure discussed in section 5.20.

Structural retrofitting and testing of the concrete condition is recommended for these basins. Based on the condition of the concrete, retrofit options, such as composite fiber fabric to strengthen the walls, can be recommended.

5.22 Primary Clarifier Tanks

The Primary Clarifier Tanks were built in 1971. The “as built” structural drawings, dated March 1971 were available for review. Due to the condition of the drawings, some information, such as the height of the tanks, could not be determined. This information was reasonably assumed for analysis purposes.

The tanks were analyzed using methods presented in ASCE 7-10 and the 2012 International Building Code. The tank wall hoop reinforcement near the water surface level and vertical reinforcement at the base of the tank are minimally overstressed. The center mechanism column has the potential of being overstressed and therefore, replacement of the center column and foundation is recommended. Testing of the concrete condition is also recommended for these tanks.

5.23 Gravity Thickeners

The Gravity Thickeners were built prior to 1964. Record drawings were not available for review. Due to the age of the structures and the period in which they were installed, it is reasonable to assume that these structures will not perform up to the current code standards. Due to the age of the tanks and the lack of information, replacement of these tanks is recommended.

5.24 Digester Nos. 1, 2 and 3

Digester Nos. 1 and 2 were built in 1975 and improved in 1988. Digester No. 3 was built in 1988. The design structural drawings, dated October 1975 and June 1988 were available for review.

The approximately 43 feet high tanks were analyzed using methods presented in ASCE 7-10 and the 2012 International Building Code. The hoop and vertical reinforcement of these pre-stressed tanks are minimally overstressed.

Testing of the concrete condition and evaluation of the pre-stressing of a five year cycle is recommended for these tanks.

5.25 DAF Tanks

The DAF Tanks were built in 1988. The construction details of the DAF Tanks are similar to the Digester Tanks. Therefore, it was decided to assume that it will behave in a similar manner in a seismic event and it will have the same concerns as the Digesters.

Testing of the concrete condition and evaluation of the pre-stressing of a five year cycle is recommended for these tanks.

5.26 Chlorine Contact Tank

The Chlorine Contact Tanks were built in 1975. The construction details of the Chlorine Contact Tanks are similar to the Secondary Sedimentation Basin. Therefore, it was decided to assume that it will behave in a similar manner in a seismic event and it will have the same concerns as the basins.

Structural retrofitting and testing of the concrete condition is recommended for these basins. Based on the condition of the concrete, retrofit options, such as composite fiber fabric to strengthen the walls, can be recommended.

6.0 RECOMMENDED ACTIONS

Based on visual assessment, and the Tier 1 screening results, replacement of the following buildings is recommended: Primary Sedimentation Building, Main Electrical / Main Switchgear Building, Digester Control Building, Operations Center / Plant Control Center Building, Effluent Pumping Station, Generator / Co-Generation Building, Storage-Vacuum Filter Building, and Storage-Butler Building. Retrofit of non-structural components is recommended for the following buildings: Headworks Building, Grit Screenings Building, Blower Building, and North Area Electrical Building.

Tier 2 evaluation is recommended for the following structures: Solids Processing Building, Maintenance Building, Collection System Maintenance Building, Chemical Handling Facilities, 16 kW Switchgear / Effluent Electrical Building, and Administration Building. Structural retrofits for six of the eight structures, replacement of one structure, further evaluation of one structure, and concrete condition testing for all eight structures is recommended for the water-retaining structures.

7.0 CONCLUSION

This study resulted in the recommendation of further investigation of several buildings at the Oxnard WTP. Seismic analysis resulted in recommendation of retrofit, replacement, and further concrete condition testing for all of the water-retaining structures.

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APPENDIX B – DETAILED STRUCTURAL SEISMIC EVALUATION AND NON-STRUCTURAL RETROFITS OF BUILDING-TYPE STRUCTURES

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APPENDIX B - DETAILED STRUCTURAL SEISMIC EVALUATION AND NON-STRUCTURAL RETROFITS OF BUILDING-TYPE STRUCTURES

1.0 INTRODUCTION

In June 2014, the City of Oxnard (Oxnard) engaged Carollo Engineers to perform a seismic evaluation of the Oxnard Wastewater Treatment Plant (OWTP). A Tier 1, i.e., screening assessment that identified potential structural and non-structural seismic vulnerabilities of the structures as they relate to Oxnard seismic performance objectives during design earthquake events was completed in October 2014. The purpose of the evaluation is to perform a deficiency based evaluation and identify components that require seismic retrofit for structures that were identified as non-compliant with the Tier 1 screening criteria.

Six buildings were recommended for further Tier 2 analysis and four were recommended for retrofit of non-structural components. One of those six buildings recommended for further analysis is proposed to be replaced as a result of overall condition assessment and therefore, is not included in this report.

2.0 APPROACH

Preliminary seismic assessments of the existing building-type structure were performed using the 2006 version of *American Society of Engineers Standards: Seismic Evaluation and Retrofit of Existing Buildings* (ASCE 31) Tier 1 evaluation procedures. This standard is commonly used as a way to evaluate anticipated seismic performance of existing buildings. ASCE 31-06 was updated and replaced with *Seismic Evaluation and Retrofit of Existing Buildings* (ASCE 41-13), which was used for the Tier 2 evaluation. Tier 2 is a follow-up step to further evaluate potential deficiencies identified in Tier 1. The purpose of Tier 2 evaluation is to perform a seismic evaluation and determine required retrofits. The additional analysis of Tier 2 is sufficient to either confirm the identified deficiency or demonstrate the adequacy of the structure.

Based on the structure's risk category as defined in ASCE 41, a Seismic Hazard Level of BPOE (Basic Performance Objective for Existing Buildings) was used. The risk category of the plant is III (three) and Damage Control Structural Performance and Position Retention Non-structural Performance levels were selected for the Tier 2 analysis. ASCE 41 defines the Damage Control Performance Level (S-2) as: "the post-earthquake damage state between the Life Safety Structural Performance Level (S-3) and the Immediate Occupancy Structural Performance Level (S-1)." Life Safety and Immediate Occupancy are defined as, "post-earthquake damage state in which a structure has damaged components but retains a margin against the onset of partial or total collapse," and "post-earthquake damage state

in which a structure remains safe to occupy and essentially retains its pre-earthquake strength and stiffness," respectively. An inventory of the specific structures evaluated for Tier 2 is provided in Table 1, including the appendix section in which the structure's assessment results can be found.

Table 1 List of Facilities
Public Works Integrated Master Plan
City of Oxnard

Structure	Section
Headworks Building	5.1
Grit Screening Building	5.2
Blower Building	5.3
North Area Electrical Building	5.4
Solids Processing Building	5.5
Chemical Handling Facilities	5.6.1
Maintenance Building	5.6.2
Collection System Maintenance Building	5.6.3
Administration Building	5.7

3.0 SUMMARY OF FINDINGS

The findings of Tier 1 screening completed with the procedures of ASCE 31-06 were updated in this report to ASCE 41-13. Table 2 lists all the structures evaluated with associated findings.

In general, the structural deficiencies that were analyzed in the Tier 2 evaluation are adequate for the performance objective. The deficient non-structural components identified in the Tier 1 screening require retrofit. With the update from ASCE 31-06 to 41-13, some of non-structural components found in ASCE 31-06 were removed from the non-structural checklist in ASCE 41-13. Although not recommended by the standard, retrofit/repair for those removed components is recommended based on our judgment.

4.0 SEISMIC ASSESSMENT METHODOLOGY

4.1 Structural Components

The seismic evaluation of the building structures at the OWTP was performed in accordance with ASCE 41-13 Tier 2 analysis procedures.

The selection of structural elements for Tier 2 evaluation was based on the Tier 1 Structural Checklist finding. The potentially deficient elements were further analyzed to determine the demands and capacities of structural systems, components, and connections associated with the deficiencies. Of the nine structures included in this report, three are reinforced

masonry with flexible diaphragm buildings, one is a reinforced masonry with stiff diaphragm building, one is a wood framed building, and four buildings have only non-structural deficiencies. Based on the building type, similarities in potential deficiencies identified in Tier 1 and similar structural detailing specified on the record drawings, the three reinforced masonry with flexible diaphragm buildings were grouped together. The conclusion of the three buildings was based on the results of the building with the higher quantity of deficiencies identified.

Table 2 Summary of Tier 2 Assessment
Public Works Integrated Master Plan
City of Oxnard

Structure	Results	
	Structural Components	**Non-Structural Components**
Headworks Building	Tier 2 Not Required(1)	Retrofit Recommended
Grit Screening Building	Tier 2 Not Required(1)	Retrofit Recommended
Blower Building	Tier 2 Not Required(1)	Retrofit Recommended
North Area Electrical Building	Tier 2 Not Required(1)	Retrofit Recommended
Solids Processing Building	No Deficiencies	Retrofit Recommended
Chemical Handling Facilities	Retrofit Recommended: wall-to-diaphragm connection	Retrofit Recommended
Maintenance Building	Retrofit Recommended: wall-to-diaphragm connection	Retrofit Recommended
Collection System Maintenance Building	Retrofit Recommended: wall-to-diaphragm connection	Retrofit Recommended
Administration Building	No Deficiencies	Retrofit Recommended

Note:
(1) No structural deficiencies identified in Tier 1.

Detailed findings of the Tier 2 structural elements recommended for retrofit are found in Section 5.

4.2 Non-structural Components

ASCE 41-13 recommends retrofit of deficient non-structural components. Further technical analysis is not required for non-structural components.

Summaries of the non-structural components recommended for retrofit are found in Section 5.

5.0 TIER 2 EVALUATION RESULTS

5.1 Headworks Building

5.1.1 Existing Structure Description

The Headworks Building is a reinforced concrete structure designed in 2003. A complete set of the design drawings was available for review. Based on the Tier 1 screening, only non-structural components were determined to be deficient.

5.1.2 Non-structural Assessment Results Summary

Table 3 summarizes non-structural deficiencies identified in the Tier 1 evaluation that are recommended for retrofit.

Table 3 Headworks Building: Non-structural Findings
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Piping: Flexible Coupling	Retrofit: Provide flexible coupling at tees and pipe diameter transitions for fluid, and fire suppression piping located in the ground floor of the building.
Building Contents and Furnishing: Drawers	This component does not require analysis per ASCE 41-13. Recommendation: Drawers should be repaired to have latches to keep them closed during an earthquake.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	This component does not require analysis per ASCE 41-13. Recommendation: Cabinet doors and drawers should be repaired to have latches to keep them closed during an earthquake.

5.2 Grit Screenings Building

5.2.1 Existing Structure Description

The Grit Screenings Building is a reinforced concrete structure designed in 2003. A complete set of design drawings was available for review. Based on the Tier 1 screening, only non-structural components were determined to be deficient.

5.2.2 Non-structural Assessment Results Summary

Table 4 summarizes non-structural deficiencies identified in the Tier 1 evaluation that are recommended for retrofit.

Table 4 Grit Screenings Building: Non-structural Findings
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Light Fixtures	Retrofit: Upgrade emergency lighting anchorage to prevent failing or impact damage due to swaying during an earthquake.

5.3 Blower Building

5.3.1 Existing Structure Description

The Blower Building has reinforced masonry bearing walls building with a flexible designed in 1975. A complete set of design drawings was available for review. Based on the Tier 1 screening, only non-structural components were determined to be deficient.

5.3.2 Non-structural Assessment Results Summary

Table 5 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

Table 5 Blower Building: Non-structural Findings
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Light Fixtures: Emergency Lighting Anchorage	Retrofit: Emergency lighting anchoring system shall be retrofit to prevent failing or swaying during an earthquake.
Mechanical & Electrical Equipment: Deterioration	This component does not require analysis per ASCE 41-13. Repair of deterioration recommended.

5.4 North Area Electrical Building

5.4.1 Existing Structure Description

The North Area Electrical Building is a reinforced concrete shear walls building with a stiff diaphragm designed in 1988. A complete set of design drawings was available for review. Based on the Tier 1 screening, only non-structural components were identified to be potentially deficient.

5.4.2 Non-structural Assessment Results Summary

Table 6 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

Table 6 North Area Electrical Building: Non-structural Findings
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Contents and Furnishing: Tall Narrow Contents	Retrofit: Anchor contents over 6 feet in height to the floor slab or adjacent walls to prevent damage during an earthquake.
Piping: Fire Suppression Piping	Retrofit: Anchor fire suppression piping in accordance with NFPA-13.
Contents and Furnishing: Drawers	This component does not require analysis per ASCE 41-13. Recommendation: Drawers should be repaired to have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	This component does not require analysis per ASCE 41-13. Recommendation: Cabinets that are arranged in groups should be attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawers Locks	This component does not require analysis per ASCE 41-13. Recommendation: Cabinet doors and drawers should be repaired to have latches to keep them closed during an earthquake.

5.5 Solids Processing Building

5.5.1 Existing Structure Description

The Solids Processing Building is a three-story reinforced masonry bearing walls building with a stiff diaphragm designed in 1988. A complete set of design drawings was available for review.

5.5.2 Structural Assessment Results Summary

The structural deficiencies identified in Tier 1 were further analyzed to determine the adequacy of the building shear walls and roof diaphragm. The results of the structural items analyzed using the Tier 2 procedures are listed in Table 7.

Table 7 Solids Processing Building: Structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Lateral –Force-Resisting System: Shear Stress Check	Shear walls are adequate for the anticipated seismic hazard level. Retrofit not recommend.
Lateral –Force-Resisting System: Reinforcing Steel	Shear walls are adequate for the anticipated seismic hazard level. Retrofit not recommend.
Connections: Girder/Column Connection	No Tier 2 procedure is available to demonstrate compliance of this component. Retrofit recommended based on the demand capacity ratio of the connection.

5.5.3 Non-structural Assessment Results Summary

Table 8 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

Table 8 Solids Processing Building: Non-structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Light Fixtures	Retrofit: Independently support light fixtures in suspended grid ceiling by a minimum of two wires.
Mechanical & Electrical Equipment: Deterioration	This component does not require analysis per ASCE 41-13. Repair of deterioration recommended.
Piping: Flexible Couplings	Retrofit: Provide flexible coupling at tees and pipe diameter transitions for fluid, and fire suppression piping located in the ground floor of the building.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Retrofit: Retrofit the anchoring system of equipment mounted on vibration isolators to be equipped with restraints or snubbers.
Piping: Fluid and Gas Piping Anchorage and Bracing	Retrofit: Anchor or brace fluid and gas piping to the structure to prevent breakage.

5.6 Grouped Buildings

5.6.1 Chemical Handling Facilities

5.6.1.1 Existing Structure Description

The Chemical Handling Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1988. The building is currently used as the electrical shop and does not serve its original purpose.

5.6.1.2 Structural Assessment Results Summary

The structural deficiencies identified in Tier 1 were further analyzed to determine the adequacy of the building shear walls, roof diaphragm, and wall to diaphragm connections. The results of the structural items analyzed using the Tier 2 procedures are listed in Table 9.

Table 9 Chemical Handling Facilities: Structural Findings
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Lateral –Force-Resisting System: Reinforcing Steel	Shears walls are adequate for the anticipated seismic hazard level. Retrofit not recommended.
Lateral –Force-Resisting System: Proportions	Shears walls are adequate for the anticipated seismic hazard level. Retrofit not recommended.
Diaphragm: Straight Sheathing	Shears walls are adequate for the anticipated seismic hazard level. Retrofit not recommended.
Connections: Wood Ledgers	The connection between the wall panels and diaphragm induces cross-grain bending. Retrofit wall-to-diaphragm connection using strap ties.

5.6.1.3 Non-structural Assessment Results Summary

Table 10 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

5.6.2 Maintenance Building

5.6.2.1 Existing Structure Description

The Maintenance Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1977. Record drawings were not available for review. Due to lack of information, and based on the similar building type, similarities in potential deficiencies identified in Tier 1, and because Chemical Handling Building identified more deficiencies, the adequacy of the Maintenance Building is grouped with the structural results of the Chemical Handling Building.

Table 10 Chemical Handling Facilities: Non-structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Building Contents and Furnishing: Tall Narrow Contents	Retrofit: Anchor contents over 6 feet in height to the floor slab or adjacent walls to prevent damage during an earthquake.
Mechanical & Electrical Equipment: Deterioration	This component does not require analysis per ASCE 41-13. Repair of deterioration recommended.
Piping: Fire Suppression Piping	Retrofit: Anchor fire suppression piping in accordance with NFPA-13.
Piping: Flexible Couplings	Retrofit: Provide flexible coupling at tees and pipe diameter transitions for fluid, and fire suppression piping.
Contents and Furnishing: Drawers	This component does not require analysis per ASCE 41-13. Recommendation: Drawers should be repaired to have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	This component does not require analysis per ASCE 41-13. Recommendation: Cabinets that are arranged in groups should be attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	This component does not require analysis per ASCE 41-13. Recommendation: Cabinet doors and drawers should be repaired to have latches to keep them closed during an earthquake.

5.6.2.2 Structural Assessment Results Summary

The structural deficiencies identified in Tier 1 were further analyzed to determine the adequacy of the building shear walls, roof diaphragm, and wall to diaphragm connections. The results of the Maintenance Building were grouped with the results of the Chemical Handling Building, and are summarized in Table 11.

5.6.2.3 Non-structural Assessment Results Summary

Table 12 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

Table 11 Maintenance Building: Structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Lateral-Force-Resisting System: Reinforcing Steel	Shear walls are adequate for the anticipated seismic hazard level. Retrofit not recommended.
Diaphragm: Spans	The diaphragm is adequate for the anticipated seismic hazard level. Retrofit not recommended.
Diaphragm: Straight Sheathing	The diaphragm is adequate for the anticipated seismic hazard level. Retrofit not recommended.
Connections: Wood Ledgers	The connection between the wall panels and diaphragm induces cross-grain bending. Retrofit wall-to-diaphragm connection using strap ties.

Table 12 Maintenance Building: Non-structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Mechanical & Electrical Equipment: Deterioration	This component does not require analysis per ASCE 41-13. Repair of deterioration recommended.
Piping: Fire Suppression Piping	Retrofit: Anchor fire suppression piping in accordance with NFPA-13.
Building Contents and Furnishing: Drawers	This component does not require analysis per ASCE 41-13. Recommendation: Drawers should be repaired to have latches to keep them closed during an earthquake.
Building Contents and Furnishing: File Cabinets	This component does not require analysis per ASCE 41-13. Recommendation: Cabinets that are arranged in groups should be attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	This component does not require analysis per ASCE 41-13. Recommendation: Cabinet doors and drawers should be repaired to have latches to keep them closed during an earthquake.

5.6.3 Collection System Maintenance Building

5.6.3.1 Existing Structure Description

The Collection System Maintenance Building is a reinforced masonry bearing walls building with a flexible diaphragm designed in 1988. A partial set of design drawings was available for review. The building is currently used as a maintenance building and houses staff offices. Based on the building type, similarities in potential deficiencies identified in Tier 1, and similar structural detailing specified on the design drawings, the adequacy of the Collection System Maintenance Building is grouped with the structural results of the Chemical Handling Building.

5.6.3.2 Structural Assessment Results Summary

The structural deficiencies identified in Tier 1 were further analyzed to determine the adequacy of the building shear walls, roof diaphragm, and wall to diaphragm connections. The results of the Collection System Maintenance Building is grouped with the results of the Chemical Handling Building, and are summarized in Table 13.

Table 13 Collection System Maintenance Building: Structural Findings
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Lateral –Force-Resisting System: Shear Stress Check	Shear walls are adequate for the anticipated seismic hazard level. Retrofit not recommend.
Lateral –Force-Resisting System: Reinforcing Steel	Shear walls are adequate for the anticipated seismic hazard level. Retrofit not recommend.
Diaphragm: Straight Sheathing	The diaphragm is adequate or the anticipated seismic hazard level. Retrofit not recommend.
Diaphragm: Diagonally Sheathed and Unblocked Diaphragms	The diaphragm is adequate for the anticipated seismic hazard level. Retrofit not recommend.
Connections: Wood Ledgers	The connection between the wall panels and diaphragm induces cross-grain bending. Retrofit wall-to-diaphragm connection using strap ties.

5.6.3.3 Non-structural Assessment Results Summary

Table 14 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

5.7 Administration Building

5.7.1 Existing Structure Description

The Administration Building is a wood framed building designed in 1975. The building is used as a laboratory and office space.

Table 14 Collection System Maintenance Building: Non-structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Light Fixtures: Emergency Lighting Anchorage	Retrofit: Upgrade emergency lighting anchorage to prevent failing or impact damage due to swaying during an earthquake.
Piping Fire Suppression Piping	Retrofit: Anchor fire suppression piping in accordance with NFPA-13.
Piping: Flexible Couplings	Retrofit: Provide flexible coupling at tees and pipe diameter transitions for fluid, and fire suppression piping located in the east room of the building.
Contents and Furnishing: Drawers	This component does not require analysis per ASCE 41-13. Recommendation: Drawers should be repaired to have latches to keep them closed during an earthquake.
Contents and Furnishing: File Cabinets	This component does not require analysis per ASCE 41-13. Recommendation: Cabinets that are arranged in groups should be attached to one another.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawer Locks	This component does not require analysis per ASCE 41-13. Recommendation: Cabinet doors and drawers should be repaired to have latches to keep them closed during an earthquake.
Ducts: Duct Bracing	Retrofit: Retrofit the anchoring system for rectangular ductworks to prevent failing or impact damage due to swaying during an earthquake.
Mechanical and Electrical Equipment: Vibration Isolators Restrained	Retrofit: Retrofit the anchoring system of equipment mounted on vibration isolators to be equipped with restraints or snubbers.

5.7.2 Structural Assessment Results Summary

The structural deficiencies identified in Tier 1 were further analyzed to determine the adequacy of the building shear walls. The results of the structural items analyzed using the Tier 2 procedures are listed in Table 15.

Table 15 Administration Building: Structural Findings Public Works Integrated Master Plan City of Oxnard	
Component	**Retrofit Action**
Lateral-Force-Resisting System: Shear Stress Check	Shear walls are adequate for the anticipated seismic hazard level. Retrofit not recommend.

5.7.3 Non-structural Assessment Results Summary

Table 16 summarizes non-structural deficiencies identified in Tier 1 evaluation that are recommended for retrofit.

Table 16 Administration Building: Non-structural Components
Public Works Integrated Master Plan
City of Oxnard

Component	Retrofit Action
Hazardous Material Storage and Distribution: Toxic Substances Lateral Bracing and Anchorage	Retrofit: Restrain toxic/hazardous substances stored in breakable containers to prevent from falling with means of latched doors, shelf clips, wires or other methods.
Light Fixtures: Independent Support	Retrofit: Independently support light fixtures in suspended grid ceiling by a minimum of two wires.
Mechanical & Electrical Equipment: Fall-pone Equipment	Retrofit: Mount equipment that is attached to the walls and weighs over 20 lbs.
Mechanical & Electrical Equipment: Deterioration	This component does not require analysis per ASCE 41-13.
Piping: Fire Suppression Piping	Retrofit: Anchor fire suppression piping in accordance with NFPA-13.
Building Contents and Furnishing: Drawers	This component does not require analysis per ASCE 41-13.
Building Contents and Furnishing: File Cabinets	This component does not require analysis per ASCE 41-13.
Building Contents and Furnishing: File Cabinets Attachments, Doors, and Drawers Locks	This component does not require analysis per ASCE 41-13.
Mechanical & Electrical Equipment: Electrical Equipment Bracing	Retrofit: Laterally brace and anchor electrical and mechanical equipment and associated wiring for the equipment located in the Mechanical and Electrical Equipment Room 129 on the second floor.

6.0 RECOMMENDED ACTIONS

Based on the Tier 2 evaluation results, a structural retrofit is recommended for the following structures:

- Chemical Handling Facilities.
- Maintenance Building.
- Collection System Maintenance Building.

Non-structural retrofits are recommended for the following structures:

- Headworks Building.
- Grit Screenings Building.
- Blower Building.
- North Area Electrical Building.
- Solids Processing Building.
- Chemical Handling Facilities.
- Maintenance Building.
- Collection System Maintenance Building.
- Administration Building.

7.0 CONCLUSION

Based on the Tier 2 evaluation results, structural and non-structural retrofits are recommended for the nine structures discussed in this memo. Project Memo 3.7.1 Alternatives Analysis outlines the cost estimates associated with the recommended structural and non-structural retrofits based on the results of the of the Tier 2 evaluation, and the general condition assessment of the buildings at OWTP.

8.0 REFERENCES

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APPENDIX C – PRELIMINARY STRUCTURAL SEISMIC ASSESSMENT OF BUILDINGS – STRUCTURAL AND NON-STRUCTURAL FINDINGS

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Headworks Building

3.7.9 Concrete Shear Walls with Stiff Diaphragms

Building System		Compliance
CONCRETE WALL CRACKS	All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1116 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)	C
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)	NC
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)	NA
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)	C
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)	NA
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)	NA
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)	NA

Headworks Building

		Compliance
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)	NA
TORSION	The estimated distance bt':tween 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)	C
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	NA
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)	NA
Connections		
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)	C
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)	C
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)	NA
REDUNDANCY	The number of lines of shear walls 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)	C

Headworks Building

		Compliance
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)	C
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)	C

3.7.9S Concrete Shear Walls with Stiff Diaphragms

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)	NA

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)	C
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)	NA
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)	NA
PLAN IRREGULARITIES	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)	NA

Lateral Force Resisting System

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 8db This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5)	NA
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 1350 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)	NA

Headworks Building

		Compliance
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 4.4.1.4.9, 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)	NA
FLAT SLABS	Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.6.3)	NA
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)	C
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)	C

Lateral Force Resisting SystemLateral Force Resisting System

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)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

Headworks Building

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

Headworks Building

		Compliance
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)	C
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	C
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

Headworks Building

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	C
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

Headworks Building

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	C

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

Headworks Building

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

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3.7.9 Concrete Shear Walls with Stiff Diaphragms

Building System		Compliance
CONCRETE WALL CRACKS	All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1116 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)	C
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)	NC
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)	C
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)	C
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)	C
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)	NA
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)	NA

		Compliance
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)	C
TORSION	The estimated distance bt':tween 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)	C
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	C
Connections		
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)	C
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)	C
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)	NA
REDUNDANCY	The number of lines of shear walls 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)	C

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		Compliance
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)	C
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)	C

3.7.9S Concrete Shear Walls with Stiff Diaphragms

		Compliance
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)	NA
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)	NA
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)	C
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)	C
PLAN IRREGULARITIES	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)	NA
Lateral Force Resisting System		
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 8db This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5)	NA
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 1350 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)	NA

		Compliance
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 4.4.1.4.9, 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)	NA
FLAT SLABS	Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.6.3)	BA
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)	C
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)	C
Lateral Force Resisting SystemLateral Force Resisting System		
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)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA
Hazardous Materials Storage and Distribution		
Toxic Substances Lateral Bracing and Anchorage	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)	C

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	NC
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	C
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	C
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	C

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		Compliance
Stairs		
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)	C
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)	C

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

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		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	C
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	C
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	C

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	C
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

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		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

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3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System		Compliance
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)	C
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)	NC
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)	C
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	NC
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	NC
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)	C
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)	NA

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		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	C

Connections

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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	C

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	C

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	C
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)	NA
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	C
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	NA
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	NC

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	NC
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	C

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	C

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	C
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	C
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NC
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	C
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	C
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. (Tier 2: Sec. 4.8.3.2)	NA

Primary Sedimentation Building

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NC
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	C

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3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System		Compliance
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)	C
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)	NC
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)	C
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	NA
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)	NA

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		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	NC

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		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	C

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	NA
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	NA
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

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		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	C

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

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		Compliance
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)	C
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

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		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	C
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

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		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA

Metal Stud Back-Up Systems

Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C

Parapets, Cornices, Ornamentation, and Appendages

Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

Partitions

Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Main Switch Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

Main Switch Building

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

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Structural and Non-Structural Findings

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3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System		Compliance
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)	C
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)	C
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)	NA
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	NA
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)	NA

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		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	C

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		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	C

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	C
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	C
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)	C
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	C
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NA

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

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3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

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		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	NC
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

Blower Building

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C

Parapets, Cornices, Ornamentation, and Appendages

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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA

Partitions

Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA

Piping

Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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Stairs

		Compliance
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

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		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	NA
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

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		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NC
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

Blower Building

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA

Metal Stud Back-Up Systems

Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C

Parapets, Cornices, Ornamentation, and Appendages

Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

Partitions

Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Blower Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

Blower Building

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

North Area Electrical Building

Compliance

3.7.9 Concrete Shear Walls with Stiff Diaphragms

Building System

CONCRETE WALL CRACKS	All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1116 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)	C
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)	C
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)	C
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)	C
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)	NA
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)	NA
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)	NA

		Compliance
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)	NA
TORSION	The estimated distance bt':tween 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)	C
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
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)	C
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)	NA
REDUNDANCY	The number of lines of shear walls 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)	C

		Compliance
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)	C
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)	C

3.7.9S Concrete Shear Walls with Stiff Diaphragms

		Compliance
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)	NA
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)	C
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)	NA
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)	NA
PLAN IRREGULARITIES	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)	NA
Lateral Force Resisting System		
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 8db This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.2.5)	NA
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 1350 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)	NA

		Compliance
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 4.4.1.4.9, 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)	C
FLAT SLABS	Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.1.6.3)	NA
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)	C
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)	C

Lateral Force Resisting SystemLateral Force Resisting System

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)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	C
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	C
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	C
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	C
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	NA
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	C
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	C
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NA

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	NA
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	C
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NS
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. (Tier 2: Sec. 4.8.3.2)	C

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

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Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	NC
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)	C
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	NC
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)	C
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)	NA

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		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	NC

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		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	C

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	NA
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	C
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)	NA
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	C
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	C

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	NA
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NA

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NC
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

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		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NC
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

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Compliance

3.7.14 Reinforced Masonry Bearing Walls with Stiff Diaphragms

Building 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)	C
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)	C
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	C
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)	C
REINFORCED MASONRY WALL CRACKS	All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1116 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.10)	C

		Compliance
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)	NA
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)	C
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	C
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	NC
TOPPING SLAB TO WALLS OR FRAMES	Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety, and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy. (Tier 2: Sec. 4.6.2.3)	NA
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)	C

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		Compliance
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: Sec. 4.6.1.1)	C
Diaphragms		
TOPPING SLAB	Precast concrete diaphragm elements shall be interconnected by a continuous reinforced concrete topping slab. (Tier 2: Sec. 4.5.5.1)	NA
Lateral Force Resisting System		
REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	NC

3.7.14S Reinforced Masonry Bearing Walls with Stiff Diaphragms

		Compliance
Diaphragms		
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)	C
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4. feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	C
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
Lateral Force Resisting System		
PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
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)	C
Masonry Bearing Walls with Stiff Diaphragms		
PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
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)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	C
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NC
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	TBD
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	C
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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		Compliance
Stairs		
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)	NA
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)	NA

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3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	C

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		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NC

Metal Stud Back-Up Systems

Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C

Parapets, Cornices, Ornamentation, and Appendages

Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	C
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

Partitions

Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	NC
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	C
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NC

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		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	C
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Plant Control Center Building

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	NA
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)	NC
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)	NC
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	NC
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)	C
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)	NA

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	NC
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	NC
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)	NC
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: Sec. 4.6.1.1)	NC

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	NC

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	NC
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	NA
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	N/A
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)	NA
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)	NA
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	NC

		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	C
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	C
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

Plant Control Center Building

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	C
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	C

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	C
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	NC
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NA

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NC
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Plant Control Center Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	C
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	C

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NC
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Effluent Pump Station (EPS) Structure

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	NC
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)	NA
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	NC
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	NC
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)	NA
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)	NA

Effluent Pump Station (EPS) Structure

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	NC
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	NA
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)	NA
Connections		
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)	NC
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	NC
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)	NC
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: Sec. 4.6.1.1)	NC

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	NC

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	NC

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	NC
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	NC
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	NA
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	NC

Effluent Pump Station (EPS) Structure

		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	NC
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	NC
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	NA
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

Effluent Pump Station (EPS) Structure		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA
Hazardous Materials Storage and Distribution		
Toxic Substances Lateral Bracing and Anchorage	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)	NA

Effluent Pump Station (EPS) Structure

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

Effluent Pump Station (EPS) Structure

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

Effluent Pump Station (EPS) Structure

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NC
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	C
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NA

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NC
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Effluent Pump Station (EPS) Structure

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

Effluent Pump Station (EPS) Structure

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NC
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Co-Generation Building

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	NC
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)	NA
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	NC
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)	C
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)	C

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	C
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	C
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	C

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	C

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	C
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	C
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	C
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)	C
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	C
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA
Hazardous Materials Storage and Distribution		
Toxic Substances Lateral Bracing and Anchorage	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)	C

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	C
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NC
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	C
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	C
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	C

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	C
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NC
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	C
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	C
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NC
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NC
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Co-Generation Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	C
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	C

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Maintenance Building

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	NC
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)	NA
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	NA
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)	NA

Maintenance Building

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	NC
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	NC
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)	NC
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: Sec. 4.6.1.1)	NC

Maintenance Building

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	NC

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	NC
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	C
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	NC

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	NC
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	NC
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NC
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)	NC
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	NC

Maintenance Building

		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	NC
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	NC
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	NC

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	C
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

Maintenance Building

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

Maintenance Building

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

Maintenance Building

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

Maintenance Building

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	C

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Maintenance Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

Maintenance Building		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	C
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	C
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

Maintenance Building

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Collection System Maintenance Building

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	C
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)	C
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	NA
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)	NA

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	C

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	NC

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	NC

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	C
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)	C
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	C
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

Collection System Maintenance Building

		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	NC
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	NC

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	C
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	NC
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. 4.8.3.1)	C
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	NA

		Compliance
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)	NA
Emergency Power Mounting	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)	NA
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	C
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NC
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	C
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	C
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	NA
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Collection System Maintenance Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	C
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Chemical Handling Building

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	C
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)	C
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	NA
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)	NA

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	C

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	NC

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	C

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	C
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)	C
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	NA
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	NC
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NA

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	C
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	NC
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	NA
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Chemical Handling Building

Piping

		Compliance
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Vacuum Filter Building

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System		Compliance
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)	C
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)	NC
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)	NA
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	NC
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	NC
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)	NA
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)	NA

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	NC
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	NC
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	NC
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)	NC
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: Sec. 4.6.1.1)	NC

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	NC

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	NC
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	NC

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	NC
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	NC
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)	NC
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NC
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)	NC
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	NC

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		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	NC
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NC

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	NC
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	NC

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	NC
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

Vacuum Filter Building

		Compliance
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)	NC
Emergency Power Mounting	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)	NA
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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Stairs

		Compliance
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

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		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	NA
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	C
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NA

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		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	NC
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	C

Vacuum Filter Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

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		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

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3.7.5 Steel Light Frames

		Compliance
Buiding System		
TORSION	The estimated distance between the story center of mass and the story center of rigidity shall be less 20 percent of the building width in either plan dimension for Life Safety and Immediate Occupancy	NC
Building System		
DETERIORATION OF STEEL	There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical-or lateral-force-resisting systems	NC
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	C
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	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation	C
Connections		
ROOF PANELS	Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist sesimic forces for Life Safety and Immediate Occupancy	C
STEEL COLUMNS	The columns in lateral-force-resisting frames ahll be anchored to the building foundation for Life Safety, and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy	NA

Butler Building

		Compliance
TRANSFER OF STEEL FRAMES	Diaphragms shall be connected for transfer of load to the steel frames for Life Safety, and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy	C
WALL PANELS	Metal, fiberglass, or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy	C
WALL PANELS	Metal, fiberglass, or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy	C

Lateral-Force-Resisting System

AXIAL STRESS CHECK	The axial stress in the diagonals, calculated using the Quick Check procedure of Section 3.5.3.4, shall be less than 0.50Fy for Life Safety and for Immediate Occupancy	NC

3.7.5S Steel Light Frames

		Compliance
Connections		
UPLIFT AT PILE CAPS	Pile caps shall have reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy	NA
Diaphragms		
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	NA
OTHER DIAPHRAGMS	The diaphragm shall not consist of a system other than wood, metal deck, concrete, or horizontal bracing	C
PLAN IRREGULARITIES	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	C
Lateral-Force-Resisting System		
BEAM PENETRATIONS	All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only	NA
BOTTOM FLANGE BRACING	The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only	NA
COMPACT MEMBERS	All frame elements shall meet section requirements set forth by Seismic Provisions for Structural Steel Building Table 1-91	NA
MOMENT-RESISTING CONNECTIONS	All moment connections shall be able to develop the strength of the adjoining members or panel zones	NA
OUT-OF-PLANE BRACING	Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only	NA

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	NC
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

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		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NA

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		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	NC

		Compliance
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)	NC
Emergency Power Mounting	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)	NA
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NA
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NA

		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

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		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	NA
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NA

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		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	NC
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	NA
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	NA
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

16 kW SWGR Building/Effluent PS VFD Building

Compliance

3.7.13 Reinforced Masonry Bearing Walls with Flexible Diaphragms

Building System

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)	C
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)	C
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)	NA
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)	C
MASONRY JOINTS	The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	C
MASONRY UNITS	There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	C
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)	NA
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)	NA

		Compliance
REINFORCED MASONRY 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. 4.3.3.10)	C
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C
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)	NA
Connections		
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)	C
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
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)	C
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: Sec. 4.6.1.1)	C

		Compliance
WOOD LEDGERS	The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	C

Lateral Force Resisting System

REDUNDANCY	The number of lines of shear walls 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)	C
REINFORCING STEEL	The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	NC
SHEAR STRESS CHECK	The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	NC

3.7.13S Reinforced Masonry Bearing Walls with Flexible Diaphragms

		Compliance
Connections		
STIFFNESS OF WALL ANCHORS	Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	C
Diaphragms		
CROSS TIES	There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	C
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)	C
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-l. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	NA
OPENINGS AT EXTERIOR MASONRY SHEAR WALLS	Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: Sec. 4.5.1.6)	NA
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)	C
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)	C
PLAN IRREGULARITIES	There shall be tensile capacity to develop the strength of the diaphragm at re-entrant comers or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	NA
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)	C

		Compliance
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-1 for Life Safety and 3-to-l for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NA

Lateral Force Resisting System

PROPORTIONS	The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.4)	NC
REINFORCING AT OPENINGS	All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	NA
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)	NA
Supporting Partitions	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. 4.8.2.1)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NS

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	NC
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. 4.8.3.1)	NA
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	C

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

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		Compliance
Stairs		
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)	NA
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)	NA

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	NA
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NA
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	NA
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NA
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NA
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	NA
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	NA
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	NA

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	NA
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	NA
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	NA
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NC
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

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		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	NA
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)	NA
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NA

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

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Structural and Non-Structural Findings

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3.7.2 Wood Frames, Commercial and Industrial

Building System

		Compliance
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)	NC
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)	N
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)	C
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)	NA
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)	NA
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)	NA
VERTICAL DISCONTINUITIES	All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	C

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		Compliance
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)	NA
WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS	There shall be no more than 15 percent of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.3.3.2)	C
Connections		
GIRDER/COLUMN CONNECTION	There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	C
WOOD POSTS	There shall be a positive connection of wood posts to the foundation. (Tier 2: Sec. 4.6.3.3)	C
WOOD SILLS	All wood sills shall be bolted to the foundation. (Tier 2: Sec. 4.6.3.4)	C
Lateral Force Resisting System		
SHEAR STRESS CHECK	The shear stress in the shear wall, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the following values for Life Safety and Immediate Occupancy (Tier 2: Sec. 4.4.2.7.1): Structural panel sheathing 1,000 plf, Diagonal sheathing 700 plf, Straight shthing 100 plf. All other conditions 100 plf	NC
Lateral-Force-Resisting System		
CRIPPLE WALLS	Cripple walls below first-floor-level shear walls shall be braced to the foundation with wood structural panels. (Tier 2: Sec. 4.4.2.7.7)	NA
GYPSUM WALLBOARD OR PLASTER SHEAR WALLS	Interior plaster or gypsum wallboard shall not be used as shear walls on buildings over one story in height with the exception of the uppermost level of a multi-story building. (Tier 2: Sec. 4.4.2.7.3)	C

Administration Building

		Compliance
HILLSIDE SITE	For structures that are taller on at least one side by more than one-half story due to a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1-to-1 for Life Safety and 1-to-2 for Immediate Occupancy. (Tier 2: Sec. 4.4.2.7.6)	NA
NARROW WOOD SHEAR WALLS	Narrow wood shear walls with an aspect ratio greater than 2-to-1 for Life Safety and 1.5-to-1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of moderate and high seismicity. Narrow wood shear walls with an aspect ratio greater than 2-to-1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of low seismicity. (Tier 2: Sec. 4.4.2.7.4)	NA
OPENINGS	Walls with openings greater than 80 percent of the length shall be braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or shall be supported by adjacent construction through positive ties capable of transferring the lateral forces. (Tier 2: Sec. 4.4.2.7.8)	NA
REDUNDANCY	The number of lines of shear walls 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)	C
STUCCO (EXTERIOR PLASTER) SHEAR WALLS	Multi-story buildings shall not rely on exterior stucco walls as the primary lateral-force-resisting system. (Tier 2: Sec. 4.4.2.7.2)	C
WALLS CONNECTED THROUGH FLOORS	Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor. (Tier 2: Sec. 4.4.2.7.5)	C

3.7.2S Wood Frames, Commercial and Industrial

		Compliance
Connections		
WOOD SILL BOLTS	Sill bolts shall be spaced at 6 feet or less for Life Safety and 4 feet or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete. (Tier 2: Sec. 4.6.3.9)	C
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)	C
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)	C
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)	C
PLAN IRREGULARITIES	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)	NA
ROOF CHORD CONTINUITY	All chord elements shall be continuous, regardless of changes in roof elevation. (Tier 2: Sec. 4.5.1.3)	NA
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. Wood commercial and industrial buildings may have rod-braced systems. (Tier 2: Sec. 4.5.2.2)	C
STRAIGHT SHEATHING	All straight sheathed diaphragms shall have aspect 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)	C
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-l for Life Safety and 3-to-1 for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	NA

		Compliance
Lateral-Force-Resisting System		
HOLD-DOWN ANCHORS	All shear walls shall have hold-down anchors constructed per acceptable construction practices, attached to the end studs. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.7.9)	C

3.9.1 Basic Nonstructural Component Checklist

		Compliance
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)	C
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exits and corridors or weighing more than 2 lb/ft^2 shall be laterally restrained by a minimum of 4 diagonal wires or rigid members attached to the structure above at a spacing equal to or less than 12 ft (Tier 2: Sec. 4.8.2.1)	C
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)	C
Supporting Partitions	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. 4.8.2.1)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached for each 10 square feet of area (Tier 2: Sec. 4.8.2.4)	NA
Cladding and Glazing		
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)	NA
Cladding Anchorage	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 the Basic Nonstructural Component checklist is required by Table 3-2 (Tier 2: Sec. 4.8.4.1)	NA
Cladding Isolation	For moment frame buildings of steel or concrete, panel connections shall be detailed to accommodate a drift ratio of 0.02 for Life Safety and 0.01for Immediate Occupancy (Tier 2: Sec. 4.8.4.2)	NA

		Compliance
Connections Out of Plane	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 Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.4.7)	NA
Damage	There shall be no damage to exterior wall cladding. (Tier 4.8.4.8)	NA
Deterioration in Connections	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.4.2)	NA
Drift 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)	NA
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 be laminated, annealed, or heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.9)	NA
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)	NA
Multi-Story Panels Drift	For multi-story panels attached at each floor level, panel connections shall be detailed to accommodate a story drift ratio of 0.02 and 0.01 for immediate occupancy. Panel connection detailing for a story drift ratio (Tier 2: Sec. 4.8.4.4)	NA
Panel Connections	Exterior cladding panels shall be anchored with a minimum of 2 connections for each wall panel for Life Safety and 4 connections for Immediate Occupancy. (Tier 2: Sec. 4.8.4.6)	NA

Hazardous Materials Storage and Distribution

Toxic Substances Lateral Bracing and Anchorage	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)	NC

Administration Building

		Compliance
Light Fixtures		
Emergency Lighting Anchorage	Emergency lighting shall be anchored or braced to prevent falling or swaying during an earthquake. (Tier 2: Sec. 4.8.3.2)	C
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. 4.8.3.1)	NC
Masonry Chimneys		
Urm Chimneys	No reinforced masonry chimney shall extend above the roof surface more than twice the least dimension of the chimney. A height above the roof surface of 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)	NA
Masonry Veneer		
Deterioration	There shall be no evidence of deterioration, damage or corrosion in any of the connection elements. (Tier 2: Sec. 4.8.5.4)	NA
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)	NA
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)	NA
Weakened Planes	Masonry veneer shall be anchored to the back-up adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 4.8.5.3)	NA
Mechanical and Electrical Equipment		
Attached Equipment	Equipment weighting over 20 lb that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be mounted. (Tier 2: Sec 4.8.12.2)	NC

		Compliance
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)	NC
Emergency Power Mounting	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)	C
Hazardous Material Equipment	HVAC or other equipment containing hazardous material shall not have damaged supply lines or unbraced isolation supports. (Tier 2: Sec. 4.8.12.2)	C
Parapets, Cornices, Ornamentation, and Appendages		
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 the Basic Nonstructural Component Checklist is required by Table 3-2. (Tier 2: Sec. 4.8.8.2)	NA
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)	NA
Partitions		
Unreinforced Masonry Bracing	Unreinforced masonry or hollow clay tile partitions shall be braded at a 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)	NA
Piping		
Fire Suppression Piping	Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). (Tier 2: Sec. 4.8.13.1)	NC
Flexible Couplings	Fluid, gas, and fire suppression piping shall have flexible couplings. (Tier 2: Sec. 4.8.13.2)	NC

Administration Building

		Compliance
Stairs		
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)	NA
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)	C

3.9.1S Supplemental Nonstructural Component Checklist

		Compliance
Building Contents and Furnishing		
Access Floor Anchorage	Access floors over 9 inches in height shall be braced. (Tier 2: Sec. 4.8.11.4)	C
Drawers	Cabinet drawers shall have latches to keep them closed during an earthquake (Tier 2: Sec 4.8.11.3)	NC
Equipment Bracing and Anchorage to Access Floors	Equipment and computers supported on access floor systems shall be either attached to the structure or fastened to a laterally braced floor system. (Tier 2: Sec. 4.8.11.5)	C
File Cabinets	File cabinets arranged in groups shall be attached to one another. (Tier 2: Sec. 4.8.11.2)	NC
File Cabinets Attachments, Doors, and Drawer Locks	Cabinet doors and drawers shall have latches to keep them closed during an earthquake. (Tier 2: Sec. 4.8.11.3)	NC
Ceiling Systems		
Edges Separation	The edges of integrated suspended ceilings shall be separated from enclosing walls by a minimum of 1/2 inch. (Tier 2: Sec. 4.8.2.5)	C
Seismic Joint	The ceiling system shall not extend continuously across any seismic joint. (Tier 2: Sec. 4.8.2.6)	C
Cladding and Glazing		
Safety Glass	All exterior glazing 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. 4.8.4.9)	NA
Concrete Block and Masonry Back-Up Systems		
Anchorage	Back-up shall have a positive anchorage to the structural framing at a spacing equal to or less than 4 feet along the floors and roof. (Tier 2: Sec. 4.8.7.1)	NA
Concrete Block	Concrete block shall qualify as reinforced masonry (Tier 2: Sec. 4.8.7.1)	C

		Compliance
Urm Back-Up	There shall be no unreinforced masonry back-up. (Tier 2: Sec. 4.8.7.2)	NA
Ducts		
Duct Bracing	Rectangular ductwork exceeding 6 square feet in cross-sectional area, and round ducts exceeding 28 inches in diameter, shall be braced. Maximum spacing of transverse bracing shall not exceed 30 feet. Maximum spacing of longitudinal bracing shall not exceed 60 feet. Intermediate supports shall not be considered part of the lateral-force resisting system. (Tier 2: Sec. 4.8.14.2)	C
Duct Supports	Ducts shall not be supported by piping or electrical conduit. (Tier 2: Sec. 4.8.14.3)	C
Stair and Smoke Duct Bracing	Stair pressurization and smoke flow of gas and high temperature energy in the event of an earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	NA
Elevators		
Brackets	The brackets that tie the car rails and the counterweight rail to the building structure shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.7)	NA
Counterweight Rails	All counterweight rails and divider beams shall be sized in accordance with ASME A17.1. (Tier 2: Sec. 4.8.16.6)	NA
Go-Slow Elevators	The building shall have a go-slow elevator system. (Tier 2: Sec. 4.8.16.9)	NA
Retainer Guards	Cable retainer guards on sheaves and drums shall be present to inhibit the displacement of cables. (Tier 2: Sec. 4.8.16.4)	NA
Retainer Plate	A retainer plate shall be present at the top and bottom of both car and counterweight. (Tier 2: Sec. 4.8.16.5)	NA
Seismic Switch	All elevators shall be equipped with seismic switches that will terminate operations when the ground motion exceeds 0.10g. (Tier 2: Sec. 4.8.16.2)	NA
Shaft Walls	All elevator shaft walls shall be anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 4.8.16.3)	NA

		Compliance
Spreader Bracket	Spreader brackets shall not be used to resist seismic forces. (Tier 2: Sec. 4.8.16.8)	NA
Support System	All elements of the elevator system shall be anchored. (Tier 2: Sec. 4.8.16.1)	NA
Hazardous Materials Storage and Distribution		
Gas Cylinder Restraints	Compressed gas-cylinders shall be restrained. (Tier 2: Sec. 4.8.15.2)	NA
Hazardous Materials Shutoff Valves	Piping containing hazardous materials shall have shut-off valves or other devices to prevent major spills or leaks. (Tier 2: Sec. 4.8.16.4)	C
Light Fixtures		
Lens Covers	Lens covers on light fixtures shall be attached or supplied with safety devices. (Tier 2: Sec. 4.8.3.4)	C
Pendant Supports	Light fixtures on pendant supports shall be attached at a spacing equal to or less than 6 feet and, if rigidly, supported, shall be free to move with the structure to which they are attached without damaging adjoining materials. (Tier 2: Sec. 4.8.3.3)	NA
Masonry Veneer		
Mortar	The mortar in masonry veneer shall not be easily scraped away from the joints by hand with a metal tool, and there shall not be significant areas of eroded mortar. (Tier 2: Sec. 4.8.5.5)	NA
Stone Cracks	There shall be no visible cracks or signs of visible distortion in the stone. (Tier 2: Sec. 4.8.5.7)	NA
Weep Holes	In veneer braced by stud walls, functioning weep holes and base flashing shall be present. (Tier 2: Sec. 4.8.5.6)	NA
Mechanical and Electrical Equipment		
Door Drift Allowance	Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 4.8.12.8)	NA
Electrical Equipment Bracing	Electrical equipment and associated wiring shall be laterally braced to the structural system. (Tier 2: Sec. 4.8.12.7)	NC

		Compliance
Heavy Equipment Anchorage	Equipment weighing over 100 pounds shall be anchored to the structure or foundation. (Tier 2: Sec. 4.8.12.6)	C
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Metal Stud Back-Up Systems		
Openings	Steel studs shall frame window and door openings. (Tier 2: Sec. 4.8.6.2)	C
Stud Tracks	Stud tracks shall be fastened to structural framing at a spacing equal to or less than 24 inches on center. (Tier 2: Sec. 4.8.6.1)	C
Parapets, Cornices, Ornamentation, and Appendages		
Appendages	Cornices, parapets, signs, and other appendages that extend above the highest anchorage level 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. f4.8.8.4)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA
Partitions		
Drift Allowance	Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.02 in steel moment frame, concrete moment frame, and wood frame buildings. Rigid cementitious partitions shall be detailed to accommodate a drift ratio of 0.005 in other buildings. (Tier 2: Sec. 4.8.1.2)	NA
Lateral Bracing for Tops	The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet. (Tier 2: Sec. 4.8.1.4)	NA
Seismic Control Joints	Partitions at structural separations shall have seismic or control joints. (Tier 2: Sec. 4.8.1.3)	NA

Administration Building

		Compliance
Piping		
C-Clamps	One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained. (Tier 2: Sec. 4.8.13.5)	C
Fluid and Gas Piping Anchorage and Bracing	Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping. (Tier 2: Sec 4.8.13.3)	C
Shut-Off Valves	Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure. (Tier 2: Sec. 4.8.13.4)	C

3.9.2 Intermediate Nonstructural Component Checklist

		Compliance
Ceiling Systems		
Integrated Ceilings	Integrated suspended ceilings at exists 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. 4.8.2.3)	C
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)	C
Suspended Lath and Plaster	Ceilings consisting of suspended lath and plaster or gypsum board shall be attached to resist seismic forced for every 12 square feet of area. (Tier 2: Sec. 4.8.2.4)	NA
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 an exterior walking surface shall be laminated, annealed, or laminated heat strengthened safety glass that will remain in the frame when cracked (Tier 2: Sec. 4.8.4.8)	NA
Laminated Safety Glass	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 an 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)	NA
Ducts		
Stair and Smoke Duct Bracing	Stair pressurization and smoke control ducts shall be braced and shall have flexible connections at seismic joints. (Tier 2: Sec. 4.8.14.1)	NA
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. (Tier 2: Sec. 4.8.3.2)	NC

		Compliance
Masonry Chimneys		
Anchorage	Masonry chimneys shall be anchored at each floor level and the roof. (Tier 2: Sec. 4.8.9.2)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)	NA
Mechanical and Electrical Equipment		
Vibration Isolators Restrained	Equipment mounted on vibration isolators shall be equipped with restraints or snubbers. (Tier 2: Sec. 4.8.12.4)	NA
Parapets, Cornices, Ornamentation, and Appendages		
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)	NA
Concrete Parapets	Concrete parapets with height-to-thickness ratios greater than 2.5 shall have vertical reinforcement. (Tier 2: Sec. 4.8.8.3)	NA

ASCE31 Tier 1 Seismic Screening
Structural and Non-Structural Findings

Oxnard WTP

Compliance

3.8 Geologic Site Hazards and Foundations Checklist

Capacity of Foundations

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)	NA
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 0.6Sa• (Tier 2: Sec. 4.7.3.2)	C
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)	NA
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)	C
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)	C

Condition of Foundations

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)	C
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)	C

Geologic Site Hazards

		Compliance
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)	NA
SLOPE FAILURE	The buildin£ site shall be sufficiently remote from potential earthquakeinduced 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)	NC
SURFACE FAULT RUPTURE	Surface fault rupture and surface displacement at the building site is not anticipated. (Tier 2: Sec. 4.7.1.3)	NC

APPENDIX D – OXNARD WASTEWATER TREATMENT PLANT CONCRETE BASINS-CONDITION ASSESSMENT

OXNARD WASTEWATER TREATMENT PLANT
CONCRETE BASINS – CONDITION ASSESSMENT

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V&A Project No. 14-0195 T04

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ES EXECUTIVE SUMMARY

V&A Consulting Engineers, Inc. (V&A) was retained by Carollo Engineers to perform a condition assessment of five concrete basins at the Oxnard Wastewater Treatment Plant (OWTP) in Oxnard, California. The purpose of this project was to perform a condition assessment to aid Carollo and the City of Oxnard (City) in determining if the structures are adequate for another 30 years of service life. The focus of the assessment activities was to conduct confined-space-entry evaluations of the interior concrete surfaces of the selected basins.

Condition assessment methods included visual and qualitative evaluation and core sampling. Core samples were drilled and removed from each structure entered. Core samples were tested for compressive strength, carbonation depth, and chloride contamination depth, and used for petrographic analysis. Additional techniques included surface pH measurements, soundings, and scanning of the reinforcing steel depth and spacing using surface penetrating radar (SPR).

The structures selected for entry and evaluation were the following:

- Activated Sludge Tank (AST) 1B.
- Primary Clarifier (PC) 1.
- Secondary Sedimentation Tank (SST) 2.
- The South Chlorine Contact Chamber (CCC).
- The West Flow Equalization Basin (FEB).

Some of the other ASTs, SSTs, and PCs, as well as the East FEB, were also documented from topside. The majority of the evaluation was performed during the first site visit on January 13 and 14, 2015. During the first site visit, the South CCC was evaluated from topside. A second site visit was conducted on February 26, 2015, in order to conduct a confined space entry for further evaluation of the South CCC.

Conclusions

Based on the information gathered during the condition assessment, V&A presents the following conclusions.

West Flow Equalization Basin

- **Core samples** – Core samples were collected from the west wall and floor of the West FEB. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.45 inches at the sample locations. However, the minimum reinforcing steel depth was much less at the scan locations on the north and east walls, so the steel may be subject to corrosion there if the carbonation depth is similar.
  - Chloride testing indicated that the reinforcing steel may be subject to corrosion at the west wall sample location. Due to the lower reinforcing steel depth on the north and east walls, the steel may also be subject to corrosion there if the chloride contamination depth is similar.
  - Compressive strength of the west wall and floor core samples was 8,240 and 5,360 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the West FEB floor. The water-cement ratio of the sample was estimated at 0.45, which is equal to the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.
- **Surface penetrating radar** – Scans were conducted on the west, north, and east walls as well as the floor. The depth of concrete cover over the reinforcing steel in many locations was significantly less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 0.4 inches, on the east wall near an area of visible spalling.
- **Concrete surfaces** – In general, the concrete interior surfaces of the West FEB were in good condition. The concrete surfaces, particularly the floor, showed generalized shrinkage cracking. Soundings in the West FEB generally indicated sound, hard concrete. There were several areas where minor or moderate defects or evidence of deterioration was observed. As a result of the number and frequency of these observations, the West FEB is rated VANDA Level 2 for concrete condition. Specific observations include the following:
  - Construction joints on the west wall typically had a concrete mortar overlay that was spalling or loose in many places. Over a length of approximately 50 feet near the midpoint of the wall, there was a horizontal reinforcing bar running along the joint with very little concrete cover, and it was exposed in some locations.
  - The sealant at the expansion joints is generally cracked and split, although it is still somewhat pliable. In some places, sections of the sealant are missing or there are weeds growing out of the gaps. A few locations exhibited minor spalling of the concrete adjacent to the expansion joints.

- The east and west walls exhibited minor exposed aggregate in some locations. Surface defects such as bug holes and apparent rock pockets were also observed.
- There was minor vertical cracking in the south wall. The wall along the ramp was cracked in a few locations, possibly through its entire thickness.
- The walls of the West FEB exhibited spalling in isolated locations. Most of these were small, individual spalls. There was a pattern of spalling over the vertical bars in the east wall. There was also one diagonal bar visible through a spalled area a few feet in length near the top of the west wall.
- The columns holding up the ramp and platform at the north end of the basin exhibited minor areas of exposed aggregate. One of the columns had a small gouge on one of the corners. The tapered concrete collar at the base of some columns was broken and hollow-sounding.

- **Additional observations –** A few additional observations were noted in the West FEB:
  - There is a ductile iron pipe near the south wall that exhibits signs of coating failure and corrosion, particularly on the coupling hardware and supports.
  - The wall along the ramp leading into the FEB is only about 18 inches high, which poses a fall hazard for personnel walking near the edge.

Secondary Sedimentation Tank 2

- **Core samples –** Core samples were collected from the north wall and floor of SST 2. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.40 inches at the sample locations. The reinforcement depth was similar or greater at the scan locations on the east and south walls, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.
  - Based on the chloride testing results, there is chloride contamination at the surface and decreasing with depth into the concrete. The chloride contamination is not above the given threshold of 0.025% at the reinforcing steel depth, but this threshold may vary based on other factors. Corrosion of the reinforcing steel may be a future concern if this contamination continues. There may also be locations within the structure where the reinforcing steel cover depth is less or the chloride contamination depth is greater.
  - Compressive strength of the north wall and floor core samples was 6,940 and 4,270 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the north wall of SST 2. The water-cement ratio of the sample was estimated at 0.43, which is below the maximum

water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.

- **Surface penetrating radar** – Scans were conducted on the north, east, and south walls as well as the floor. The depth of concrete cover over the reinforcing steel in some locations was somewhat less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 1.7 inches.
- **Concrete surfaces** – In general, the concrete interior surfaces of SST 2 were in good condition and are rated VANDA Level 1 for concrete condition. There were several areas where minor defects or evidence of deterioration was observed. These are presently minor issues, but they may accelerate future deterioration of the structure. Specific observations include the following:
  - Cracking was observed in many locations within SST 2, including cracks in the slab overhanging the west end of the basin, vertical cracks along the length of the north wall, hairline cracks in some other locations, and general cracking in some areas of the floor. The cracks in the slab at the west end had begun to separate slightly. There was possible groundwater infiltration from the floor cracking in one location.
  - The sealant at the expansion joints is in fair condition, with some signs of brittleness and shrinkage. The expansion joint near the west end of the basin exhibited gaps and possible groundwater infiltration.
  - There is a gap between the east wall and the fill concrete at the bottom of the wall. The fill concrete becomes thin near the toe, due to its circular concave surface, and it is irregular and possibly broken in this area.
- **Additional observations** – There was evidence of coating failure and minor surface corrosion on the metallic appurtenances within SST 2.

Activated Sludge Tank 1B

- **Core samples** – Core samples were collected from the west wall and floor of AST 1B. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.50 inches at the sample locations. The reinforcement depth was similar or greater at the scan locations on the north and east walls, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.
  - Based on the chloride testing results, there is chloride contamination at the surface and decreasing with depth into the concrete. The chloride contamination is not above the given threshold of 0.025% at the reinforcing steel depth, but this threshold may vary based on other factors. Corrosion of the reinforcing steel may be a future concern if this

contamination continues. There may also be locations within the structure where the reinforcing steel cover depth is less or the chloride contamination depth is greater.

  - Compressive strength of the west wall and floor core samples was 6,920 and 6,270 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the AST 1B floor. The water-cement ratio of the sample was estimated at 0.45, which is equal to the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.

- **Surface penetrating radar** – Scans were conducted on the west, north, and east walls as well as the floor. The minimum depth of cover at the floor scan location was slightly less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 1.8 inches.
- **Concrete surfaces** – In general, the concrete interior surfaces of AST 1B were in good condition and are rated VANDA Level 1 for concrete condition. There were several areas where minor defects or evidence of deterioration was observed. These are presently minor issues, but they may accelerate future deterioration of the structure. Some of these locations were rated VANDA Level 2. Specific observations include the following:
  - Cracking was observed in many locations within AST 1B, including minor cracks in the floor, west wall, and walkways. There was also cracking in the top of the east wall. The concrete appeared to be loose in some of these areas, and one location may have been repaired previously. The ends of the reinforcing bars were also visible at the top of the east wall. The top of the east wall is rated VANDA Level 2 for concrete condition.
  - There were several locations where there was corrosion staining evident at the interior surface of the concrete walls. Most of these appeared to be due to wires or other metal objects embedded in the concrete. One location appeared to have an exposed reinforcing bar.
  - The sealant at the expansion joints is generally cracked and split, although it is still somewhat pliable. In some places, there are gaps between the sealant and the concrete. One location exhibited active groundwater infiltration during the evaluation. Spalling of the concrete was noted adjacent to the expansion joints in one location, which was rated VANDA Level 2 for concrete condition as a result.
- **Additional observations** – There were several steel manifold pipes crossing AST 1B. These exhibited minor coating failure and surface corrosion. There was also minor coating failure and surface corrosion on the sluice gates and their frames.

Primary Clarifier 1

- **Core samples** – Core samples were collected from the wall and floor of PC 1 near the catwalk. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.15 inches at the sample locations. The reinforcement depth was similar or greater at the other two scan locations on the wall, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.
  - Based on the chloride testing results, the reinforcing steel is not expected to be subject to corrosion due to chloride at the wall sampling location. The results are unclear for the floor sample location.
  - Compressive strength of the wall and floor core samples was 4,910 and 5,760 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the PC 1 floor. This sample included approximately 3 inches of mortar topping over the concrete. The water-cement ratio of the concrete (lower) layer was estimated at 0.48, which is above the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.
- **Surface penetrating radar** – Scans were conducted at three locations on the wall and one location on the floor. The minimum depth of cover over the vertical bars at one wall scanning location was somewhat less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 1.5 inches.
- **Concrete surfaces** – The interior concrete surfaces of PC 1 were in fair condition, showing some evidence of deterioration, and were rated VANDA Level 2 for concrete condition. The condition of the PC 1 concrete was very uniform around the circumference of the clarifier. In general, the wall exhibited exposed medium-diameter aggregate up to about 4 feet above the floor. The wall also exhibited a pattern of fine vertical cracks spaced approximately every 1 to 2 feet. The floor showed a pattern of general fine cracks across most of its surface. In one location, there was minor apparent groundwater infiltration from the floor cracks. Except near the center column, the cracks in the floor and wall exhibited minimal separation. A few other notable observations from PC 1 are as follows:
  - Near the stairway, there was a section of broken concrete at the top of the clarifier wall.
  - The effluent towers also exhibited varying degrees of cracking within the top few inches of the concrete wall. The effluent towers are covered by a grating. On some of the other primary clarifiers, the gratings are visibly displaced because of corrosion around the seating surface. According to operations staff, the gratings have fallen through on at

least one prior occasion, and staff is restricted from climbing on top of the effluent towers.
    - The wall is coated on its outer surfaces and the upper part of the interior surface. The coating on the interior surface is deteriorated near the apparent normal water line.

- **Additional observations** – Most of the steel components within PC 1 showed some degree of corrosion and were rated VANDA Level 3 or 4 for metal condition. The launders, their support brackets, the rake arms, and the center support structure exhibited coating failure and corrosion, primarily at edges. Some of the smaller members, such as the cross-braces across the top of the launders, showed severe section loss (more than 50% in some cases). The catwalk frame exhibited perforations and broken welds. Due to the visible corrosion damage on the catwalk, plant operations staff has restricted access to the catwalks and normally keeps them cordoned off.

South Chlorine Contact Chamber

- **General** – A confined space entry was conducted to assess the condition of the existing coating, conduct coating adhesion tests, and obtain concrete samples for testing. The coated concrete surfaces of the South CCC were evaluated and documented from within the channels. There is cracking and spalling at the top of the east and west walls.
- **Coating condition** – The coating is in poor condition, as it exhibits blistering and delaminations on approximately 40% of the immersed surfaces. Per OWTP maintenance staff, the large blisters have been evident for several years and have not increased in size. Approximately 22 large blisters and several areas of small blisters were visible. The coating does not appear to have punctured at the blister locations. A few edge delaminations, which were due to overspray, were visible on the lower surfaces of the walls.
- **Concrete degradation** – At the northeast corner of the South CCC, there was a crack extending through the top of the concrete wall. The crack has separated slightly. The top of the west wall was spalling around the railing bases. Otherwise, concrete degradation was not observed in the South CCC during the evaluation.
- **Additional observations** – The support brackets and bolts of the baffles were in good condition. The metal surfaces of the sluice gates were in good condition, but there was water leaking in through the gates.

Other Structures

Photographic documentation from topside was also collected for some of the other structures at the OWTP. These consisted of the ASTs, SSTs, and FEB that were out of service at the time, as well as the other three PCs.

Recommendations

Based on the conclusions of the field assessment, V&A presents the following recommendations for consideration.

West Flow Equalization Basin

- Apply an organosilane corrosion inhibitor to the concrete to reduce the migration of chlorides into the concrete. Products similar to BASF MasterProtect 8000 CI are recommended.
- Remove and replace the cracked overlay on the construction joints. This can be done by chipping out the concrete to a depth of 1 inch and applying a repair mortar such as Sika Sikatop 123.
- Replace the sealant in the expansion joints. Consider repairing the adjacent areas of spalled concrete on the floor. Also, replace the sealant in the joints surrounding the sprinklers at the north and south ends of the basin. The joints may be sealed with products such as Sikaflex 2C SL on horizontal surfaces and Sikaflex 2C NS on vertical walls.
- Monitor the construction joints and areas of spalling for evidence of further degradation and corrosion of the exposed reinforcing steel.
- Seal the cracks in the wall running along the edge of the ramp. Repair the spalled concrete on the wall adjacent to the expansion joint.
- Monitor the cracks in other locations for widening or corrosion staining.
- Consider adding a railing to the top of the wall along the ramp to mitigate the fall hazard.
- Repair the areas of damaged concrete on the columns at the north end of the basin. The surfaces should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 3 to 4. Products such as Sika Sikatop 123 or BASF MasterEmaco S488 CI are recommended.
- Consider evaluating the piping, sprinklers, etc., for condition. If it is not significantly corroded upon further investigation, recoat the ductile iron pipe near the south wall.
- Reassess the concrete interior surfaces of the West FEB in approximately 10 years.

Secondary Sedimentation Tank 2

- Seal the cracks in the slab over the west end of the basin. Monitor these cracks for further widening or corrosion staining.
- Monitor the cracks in other locations for separation and additional groundwater infiltration.
- Replace the sealant in the expansion joints with a product such as Sikaflex 2C SL.

- Consider recoating the metallic appurtenances within SST 2. Products such as two coats of Carboline Carboguard 890, PPG Amerlock 2, or International Paint Bar-Rust 233, at 4 to 6 mils per coat, should be applied on steel that has been abrasive-blasted per SSPC SP10 with a 2 to 3 mil surface profile.

Activated Sludge Tank 1B

- Repair the cracking and exposed ends of the reinforcing bars at the top of the east wall.
- Monitor the cracks in other locations for further widening or corrosion staining.
- Monitor the areas of corrosion staining for evidence of further degradation and corrosion of exposed reinforcing steel.
- Replace the sealant in the expansion joints. Repair the spalled concrete adjacent to one of the expansion joints. The spalled surfaces should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 3 to 4. Products such as Sika Sikatop 123 or BASF MasterEmaco S488 CI are recommended. The joints may be sealed with products such as Sikaflex 2C SL on horizontal surfaces and Sikaflex 2C NS on vertical walls.
- Consider recoating the metallic appurtenances within AST 1B. Products such as two coats of Carboline Carboguard 890, PPG Amerlock 2, or International Paint Bar-Rust 233, at 4 to 6 mils per coat, should be applied on steel that has been abrasive-blasted per SSPC SP10 with a 2 to 3 mil surface profile.

Primary Clarifier 1

- Coat the interior surfaces of the clarifier as follows. Surfaces above the elevation of the trough weir, and 1 foot below, should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 4 to 5. A 100% epoxy or polyurethane coating with a dry film thickness of 125 mils is recommended to be applied on the concrete.

  Extending the coating down the wall to the floor is optional, but not required, as the surfaces will always be immersed and the surfaces were in VANDA Level 2 condition. If the concrete will be continuously submerged, it is anticipated that this will be acceptable since there will be limited oxygen available to facilitate corrosion. If the clarifier will be left out of service for long periods of time and subject to possible wind-borne chloride contamination, coating the lower wall surfaces may be justified.
- Seal the cracks and delaminations in the floor near the center column. Coat the small segment of exposed reinforcing steel in the center well, ensuring that the coating terminates adequately on the surrounding concrete.
- Repair the broken concrete at the top of the wall and effluent towers. In planning the repairs, consider whether the repairs conducted previously on the other clarifiers have provided

adequate long-term performance. Also consider whether there are ways to make the grating support less likely to fail in the event that future deterioration does occur.

- Replace the launders with fiberglass launders and replace the bridge support structural members. Replace the bridge support with coated steel. Products such as two coats of Carboline Carboguard 890, PPG Amerlock 2, or International Paint Bar-Rust 233, at 4 to 6 mils, per coat should be applied on steel that has been abrasive-blasted per SSPC SP10 with a 2 to 3 mil surface profile. A finish coat of Carboline Carbothane 133VOC, PPG Amerlock 2, or International Paint Devthane 379H at 2 to 3 mils dry film thickness is recommended on non-immersed steel exposed to ultraviolet light.
- Reassess the concrete interior surfaces of PC 1 in approximately 10 years.

South Chlorine Contact Chamber

- Plan for the removal and replacement of the existing lining in the South CCC in the next 10 years. The lining is still protecting the concrete, but it may begin to peel off the walls in the future. The concrete should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 4 to 5. A 100% polyurethane coating with a dry film thickness of 125 mils is recommended to be applied on the concrete. Products such as International Paint Polibrid 705 or Global EcoTech Enduraflex EF1988 are compatible products with the existing system.
- Seal the crack at the northeast corner and monitor it for further widening.
- Repair the spalling damage around the railing bases at the west wall.

1.0 INTRODUCTION

V&A Consulting Engineers, Inc. (V&A) was retained by Carollo Engineers to perform a condition assessment of five concrete basins at the Oxnard Wastewater Treatment Plant (OWTP) in Oxnard, California. The purpose of this project was to perform a condition assessment to aid Carollo and the City of Oxnard (City) in determining if the structures are adequate for another 30 years of service life. The focus of the assessment activities was to conduct confined-space-entry evaluations of the interior concrete surfaces of the selected basins.

Condition assessment methods included visual and qualitative evaluation and core sampling. Core samples were drilled and removed from each structure entered. Core samples were tested for compressive strength, carbonation depth, and chloride contamination depth, and used for petrographic analysis. Additional techniques included surface pH measurements, soundings, and scanning of the reinforcing steel depth and spacing using surface penetrating radar (SPR).

Figure 1-1 shows the location of the structures within the OWTP. The structures selected for entry and evaluation were the following:

- Activated Sludge Tank (AST) 1B.
- Primary Clarifier (PC) 1.
- Secondary Sedimentation Tank (SST) 2.
- The South Chlorine Contact Chamber (CCC).
- The West Flow Equalization Basin (FEB).

Some of the other ASTs, SSTs, and PCs, as well as the East FEB, were also documented from topside, as shown in Appendix C. The majority of the evaluation was performed during the first site visit on January 13 and 14, 2015. During the first site visit, the South CCC was evaluated from topside. A second site visit was conducted on February 26, 2015, in order to conduct a confined space entry for further evaluation of the South CCC.

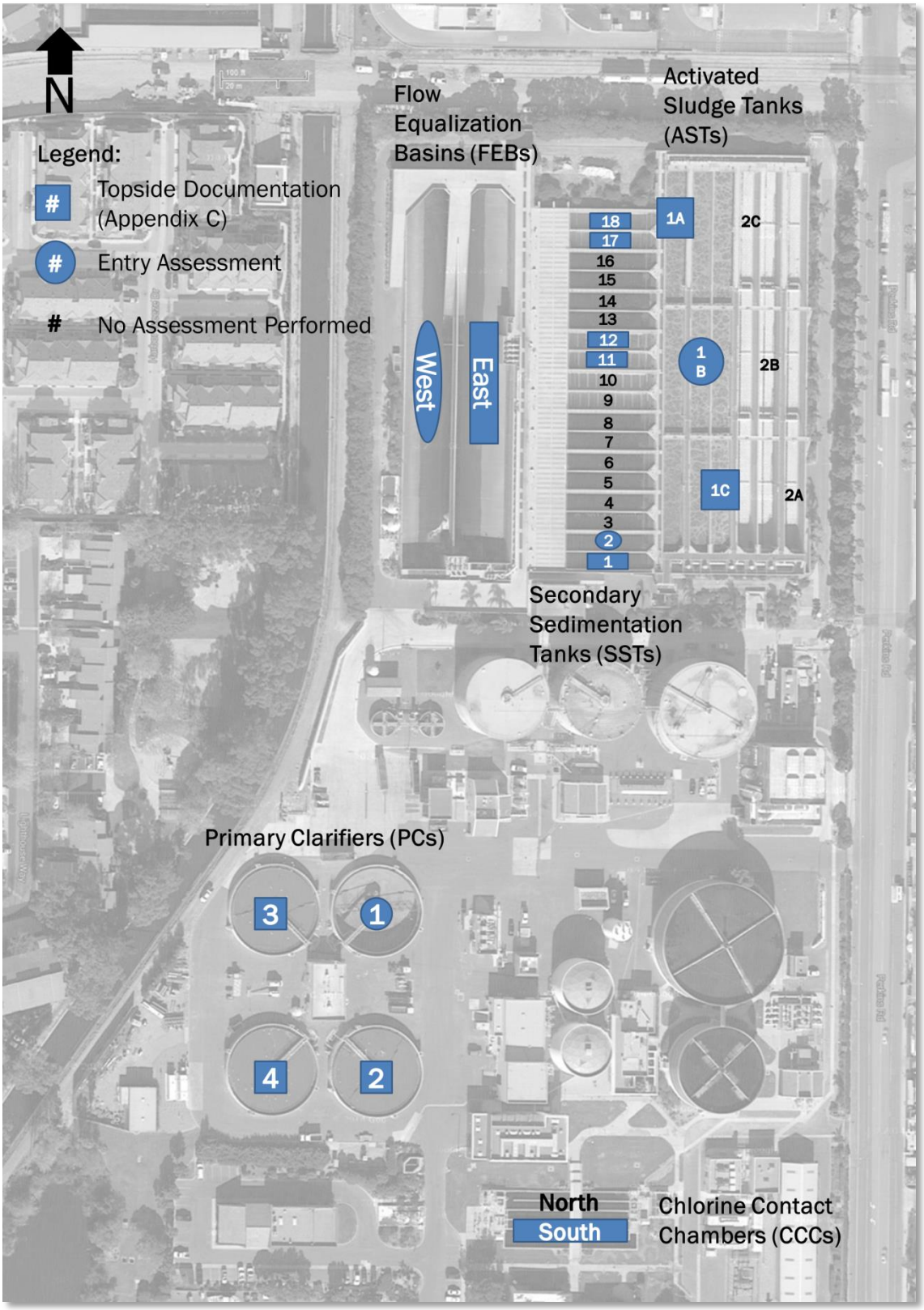

Figure 1-1. Aerial View of the City of Oxnard Wastewater Treatment Plant

2.0 METHODS AND PROCEDURES

2.1 Access and Confined Space Entry

The interior of the structures that were entered are considered non-permit confined spaces. The confined space entries were made using precautions including non-permit space certification procedures, atmospheric monitoring equipment, and appropriate personal protective equipment. Access into SST 2, AST 1B, PC 1, and the South CCC was by an extension ladder that was placed on the platform above and secured. A self-retracting lifeline (SRL) was used to provide fall protection and emergency retrieval capabilities. The West FEB did not require ladders or fall protection, as access was by a ramp from the north end of the basin.

OWTP staff ensured that the basins were drained and cleaned prior to entry. V&A and OWTP staff also conducted lockout/tagout (LOTO) procedures prior to entry to ensure that hazardous sources of energy, such as influent flows or chemical feeds, were deactivated.

2.2 Visual/Qualitative

Visual and qualitative evaluations were conducted from within each structure that was entered for condition assessment. The primary investigative method was to conduct visual examinations supplemented with digital photographs. The visual assessment focused on the condition of reinforced concrete surfaces and coatings. Defects such as cracks, spalls, exposed aggregate, reinforcing steel staining and other concrete defects were documented with digital photographs. The assessments are subjective in nature and are based on V&A's extensive experience evaluating concrete and steel structures in the water and wastewater industry.

2.3 Concrete pH Measurement

Within the West FEB, SST 2, AST 1B, and PC 1, V&A conducted two in-situ pH measurements within each basin to determine the pH of the concrete exposed to the wastewater environment. These in-situ pH measurements were made with a pH-indicating pencil manufactured by Micro Essential Laboratory. The pH of the South CCC concrete was measured from the concrete powder samples submitted to Scientific Construction Laboratories, Inc. (SCL). SCL used an electronic pH probe manufactured by Hanna Instruments.

Cementitious mortars are generally made from a combination of aggregate, sand and Portland cement. The Portland cement in mortar has a pH of approximately 13.5 after curing. This elevated

pH level provides corrosion control for the steel. Steel will transform from a state of active corrosion to a state of passivity, which is characterized by a thin layer of iron oxide that protects the steel from corrosion when the steel surface is exposed to a pH greater than 10. At a pH of less than 10, corrosion is possible. V&A has developed a table correlating the effect of the pH of the environment on the rate of corrosion of concrete. The data in Table 2-1 is derived from past experience and review of literature, such as American Concrete Institute (ACI) 201.2R-92, "Guide to Durable Concrete."

Table 2-1. pH and Corrosivity Correlation for Reinforced Concrete

pH	Degree of Corrosivity
< 7	Severe
7 to 9	Moderate
9 to 11	Mild
>11	Negligible

2.4 Soundings

Soundings are performed using a chipping hammer to tap the concrete structure surfaces. The sound from the tap can indicate discontinuities within the surface. The sound returned from sound concrete without subsurface voids is a solid "ping" noise. A "hollow" sound generally means that a void or discontinuity exists beneath the sounding location. A soft "thud" typically results from deteriorated concrete and soft cement paste. V&A conducted soundings at 20 or more equally distributed locations on the walls of the structures to listen for concrete surface delaminations. Soundings were also performed in areas of concern such as visible cracks and spalls.

2.5 Penetration Measurements

Penetration measurements involve applying a constant force from a chipping hammer to the concrete surface, until sound, hard material is reached, and then measuring the depth of the resulting cavity. The cavity depth provides quantitative data on the integrity and condition of the concrete surfaces. Typically, as concrete deteriorates, the cement paste begins to lose integrity and becomes soft. The penetration measurement sites were not repaired, as the penetration depths from this evaluation measured 1/8 of an inch or less.

2.6 Surface Penetrating Radar (SPR)

A Geophysical Survey Systems, Inc., StructureScan Mini High Resolution (HR) surface penetrating radar (SPR) unit was used to measure the depth and spacing of reinforcing steel and detect coarse voids and defects within the concrete walls and floor slabs at four 3-foot by 3-foot areas within each

structure. The portable wheel-mounted unit is rolled across the surface to be investigated. A radar beam scans up to 16 inches into the concrete and generates a 2-dimensional image of the underlying concrete member. The distance scanned is plotted on the x-axis and the depth scanned on the y-axis. Figure 2-1 shows a sample graphical image of the SPR scan. Automatic and manual procedures were used to locate the depth of the reinforcing steel on the resulting plots. The SPR unit is also equipped with laser markers on the sides, which facilitated marking the reinforcing steel bar locations on the concrete surfaces for positioning of the core drill.

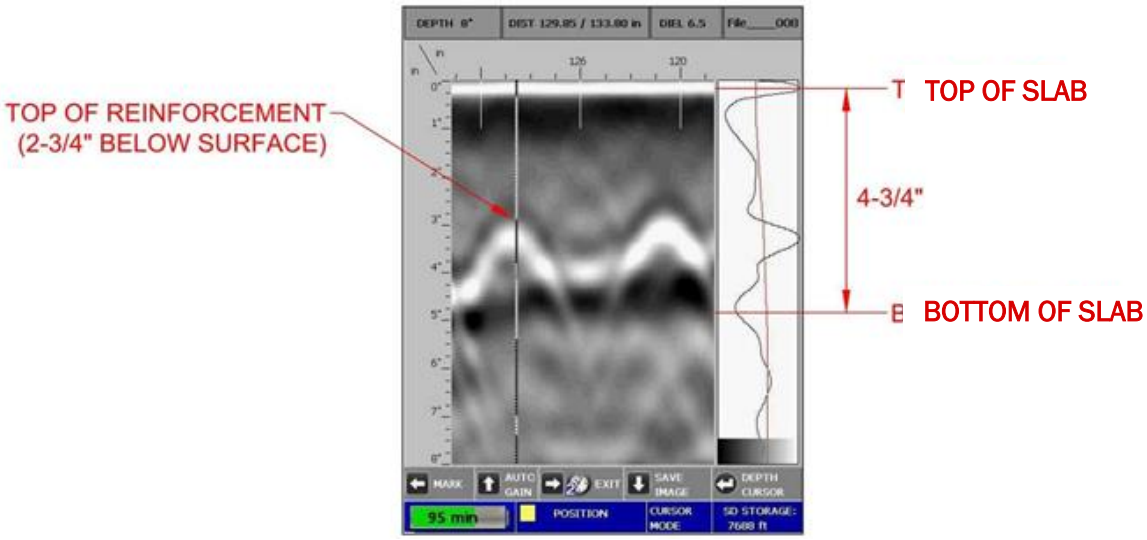

Figure 2-1. Sample SPR Scan

Concrete cover depth is an important element in corrosion protection of reinforced concrete structures. The greater the thickness of concrete cover, the less likely that corrosive constituents have reached the embedded reinforcing steel.

According to ACI 350-06, "Code Requirements for Environmental Engineering Concrete Structures," the minimum depth of concrete cover for corrosion protection of reinforcing steel in water-retaining structures should be 2 inches. In formed concrete surfaces exposed to earth, water, sewage, weather, or in contact with the ground, the minimum depth to reinforcing steel should also be 2 inches. Thus for the structures that were evaluated, the minimum depth of concrete cover over reinforcing steel should be 2 inches.

2.7 Concrete Core Sampling and Testing

V&A subcontracted with Penhall Co. of Los Angeles to perform concrete core drilling and repairs. Cylindrical core samples of concrete were taken from the walls and floors of the structures using a core drill anchored with concrete bolts to the surface being drilled. Water is injected into the hollow rotating core to cool the diamond cutting ring at the end of the core shaft and to remove the concrete particles so the core does not bind. Cores were taken to determine depth of carbonation,

concrete compressive strength, and chloride concentration, and to perform petrographic analysis of the concrete samples. Coring was also used to verify the reinforcing steel bar diameter. V&A used SPR to verify the location of the reinforcing steel prior to the core drilling. Penhall patched the core holes with Sikatop 123+ polymer-modified repair mortar with FerroGard 901 corrosion inhibitor.

2.7.1 Depth of Carbonation Test

Two core samples from each structure were used to test the depth of concrete carbonation. The carbonation of concrete refers to the reaction of atmospheric carbon dioxide (CO_2) with cement hydrates in concrete. Atmospheric CO_2 penetrates into the surface of the concrete and reacts with cement hydrates such as calcium hydroxide ($Ca(OH)_2$) to form $CaCO_3$. Other reactions with cement hydrates may produce silica, alumina, and ferric oxide. The carbonation of concrete reduces the pH of the pore water in the hydrated cement from approximately 13 to 9. This reaction causes a loss of hardness and durability of the concrete and inhibits passivation of the reinforcing steel if it is already exposed to air or water.

SCL measured the depth of carbonation on the core samples by applying "Deep Purple" solution (Germann Instruments), which becomes a lavender color above a pH between 8.5 to 9.5. This visually distinct color can be used to distinguish between carbonated cement paste (uncolored) and unaltered cement paste (lavender color). The core samples were cut into flat slices in the laboratory, and the freshly cut surfaces were sprayed with the indicator solution within an hour.

2.7.2 Chloride Content Test

Two core samples from each structure were used to test the depth of chloride contamination. SCL performed chloride content tests in accordance with ASTM C1218, "Standard Test Method for Water-Soluble Chloride in Mortar and Concrete," using a silver nitrate solution. The chloride content tests were performed on pulverized samples of the concrete in 1/2-inch depth increments to a maximum depth of 2 inches.

The chloride concentration in concrete can vary depending on the type of aggregate used, water-to-cement ratio, and other mix ingredients. Corrosion can occur in concrete with a high water-to-cement ratio, surfaces with concrete cover less than 1 inch over reinforcing steel, or concrete with cracks or spalls. The chlorides tend to break down otherwise protective surface deposits and can result in corrosion of reinforcing steel in concrete structures. Table 2-2 lists the maximum allowable chloride concentration in concrete for new construction from various sources. The threshold values for chloride as a percent by weight of concrete were converted from the standard values by dividing by a factor of 6 for a 7-sack concrete mix (as reported from the petrographic testing results for several of the samples).

Table 2-2. Maximum Allowable Chloride Concentration for New Reinforced Concrete

Source	Water-soluble Chloride Concentration (Percent by Weight of Cement Mortar)	Water-soluble Chloride Concentration (Percent by Weight of Concrete)
ACI 318-11 (C2 exposure)	0.15%	0.025%
FHWA-RD-76-70	0.16%	0.027%
ACI 222R-01 (dry conditions)	0.15%	0.025%
ACI 222R-01 (wet conditions)	0.08%	0.013%

SCL reported chloride content by weight of concrete, rather than by weight of cement mortar as shown in the table. SCL recommends use of a chloride threshold of 0.025% to 0.030% by weight of concrete. To be conservative and to match the most recent ACI literature (ACI 318-11), the lower limit of 0.025% was used as the threshold in this report. It should be noted that the exact threshold for the initiation of corrosion in a given structure may vary due to other factors as discussed above. Also, the test locations represent only a small portion of the structure surfaces; the chloride contamination and reinforcing steel cover depths will vary in other parts of the structures.

2.7.3 Compressive Strength Test

Two core samples from each structure were tested for compressive strength per ASTM C42. Cores for compressive strength testing were approximately 3 inches in diameter by 6 inches long. Compressive strength testing was performed by SCL.

2.7.4 Petrographic Analysis

Applied Materials & Engineering, Inc. (AME), performed the petrographic analysis per ASTM C856 *Standard Practice for Petrographic Examination of Hardened Concrete*. This method utilizes light microscopy to examine lapped saw-cut mortar surfaces and thin sections prepared from the core sample to characterize its microstructure and alteration. Wet chemical techniques described in ASTM C856 are used to determine the type of mortar based on its Portland cement, hydrated lime or dolomitic lime, and aggregate contents.

Concrete can degrade through a number of processes including acid attack, leaching and carbonation of the cement (paste). Generally, cement is a porous material, but it is largely dependent on water-to-cement ratio, admixtures, coarse aggregates, fine aggregates, embedded items, hardened paste, and air void structure. These pores form during the hydration process where water that is not used during hydration is left behind, forming pores. The more water that is used in the concrete mix (i.e., higher water-to-cement ratio), the more porous the concrete matrix will become.

2.7.5 Reinforcing Bar Size Verification

Reinforcing steel size was verified at core locations by coring directly over the top of the reinforcing steel and chipping out the concrete cover. Care was taken not to damage the reinforcing steel. The core holes that were drilled for verification of the reinforcing bar sizes were repaired using the same methods that were used for repairing the core sample holes.

2.8 VANDA™ Concrete Condition Rating System

The VANDA™ Concrete Condition Index (Table 2-3) was created by V&A to provide consistent reporting of corrosion damage based on qualitative, objective criteria. Condition of concrete can vary from Level 1 to Level 4 based upon visual observations and field measurements, with Level 1 indicating the best case and Level 4 indicating severe damage.

Table 2-3. VANDA™ Concrete Condition Index Rating System

Condition Rating	Description	Representative Photograph
Level 1	**None/Minimal Damage to Concrete** Hardness: No Loss Surface Profile: No Loss Cracking: Shrinkage Cracks Spalling: None Reinforcing Steel (Rebar): Not Exposed or Damaged	
Level 2	**Damage to Concrete Mortar** Hardness: Damage to Concrete Mortar Surface Profile: Some Loss Cracking: Thumbnail Sized Cracks of Minimal Frequency Spalling: Shallow Spalling of Minimal Frequency, Related Rebar Damage Reinforcing Steel (Rebar): May Be Exposed but Not Damaged	
Level 3	**Loss of Concrete Mortar/Damage to Rebar** Hardness: Complete Loss Surface Profile: Large Diameter Exposed Aggregate Cracking: ¼-inch to ½-inch Cracks, Moderate Frequency Spalling: Deep Spalling of Moderate Frequency, Related Rebar Damage Reinforcing Steel (Rebar): Exposed and Damaged, Can Be Rehabilitated	
Level 4	**Rebar Severely Corroded/Significant Damage to Structure** Hardness: Complete Loss Surface Profile: Large Diameter Exposed Aggregate Cracking: ½-inch Cracks or Greater, High Frequency Spalling: Deep Spalling at High Frequency, Related Rebar Damage Reinforcing Steel (Rebar): Damaged or Consumed, Loss of Structural Integrity	

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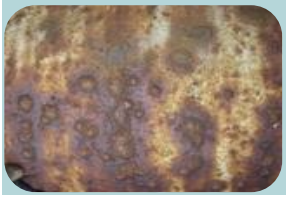
2.9 VANDA™ Metal Condition Rating System

The VANDA™ Metal Condition Index (Table 2-4) was created by V&A to provide consistent reporting of corrosion damage based on qualitative, objective criteria. Condition of ferrous metal can vary from Level 1 to Level 4 based upon visual observations and field measurements, with Level 1 indicating the best case and Level 4 indicating severe damage.

Table 2-4. VANDA™ Metal Condition Index Rating System

Condition Rating	Description	Representative Photograph
Level 1	**Little or No Corrosion** Loss of Wall Thickness %: None Pitting Depth (as % of Wall Thickness): None to Minimal Extent (Area) of Corrosion: None	
Level 2	**Minor Surface Corrosion** Loss of Wall Thickness %: < 25% Pitting Depth (as % of Wall Thickness): < 25% Extent (Area) of Corrosion: Localized	
Level 3	**Moderate to Significant Corrosion** Loss of Wall Thickness %: 25%-75% Pitting Depth (as % of Wall Thickness): 25%-75% Extent (Area) of Corrosion: 25%-75%	
Level 4	**Severe Corrosion; Immediate Repair/Replacement Needed** Loss of Wall Thickness %: > 75% Pitting Depth (as % of Wall Thickness): 75% or More Extent (Area) of Corrosion: Affects Most or All of Surface	

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3.0 RESULTS

3.1 West Flow Equalization Basin

3.1.1 Core Sampling Results

Core samples in the West FEB were taken from two locations, one near the midpoint of the west wall and one near the midpoint of the floor. The west wall core samples were taken at a height of approximately 6 feet above the floor, about 52 feet south of the expansion joint that crosses the FEB near the bottom of the ramp. The floor core samples were taken from a location approximately 10 feet east of the west wall, about 5 feet south of the expansion joint that crosses the FEB near the bottom of the ramp. The expansion joint used for reference for the coring locations is shown on Drawing S-2802 at a northing of 594.57 feet.

One of the vertical reinforcing bars was exposed at the coring location on the west wall. It appeared to be a No. 8 bar. One of the reinforcing bars running east-west was exposed at the coring location on the floor. It appeared to be a No. 7 bar.

The core samples were sent to SCL for testing of compressive strength, carbonation depth, and chloride contamination depth. SCL sent some of the core samples to AME for petrographic analysis. A summary of the laboratory analysis findings is provided in this section. The laboratory reports are provided in Appendix B.

Table 3-1 shows the carbonation depth, surface pH, and penetration depth measurements from the four core sampling and SPR scanning locations (see Section 3.1.2) within the West FEB. Based on the carbonation testing results from the core samples, the concrete has lost alkalinity to a maximum depth of 0.45 inches at the sampling locations. SPR scans at these locations indicated a minimum concrete cover of 1.3 inches, so the reinforcing steel is still embedded in an alkaline (protective) environment. However, the minimum reinforcing steel depth was 0.4 to 0.7 inches at the scan locations on the north and east walls, so the steel may be subject to corrosion there if the carbonation depth is similar.

The surface pH was measured at the SPR scanning locations and indicates a surface loss of alkalinity. Penetration depth measurements at these locations indicate that the lowered surface pH has not been associated with a significant loss of concrete hardness.

Table 3-1. Carbonation, pH, and Penetration Measurements – West FEB

Core/SPR Loc.	Max. Depth of Carbonation (in.)	Surface pH	Penetration Depth (in.)
West Wall	0.45	–	–
Floor	0.40	–	–
East Wall	No core sample	8	1/16
North Wall	No core sample	8	1/16

Table 3-2 summarizes the chloride testing results from the core sampling locations within the West FEB. The table also includes the minimum reinforcing steel depth as measured by SPR scanning. At the west wall sample location, there is more than 0.025% chloride content at the depth of the reinforcing steel, so it may be subject to corrosion there. The minimum reinforcing steel depth measured 0.4 to 0.7 inches at the scan locations on the north and east walls, so the steel may also be subject to corrosion there if the chloride contamination depth is similar. Spalling over the vertical bars was noted near the east wall scanning location.

Table 3-2. Chloride Content Test Results for West FEB

Core Location	Chloride Percentage by Weight of Concrete			Min. Depth to Reinforcing Steel (in.)	Chlorides above 0.025% at Reinforcement Depth?
	Depth 0.5 in. to 1.0 in.	Depth 1.0 in. to 1.5 in.	Depth 1.5 in. to 2.0 in.		
West Wall	**0.0657%**	**0.0253%**	0.0053%	1.3	Yes
Floor	**0.0284%**	0.0109%	0.0031%	2.2	No

Table 3-3 summarizes the compressive strength test results for the core samples from the West FEB. The results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.

Table 3-3. Compressive Strength Test Results for West FEB

Core Loc.	Capped Ht. (in.)	Dia. (in.)	Max. Load (lbf)	Compressive Strength (psi)
West Wall	5.6	2.74	48,600	8,240
Floor	5.4	2.74	31,600	5,360

AME performed petrographic analysis on a core sample from the West FEB floor. The water-cement ratio of the sample was estimated at 0.45. This is equal to the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. The sample consisted of 31.4% cement paste, 67.8% aggregate, and 0.8% air (not air-entrained). The cementitious materials content was calculated to be 6.9 sacks per cubic yard. The petrographic analysis indicated that the core samples from the West

FEB (floor), SST 2 (north wall), and AST 1B (floor) were the same concrete mixture, aggregate, and composition. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.

3.1.2 Surface Penetrating Radar Scans

SPR scanning in the West FEB was conducted at four locations. Two of the locations were the same as the west wall and floor core sampling locations, as described above. Scans were also conducted on the east wall and the north wall. The east wall scanning location was approximately 3 feet above the ramp and 10 feet north of the bottom of the ramp. The north wall scanning location was within the bottom 3 feet of the wall, approximately 5 feet west of the second column from the east supporting the platform at the north end of the FEB.

Table 3-4 summarizes the depth and spacing of reinforcing steel as measured at the SPR scanning locations. The depth of cover in many locations was significantly less than the 2 inches recommended as a guideline for this type of structure (see Section 2.6).

Table 3-4. SPR Scan Results for West FEB

Loc.	Bar Dir.	Reinforcing Bar Depth (in.)			Reinforcing Bar Spacing (in.)		
		Min.	Avg.	Max.	Min.	Avg.	Max.
West Wall	V	1.3	1.7	2.0	4.9	5.8	6.5
West Wall	H	1.5	2.9	4.7	7.7	10.6	11.9
Floor	E-W	2.2	2.6	3.0	3.9	5.8	7.3
Floor	N-S	3.6	4.0	4.3	6.4	11.1	12.7
East Wall*	V	0.4	0.7	1.3	5.0	7.8	9.6
East Wall	H	1.8	2.2	2.7	10.3	11.7	13.1
North Wall	V	0.7	1.4	2.7	4.9	5.9	6.9
North Wall	H	2.1	2.6	3.2	9.8	11.5	12.7

* At this location there appeared to be two sets of vertical bars over part of the scan area. Depth and spacing is reported for the shallowest set of bars only.

3.1.3 Visual and Qualitative Evaluation

In general, the concrete interior surfaces of the West FEB were in good condition. Photo 3-1 through Photo 3-3 show the general appearance of the West FEB interior. The concrete surfaces, particularly the floor, showed generalized shrinkage cracking (Photo 3-4). Soundings in the West FEB generally indicated sound, hard concrete. Details of the soundings performed in the West FEB are shown in Table 3-5.

Table 3-5. Soundings in West FEB

Location	Number of Soundings	Results
South wall, west wall near corner, and nearby floor	5+	• Sound, hard concrete; no voids noted • Includes areas with exposed aggregate
West wall, sloped wall "toe," and floor near expansion joint approx. 80 feet north of south wall	3	• Sound, hard concrete; no voids noted
West wall, sloped wall "toe," and floor near west wall coring location	3	• Sound, hard concrete; no voids noted
North wall, west wall near corner, and nearby floor	9	• Sound, hard concrete; no voids noted
Six northernmost columns supporting ramps and platform over north end of FEB	Multiple each	• Sound, hard concrete except in areas with exposed aggregate • Tapered concrete fill at bases sounds hollow where cracks are visible • Tapered concrete fill at bases sounds solid where cracks are not visible

Photo 3-1. West FEB as viewed from platform at north end.

Photo 3-2. West wall near midpoint of West FEB.

Photo 3-3. East wall of West FEB below ramp.

Photo 3-4. Typical cracking on West FEB floor.

There were several areas where minor or moderate defects or evidence of deterioration was observed, as described below. As a result of the number and frequency of these observations, the West FEB is rated VANDA Level 2 for concrete condition. Key observations are illustrated in this section; additional photos are provided in Appendix A.

- **Construction joints:** Along the length of the west wall, there is a horizontal construction joint with a mortar overlay approximately 5.5 feet above the floor. In many locations, the mortar overlay was found to be spalling off of the surface or cracked and loose. Over the distance between the wall coring location and the expansion joint crossing the FEB near the bottom of the ramp (approximately 50 feet), there was a horizontal reinforcing bar running along the joint with very little concrete cover, and it was exposed in some locations (Photo 3-5 and Photo 3-6). Similar mortar overlays, with evidence of deterioration, were found on some of the vertical construction joints along the west wall as well.

Photo 3-5. Broken mortar and exposed reinforcing bar at some locations along construction joint in west wall.

Photo 3-6. Reinforcing bar exposed at construction joint intermittently over approximate 50-foot length.

- **Expansion joints:** There were several expansion joints running east-west across the FEB. The sealant at the expansion joints is generally cracked and split, although it is still somewhat pliable. In some places, sections of the sealant are missing or there are weeds growing out of the gaps. A few locations exhibited minor spalling of the concrete adjacent to the expansion joints. Conversely, the control joints cast into the floor slab typically were in good condition. Photo 3-7 through Photo 3-10 illustrate these observations.

Photo 3-7. Weeds growing from expansion joint in floor.

Photo 3-8. Spalled concrete adjacent to expansion joint in floor.

Photo 3-9. Spalled concrete adjacent to expansion joint in wall at bottom of ramp.

Photo 3-10. Typical control joints in floor.

- **Surface defects:** The east wall of the West FEB (dividing wall between the two FEBs) exhibited minor exposed aggregate in some locations near the apparent high water line. There were also some locations along the lower part of the east wall that exhibited bug holes or rock pockets (Photo 3-11). On the west wall of the West FEB, there were some rock pockets and areas of exposed aggregate in isolated locations (Photo 3-12 and Photo 3-13).

  On the exterior of the wall along the edge of the ramp, as well as the outside edge of the ramp itself, there was an apparent overlay coating of mortar in some locations. This was cracked and delaminating from the concrete substrate in some locations. Photo 3-14 and Photo 3-15 illustrate these observations.

Photo 3-11. Bug holes and exposed aggregate along lower east wall.

Photo 3-12. Typical concrete surfaces along toe of west wall with intermittent areas of exposed aggregate.

Photo 3-13. Typical isolated rock pocket in west wall near southwest corner.

Photo 3-14. Overlay layer spalling off of edge of wall and ramp.

Photo 3-15. Cracked surface layer near bottom of ramp.

- **Cracking:** The south wall of the West FEB exhibited a few near-vertical cracks (Photo 3-16). The cracks exhibit minimal separation. The platform at the north end of the FEB exhibited minor cracking on the underside. In this area, there was efflorescence from the cracks as well as the construction joints. In a few locations, the wall along the edge of the ramp exhibited cracking that probably extended through the wall (Photo 3-17).

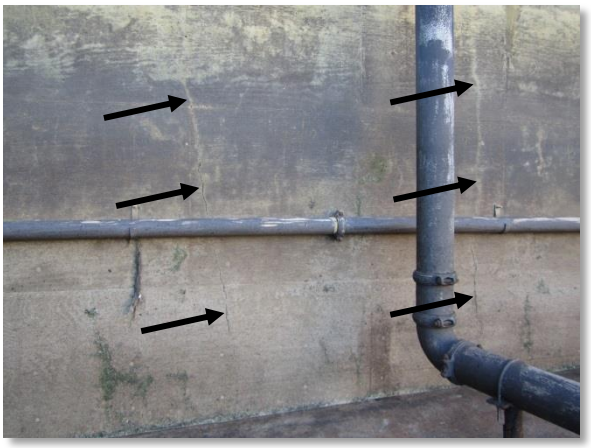


Photo 3-16. Cracks in south wall.

Photo 3-17. Cracks in a few locations are visible on both sides of the wall and appear to extend through it.

- **Spalling:** The walls of the West FEB exhibited spalling in isolated locations. Most of these were small, individual spalls up to a few inches in length (Photo 3-18). There was a pattern of spalling over the vertical bars in the east wall, which forms the dividing wall between the two FEBs (Photo 3-19). There was also one diagonal bar visible through a spalled area a few feet in length near the top of the west wall (Photo 3-20 and Photo 3-21). There was also spalling near some of the expansion joints (see above).

Photo 3-18. Typical minor spalling on outside of ramp.

Photo 3-19. Spalling on east wall near bottom of ramp.

Photo 3-20. Location of spall near top of midpoint of west wall.

Photo 3-21. Detail view of spall near top of midpoint of west wall.

- **Joints surrounding sprinklers:** The FEB is equipped with a row of sprinklers running along the middle of the floor. The northernmost and southernmost sprinklers had separate concrete joints in the concrete floor around them (Photo 3-22 and Photo 3-23). At the south end of the FEB, the joints had been filled with sealant, which was coming loose. The joints at the north end exhibited minor chipping of the adjacent concrete edges. A few of the sprinkler heads within the FEB were missing and apparently capped off.

Photo 3-22. Joints surrounding sprinkler near north end of FEB.

Photo 3-23. Joints around sprinkler near south end of FEB, with sealant coming loose.

- **Columns:** At the north end of the FEB, there are columns holding up the ramp as well as a platform that overhangs the north end of the basin. Some of the columns exhibited minor areas of exposed aggregate. One of the columns had a small gouge on one of the corners. Some of the columns had a tapered concrete collar at the base, and in some cases this concrete was broken and hollow-sounding. Photo 3-24 through Photo 3-27 illustrate these observations.

Photo 3-24. Columns at north end of West FEB.

Photo 3-25. Typical exposed aggregate on column.

Photo 3-26. Damaged corner on column.

Photo 3-27. Cracked concrete at base of column with apparent repair at right.

3.1.4 Additional Observations

There was a ductile iron pipe descending into the FEB near the south wall that exhibited corrosion on its supports as well as on the hardware for the Victaulic couplings. The coating on the underside of the horizontal pipe has failed and there may be corrosion occurring there as well. The coating and corrosion products were not disturbed, so the extent of metal loss is unknown. Appendix A provides more information on these observations.

The wall along the ramp leading into the FEB is only about 18 inches high, which poses a fall hazard for personnel walking near the edge.

Photo 3-28. North end of wall along ramp. Low height of wall presents a fall hazard.

3.2 Secondary Sedimentation Tank 2

3.2.1 Core Sampling

Core samples in SST 2 were taken from two locations near the west end of the basin, one on the north wall and one on the floor. The north wall core samples were taken at a height of approximately 4 feet above the floor, about 16 feet east of the end of the overhanging platform above the west end of the basin. The floor core sampling location was approximately 7 feet south of the north wall, in line with the north wall sampling location. Some of the core samples at this location broke off at approximately the 3-inch depth. The core drilling personnel suspected that this was due to a rock pocket within the concrete. In order to retrieve cores that were long enough for testing, additional cores were taken within this vicinity but closer to the south wall.

One of the vertical reinforcing bars was exposed at the coring location on the north wall. It appeared to be a No. 7 bar. One of the reinforcing bars running north-south was exposed at the coring location on the floor. It appeared to be a No. 7 bar.

The core samples were sent to SCL for testing of compressive strength, carbonation depth, and chloride contamination depth. SCL sent some of the core samples to AME for petrographic analysis. A summary of the laboratory analysis findings is provided in this section. The laboratory reports are provided in Appendix B.

Table 3-6 shows the carbonation depth, surface pH, and penetration depth measurements from the four core sampling and SPR scanning locations (see Section 3.2.2) within SST 2. Based on the carbonation testing results from the core samples, the concrete has lost alkalinity to a maximum depth of 0.40 inches at the north wall sampling location and to a negligible depth at the floor sampling location. SPR scans at these locations indicated a minimum concrete cover of 1.7 inches, so the reinforcing steel is still embedded in an alkaline (protective) environment. The reinforcement depth was similar or greater at the scan locations on the east and south walls, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.

The surface pH was measured at the SPR scanning locations and indicates a surface loss of alkalinity. Penetration depth measurements at these locations indicate that the lowered surface pH has not been associated with a significant loss of concrete hardness.

Table 3-6. Carbonation, pH, and Penetration Measurements – SST 2

Core/SPR Loc.	Max. Depth of Carbonation (in.)	Surface pH	Penetration Depth (in.)
North Wall	0.40	–	–
Floor	<0.05	–	–
East Wall	No core sample	7	1/8
South Wall	No core sample	6	1/16

Table 3-7 summarizes the chloride testing results from the core sampling locations within SST 2. The table also includes the minimum reinforcing steel depth as measured by SPR scanning. Although the chloride content is below 0.025% at the reinforcing steel depth, it is approaching this threshold at the floor sampling location. Corrosion of the reinforcing steel may be a future concern if this contamination continues. There may also be locations within the structure where the reinforcing steel cover depth is less or the chloride contamination depth is greater. The 0.025% threshold may also vary due to other factors, as discussed in Section 2.7.2.

Table 3-7. Chloride Content Test Results for SST 2

Core Location	Chloride Percentage by Weight of Concrete			Min. Depth to Reinforcing Steel (in.)	Chlorides above 0.025% at Reinforcement Depth?
	Depth 0.5 in. to 1.0 in.	Depth 1.0 in. to 1.5 in.	Depth 1.5 in. to 2.0 in.		
North Wall	**0.0350%**	0.0069%	0.0001%	1.7	No
Floor	**0.0312%**	0.0217%	0.0141%	2.1	No

Table 3-8 summarizes the compressive strength test results for the core samples from SST 2. The results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.

Table 3-8. Compressive Strength Test Results for SST 2

Core Loc.	Capped Ht. (in.)	Dia. (in.)	Max. Load (lbf)	Compressive Strength (psi)
North Wall	5.4	2.74	40,900	6,940
Floor	5.5	2.74	25,200	4,270

AME performed petrographic analysis on a core sample from the north wall of SST 2. The water-cement ratio of the sample was estimated at 0.43. This is below the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. The sample consisted of 31.5% cement paste, 67.9% aggregate, and 0.6% air (not air-entrained). The cementitious materials content was calculated to be 6.9 sacks per cubic yard. The petrographic analysis indicated that the core samples from the West FEB (floor), SST 2 (north wall), and AST 1B (floor) were the same concrete mixture, aggregate, and composition. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.

3.2.2 Surface Penetrating Radar Scans

SPR scanning in SST 2 was conducted at four locations. Two of the locations were the same as the north wall and floor core sampling locations, as described above. Scans were also conducted on the east wall and the south wall. The east wall scanning location was centered between the tee fittings

projecting from the wall. The south wall scanning location was approximately 3 feet above the floor, about 55 feet east of the end of the overhanging platform above the west end of the basin.

Table 3-9 summarizes the depth and spacing of reinforcing steel as measured at the SPR scanning locations. The minimum depth of cover in some locations on the north and east walls was somewhat less than the 2 inches recommended as a guideline for this type of structure (see Section 2.6).

Table 3-9. SPR Scan Results for SST 2

Loc.	Bar Dir.	Reinforcing Bar Depth (in.)			Reinforcing Bar Spacing (in.)		
		Min.	Avg.	Max.	Min.	Avg.	Max.
North Wall	V	1.7	1.8	2.1	4.5	6.1	7.6
North Wall	H	2.8	3.0	3.2	11.5	12.4	13.7
Floor	N-S	2.1	2.3	2.9	11.6	11.9	12.7
Floor	E-W	3.4	3.6	4.0	10.6	12.0	13.4
East Wall*	V	1.8	2.3	2.8	9.3	10.6	12.2
East Wall	H	2.7	3.1	3.9	11.6	12.3	13.0
South Wall	V	2.3	2.5	2.8	4.3	6.0	8.2
South Wall	H	3.8	3.9	4.2	9.6	11.7	13.4

* At this location there appeared to be overlapping vertical bars over part of the scan area. Depth and spacing is reported for the shallowest set of bars only.

3.2.3 Visual and Qualitative Evaluation

In general, the concrete interior surfaces of SST 2 were in good condition and were rated VANDA Level 1 for concrete condition. Photo 3-29 through Photo 3-32 show the general appearance of the SST 2 interior. Additional photos are provided in Appendix A. Soundings were performed at over 20 locations on the north, east, and south walls of SST 2, as well as the adjacent floor areas. The soundings generally indicated sound, hard concrete, except at the toe of the curved fill mortar near the east wall, which sounded hollow or loose (see details below). There were also a few soft spots, evidenced by a more muffled sound, intermittently along the south wall from 3 to 6 feet above the floor, and on the mortar overlays on the construction joints at the 3-foot height on both the north and south walls.

Photo 3-29. SST 2, looking west.

Photo 3-30. Inside SST 2, looking east.

Photo 3-31. Looking west inside SST 2.

Photo 3-32. Platform and launders over west end of SST 2.

There were several areas where minor defects or evidence of deterioration was observed, as described below. These are presently minor issues, but they may accelerate future deterioration of the structure. Key observations are illustrated in this section; additional photos are provided in Appendix A.

- **Cracking:** There were several locations throughout SST 2 that exhibited minor cracking. Except as noted, the cracks had not begun to separate. Cracks were noted as follows:
  - In the slab overhanging the west end of the basin. Near the corners of the covers over the launders, slight separation was observed (Photo 3-33).
  - Vertical cracks every few feet along the north wall of the basin (Photo 3-34). Most of these cracks extended most of the height of the wall.

- The construction joints at the midpoints of the north and south walls exhibited evidence of seepage.
- Hairline cracks on the underside of the triangular platform at the southeast corner.
- Hairline cracks in the walkway slab above the north wall.
- General cracking in some areas on the floor (Photo 3-35). Near the east end of the basin, there was one location that exhibited possible groundwater infiltration.

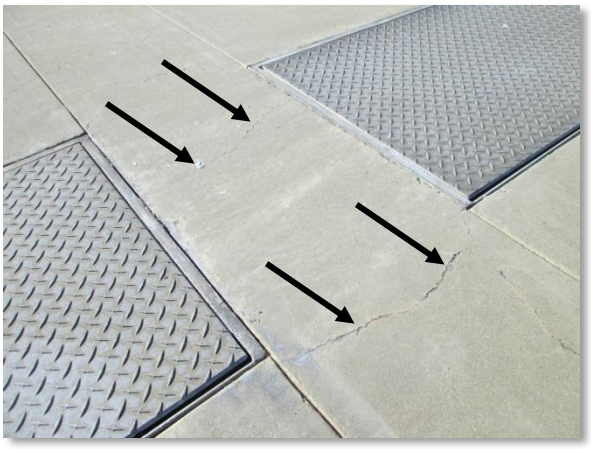


Photo 3-33. Cracking of platform above west end of SST 2 (typical).

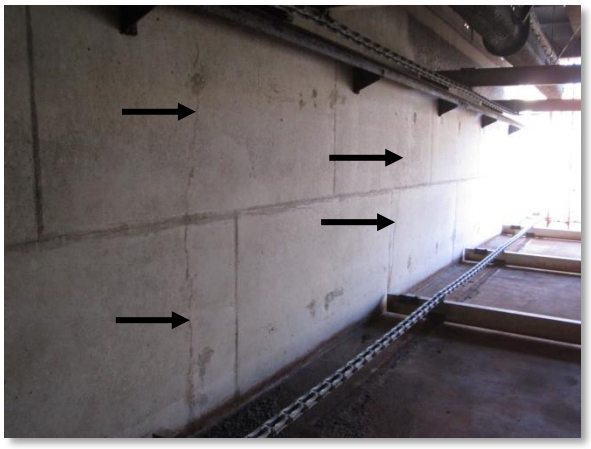


Photo 3-34. Typical vertical cracks spaced every few feet along length of north wall.

Photo 3-35. Typical minor cracking on floor of SST 2. Possible infiltration visible at bottom of image.

- **Expansion joints:** SST 2 has expansion joints running north-south across the basin. In general, the sealant was in fair condition, with some signs of brittleness and shrinkage. The expansion joint near the west end of the basin exhibited gaps and possible groundwater infiltration, as shown in Photo 3-36 and Photo 3-37.

Photo 3-36. Deteriorated sealant at expansion joint near west end of SST 2 with evidence of possible infiltration.

Photo 3-37. Deteriorated sealant at expansion joint near west end of SST 2 with evidence of possible infiltration.

- **Fill concrete at east wall:** At the bottom of the east wall, there is a tapered and concave section of concrete fill that appears to be contoured to the path of the skimmer arms. At the top edge, there is a gap between the east wall and the fill concrete (Photo 3-38). The fill concrete becomes thin near the toe, due to the circular concave surface, and it is irregular and possibly broken in this area (Photo 3-39). The fill concrete also exhibits a few vertical cracks.

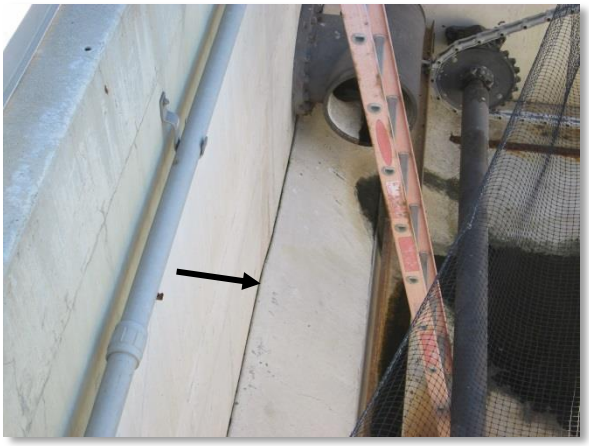


Photo 3-38. Gap between east wall and fill concrete.

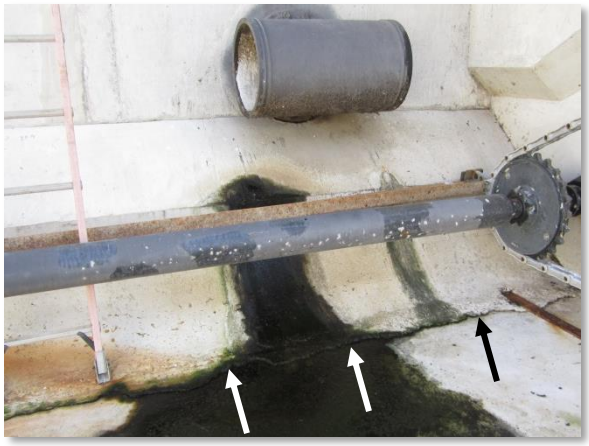


Photo 3-39. Broken or irregular concrete at toe of fill at east wall.

3.2.4 Additional Observations

Metallic appurtenances within SST consisted of the steel brackets, hardware, etc., for the skimmer mechanism, as well as the two tee fittings protruding through the east wall. The tees appear to serve as inlets to the basin. There was evidence of exterior coating failure, primarily along edges, and minor corrosion on these metallic objects. The mortar lining inside the tees was also deteriorated, with surface corrosion occurring. Appendix A provides more information on these observations.

3.3 Activated Sludge Tank 1B

3.3.1 Core Sampling

Core samples in the AST 1B were taken from two locations, one on the west wall and one on the floor. The west wall core samples were taken at a height of approximately 4 feet above the floor, about 22 feet south of the north wall of the basin. The floor core sampling location was adjacent to the west wall sampling location, near the center trough.

One of the vertical reinforcing bars was exposed at the coring location on the north wall. It appeared to be a No. 7 bar. One of the reinforcing bars running north-south was exposed at the coring location on the floor. It appeared to be a No. 7 bar.

The core samples were sent to SCL for testing of compressive strength, carbonation depth, and chloride contamination depth. SCL sent some of the core samples to AME for petrographic analysis. A summary of the laboratory analysis findings is provided in this section. The laboratory reports are provided in Appendix B.

Table 3-10 shows the carbonation depth, surface pH, and penetration depth measurements from the four core sampling and SPR scanning locations (see Section 3.3.2) within AST 1B. Based on the carbonation testing results from the core samples, the concrete has lost alkalinity to a maximum depth of 0.3 inches at the west wall sampling location and to depth of 0.5 inches at the floor sampling location. SPR scans at these locations indicated a minimum concrete cover of 1.8 inches, so the reinforcing steel is still embedded in an alkaline (protective) environment. The reinforcement depth was similar or greater at the scan locations on the east and north walls, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.

The surface pH was measured at the SPR scanning locations and indicates a surface loss of alkalinity.

Table 3-10. Carbonation, pH, and Penetration Measurements – AST 1B

Core/SPR Loc.	Max. Depth of Carbonation (in.)	Surface pH	Penetration Depth (in.)
West Wall	0.30	–	–
Floor	0.50	–	–
North Wall	No core sample	7	–
East Wall	No core sample	7	–

Table 3-11 summarizes the chloride testing results from the core sampling locations within AST 1B. The table also includes the minimum reinforcing steel depth as measured by SPR scanning. Although the chloride content is below 0.025% at the reinforcing steel depth, it is approaching this threshold at the sampling locations. Corrosion of the reinforcing steel may be a future concern if this contamination continues. There may also be locations within the structure where the reinforcing steel cover depth is less or the chloride contamination depth is greater. The 0.025% threshold may also vary due to other factors, as discussed in Section 2.7.2.

Table 3-11. Chloride Content Test Results for AST 1B

Core Location	Chloride Percentage by Weight of Concrete			Min. Depth to Reinforcing Steel (in.)	Chlorides above 0.025% at Reinforcement Depth?
	Depth 0.5 in. to 1.0 in.	Depth 1.0 in. to 1.5 in.	Depth 1.5 in. to 2.0 in.		
West Wall	**0.0355%**	0.0228%	0.0135%	3.0	No
Floor	**0.0306%**	0.0214%	0.0064%	1.8	No

Table 3-12 summarizes the compressive strength test results for the core samples from AST 1B. The results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.

Table 3-12. Compressive Strength Test Results for AST 1B

Core Loc.	Capped Ht. (in.)	Dia. (in.)	Max. Load (lbf)	Compressive Strength (psi)
West Wall	5.0	2.74	40,800	6,920
Floor	5.6	2.74	37,000	6,270

AME performed petrographic analysis on a core sample from the AST 1B floor. The water-cement ratio of the sample was estimated at 0.45. This is equal to the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. The sample consisted of 34.9% cement paste, 63.8% aggregate, and 1.3% air (not air-entrained). The cementitious materials content was calculated to be

7.5 sacks per cubic yard. The petrographic analysis indicated that the core samples from the West FEB (floor), SST 2 (north wall), and AST 1B (floor) were the same concrete mixture, aggregate, and composition. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.

3.3.2 Surface Penetrating Radar Scans

SPR scanning in AST 1B was conducted at four locations. Two of the locations were the same as the west wall and floor core sampling locations, as described above. Scans were also conducted on the north wall and the east wall. The north wall scanning location was approximately 3 feet above the floor and 4 feet west of the east wall. The east wall scanning location was approximately 3 feet above the floor, approximately 210 feet south of the north wall. The scan location was on the north side of the expansion joint at that location.

Table 3-13 summarizes the depth and spacing of reinforcing steel as measured at the SPR scanning locations. The minimum depth of cover at the floor scan location was slightly less than the 2 inches recommended as a guideline for this type of structure (see Section 2.6).

Table 3-13. SPR Scan Results for AST 1B

Loc.	Bar Dir.	Reinforcing Bar Depth (in.)			Reinforcing Bar Spacing (in.)		
		Min.	Avg.	Max.	Min.	Avg.	Max.
West Wall	V	3.0	3.4	4.1	5.0	5.9	6.9
West Wall	H	4.6	5.0	5.6	9.2	10.2	11.4
Floor	E-W	1.8	2.1	2.3	10.5	11.8	13.0
Floor	N-S	3.5	3.7	4.0	11.5	11.8	12.1
North Wall	V	2.5	2.8	3.3	10.7	11.9	14.0
North Wall	H	3.3	3.8	4.1	11.0	12.2	13.4
East Wall	V	2.0	2.2	2.5	4.2	6.0	6.9
East Wall	H	3.2	3.7	4.3	11.1	12.2	13.8

3.3.3 Visual and Qualitative Evaluation

In general, the concrete interior surfaces of AST 1B were in good condition and were rated VANDA Level 1 for concrete condition. Photo 3-40 through Photo 3-43 show the general appearance of the AST 1B interior. Additional photos are provided in Appendix A. Soundings were performed at over 20 locations on the west, north, and east walls of AST 1B, as well as the adjacent floor areas. The soundings generally indicated sound, hard concrete, except on the mortar overlays on some of the construction joints, which sounded hollow or loose. There were also a few soft spots, evidenced by a more muffled sound, intermittently along the sloped "toe" of the east wall.

Photo 3-40. Looking south from north end of AST 1B.

Photo 3-41. Looking south from north end of AST 1B.

Photo 3-42. East wall of AST 1B (typical).

Photo 3-43. West wall of AST 1B (typical).

There were several areas where minor defects or evidence of deterioration was observed, as described below. These are presently minor issues, but they may accelerate future deterioration of the structure. Key observations are illustrated in this section; additional photos are provided in Appendix A.

- **Cracking:** There were several locations throughout AST 1B that exhibited minor cracking. Except as noted, the cracks had not begun to separate. Cracks were noted as follows:
  - Small cracks in the floor, west wall, and walkways over the basin (Photo 3-44).
  - Many of the construction joints had a mortar overlay, which was missing or spalling in some locations. In one location, the spalling exposed reinforcing steel (Photo 3-45).
  - The top of the east wall exhibited cracking near the walkways crossing over the basin. The concrete appeared to be loose in some of these areas, and one location may have been repaired previously. The ends of the reinforcing bars were also visible at the top of the east wall in these locations (Photo 3-46 and Photo 3-47). The top of the east wall is rated VANDA Level 2 for concrete condition.

Photo 3-44. Typical cracking on floor and walls of center trough.

Photo 3-45. Spalling mortar with moderate corrosion of reinforcing steel near expansion joint 396 feet south of north wall.

Photo 3-46. Exposed ends of reinforcing bars at top of wall between ASTs 1B and 1C.

Photo 3-47. Cracking on top surface of wall between ASTs 1B and 1C (typical).

- Corrosion staining: There were several locations where there was corrosion staining evident at the interior surface of the concrete walls. Most of these appeared to be due to wires or other metal objects embedded in the concrete (Photo 3-48). One location appeared to have an exposed reinforcing bar (Photo 3-49).

Photo 3-48. Corrosion staining at construction joint on east wall. There may have been a metal strip embedded in the surface of the concrete.

Photo 3-49. Exposed steel (possible vertical reinforcing bar) about 4 feet above floor on west wall and about 95 feet south of north wall.

- **Expansion joints:** There were several expansion joints running east-west across the AST. The sealant at the expansion joints is generally cracked and split, although it is still somewhat pliable. In some places, there are gaps between the sealant and the concrete. Some of the joints appear to have been repaired with an overlay sealant, but there were typically gaps beneath these. One location exhibited active groundwater infiltration during the evaluation. Spalling of the concrete was noted adjacent to the expansion joints in one location, which was rated VANDA Level 2 for concrete condition as a result. Photo 3-50 through Photo 3-52 illustrate these observations.

Photo 3-50. Typical sealant in expansion joint with shrinkage and gaps.

Photo 3-51. Overlay sealant on expansion joint with gaps at ends (typical).

Photo 3-52. Spalling concrete adjacent to expansion joint on west wall about 303 feet south of north wall.

Photo 3-53. Puddle of water caused by groundwater infiltration at expansion joint 210 feet south of north wall.

- **Construction defects:** One of the construction joints along the east wall, about 150 feet south of the north wall, showed a considerable (approx. 1 inch) offset between the concrete surfaces on either side of the joint. There was an apparent rock pocket above the manifold pipe about 305 feet south of the north wall.

3.3.4 Additional Observations

There were several steel manifold pipes crossing AST 1B. These exhibited minor coating failure and surface corrosion. There was also minor coating failure and surface corrosion on the sluice gates and their frames. These observations are illustrated in Photo 3-54 and Photo 3-55 and in Appendix A.

Photo 3-54. Steel manifold pipe with minor coating failure and corrosion.

Photo 3-55. Minor coating failure and corrosion on sluice gates and frames.

3.4 Primary Clarifier 1

Locations within Primary Clarifier 1 were referenced to clock positions around the circumference of the clarifier, as shown in Figure 3-1. The 6:00 position was aligned with the catwalk to the center column.

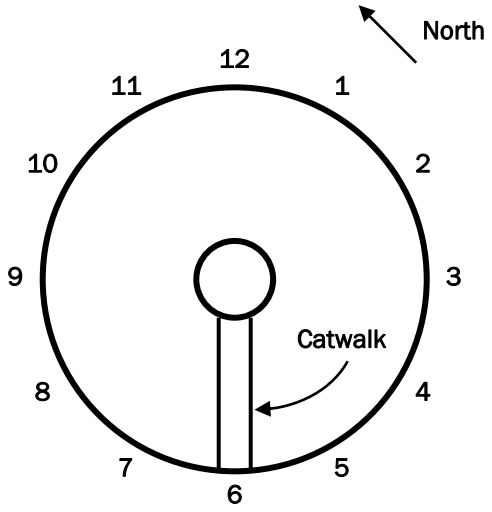


Figure 3-1. Clock Position References – PC 1

3.4.1 Core Sampling

Core samples in PC 1 were taken from two locations, one on the wall at the 5:30 position and one on the floor at the 5:00 position. The wall samples were taken at a height of approximately 4 feet above the floor. The floor samples were taken about 6 feet from the wall.

One of the vertical reinforcing bars was exposed at the coring location on the wall at the 5:30 position. It appeared to be a No. 5 bar. One of the radial reinforcing bars was exposed at the coring location on the floor at the 5:00 position. It appeared to be a No. 4 bar.

The core samples were sent to SCL for testing of compressive strength, carbonation depth, and chloride contamination depth. SCL sent some of the core samples to AME for petrographic analysis. A summary of the laboratory analysis findings is provided in this section. The laboratory reports are provided in Appendix B.

Table 3-14 shows the carbonation depth, surface pH, and penetration depth measurements from the four core sampling and SPR scanning locations (see Section 3.4.2) within PC 1. Based on the carbonation testing results from the core samples, the concrete has lost alkalinity to a maximum depth of 0.15 inches at the sampling locations. SPR scans at these locations indicated a minimum concrete cover of 1.5 inches, so the reinforcing steel is still embedded in an alkaline (protective)

environment. The reinforcement depth was similar or greater at the other two scan locations on the wall, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.

The surface pH was measured at the SPR scanning locations and indicates a surface loss of alkalinity. Penetration depth measurements at these locations indicate that the lowered surface pH has not been associated with a significant loss of concrete hardness.

Table 3-14. Carbonation, pH, and Penetration Measurements – PC 1

Core/SPR Loc.	Max. Depth of Carbonation (in.)	Surface pH	Penetration Depth (in.)
Wall at 5:30	0.15	–	–
Floor at 5:00	<0.05	–	–
Wall at 12:00	No core sample	7	1/16
Wall at 9:00	No core sample	7	1/16

Table 3-15 summarizes the chloride testing results from the core sampling locations within PC 1. The table also includes the minimum reinforcing steel depth as measured by SPR scanning. At the wall sampling location, the chloride content is well below 0.025% throughout the sample, so the steel is not expected to be subject to corrosion due to chloride. At the floor sampling location, the results are unclear, as the chloride sampling was only conducted to a depth of 2 inches, while the minimum cover over the reinforcing steel was 5.2 inches.

Table 3-15. Chloride Content Test Results for PC 1

Core Location	Chloride Percentage by Weight of Concrete			Min. Depth to Reinforcing Steel (in.)	Chlorides above 0.025% at Reinforcement Depth?
	Depth 0.5 in. to 1.0 in.	Depth 1.0 in. to 1.5 in.	Depth 1.5 in. to 2.0 in.		
Wall at 5:30	0.0068%	0.0067%	0.0058%	1.5	No
Floor at 5:00	**0.0280%**	**0.0266%**	**0.0263%**	5.2	Unknown

Table 3-16 summarizes the compressive strength test results for the core samples from PC 1. The results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.

Table 3-16. Compressive Strength Test Results for PC 1

Core Loc.	Capped Ht. (in.)	Dia. (in.)	Max. Load (lbf)	Compressive Strength (psi)
Wall	3.7	2.74	30,500	4,910
Floor	3.4	2.74	36,500	5,760

AME performed petrographic analysis on a core sample from the PC 1 floor. This sample included approximately 3 inches of mortar topping over the concrete. The water-cement ratio was estimated at 0.48 for the concrete, which is below the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures, and 0.55 for the mortar. The concrete consisted of 34.3% cement paste, 64.6% aggregate, and 1.1% air (not air-entrained). The mortar consisted of 40.4% cement paste, 57.4% aggregate, and 2.2% air (not air-entrained). The cementitious materials content was calculated to be 7.3 sacks per cubic yard for the concrete and 8.0 for the mortar. The petrographic analysis indicated that the concrete was similar to the core samples from the West FEB (floor), SST 2 (north wall), and AST 1B (floor) in terms of concrete mixture, aggregate, and composition. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion. Also, carbonation to a depth of 0.25 inches was noted within the top of the concrete layer below the mortar.

3.4.2 Surface Penetrating Radar Scans

SPR scanning in SST 2 was conducted at four locations. Two of the locations were the same as the 5:30 wall and 5:00 floor core sampling locations, as described above. Scans were also conducted on the wall at the 12:00 and 9:00 positions approximately 3 feet above the floor.

Table 3-17 summarizes the depth and spacing of reinforcing steel as measured at the SPR scanning locations. The minimum depth of cover over the vertical bars in the wall at 5:30 was somewhat less than the 2 inches recommended as a guideline for this type of structure (see Section 2.6).

Table 3-17. SPR Scan Results for PC 1

Loc.	Bar Dir.	Reinforcing Bar Depth (in.)			Reinforcing Bar Spacing (in.)		
		Min.	Avg.	Max.	Min.	Avg.	Max.
Wall at 5:30	V	1.5	2.0	2.5	12.4	14.0	16.3
Wall at 5:30	H	2.3	2.8	3.2	6.8	9.5	12.6
Floor at 5:00	Radial	5.2	6.1	7.5	14.2	17.3	19.4
Floor at 5:00	Circumf.	5.5	6.9	7.4	13.4	15.4	17.3
Wall at 12:00	V	2.1	2.4	2.8	7.3	10.8	13.2
Wall at 12:00	H	3.0	3.4	3.9	6.9	10.1	13.7
Wall at 9:00	V	2.5	2.8	3.2	13.7	14.0	14.3
Wall at 9:00	H	2.8	3.3	4.2	8.6	9.7	11.5

3.4.3 Visual and Qualitative Evaluation

Photo 3-56 and Photo 3-57 show general views of Primary Clarifier 1.

Photo 3-56. General view inside PC 1.

Photo 3-57. General view of launders and wall inside PC 1.

The interior concrete surfaces of PC 1 were in fair condition, showing some evidence of deterioration, and were rated VANDA Level 2 for concrete condition. The condition of the PC 1 concrete was very uniform around the circumference of the clarifier. In general, the wall exhibited exposed medium-diameter aggregate up to about 4 feet above the floor. The wall also exhibited a pattern of fine vertical cracks spaced approximately every 1 to 2 feet. The floor showed a pattern of general fine cracks across most of its surface. In one location, there was minor apparent groundwater infiltration from the floor cracks. Except near the center column, the cracks in the floor and wall exhibited minimal separation. Along the edges of the center well, there was apparent delamination below the upper grout or mortar floor layer and a short segment of apparent exposed reinforcing steel. The lower wall also exhibited some rock pockets, primarily near the 10:30 clock position. Photo 3-58 through Photo 3-63 illustrate typical deterioration observed on the concrete interior surfaces of PC 1.

Photo 3-58. Typical exposed aggregate and cracking on lower wall.

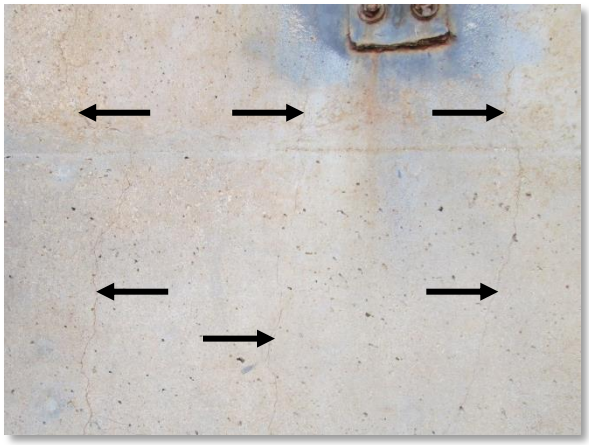


Photo 3-59. Typical vertical cracks in wall.

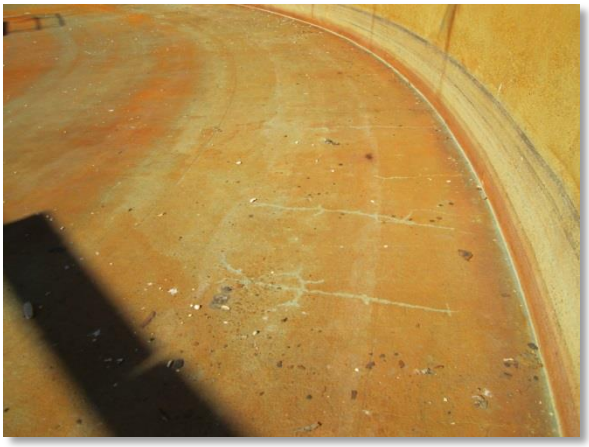


Photo 3-60. Typical cracks in PC 1 floor.

Photo 3-61. Minor apparent groundwater infiltration from cracks in floor.

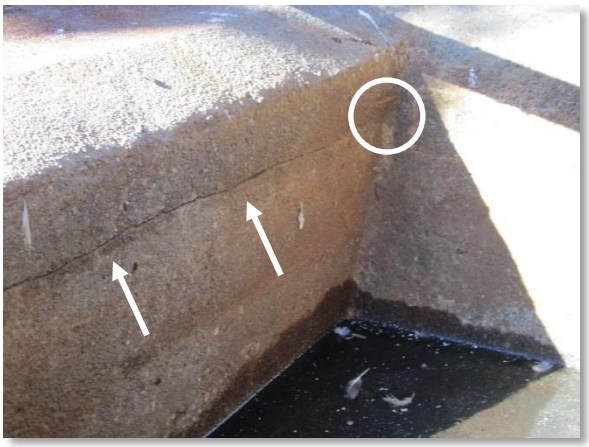


Photo 3-62. Grout or mortar joint at the center sludge pit. A short section of apparently exposed reinforcing steel was also visible (circle).

Photo 3-63. Rock pockets in PC 1 wall at approximate 10:30 position.

A few other notable observations from PC 1 are as follows:

- Near the stairway, there was a section of broken concrete at the top of the clarifier wall (Photo 3-64).
- The effluent towers also exhibited varying degrees of cracking within the top few inches of the concrete wall (Photo 3-65). The effluent towers are covered by a grating. On some of the other primary clarifiers (see Appendix C), the gratings are visibly displaced because of corrosion around the seating surface. According to operations staff, the gratings have fallen through on at least one prior occasion, and staff is restricted from climbing on top of the effluent towers.
- The wall is coated on its outer surfaces and the upper part of the interior surface. The coating on the interior surface is deteriorated near the apparent normal water line.
- Near the 7:00 position, there is a concrete pedestal for a pump located up against the exterior surface of the clarifier. The pedestal has shifted, leaving a gap between it and the clarifier wall.

Additional photos of these observations are provided in Appendix A.

Photo 3-64. Broken concrete at top of PC 1 wall near stairway.

Photo 3-65. Broken concrete at top of effluent tower (typical).

3.4.4 Additional Observations

Most of the steel components within PC 1 showed some degree of corrosion and were rated VANDA Level 3 or 4 for metal condition. The launders and their support brackets exhibited coating failure and corrosion, primarily at edges. The rake arms and center support structure were in similar condition. Some of the smaller members, such as the cross-braces across the top of the launders, showed severe section loss (more than 50% in some cases). The lower main members of the catwalk frame, which were constructed of angle sections, were perforated in several locations.

A weld within the upper horizontal railing at the end of the catwalk had apparently corroded through, leaving the railing in two pieces. Some of the diagonal braces on the catwalk frame were no longer attached at one end due to broken or corroded welds. The corrosion damage on the catwalk frame has been painted over, and its full extent was not visible. These observations are illustrated in Photo 3-66 through Photo 3-69 and in Appendix A.

Plant operations staff has restricted access to the catwalks and normally keeps them cordoned off due to the visible corrosion damage on the catwalk. Plant staff allowed limited access to the catwalks for the condition assessment activities.

Photo 3-66. Severe corrosion of cross-braces across top of PC 1 launders.

Photo 3-67. Typical coating failure and corrosion at edges on PC 1 launders.

Photo 3-68. Holes through lower members of catwalk truss. Corrosion damage has been painted over.

Photo 3-69. Corroded (separated) railing at end of PC 1 catwalk.

3.5 South Chlorine Contact Chamber

The South CCC was evaluated from topside during the first site visit in January 2015 and via confined space entry during the second site visit on February 26, 2015.

The South CCC consists of three parallel "passes" running east-west, divided by walls. The south pass is adjacent to the OWTP administration building. The north pass is adjacent to the North CCC, which itself consists of three passes. There is also a dividing wall (inner east wall) at the east end of the north and center passes that divides them from a north-south-oriented channel at the east end of the CCC. Per OWTP maintenance staff, the CCCs were constructed in 1975 and coated circa 2000. The coating was reportedly applied as an experiment in order to prolong the life of the structures; there was no significant concrete degradation that could be recalled to have occurred up to that time. No concrete repairs were reportedly done in conjunction with the coating application.

3.5.1 Concrete Sample Testing

Concrete samples in the South CCC were taken from three locations, one on the outer east wall, one on the north wall of the north pass, and one on the west wall of the center pass. The outer east wall samples were taken at a height of approximately 4 feet above the floor approximately 12 feet north of the south wall. The north pass samples were taken at a height of approximately 5 feet above the floor approximately 16 feet west of the inner east wall. The center pass samples were taken at a height of approximately 4 feet, approximately 4 feet south of the wall dividing the center and north passes.

Concrete samples were taken by drilling with a 5/8-inch-diameter bit to incremental depths and collecting the powder from within the hole. Coring was not conducted in the South CCC. The reinforcing bar size was not verified. Penetration depth measurements were not taken within the South CCC because the surfaces were coated.

The concrete samples were sent to SCL for testing of pH (carbonation depth) and chloride contamination depth. A summary of the laboratory analysis findings is provided in this section. The laboratory reports are provided in Appendix B.

Table 3-18 shows the sample pH measurements from the three concrete sampling locations (see Section 3.1.2) within the South CCC.

The pH of the concrete samples at three different locations was 11.0 or greater. Based on the pH testing results from the concrete samples, the concrete has lost a minor amount of alkalinity at the depths evaluated.

Table 3-18. Concrete pH Test Results for South CCC

Sample Location	Concrete Sample pH		
	Depth 0.0 in. to 0.5 in.	Depth 0.5 in. to 1.0 in.	Depth 1.0 in. to 1.5 in.
East wall	11.0	11.3	11.4
North wall of north pass	11.1	11.5	11.6
West wall of center pass	11.2	11.3	11.3

Table 3-19 summarizes the chloride testing results from the sampling locations within the South CCC. The table also includes the minimum reinforcing steel depth as measured by SPR scanning. The chloride content of the samples is well below 0.025%, so the steel is not expected to be subject to corrosion due to chloride at the sampling locations.

Table 3-19. Chloride Content Test Results for South CCC

Sample Location	Chloride Percentage by Weight of Concrete			Min. Depth to Reinforcing Steel (in.)	Chlorides above 0.025% at Reinforcement Depth?
	Depth 0.0 in. to 0.5 in.	Depth 0.5 in. to 1.0 in.	Depth 1.0 in. to 1.5 in.		
East wall	0.0052%	0.0033%	0.0028%	3.2	No
North wall of north pass	0.0025%	0.0065%	0.0015%	1.9	No
West wall of center pass	0.0032%	0.0051%	0.0032%	–	No

3.5.2 Surface Penetrating Radar Scans

SPR scanning was conducted at nine locations, in three groups of three scan areas, within the South CCC. The first group was in the short north-south-oriented channel at the east end of the CCC; this group included scans in the center of the inner and outer east walls and on the floor between these locations within a few feet of a joint. The wall scans were conducted approximately 12 feet north of the south wall at a height of approximately 4 feet. The second group was near the west end of the center pass; this group included three scan areas adjacent to one another on the north wall, south wall, and floor. The wall scans were taken at a height of approximately 4 feet, about 4 feet east of the end of the wall dividing the center and south passes. The third group was taken in the north pass approximately 16 feet west of the inner east wall; this group included three scan areas adjacent to one another on the north wall, south wall, and floor. The wall scans were taken at a height of approximately 5 feet.

Table 3-20 summarizes the depth and spacing of reinforcing steel as measured at the SPR scanning locations. There were two locations within the north pass, on the floor and the south wall, where the

minimum depth of cover was 1.9 inches, slightly less than the 2 inches recommended as a guideline for this type of structure (see Section 2.6). The other locations scanned exhibited concrete cover depths greater than 2 inches.

Table 3-20. SPR Scan Results for South CCC

Location	Bar Dir.	Reinforcing Bar Depth (in.)			Reinforcing Bar Spacing (in.)		
		Min.	Avg.	Max.	Min.	Avg.	Max.
Outer east wall	V	3.6	4.3	4.8	11.2	12.5	13.7
Outer east wall	H	3.2	3.5	4.0	9.2	10.9	12.6
Inner east wall	V	2.1	2.9	3.6	10.2	12.2	15.6
Inner east wall	H	2.8	3.4	3.9	11.2	11.9	12.8
Floor between inner and outer east walls	N-S	4.9	6.8	7.5	10.4	11.8	13.1
Floor between inner and outer east walls*	E-W	6.9	8.7	10.7	7.2	11.7	18.2
North wall of center pass	V	2.7	3.1	3.4	11.1	12.1	13.0
North wall of center pass	H	3.6	3.9	4.2	10.7	12.2	13.4
South wall of center pass	V	2.8	3.0	3.2	10.4	12.2	13.8
South wall of center pass	H	3.5	3.8	4.1	11.9	12.7	13.9
Floor of center pass	N-S	4.2	4.7	5.6	9.0	11.7	13.4
Floor of center pass	E-W	4.7	5.7	6.5	16.1	18.4	21.0
North wall of north pass	V	2.7	3.1	3.6	11.3	12.1	13.7
North wall of north pass	H	3.3	4.0	4.6	11.0	11.8	12.7
South wall of north pass*	V	1.9	2.8	3.6	4.2	10.1	13.4
South wall of north pass	H	3.2	3.6	4.3	10.7	11.8	13.7
Floor of north pass	N-S	1.9	2.4	2.8	11.0	12.0	13.1
Floor of north pass	E-W	2.7	3.2	3.5	17.1	18.3	20.0

* At this location there appeared to be two different bar spacings within the scan area.

3.5.3 Coating Adhesion Tests

Given that the CCC was built in 1975 and coated circa 2000 and the geotextile that is visible, the coating may be Polibrid 705. It is a 100% solids polyurethane that was applied in three layers in the following steps: 1) 20 to 30 mils of the polyurethane, 2) polypropylene geotextile fabric to provide flexibility over cracks or blisters, 3) 60 to 80 mils of the polyurethane.

The adhesion strength of the existing lining at the three separate locations was determined using the DeFelsko Positest AT-M gage per ASTM D7234 guidelines. A 1-inch-diameter drill bit was used to pre-drill the lining before the dolly was glued to the coated wall. A fast-set Gorilla Super Glue was used to affix the dollies to the existing lining and allowed to cure for 1 to 2 hours. Two dollies were glued to each location; one as the primary test and one as a backup. The dollies were glued to surfaces that were not covered with algae in order to ensure that the dolly adhered properly. Table 3-21 summarizes the results of the tests.

Typical industry-accepted coating adhesion values for concrete are between 150 psi and 250 psi. Only one measurement was acceptable and the remaining measurements indicated poor adhesion between the lining and the concrete. It is possible that the existing coating system was applied over concrete that was not abrasive-blasted but rather cleaned with high-pressure water. The high-pressure water removes the surface contaminants, but it does not remove carbonated concrete nor does it create an adequate surface profile for the coating to adhere properly.

Table 3-21. Coating Adhesion Results for South CCC

Location	Elevation	Adhesion Results (psi)	Type of Failure
Outer East Wall	3 feet above floor	98	Concrete 100%
Outer East Wall	3 feet above floor	250	Glue failure
West Wall of Center Pass	8 feet above floor	141	Concrete 100%
West Wall of Center Pass	8 feet above floor	91	Concrete 100%
North Wall of North Pass	8 feet above floor	236	Concrete 100%
North Wall of North Pass	8 feet above floor	139	Concrete 100%

3.5.4 Visual and Qualitative Evaluation – North Pass

Photo 3-70 shows an overall view of the inlet sluice gate and wooden baffle in the north pass. A small amount of water was leaking into the CCC from the bottom of the gate. Photo 3-71 and Photo 3-72 show two large blisters along the lower walls of the north pass. The blisters may be a result of not installing a saw cut into the concrete and properly terminating the coating. Per OWTP maintenance staff, the large blisters have been evident for several years and have not increased in size. Photo 3-73 shows a surface that appeared normal but was found to be hollow during sounding of the surface. Photo 3-74 shows the underside of the pedestrian bridge that spans across the CCC. The coated concrete surfaces are in VANDA Level 1 condition.

Photo 3-70. The bolts and supports of the baffles were in VANDA Level 1 condition.

Photo 3-71. Approx. 24-inch-long by 12-inch-wide blister on north wall of north pass.

Photo 3-72. Approx. 48-inch-long by 12-inch-wide blister on south wall of north pass.

Photo 3-73. Area of hollow coating on south wall of north pass suggests the coating is not properly adhered.

Photo 3-74. No cracks or spalls were observed on the underside of the pedestrian bridge.

Photo 3-75. Crack observed on the deck level at the northeast corner of the north pass.

3.5.5 Visual and Qualitative Evaluation – Center Pass

Photo 3-76 shows the pedestrian bridge that spans across the CCC. The coated concrete surfaces are in VANDA Level 1 condition. Photo 3-77 shows minor coating delamination on the lower walls of the center pass. The delamination is likely due to overspray during the lining application on the floor. The vertical walls were likely coated and cured at the time, and the overspray was applied onto those surfaces. Photo 3-78 shows blisters on the floor that were observed throughout the center pass. Photo 3-79 shows the coated bolts and support brackets for the baffles that were in good condition.

Photo 3-76. No cracks or spalls were observed on the underside of the pedestrian bridge.

Photo 3-77. Detail of coating overspray on the floor and coating delamination.

Photo 3-78. Blisters on floor were observed along a 40-foot-long section of the floor.

Photo 3-79. The coating on the brackets for the wooden baffles is in good condition.

3.5.6 Visual and Qualitative Evaluation – South Pass

Photo 3-80 shows the coated support brackets for the baffle within the south pass. Photo 3-81 shows the coated concrete surfaces on the underside of the pedestrian bridge. The coated concrete surfaces are in VANDA Level 1 condition. Photo 3-82 shows a typical coating repair observed along the lower walls of the south pass. Photo 3-83 shows a large blister observed along the lower walls of the south pass.

Photo 3-80. The coating on the brackets for the wooden baffles is in good condition.

Photo 3-81. No cracks or spalls were observed on the underside of the pedestrian bridge.

Photo 3-82. Approx. 24-inch-long by 24-inch-wide coating repair section. This section is hollow, which suggests the coating is not properly adhered.

Photo 3-83. Approx. 54-inch-long by 12-inch-wide coating blister on north wall of south pass.

3.5.7 Visual and Qualitative Evaluation – East End Channel

Photo 3-84 shows a large blister at the southeast corner of the CCC. Coating adhesion tests and concrete samples were obtained above this blister. The blisters may be a result of not installing a saw cut into the concrete and properly terminating the coating. Photo 3-85 shows the concrete surfaces above the outlet sluice gate. The surfaces were covered in sediment and cobwebs, but there were no visible defects observed.

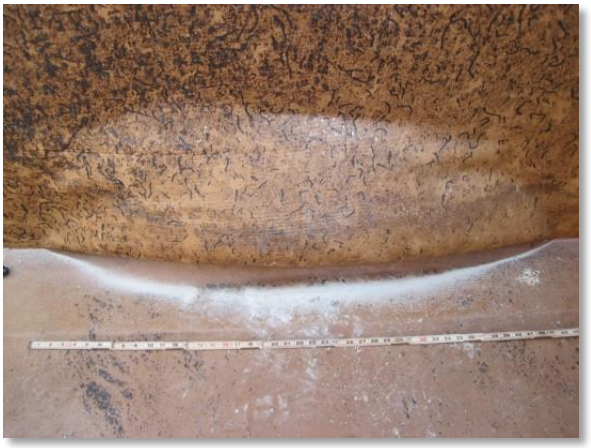


Photo 3-84. Approx. 48-inch-long by 18-inch-wide blister at east end of south pass on outside east wall of CCC.

Photo 3-85. Coated surfaces above the outlet sluice gate were in good condition.

3.5.8 Other Observations

Photo 3-86 and Photo 3-87 show the outlet sluice gate surfaces and water that was leaking in from the top of the gate. Photo 3-88 shows minor coating delamination on the top of the gate guide of the inlet sluice gate. Photo 3-89 shows water leaking into the CCC from the bottom of the gate.

Photo 3-86. Outlet sluice gate at northeast corner of CCC was leaking.

Photo 3-87. Close-up of leak on sluice gate at northeast corner of CCC.

Photo 3-88. Minor damage to the coating on the gate guide.

Photo 3-89. Minor leaking of the inlet sluice gate.

4.0 CONCLUSIONS

Based on the information gathered during the condition assessment, V&A presents the following conclusions.

4.1 West Flow Equalization Basin

- **Core samples** – Core samples were collected from the west wall and floor of the West FEB. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.45 inches at the sample locations. However, the minimum reinforcing steel depth was much less at the scan locations on the north and east walls, so the steel may be subject to corrosion there if the carbonation depth is similar.
  - Chloride testing indicated that the reinforcing steel may be subject to corrosion at the west wall sample location. Due to the lower reinforcing steel depth on the north and east walls, the steel may also be subject to corrosion there if the chloride contamination depth is similar.
  - Compressive strength of the west wall and floor core samples was 8,240 and 5,360 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the West FEB floor. The water-cement ratio of the sample was estimated at 0.45, which is equal to the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.
- **Surface penetrating radar** – Scans were conducted on the west, north, and east walls as well as the floor. The depth of concrete cover over the reinforcing steel in many locations was significantly less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 0.4 inches, on the east wall near an area of visible spalling.
- **Concrete surfaces** – In general, the concrete interior surfaces of the West FEB were in good condition. The concrete surfaces, particularly the floor, showed generalized shrinkage cracking. Soundings in the West FEB generally indicated sound, hard concrete. There were several areas where minor or moderate defects or evidence of deterioration was observed.

As a result of the number and frequency of these observations, the West FEB is rated VANDA Level 2 for concrete condition. Specific observations include the following:

- Construction joints on the west wall typically had a concrete mortar overlay that was spalling or loose in many places. Over a length of approximately 50 feet near the midpoint of the wall, there was a horizontal reinforcing bar running along the joint with very little concrete cover, and it was exposed in some locations.
- The sealant at the expansion joints is generally cracked and split, although it is still somewhat pliable. In some places, sections of the sealant are missing or there are weeds growing out of the gaps. A few locations exhibited minor spalling of the concrete adjacent to the expansion joints.
- The east and west walls exhibited minor exposed aggregate in some locations. Surface defects such as bug holes and apparent rock pockets were also observed.
- There was minor vertical cracking in the south wall. The wall along the ramp was cracked in a few locations, possibly through its entire thickness.
- The walls of the West FEB exhibited spalling in isolated locations. Most of these were small, individual spalls. There was a pattern of spalling over the vertical bars in the east wall. There was also one diagonal bar visible through a spalled area a few feet in length near the top of the west wall.
- The columns holding up the ramp and platform at the north end of the basin exhibited minor areas of exposed aggregate. One of the columns had a small gouge on one of the corners. The tapered concrete collar at the base of some columns was broken and hollow-sounding.

- **Additional observations** – A few additional observations were noted in the West FEB:
  - There is a ductile iron pipe near the south wall that exhibits signs of coating failure and corrosion, particularly on the coupling hardware and supports.
  - The wall along the ramp leading into the FEB is only about 18 inches high, which poses a fall hazard for personnel walking near the edge.

4.2 Secondary Sedimentation Tank 2

- **Core samples** – Core samples were collected from the north wall and floor of SST 2. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.40 inches at the sample locations. The reinforcement depth was similar or greater at the scan locations on the east and south walls, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.

- Based on the chloride testing results, there is chloride contamination at the surface and decreasing with depth into the concrete. The chloride contamination is not above the given threshold of 0.025% at the reinforcing steel depth, but this threshold may vary based on other factors. Corrosion of the reinforcing steel may be a future concern if this contamination continues. There may also be locations within the structure where the reinforcing steel cover depth is less or the chloride contamination depth is greater.
- Compressive strength of the north wall and floor core samples was 6,940 and 4,270 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
- Petrographic analysis was conducted on a core sample from the north wall of SST 2. The water-cement ratio of the sample was estimated at 0.43, which is below the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.

- **Surface penetrating radar** – Scans were conducted on the north, east, and south walls as well as the floor. The depth of concrete cover over the reinforcing steel in some locations was somewhat less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 1.7 inches.
- **Concrete surfaces** – In general, the concrete interior surfaces of SST 2 were in good condition and are rated VANDA Level 1 for concrete condition. There were several areas where minor defects or evidence of deterioration was observed. These are presently minor issues, but they may accelerate future deterioration of the structure. Specific observations include the following:
  - Cracking was observed in many locations within SST 2, including cracks in the slab overhanging the west end of the basin, vertical cracks along the length of the north wall, hairline cracks in some other locations, and general cracking in some areas of the floor. The cracks in the slab at the west end had begun to separate slightly. There was possible groundwater infiltration from the floor cracking in one location.
  - The sealant at the expansion joints is in fair condition, with some signs of brittleness and shrinkage. The expansion joint near the west end of the basin exhibited gaps and possible groundwater infiltration.
  - There is a gap between the east wall and the fill concrete at the bottom of the wall. The fill concrete becomes thin near the toe, due to its circular concave surface, and it is irregular and possibly broken in this area.
- **Additional observations** – There was evidence of coating failure and minor surface corrosion on the metallic appurtenances within SST 2.

4.3 Activated Sludge Tank 1B

- **Core samples** – Core samples were collected from the west wall and floor of AST 1B. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.50 inches at the sample locations. The reinforcement depth was similar or greater at the scan locations on the north and east walls, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.
  - Based on the chloride testing results, there is chloride contamination at the surface and decreasing with depth into the concrete. The chloride contamination is not above the given threshold of 0.025% at the reinforcing steel depth, but this threshold may vary based on other factors. Corrosion of the reinforcing steel may be a future concern if this contamination continues. There may also be locations within the structure where the reinforcing steel cover depth is less or the chloride contamination depth is greater.
  - Compressive strength of the west wall and floor core samples was 6,920 and 6,270 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the AST 1B floor. The water-cement ratio of the sample was estimated at 0.45, which is equal to the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.
- **Surface penetrating radar** – Scans were conducted on the west, north, and east walls as well as the floor. The minimum depth of cover at the floor scan location was slightly less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 1.8 inches.
- **Concrete surfaces** – In general, the concrete interior surfaces of AST 1B were in good condition and are rated VANDA Level 1 for concrete condition. There were several areas where minor defects or evidence of deterioration was observed. These are presently minor issues, but they may accelerate future deterioration of the structure. Some of these locations were rated VANDA Level 2. Specific observations include the following:
  - Cracking was observed in many locations within AST 1B, including minor cracks in the floor, west wall, and walkways. There was also cracking in the top of the east wall. The concrete appeared to be loose in some of these areas, and one location may have been repaired previously. The ends of the reinforcing bars were also visible at the top of the east wall. The top of the east wall is rated VANDA Level 2 for concrete condition.
  - There were several locations where there was corrosion staining evident at the interior surface of the concrete walls. Most of these appeared to be due to wires or other metal

objects embedded in the concrete. One location appeared to have an exposed reinforcing bar.

  - The sealant at the expansion joints is generally cracked and split, although it is still somewhat pliable. In some places, there are gaps between the sealant and the concrete. One location exhibited active groundwater infiltration during the evaluation. Spalling of the concrete was noted adjacent to the expansion joints in one location, which was rated VANDA Level 2 for concrete condition as a result.

- **Additional observations** – There were several steel manifold pipes crossing AST 1B. These exhibited minor coating failure and surface corrosion. There was also minor coating failure and surface corrosion on the sluice gates and their frames.

4.4 Primary Clarifier 1

- **Core samples** – Core samples were collected from the wall and floor of PC 1 near the catwalk. Test results from the core samples are as follows:
  - Carbonation testing indicated that the reinforcing steel is embedded in an alkaline (protective) environment at the sample locations. The maximum carbonation depth was 0.15 inches at the sample locations. The reinforcement depth was similar or greater at the other two scan locations on the wall, so the reinforcing steel would also be within an alkaline environment there if the carbonation depth is similar.
  - Based on the chloride testing results, the reinforcing steel is not expected to be subject to corrosion due to chloride at the wall sampling location. The results are unclear for the floor sample location.
  - Compressive strength of the wall and floor core samples was 4,910 and 5,760 psi, respectively. These results exceed the current requirement of 4,000 psi in ACI 350 for water-retaining structures.
  - Petrographic analysis was conducted on a core sample from the PC 1 floor. This sample included approximately 3 inches of mortar topping over the concrete. The water-cement ratio of the concrete (lower) layer was estimated at 0.48, which is above the maximum water-cement ratio of 0.45 given in ACI 350 for water-retaining structures. A minor degree of alkali-silica reaction (ASR) was noted, but it was not observed to be causing deleterious expansion.
- **Surface penetrating radar** – Scans were conducted at three locations on the wall and one location on the floor. The minimum depth of cover over the vertical bars at one wall scanning location was somewhat less than the 2 inches recommended as a guideline for this type of structure. The minimum measured depth of cover was 1.5 inches.
- **Concrete surfaces** – The interior concrete surfaces of PC 1 were in fair condition, showing some evidence of deterioration, and were rated VANDA Level 2 for concrete condition. The condition of the PC 1 concrete was very uniform around the circumference of the clarifier. In

general, the wall exhibited exposed medium-diameter aggregate up to about 4 feet above the floor. The wall also exhibited a pattern of fine vertical cracks spaced approximately every 1 to 2 feet. The floor showed a pattern of general fine cracks across most of its surface. In one location, there was minor apparent groundwater infiltration from the floor cracks. Except near the center column, the cracks in the floor and wall exhibited minimal separation. A few other notable observations from PC 1 are as follows:

  - Near the stairway, there was a section of broken concrete at the top of the clarifier wall.
  - The effluent towers also exhibited varying degrees of cracking within the top few inches of the concrete wall. The effluent towers are covered by a grating. On some of the other primary clarifiers, the gratings are visibly displaced because of corrosion around the seating surface. According to operations staff, the gratings have fallen through on at least one prior occasion, and staff is restricted from climbing on top of the effluent towers.
  - The wall is coated on its outer surfaces and the upper part of the interior surface. The coating on the interior surface is deteriorated near the apparent normal water line.

- **Additional observations** – Most of the steel components within PC 1 showed some degree of corrosion and were rated VANDA Level 3 or 4 for metal condition. The launders, their support brackets, the rake arms, and the center support structure exhibited coating failure and corrosion, primarily at edges. Some of the smaller members, such as the cross-braces across the top of the launders, showed severe section loss (more than 50% in some cases). The catwalk frame exhibited perforations and broken welds. Due to the visible corrosion damage on the catwalk, plant operations staff has restricted access to the catwalks and normally keeps them cordoned off.

4.5 South Chlorine Contact Chamber

- **General** – A confined space entry was conducted to assess the condition of the existing coating, conduct coating adhesion tests, and obtain concrete samples for testing. The coated concrete surfaces of the South CCC were evaluated and documented from within the channels. There is cracking and spalling at the top of the east and west walls.

- **Coating condition** – The coating is in poor condition, as it exhibits blistering and delaminations on approximately 40% of the immersed surfaces. Per OWTP maintenance staff, the large blisters have been evident for several years and have not increased in size. Approximately 22 large blisters and several areas of small blisters were visible. The coating does not appear to have punctured at the blister locations. A few edge delaminations, which were due to overspray, were visible on the lower surfaces of the walls.

- **Concrete degradation** – At the northeast corner of the South CCC, there was a crack extending through the top of the concrete wall. The crack has separated slightly. The top of the west wall was spalling around the railing bases. Otherwise, concrete degradation was not observed in the South CCC during the evaluation.

- **Additional observations** – The support brackets and bolts of the baffles were in good condition. The metal surfaces of the sluice gates were in good condition, but there was water leaking in through the gates.

4.6 Other Structures

Photographic documentation from topside was also collected for some of the other structures at the OWTP. These consisted of the ASTs, SSTs, and FEB that were out of service at the time, as well as the other three PCs. Appendix C documents these structures in terms of notable observations and significant differences with respect to the structures evaluated via entry.

5.0 RECOMMENDATIONS

Based on the conclusions of the field assessment, V&A presents the following recommendations for consideration.

5.1 West Flow Equalization Basin

- Apply an organosilane corrosion inhibitor to the concrete to reduce the migration of chlorides into the concrete. Products similar to BASF MasterProtect 8000 CI are recommended.
- Remove and replace the cracked overlay on the construction joints. This can be done by chipping out the concrete to a depth of 1 inch and applying a repair mortar such as Sika Sikatop 123.
- Replace the sealant in the expansion joints. Consider repairing the adjacent areas of spalled concrete on the floor. Also, replace the sealant in the joints surrounding the sprinklers at the north and south ends of the basin. The joints may be sealed with products such as Sikaflex 2C SL on horizontal surfaces and Sikaflex 2C NS on vertical walls.
- Monitor the construction joints and areas of spalling for evidence of further degradation and corrosion of the exposed reinforcing steel.
- Seal the cracks in the wall running along the edge of the ramp. Repair the spalled concrete on the wall adjacent to the expansion joint.
- Monitor the cracks in other locations for widening or corrosion staining.
- Consider adding a railing to the top of the wall along the ramp to mitigate the fall hazard.
- Repair the areas of damaged concrete on the columns at the north end of the basin. The surfaces should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 3 to 4. Products such as Sika Sikatop 123 or BASF MasterEmaco S488 CI are recommended.
- Consider evaluating the piping, sprinklers, etc., for condition. If it is not significantly corroded upon further investigation, recoat the ductile iron pipe near the south wall.
- Reassess the concrete interior surfaces of the West FEB in approximately 10 years.

5.2 Secondary Sedimentation Tank 2

- Seal the cracks in the slab over the west end of the basin. Monitor these cracks for further widening or corrosion staining.
- Monitor the cracks in other locations for separation and additional groundwater infiltration.
- Replace the sealant in the expansion joints with a product such as Sikaflex 2C SL.
- Consider recoating the metallic appurtenances within SST 2. Products such as two coats of Carboline Carboguard 890, PPG Amerlock 2, or International Paint Bar-Rust 233, at 4 to 6 mils per coat, should be applied on steel that has been abrasive-blasted per SSPC SP10 with a 2 to 3 mil surface profile.

5.3 Activated Sludge Tank 1B

- Repair the cracking and exposed ends of the reinforcing bars at the top of the east wall.
- Monitor the cracks in other locations for further widening or corrosion staining.
- Monitor the areas of corrosion staining for evidence of further degradation and corrosion of exposed reinforcing steel.
- Replace the sealant in the expansion joints. Repair the spalled concrete adjacent to one of the expansion joints. The spalled surfaces should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 3 to 4. Products such as Sika Sikatop 123 or BASF MasterEmaco S488 CI are recommended. The joints may be sealed with products such as Sikaflex 2C SL on horizontal surfaces and Sikaflex 2C NS on vertical walls.
- Consider recoating the metallic appurtenances within AST 1B. Products such as two coats of Carboline Carboguard 890, PPG Amerlock 2, or International Paint Bar-Rust 233, at 4 to 6 mils per coat, should be applied on steel that has been abrasive-blasted per SSPC SP10 with a 2 to 3 mil surface profile.

5.4 Primary Clarifier 1

- Coat the interior surfaces of the clarifier as follows. Surfaces above the elevation of the trough weir, and 1 foot below, should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 4 to 5. A 100% epoxy or polyurethane coating with a dry film thickness of 125 mils is recommended to be applied on the concrete.

  Extending the coating down the wall to the floor is optional, but not required, as the surfaces will always be immersed and the surfaces were in VANDA Level 2 condition. If the concrete will be continuously submerged, it is anticipated that this will be acceptable since there will be limited oxygen available to facilitate corrosion. If the clarifier will be left out of service for

long periods of time and subject to possible wind-borne chloride contamination, coating the lower wall surfaces may be justified.

- Seal the cracks and delaminations in the floor near the center column. Coat the small segment of exposed reinforcing steel in the center well, ensuring that the coating terminates adequately on the surrounding concrete.
- Repair the broken concrete at the top of the wall and effluent towers. In planning the repairs, consider whether the repairs conducted previously on the other clarifiers have provided adequate long-term performance. Also consider whether there are ways to make the grating support less likely to fail in the event that future deterioration does occur.
- Replace the launders with fiberglass launders and replace the bridge support structural members. Replace the bridge support with coated steel. Products such as two coats of Carboline Carboguard 890, PPG Amerlock 2, or International Paint Bar-Rust 233, at 4 to 6 mils, per coat should be applied on steel that has been abrasive-blasted per SSPC SP10 with a 2 to 3 mil surface profile. A finish coat of Carboline Carbothane 133VOC, PPG Amerlock 2, or International Paint Devthane 379H at 2 to 3 mils dry film thickness is recommended on non-immersed steel exposed to ultraviolet light.
- Reassess the concrete interior surfaces of PC 1 in approximately 10 years.

5.5 South Chlorine Contact Chamber

- Plan for the removal and replacement of the existing lining in the South CCC in the next 10 years. The lining is still protecting the concrete, but it may begin to peel off the walls in the future. The concrete should be abrasive-blasted to meet an ICRI 310.2 Concrete Surface Profile 4 to 5. A 100% polyurethane coating with a dry film thickness of 125 mils is recommended to be applied on the concrete. Products such as International Paint Polibrid 705 or Global EcoTech Enduraflex EF1988 are compatible products with the existing system.
- Seal the crack at the northeast corner and monitor it for further widening.
- Repair the spalling damage around the railing bases at the west wall.

APPENDIX A. ADDITIONAL PHOTOGRAPHIC DOCUMENTATION

AST 1B

General

Photo A-1. Looking south from midpoint of AST 1B.

Photo A-2. Looking north from midpoint of AST 1B.

Photo A-3. North wall of AST 1B.

Photo A-4. South wall of AST 1B.

Photo A-5. Underside of platform at north end of AST 1B.

Photo A-6. Center trough at south end of AST 1B (typical).

Condition Assessment

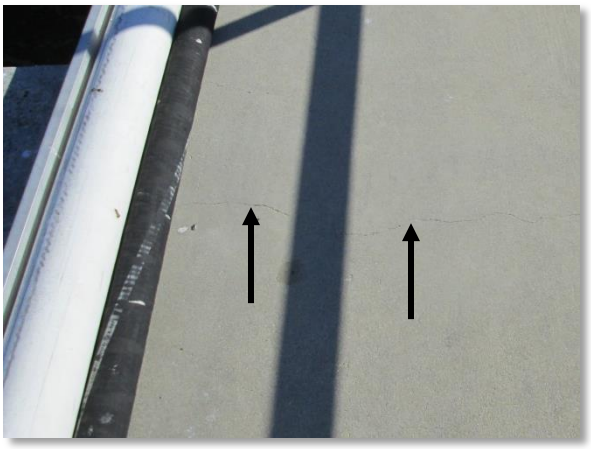


Photo A-7. Crack across walkway over AST 1B.

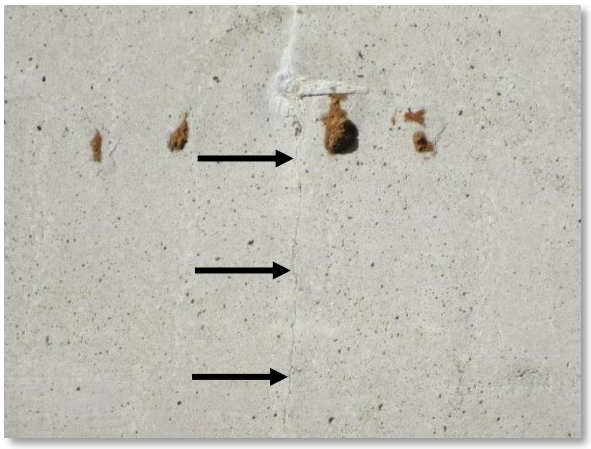


Photo A-8. Hairline cracking on west wall.

Photo A-9. Loss of mortar over construction joint on east wall about 350 feet south of north wall.

Photo A-10. Multiple small sources of corrosion staining on west wall.

Photo A-11. Multiple small sources of corrosion staining on north wall.

Photo A-12. Typical sealant in expansion joint with shrinkage and gaps.

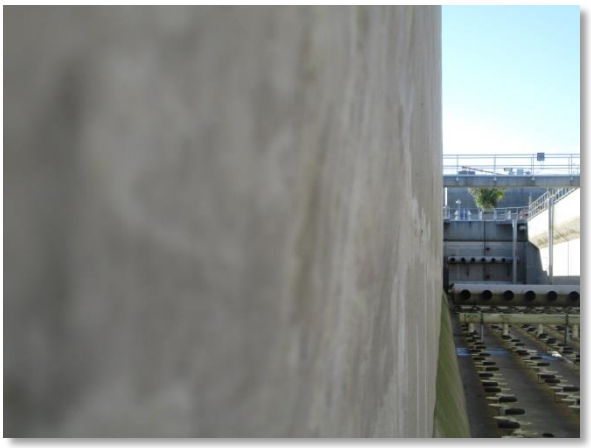


Photo A-13. Uneven construction joint (approx. 1-inch offset) on east wall about 150 feet south of north wall.

Photo A-14. Rock pocket above manifold pipe penetration about 305 feet south of north wall.

Additional Observations

Photo A-15. Minor coating failure and corrosion on sluice gates and frames.

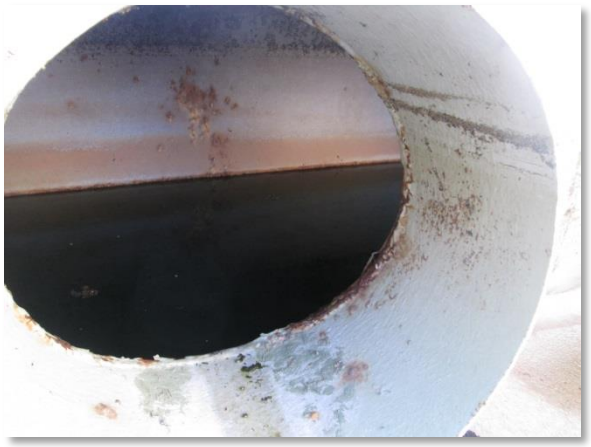


Photo A-16. Steel manifold pipe with minor coating failure and corrosion.

Photo A-17. Steel manifold pipe with minor coating failure and corrosion.

Photo A-18. Steel manifold pipe with minor coating failure and corrosion.

PC 1

General

Photo A-19. General view of PC 1.

Photo A-20. General view of launders and wall inside PC 1.

Photo A-21. PC 1 rake arms.

Photo A-22. PC 1 center column.

Condition Assessment

Photo A-23. Typical exposed aggregate on lower wall.

Photo A-24. Typical cracks in PC 1 floor.

Photo A-25. Cracks near center column have separated about 1/8 of an inch.

Photo A-26. Rock pockets in PC 1 wall at approximate 10:30 position.

Photo A-27. Deteriorated coating on upper interior surfaces of wall.

Photo A-28. Gap between pump base and clarifier wall.

Additional Observations

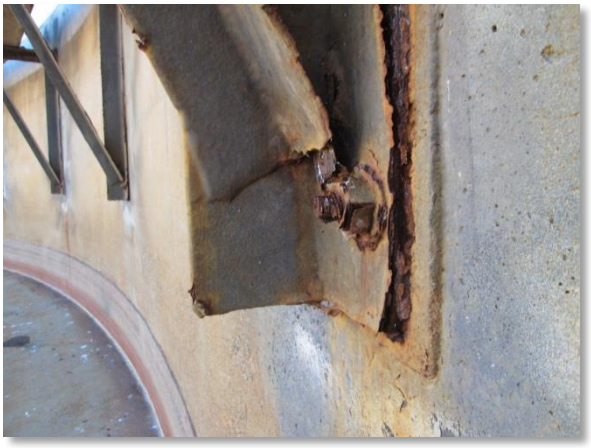


Photo A-29. Typical coating failure and corrosion on PC 1 launder brackets.

Photo A-30. End of rake arm within PC 1.

Photo A-31. Typical coating failure and exfoliating corrosion products on PC 1 rake arms.

Photo A-32. Loose bracing on PC 1 catwalk truss due to broken or corroded welds.

SST 2

General

Photo A-33. Interior of east end of SST 2.

Photo A-34. Underside of platform at west end of SST 2.

Photo A-35. Southwest corner of SST 2, above sump.

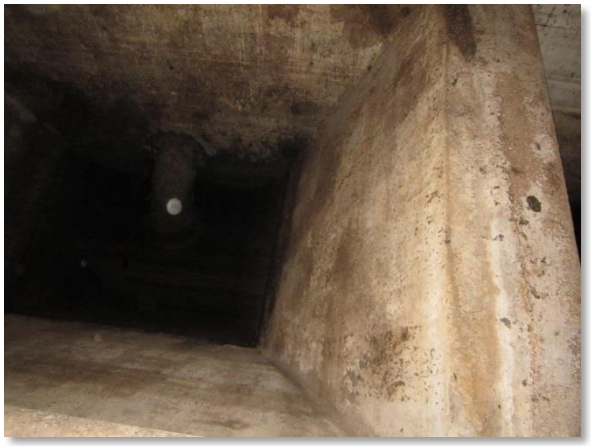


Photo A-36. Sump at southwest corner of SST 2.

Condition Assessment

Photo A-37. Cracking of platform above west end of SST 2.

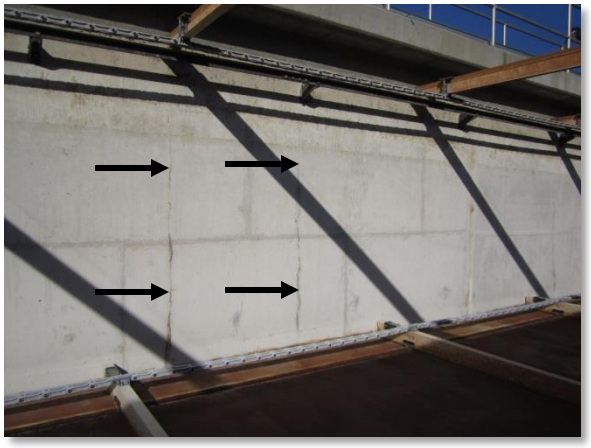


Photo A-38. Typical vertical cracks spaced every few feet along length of north wall.

Photo A-39. Evidence of possible seepage through construction joint near midpoint of north wall (south wall similar).

Photo A-40. Detail of possible seepage through construction joint near midpoint of north wall.

Photo A-41. Minor cracking on underside of diagonal platform over southeast corner of SST 2.

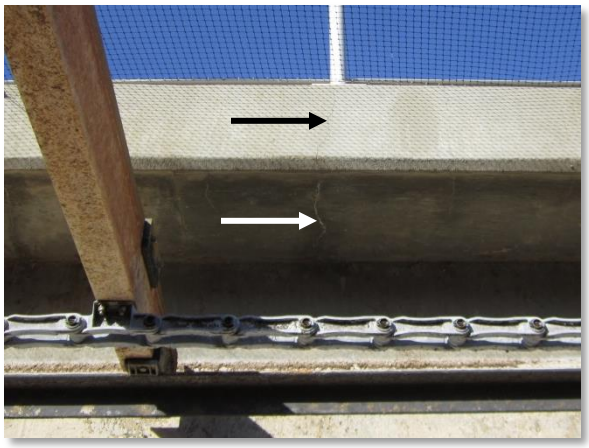


Photo A-42. Minor cracking of walkway above north wall of SST 2.

Photo A-43. Minor cracking in tapered fill concrete at east wall of SST 2.

Additional Observations

Photo A-44. Coating failure and minor corrosion on brackets for skimmer system.

Photo A-45. Apparent corrosion of floor tracks for skimmer system.

Photo A-46. Inlet tee at east wall. Arrow denotes minor coating failure and surface corrosion.

Photo A-47. Damage to cement mortar lining inside inlet tee at east wall.

West FEB

General

Photo A-48. South wall of West FEB.

Photo A-49. Southeast corner of West FEB.

Photo A-50. Northwest corner of West FEB.

Photo A-51. Northwest corner of West FEB.

Condition Assessment

Photo A-52. Construction joints on west wall with deteriorating mortar overlay (typical).

Photo A-53. Construction joints on west wall with deteriorating mortar overlay (typical).

Photo A-54. Typical condition of expansion joint sealant on walls.

Photo A-55. Typical condition of expansion joint sealant on floor.

Photo A-56. Typical view of lower east wall.

Photo A-57. Typical view of lower east wall.

Photo A-58. Southwest corner of West FEB with isolated rock pockets.

Photo A-59. Detail of southwest corner of West FEB.

Photo A-60. Typical minor spalling on west wall.

Photo A-61. Typical minor corrosion staining on west wall.

Photo A-62. Minor cracking and efflorescence on bottom of platform at northwest corner of West FEB.

Photo A-63. Wood embedded in wall at northeast corner.

Additional Observations

Photo A-64. Corroding pipe support near south wall.

Photo A-65. Corroded hardware on Victaulic couplings for pipe at south wall.

Photo A-66. Underside of horizontal pipe near south wall.

Photo A-67. Missing sprinkler head in West FEB.

South CCC

General

Photo A-68. General coating condition in south pass.

Photo A-69. General view of west wall from center pass.

Photo A-70. West end of north pass.

Photo A-71. General coating condition on upper walls.

Photo A-72. Northeast corner and sluice gate.

Photo A-73. Coating condition at east end of CCC.

Photo A-74. Coating condition at top of north wall of north pass (North CCC at left).

Condition Assessment

Photo A-75. Typical coating patch.

Photo A-76. Typical coating patch.

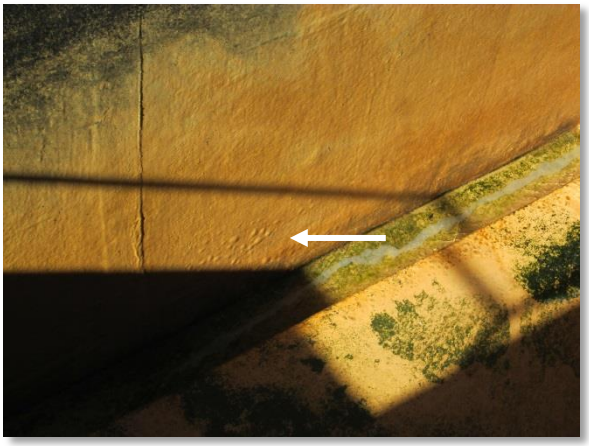


Photo A-77. Typical blisters on lower wall.

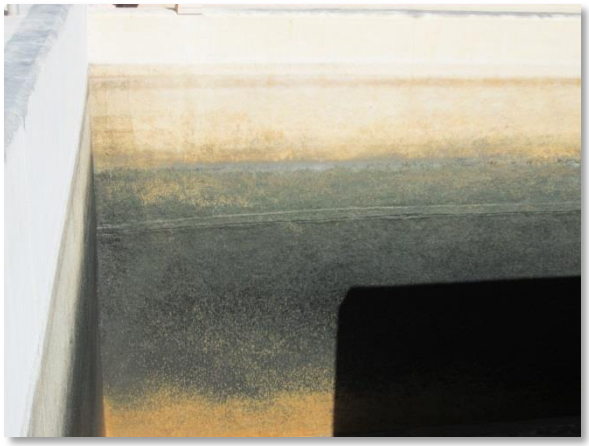


Photo A-78. Typical coating texture.

Photo A-79. Coating termination at top of south wall near walkway.

Photo A-80. Coating delamination at northeast corner.

APPENDIX B. CONCRETE SAMPLE TESTING REPORTS

February 6, 2015 SCL Project No. 15006

Mr. Michael Johannessen
Villalobos and Associates
155 Grand Ave, Suite 700
Oakland, CA 94612

Email: mjohannessen@vaengineering.com

RE: V&A Job #14-0195 - Oxnard WWTP
Concrete Evaluation
Oxnard, California

Dear Mr. Johannessen:

Scientific Construction Laboratories, Inc. (SCL) has completed materials testing of the cores from the above referenced project. The purpose of the testing was to determine material properties and to use this information to assist future remedial work, etc. This report includes test results, and a brief summary of results.

LABORATORY TESTING

VISUAL EXAMINATION OF CONCRETE CORES

Each of the cores were visually inspected and photographed. Photos of cores in the as-received condition are shown in the attached visual inspection data sheets. The maximum size aggregate was found to be approximately three quarters of an inch. The paste was found to be hard and intact.

CARBONATION DEPTH MEASUREMENTS

Depth of carbonation was determined on each core sample by an application of *Deep Purple* (manufactured by Germann Instruments) on freshly-cut cross sections of concrete core samples. These results indicate that the depth of carbonation on the concrete cores to range from less than 0.05 inches to 0.5 inches. Results are shown in table #1 and photo #1.

CHLORIDE CONTENT TESTING

Chloride content tests were performed on concrete powder samples in accordance ASTM C1218 –*Standard Test Method for Water-Soluble Chloride in Mortar and Concrete*. Sections of each sample were pulverized to pass a #20 sieve. This method involves digesting a small amount of the sample followed by titrating the resulting sample with a silver nitrate solution. Three

samples were tested from each of the eight cores for a total of twenty-four tests. The depths on each core that were tested were from 0.5" to 1.0", 1.0" to 1.5", and 1.5" to 2.0". Test results are reported in Table 2. The average chloride content of the eight samples tested at the depth of 0.5" to 1.0" was found to be 0.0327% by weight of concrete which exceeds the threshold to initiate corrosion. The chloride content at which corrosion may occur (~0.025 - 0.030% by weight of concrete) is commonly referred to as the chloride threshold. This is the point at which a protective passive oxidation layer around the reinforcing steel is broken down allowing corrosion to occur. The average chloride content dropped on the eight samples tested from 1.5" to 2.0" to 0.0094% by weight of concrete.

CONCRETE COMPRESSIVE STRENGTH TESTING

Eight concrete cores were tested for compressive strength. The average compressive strength was 6,080 psi. Compressive strength results are shown in Table 3.

PETROGRAPHIC EXAMINATION

Examinations were performed on four concrete samples submitted to Applied Materials and Engineering (AME). The full report is attached in the appendices. A summary of the report is as follows:

1. The concrete was not air entrained.
2. Trace amounts of reactive aggregate particles were found in some of the concretes, but no deleterious cracking or alkali-silica gel formation was observed.
3. The estimated water to cement ratio is 0.44.
4. Cement content is estimated to be 7.2 sacks/yd.
5. Core P from the primary clarifier floor had a mortar topping from the surface to a depth of approximately 3.0 inches.

SUMMARY

A brief summary of the laboratory testing is as follows:

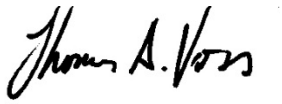
1. The chloride content testing showed that each of the cores demonstrated exposure to either saltwater or brackish waters during the lifetime of the structure. Chloride content profiling demonstrated contamination was typically to a depth of one inch and in some cases (Primary Clarifier Floor) up to two inches.
2. The depth of carbonation was measured at a maximum of 0.50 inches.
3. No information has been provided regarding design compressive strengths but the average strength exceeded 6000 psi.

4. Petrographic examination showed that the concrete was a seven sack mix with an estimated water to cementitious ratio of 0.44. Alkali-Silica reactivity was minor.

If you have any questions, please call.

Very truly yours,

SCIENTIFIC CONSTRUCTION LABORATORIES, INC.



Thomas A. Voss
Civil Engineer

TABLE 1. CONCRETE DEPTH OF CARBONATION TEST RESULTS		
Core No.	Location	Maximum Depth of Carbonation (inches)
A	Activated Sludge Basin 1B (Aeration Basin/AST) – West Wall	0.30
D	Activated Sludge Basin 1B (Aeration Basin/AST) – Floor	0.50
F	Secondary Sedimentation Basin 2 (SST) – North Wall	0.40
G	Secondary Sedimentation Basin 2 (SST) – Floor	<0.05
J	West Flow Equalization Basin (FEB) – West Wall	0.45
L	West Flow Equalization Basin (FEB) - Floor	0.40
N	Primary Clarifier 1 - Wall	0.15
P	Primary Clarifier 1 - Floor	<0.05

TABLE 2. CHLORIDE TESTING

Core No.	Location	% Chloride by Weight of Concrete (at three depths)		
		0.5″ to 1.0″	1.0″ to 1.5″	1.5″ to 2.0″
A	Activated Sludge Basin 1B (Aeration Basin/AST) – West Wall	0.0355	0.0228	0.0135
D	Activated Sludge Basin 1B (Aeration Basin/AST) – Floor	0.0306	0.0214	0.0064
F	Secondary Sedimentation Basin 2 (SST) – North Wall	0.0350	0.0069	0.00009
G	Secondary Sedimentation Basin 2 (SST) – Floor	0.0312	0.0217	0.0141
J	West Flow Equalization Basin (FEB) – West Wall	0.0657	0.0253	0.0053
L	West Flow Equalization Basin (FEB) - Floor	0.0284	0.0109	0.0031
N	Primary Clarifier 1 - Wall	0.0068	0.0067	0.0058
P	Primary Clarifier 1 - Floor	0.0280	0.0266	0.0263

TABLE 3. CONCRETE COMPRESSIVE STRENGTH TEST RESULTS

Core No.	Location	Capped Height (in.)	Diameter (in.)	Maximum Load (lbf)	Compressive Strength* (psi)
B	Activated Sludge Basin 1B (Aeration Basin/AST) – West Wall	5.0	2.74	40,800	6,920
C	Activated Sludge Basin 1B (Aeration Basin/AST) – Floor	5.6	2.74	37,000	6,270
E	Secondary Sedimentation Basin 2 (SST) – North Wall	5.4	2.74	40,900	6,940
H	Secondary Sedimentation Basin 2 (SST) – Floor	5.5	2.74	25,200	4,270
I	West Flow Equalization Basin (FEB) – West Wall	5.6	2.74	48,600	8,240
K	West Flow Equalization Basin (FEB) - Floor	5.4	2.74	31,600	5,360
M	Primary Clarifier 1 - Wall	3.7	2.74	30,500	4,910
O	Primary Clarifier 1 - Floor	3.4	2.74	36,500	5,760

*Compressive strengths corrected for L/D ratios of less than 1.75 as per ASTM C42

Photo #1 –Depth of carbonation testing on each of the eight cores.

Appendix

Visual Inspection of Concrete Cores

AME Petrographic Report

3397 MT. DIABLO BLVD., SUITE E, LAFAYETTE, CA 94549 (925) 284-3363 / (925) 284-3360 FAX

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core A -Activated Sludge Basin 1B (Aeration Basin/AST) – West Wall**

General Properties

Length of Core, inches:	5.3 inches
Diameter, inches:	2.74 inches
Reinforcing Steel:	None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. There was a slight discoloration (tannish) of the paste from the surface to a depth of 1/8 inch. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core D - Activated Sludge Basin 1B (Aeration Basin/AST) – Floor**

General Properties

Length of Core, inches: 5.5 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. There was a slight discoloration (tannish) of the paste from the surface to a depth of 1/8 inch. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core F - Secondary Sedimentation Basin 2 (SST) – North Wall**

General Properties

Length of Core, inches: 4.3 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. There was a slight discoloration (tannish) of the paste from the surface to a depth of 1/8 inch. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core G -Secondary Sedimentation Basin 2 (SST) – Floor**

General Properties

Length of Core, inches: 3.6 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core J -West Flow Equalization Basin (FEB) – West Wall**

General Properties

Length of Core, inches: 2.1 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core L -West Flow Equalization Basin (FEB) - Floor**

General Properties

Length of Core, inches: 2.9 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core N -Primary Clarifier 1 - Wall**

General Properties

Length of Core, inches: 4.6 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. The maximum size aggregate is approximately 0.75 inches. The aggregate was well graded.

Scientific Construction Laboratories, Inc.

Visual Examination of Cores

Core ID: **Core P -Primary Clarifier 1 - Floor**

General Properties

Length of Core, inches: 5.0 inches

Diameter, inches: 2.74 inches

Reinforcing Steel: None found

Observations and Comments

No scaling on the exterior surface of the core was observed. The paste was hard and intact throughout the core section. The top three inches of the core did not contain coarse aggregate. This section appears to be either a topping material or a partial depth repair. The maximum size aggregate in the rest of the core is approximately 0.75 inches. The aggregate was well graded.

APPLIED MATERIALS & ENGINEERING, INC.
980 41st Street
Oakland, CA 94608
Tel: (510) 420-8190
FAX: (510) 420-8186
e-mail: info@appmateng.com

February 6, 2015

Project Number: 115054C

Mr. Tom Voss
SCIENTIFIC CONSTRUCTION LABORATORIES, INC.
3397 Mt. Diablo Blvd., Suite E
Lafayette, CA 94549

Fax Transmittal: (925) 284-3360

Subject: Petrographic Examinations of Concrete Samples
Oxnard WWTP

Dear Mr. Voss:

As requested, Applied Materials & Engineering, Inc. (AME) has examined four (4) concrete core samples reportedly removed from the above-captioned project. The objectives of the examinations were to determine the physical and mineralogical properties of the concrete, and if any deleterious reactions were present.

SAMPLE IDENTIFICATION

Four (4) longitudinally sliced half-core samples were received in good condition on January 20, 2015. The core sample descriptions are given in Table I and shown, as received, in Photo 1.

TEST METHOD & RESULTS

The concrete was examined following procedures described in ASTM C 856, "*Standard Practice for Petrographic Examination of Hardened Concrete*."

The following information was obtained:

Cores D, F and L

a) Cores D, F and L represented the same concrete mixture, contained the same aggregates, and had nearly identical compositions. The concrete was composed of portland cement/fly ash paste and normal-weight siliceous aggregate. The concrete was well proportioned and properly consolidated.

b) The aggregate consisted of ¾" maximum size subround to subangular coarse aggregate with a lithology dominated by granitic rock types (granite, granodiorite, diorite and some gabbro), arkosic to arenitic sandstone, mafic volcanic rocks, vein quartz and lesser amounts of limestone and opaline

shale. The opaline shale was reactive. The fine aggregate was composed of rock fragments and minerals typical of the coarse aggregate, including reactive opal and opaline shale.

c) On average, the concrete was composed of approximately 33% cement paste and 67% aggregate, by volume. The cementitious paste contained approximately 15% residual fly ash particles, by volume of paste. The air content was less than 1%. The concrete was not air-entrained.

d) The average volumetric coarse-to-fine aggregate ratio (CA/FA) was approximately 1.4:1. The volumetric proportions are given in Table II. The aggregate was generally well graded and well distributed.

e) The bulk cementitious paste was medium gray and hard (difficult to scratch with steel probe), with a Mohs Hardness of 4 to 4½. The aggregate-to-paste bond was good.

f) The amount of unhydrated portland cement (UPC) clinker in the cementitious paste was approximately 6% to 8%. The paste was well hydrated and had very low to low capillary void porosity (dense paste).

g) The maximum carbonation depth, measured from the exterior surfaces, was 0.29" (Core F). Photo 2 shows the paste carbonation on longitudinally sawn-cut sections of the cores. On all cores a thin band of brownish-gray discoloration occurred directly beneath the carbonated layers. The band appeared to be due to slight alteration of the paste due to aggressive water.

h) The average water-cementitious materials ratio (w/cm), estimated from the optical examination, was approximately 0.44 ± 0.05. Based on the estimated w/cm (0.44) and the average volumetric proportion of paste (33%), the calculated cementitious materials content was approximately 7.2 sacks/yd^3. Core L had a higher paste content compared to Cores D and F, which increased the average cementitious materials content.

i) There was minor alkali-silica reactivity (ASR) involving some volcanic rock types, sandstone and some opal/opaline shale. The ASR was observed primarily as loss of calcium hydroxide around the reactive particles (calcium hydroxide depletion) and minor radial microcracking in the surrounding cement paste. Some internal aggregate cracking was observed in the sandstones, but was common in the opal/opaline shale particles. Overall, ASR gel was generally absent, although trace amounts ASR gel was observed in one crack and a small void in Core F. Overall microcracking was low and the ASR is considered to be minor.

Core P

a) Core P consisted of a portland cement paste and normal-weight siliceous aggregate concrete (base), overlaid with a mortar (topping). The lower half the core was concrete and the upper half was mortar. Both the concrete and the topping mortar were well proportioned and properly consolidated. Neither the concrete nor the mortar pastes contained fly ash.

b) The base concrete aggregate consisted of ¾" maximum size subround to subangular coarse aggregate and siliceous fine aggregate with lithologies identical to Cores D, F and L. The topping mortar also had the same aggregate rock and mineral types, except very few particles larger than ⅛" were present. As with Cores D, F and L, the aggregates contained reactive opal and opaline shale.

c) The concrete was composed of approximately 34% cement paste and 65% aggregate, by volume. The concrete was not air-entrained. The air content was approximately 1%. The volumetric coarse-to-fine aggregate ratio (CA/FA) was approximately 1.2:1. The aggregate was generally well graded and well distributed.

d) The concrete bulk cement paste was medium light gray and hard (difficult to scratch with steel probe), with a Mohs Hardness of 4 to 4½. The aggregate-to-paste bond was good.

e) The amount of unhydrated portland cement (UPC) clinker in the cement paste was approximately 6%. The cement paste was well hydrated and had moderate capillary void porosity (fairly dense paste).

f) The maximum carbonation depth, measured from the surface beneath the mortar topping, was nominally 0.16", but reached to 0.25" along bleed channels next to some coarse aggregate particles. A thin band of brownish-gray discoloration occurred directly beneath mortar topping within the carbonated layer of the concrete. The band appeared to be due to slight alteration of the paste due to aggressive water. Photo 2 shows the paste carbonation on longitudinally sawn-cut sections of the cores.

g) The water-cement ratio (w/c) of the concrete, estimated from the optical examination, was approximately 0.48 ± 0.05. Based on the estimated w/cm (0.48) and the volumetric proportion of paste (34%), the calculated cement content was approximately 7.3 sacks/yd^3.

h) The mortar was composed of approximately 40% cement paste and 57% aggregate, by volume. The mortar was not air-entrained. The air content was approximately 2%. The aggregate was generally well graded and well distributed.

i) The mortar bulk cement paste was medium light gray and hard (difficult to scratch with steel probe), with a Mohs Hardness of 4. The aggregate-to-paste bond was good.

j) The amount of unhydrated portland cement (UPC) clinker in the cement paste of the mortar was approximately 5% to 7%. The cement paste was well hydrated and had moderate capillary void porosity (fairly dense paste).

k) The maximum carbonation depth of the mortar, measured from the exterior surface less than 0.04". The paste carbonation on longitudinally sawn-cut section of Core P is shown in Photo 2.

l) The water-cement ratio (w/c) of the mortar, estimated from the optical examination, was approximately 0.48 ± 0.05. Based on the estimated w/cm (0.48) and the volumetric proportion of

paste (34%), the calculated cement content was approximately 7.3 sacks/yd^3. The volumetric proportions for Core P are given in Table II.

m) As with Cores D, F and L, both the concrete and topping mortar had minor ASR.

Details of the petrographic examinations are given in Appendix A.

CONCLUSIONS

1) The concrete represented by Cores D. F and L was composed of portland cement/fly ash paste and subround to subangular siliceous coarse aggregate.

2) The concrete represented by Core P was composed of portland cement and subround to subangular siliceous coarse aggregate. The concrete in Core P was overlaid with a topping mortar of similar composition but without coarse aggregate.

3) There was minor alkali-silica reactivity (ASR) between the cementitious pastes and some volcanic, sandstone and opal/opal-bearing rocks. At this time, microcracking due to ASR is minor (low). Only trace amounts of ASR gel were detected (only observed in Core F) and deleterious expansion due to ASR was not observed. There was a minor amount of paste alteration at the surfaces of the concretes, which was most likely due to alteration by aggressive water.

4) The opal and opal-bearing rock are considered highly reactive aggregate which can potentially cause deleterious expansion due to ASR.

Please call if any questions arise.

Sincerely,

APPLIED MATERIALS & ENGINEERING, INC.

Jon Asselanis
Materials Scientist/Petrographer

Reviewed by:

Armen Tajirian, Ph.D., P.E.
Principal

Samples will be held for 30 days after submittal of final report and then discarded unless notified in writing. Storage of held samples will be billed monthly. There is a $100 per month storage fee. Return shipment charges are the responsibility of the client

TABLE I

SAMPLE IDENTIFICATIONS

Oxnard WWTP

AME Project No. 115054C

Core ID	Diameter (in.)*	Nominal Length (in.)	Description
D	2.66	5.65	Activated Sludge Basin 1B – Floor
F	2.70	4.24	Secondary Sedimentation Basin 2 – North Wall
L	2.66	2.91	West Flow Equalization Basin – Floor
P	2.71	5.15	Primary Clarifier – Floor

*widest dimension of longitudinal saw-cut

TABLE II

VOLUMETRIC PROPORTIONS OF CONCRETE CORE SAMPLES

Oxnard WWTP

AME Project No. 115054C

Component	D	F	L	Average D, F, L	P (Base)	P (Topping)
Paste, %	31.4	31.5	34.9	32.6	34.3	40.4
Coarse Aggregate, %	40.2	40.8	36.0	39.0	35.2	0.0
Fine Aggregate, %	27.6	27.0	27.8	27.5	29.4	57.4
Entrained Air*, %	0.5	0.2	0.3	0.3	0.5	1.9
Entrapped Air, %	0.3	0.5	0.9	0.6	0.6	0.3
Total, %	100.0	100.0	100.0	100.0	100.0	100.0
Coarse to Fine Aggregate Ratio	1.46:1	1.51:1	1.3:1	1.4:1	1.2:1	----
Total Air Content, %	0.8	0.6	1.3	0.9	1.1	2.2
Total Aggregate Content, %	67.8	67.9	63.8	66.5	64.6	57.4
Estimated water-cementitious materials ratio	0.45	0.43	0.45	0.44	0.48	0.55
Estimated cementitious materials content (lb/yd³)	6.9	6.9	7.5	7.2	7.3	8.0

*spherical air voids smaller than 1 mm (0.039″) in diameter

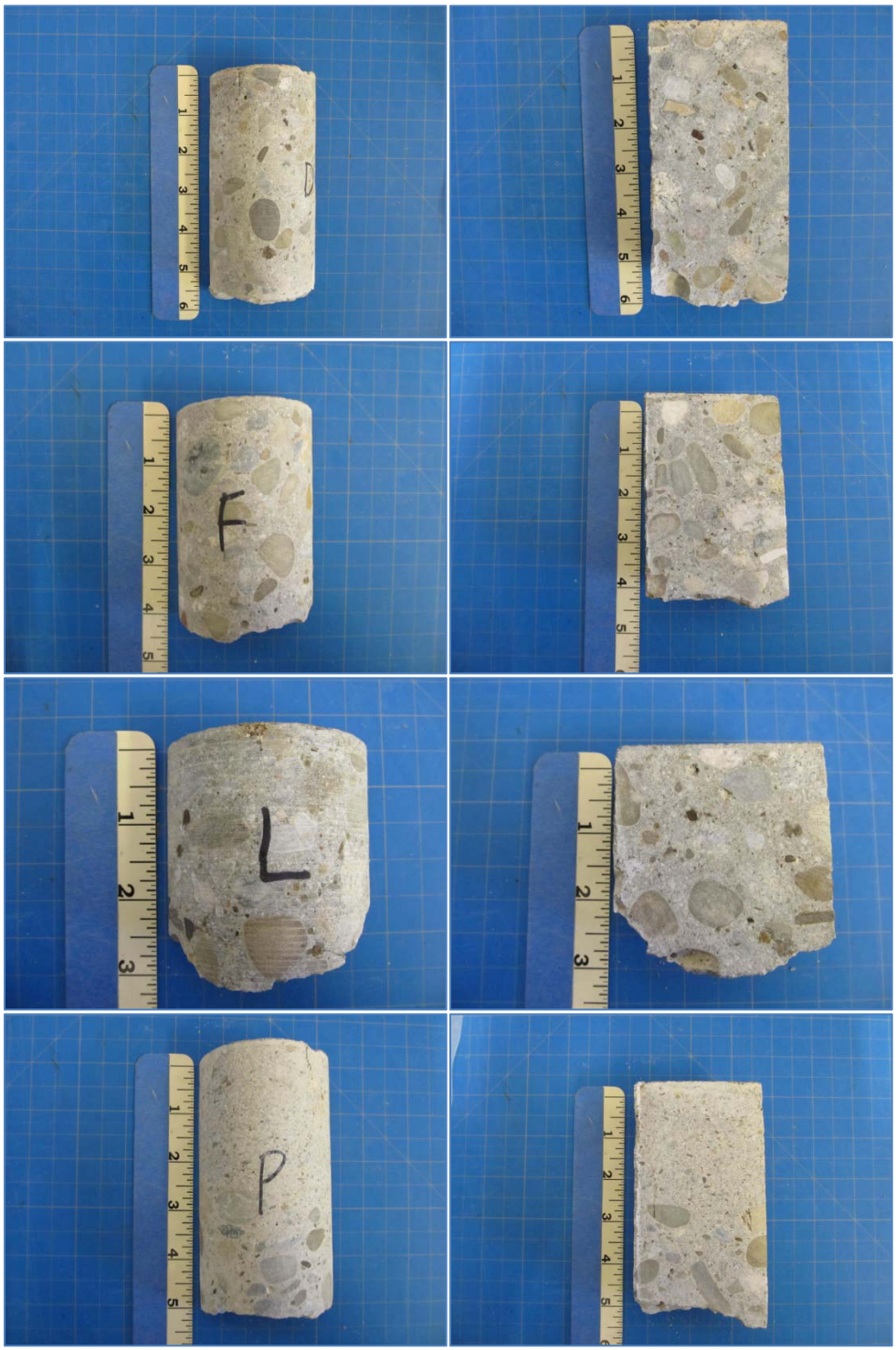


Photo 1. Core samples as received. The photo on the right is the sawn-cut face of the core sample shown to the left.

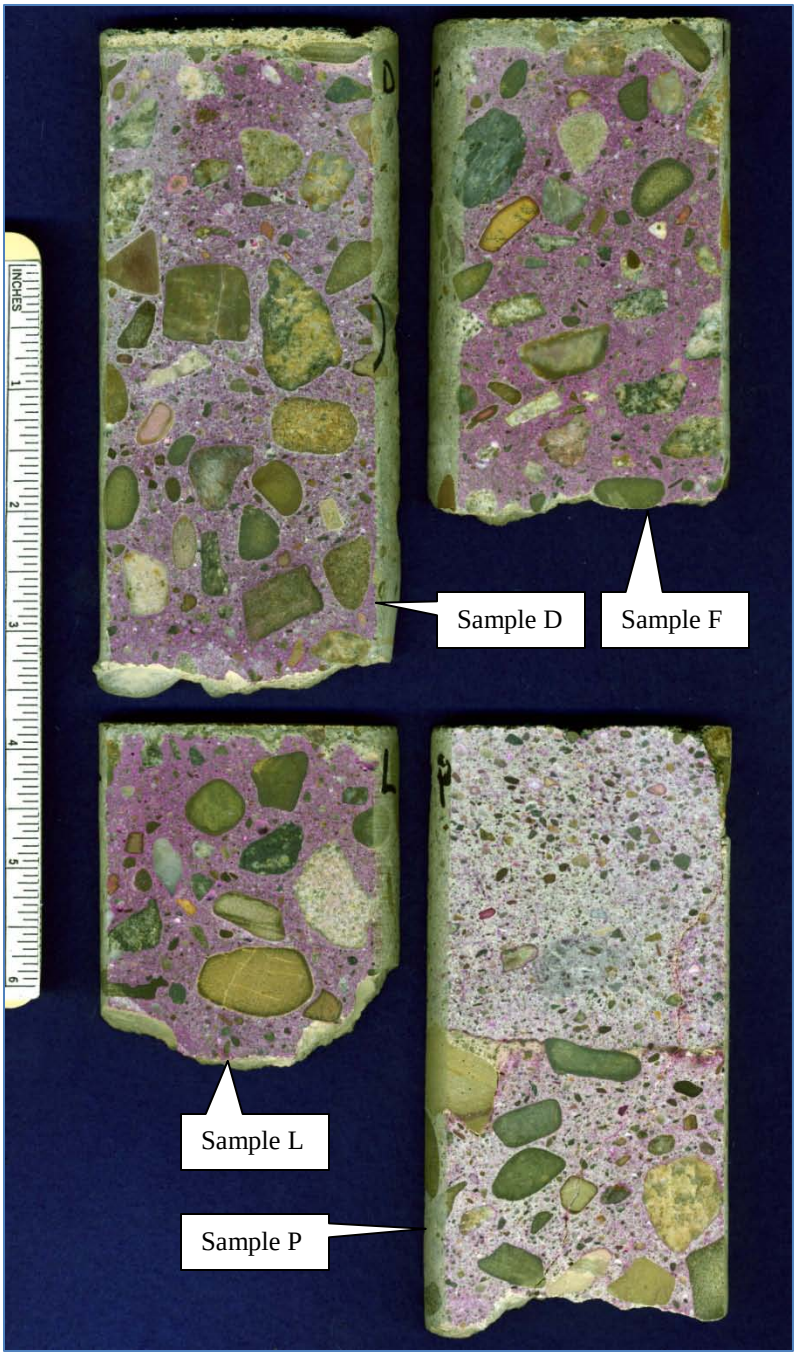


Photo 2. Carbonation across the length of the core samples. Non-carbonation paste has been stained purple by phenolphthalein pH indicator solution.

APPENDIX A

PETROGRAPHIC EXAMINATION DATA SHEETS

Petrographic Examination
Macroscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/29/2015

Sample ID: D

GENERAL AGGREGATE PROPERTIES:

Maximum Size Aggregate (MSA), in.: ¾"
Volumetric Proportions (% Aggregate): 68
Distribution: Good
Segregation: None
Flat & Elongated Particles: Nil
CA/FA: 1.46:1
Gap Graded: Slightly gapped at #4
One Size: No

Point Count	Core D	
	Count	%
Paste	647	31.4
CA	828	40.2
FA	569	27.6
Entrained Air*	10	0.5
Entrapped Air	7	0.3
Total	2061	100.0
CA/FA		1.46
Total % Air		0.8
Total % Agg		67.8

* voids with diameters < 1 mm

Coarse Aggregate Rock Types: Normal Weight
Major: Granitic rock types, quartzite
Minor: Vein quartz, arkosic sandstone
Trace: Scoria, opal/opaline shale, limestone
Shape and Texture: Subround to subangular

Calculated cement (cementitious materials) content (sacks/yd³): 6.9

Fine Aggregate Mineral Species and Rock Types:
Major: Feldspar, quartz, granitic rock fragments
Minor: Volcanic rock fragments, arkosic sandstone rock fragments, opal
Trace: Opaques, biotite mica, pyroxene, calcite, scoria
Shape and Texture: Angular

Reinforcement: None

Air Content:
Entrained: 0.5%
Entrapped: 0.3%
Total: 0.8%

Cement Paste:
Color: Medium gray
Scratch Hardness (Mohs Hardness): 4 to 4½

Surface Carbonation Depth, in. (Determined by pH):
Up to 0.24" depth from exterior surface

Cracking and Other Features: Grayish brown band (0.04" thick) directly beneath carbonated paste layer, passes through sandstone CA particle. Apparent broom finish.

MISCELLANEOUS SAMPLE INFORMATION:

	Diameter (in.)	Length, nominal (in.)
Half core sample sliced longitudinally	2.66	5.65

Petrographic Examination
Microscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/29/2015

Sample ID: D

Thin-section (TS) Number(s): 3207, 3208

CEMENT PASTE PROPERTIES:

Carbonation: Determined by thin-section:
Carbonation Intensity: Medium

Calcium Hydroxide Content (CH)*: 15%
Size: Small
Distribution: Even

Transition Zone (TZ) Development: Very thin to thin

Capillary Void Porosity (CVP): Very low, some mottling, particularly beneath carbonated layer

Unhydrated Portland Cement Particles (UPC's), %*: 6% to 7%
Shape: Subangular to subround
Type: Belite clusters, belite
Size: Clusters up to 0.210 mm, but typically < 0.080 mm across
Grain Relief: Very low (well hydrated)

Pozzolans*, Additives and Pigments: 15% Fly ash
*percent of cement paste volume

Estimated water-binder ratio (w/b): 0.45 ± 0.05
(Binder = cement + pozzolan)

Secondary Deposits: Brown discoloration (cloudiness) of paste directly beneath carbonated paste layer. Possible aggressive water alteration. Minor CH depletion around some aggregate particles, ettringite filling and partially lining some voids

Deleterious Reactions: Very minor ASR (internal cracking of opal particles, CH depletion and reaction rims around some CA and FA particles, but no ASR gel observed)

Fiber Reinforcement (type and amount**): None
**percent of sample volume

Microcracking:
Radial: Low
Transverse: Low

MISCELLANEOUS CEMENT PASTE INFORMATION: ----

Petrographic Examination
Macroscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/29/2015

Sample ID: F

GENERAL AGGREGATE PROPERTIES:

Maximum Size Aggregate (MSA), in.: ¾"
Volumetric Proportions (% Aggregate): 68
Distribution: Good
Segregation: No
Flat & Elongated Particles: Nil
CA/FA: 1.51:1
Gap Graded: Gapped @ #4
One Size: No

Point Count	Core F	
	Count	%
Paste	536	31.5
CA	695	40.8
FA	460	27.0
Entrained Air*	3	0.2
Entrapped Air	8	0.5
Total	1702	100.0
CA/FA		1.51
Total % Air		0.6
Total % Agg		67.9

* voids with diameters < 1 mm

Coarse Aggregate Rock Types: Normal Weight
Major: Granitic rock types, quartzite
Minor: Vein quartz, arkosic sandstone
Trace: Limestone
Shape and Texture: Subround to subangular

Calculated cement (cementitious materials) content (sacks/yd³): 6.9

Fine Aggregate Mineral Species and Rock Types:
Major: Feldspar, quartz, granitic rock fragments
Minor: Volcanic rock fragments, arkosic sandstone rock fragments, opal
Trace: Opaques, biotite mica, pyroxene, calcite, scoria
Shape and Texture: Angular

Reinforcement: None

Air Content:
Entrained: 0.2%
Entrapped: 0.5%
Total: 0.6%

Cement Paste:
Color: Medium gray
Scratch Hardness (Mohs Hardness): 4

Surface Carbonation Depth, in. (Determined by pH):
Up to 0.29" depth from exterior surface

Cracking and Other Features: Grayish brown band (0.03" thick) directly beneath carbonated paste layer, passes through sandstone CA particle and gradaully decreases in color to approximately 0.30" depth. Smooth form finish.

MISCELLANEOUS SAMPLE INFORMATION: Diameter (in.) Length, nominal (in.)
Half core sample sliced longitudinally 2.70 4.24

Petrographic Examination
Microscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/29/2015

Sample ID: F

Thin-section (TS) Number(s): 3209, 3210

CEMENT PASTE PROPERTIES:

Carbonation: Determined by thin-section:
Carbonation Intensity: Medium typically

Calcium Hydroxide Content (CH)*: 15%
Size: Small
Distribution: Even

Transition Zone (TZ) Development: Very thin to nil

Capillary Void Porosity (CVP): Very low, with some mottling

Unhydrated Portland Cement Particles (UPC's), %*: 6% to 8%
Shape: Subangular to subround
Type: Belite clusters
Size: Clusters up to 0.100 mm, typically < 0.085 mm across
Grain Relief: Very low (well hydrated)

Pozzolans*, Additives and Pigments: 15% to 20% Fly ash
*percent of cement paste volume

Estimated water-binder ratio (w/b): 0.43 ± 0.05
(Binder = cement + pozzolan)

Secondary Deposits: Ettringite lining a few voids, Trace amounts of ASR gel in small voids and cracks

Deleterious Reactions: Minor ASR

Fiber Reinforcement (type and amount**): None
**percent of sample volume

Microcracking:
Radial: Low
Transverse: Low (more prominent near surface)

MISCELLANEOUS CEMENT PASTE INFORMATION: ----

Petrographic Examination
Macroscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/30/2015

Sample ID: L

GENERAL AGGREGATE PROPERTIES:

Maximum Size Aggregate (MSA), in.: ¾"
Volumetric Proportions (% Aggregate): 64
Distribution: Good
Segregation: No
Flat & Elongated Particles: Nil
CA/FA: 1.3:1
Gap Graded: Gapped @ #4
One Size: No

Point Count	Core L	
	Count	%
Paste	442	34.9
CA	456	36.0
FA	352	27.8
Entrained Air*	4	0.3
Entrapped Air	12	0.9
Total	1266	100.0
CA/FA		1.30
Total % Air		1.3
Total % Agg		63.8

* voids with diameters < 1 mm

Coarse Aggregate Rock Types: Normal Weight
Major: Granitic rock types, quartzite
Minor: Vein quartz, arkosic/arenite sandstone
Trace: Limestone
Shape and Texture: Subround to subangular

Calculated cement (cementitious materials) content (sacks/yd³): 7.5

Fine Aggregate Mineral Species and Rock Types:
Major: Feldspar, quartz, granitic rock fragments
Minor: Volcanic rock fragments, arkosic sandstone rock fragments, opal
Trace: Opaques, biotite mica, pyroxene, calcite, scoria
Shape and Texture: Angular

Reinforcement: None

Air Content:
Entrained: 0.3%
Entrapped: 0.9%
Total: 1.3%

Cement Paste:
Color: Medium gray
Scratch Hardness (Mohs Hardness): 4½

Surface Carbonation Depth, in. (Determined by pH):
Up to 0.25" depth from surface, nominally 0.10"

Cracking and Other Features: Grayish brown band (0.03" thick) directly beneath carbonated paste layer. Smooth surface, slightly eroded with brown discoloration.

MISCELLANEOUS SAMPLE INFORMATION:

	Diameter (in.)	Length, nominal (in.)
Half core sample sliced longitudinally	2.66	2.91

Petrographic Examination
Microscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/30/2015

Sample ID: L

Thin-section (TS) Number(s): 3211

CEMENT PASTE PROPERTIES:

Carbonation: Determined by thin-section:
Carbonation Intensity: Medium

Calcium Hydroxide Content (CH)*: 15% to 18%
Size: Small
Distribution: Even

Transition Zone (TZ) Development: Thin to nil

Capillary Void Porosity (CVP): Low, slightly mottled

Unhydrated Portland Cement Particles (UPC's), %*: 6% to 8%
Shape: Subangular to subround
Type: Belite clusters, som ebelite
Size: Clusters typically < 0.100 mm across
Grain Relief: Low

Pozzolans*, Additives and Pigments: 13% to 15% Fly ash
*percent of cement paste volume

Estimated water-binder ratio (w/b): 0.45 ± 0.05
(Binder = cement + pozzolan)

Secondary Deposits: Some secondary CH in small voids, traces of ettringite

Deleterious Reactions: Minor CH depletion around some particles

Fiber Reinforcement (type and amount**): None
**percent of sample volume

Microcracking:
Radial: Low
Transverse: Low

MISCELLANEOUS CEMENT PASTE INFORMATION: ----

Petrographic Examination
Macroscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/30/2015

Sample ID: P (Base)

GENERAL AGGREGATE PROPERTIES:

Maximum Size Aggregate (MSA), in.: ¾"
Volumetric Proportions (% Aggregate): 65
Distribution: Moderately good
Segregation: No
Flat & Elongated Particles: Appears low
CA/FA: 1.2:1
Gap Graded: Gapped at #4
One Size: No

Point Count	Core P (Base)	
	Count	%
Paste	401	34.3
CA	412	35.2
FA	344	29.4
Entrained Air*	6	0.5
Entrapped Air	7	0.6
Total	1170	100.0
CA/FA		1.20
Total % Air		1.1
Total % Agg		64.6

* voids with diameters < 1 mm

Coarse Aggregate Rock Types: Normal Weight
Major: Granitic rock types, quartzite
Minor: Vein quartz, arkosic to arenite sandstone, limestone
Trace: ----
Shape and Texture: Subround to subangular

Calculated cement (cementitious materials) content (sacks/yd³): 7.3

Fine Aggregate Mineral Species and Rock Types:
Major: Feldspar, quartz, granitic rock fragments
Minor: Volcanic rock fragments, arkosic sandstone rock fragments, opal
Trace: Opaques, biotite mica, pyroxene, calcite, scoria
Shape and Texture: Angular

Reinforcement: None

Air Content:
Entrained: 0.5%
Entrapped: 0.6%
Total: 1.1%

Cement Paste:
Color: Medium light gray
Scratch Hardness (Mohs Hardness): 4 to 4½

Surface Carbonation Depth, in. (Determined by pH):
Negligible up to 0.05" depth on topping surface, from 0.07" to 0.25" on surface of base

Cracking and Other Features: Cracks extending from base to surface of topping.Core consists of nearly equal halves of base concrete and topping or overlay. Gray discoloration band at surface of base concrete. Bleed channels observed (carbonated)

MISCELLANEOUS SAMPLE INFORMATION: Diameter (in.) Length, nominal (in.)
Half core sample sliced longitudinally 2.71 5.15

Petrographic Examination
Microscopic Analysis

Client: SCL
Project: Oxnard WWTP
AME Project Number: 115054C
1/30/2015

Sample ID: P (Base)

Thin-section (TS) Number(s): 3213

CEMENT PASTE PROPERTIES:

Carbonation: Determined by thin-section:
Carbonation Intensity: Medium

Calcium Hydroxide Content (CH)*: 20% to 22%
Size: Small
Distribution: Even

Transition Zone (TZ) Development: Moderately thin

Capillary Void Porosity (CVP): Moderate

Unhydrated Portland Cement Particles (UPC's), %*: 6%
Shape: Subangular to subround
Type: Belite clusters, belite
Size: Clusters up to 0.170 mm across, typically < 0.100 mm
Grain Relief: Low

Pozzolans*, Additives and Pigments: None
*percent of cement paste volume

Estimated water-binder ratio (w/b): 0.48 ± 0.05
(Binder = cement + pozzolan)

Secondary Deposits: Ettringite particle lining some voids

Deleterious Reactions: Minor CH depletion, some paste discoloration, traces of ASR around some FA particles

Fiber Reinforcement (type and amount**): None
**percent of sample volume

Microcracking:
Radial: Moderately low
Transverse: Low

MISCELLANEOUS CEMENT PASTE INFORMATION: ----

Petrographic Examination
Macroscopic Analysis

Client: SCL
Project: Monterey Outfall
AME Project Number: 114551C
9/15/2014

Sample ID: P (Topping)

GENERAL AGGREGATE PROPERTIES:

Maximum Size Aggregate (MSA), in.: ⅛" (occasional particles up to ⅜")
Volumetric Proportions (% Aggregate): 57
Distribution: Good
Segregation: No
Flat & Elongated Particles: Nil
CA/FA: 0:1
Gap Graded: No
One Size: No

Coarse Aggregate Rock Types: (No CA)
Major: ----
Minor: ----
Trace: ----
Shape and Texture: ----

Point Count	Core P (Topping)	
	Count	%
Paste	689	40.4
CA	0	0.0
FA	978	57.4
Entrained Air*	32	1.9
Entrapped Air	5	0.3
Total	1704	100.0
CA/FA		0.00
Total % Air		2.2
Total % Agg		57.4

* voids with diameters < 1 mm

Calculated cement (cementitious materials) content (sacks/yd³): 8.0

Fine Aggregate Mineral Species and Rock Types:
Major: Feldspar, quartz, granitic rock fragments
Minor: Volcanic rock fragments, arkosic sandstone rock fragments, opal
Trace: Opaques, biotite mica, pyroxene, calcite, scoria
Shape and Texture: Angular

Reinforcement: None

Air Content:
Entrained: 1.9%
Entrapped: 0.3%
Total: 2.2%

Cement Paste:
Color: Medium light gray
Scratch Hardness (Mohs Hardness): 4

Surface Carbonation Depth, in. (Determined by pH): < 0.04"

Cracking and Other Features: Cracks extending from base to surface of topping.Core consists of nearly equal halves of base concrete and topping or overlay.

MISCELLANEOUS SAMPLE INFORMATION: Diameter (in.) Length, nominal (in.)
Half core sample sliced longitudinally 2.71 5.15

Petrographic Examination
Microscopic Analysis

Client: SCL
Project: Monterey Outfall
AME Project Number: 114551C
9/15/2014

Sample ID: P (Topping)

Thin-section (TS) Number(s): 3212

CEMENT PASTE PROPERTIES:

Carbonation: Determined by thin-section:
Carbonation Intensity: Generally Medium. Some large crystals in TZ

Calcium Hydroxide Content (CH)*: 20% to 25% (some secondary CH)
Size: Small
Distribution: Even

Transition Zone (TZ) Development: Thin to occasionally moderately thick

Capillary Void Porosity (CVP): Moderate

Unhydrated Portland Cement Particles (UPC's), %*: 5% to 7%
Shape: Subangular to subround
Type: Belite clusters, belite, some alite
Size: Clusters up to 0.090 mm across
Grain Relief: Low to moderately low (well to moderately well hydrated)

Pozzolans*, Additives and Pigments: None
*percent of cement paste volume

Estimated water-binder ratio (w/b): 0.55 ± 0.05
(Binder = cement + pozzolan)

Secondary Deposits: Ettringite filling or partially filling most voids

Deleterious Reactions: CH depletion around some aggregate particles (particularly volcanics)

Fiber Reinforcement (type and amount**): None
**percent of sample volume

Microcracking:
Radial: Moderate
Transverse: Low

MISCELLANEOUS CEMENT PASTE INFORMATION: ----

March 12, 2015 SCL Project No. 15006

Mr. Michael Johannessen
Villalobos and Associates
155 Grand Ave, Suite 700
Oakland, CA 94612

Email: mjohannessen@vaengineering.com

RE: V&A Job #14-0195 T04- Oxnard WWTP
Concrete Evaluation
Oxnard, California

Dear Mr. Johannessen:

Scientific Construction Laboratories, Inc. (SCL) has completed materials testing of the submitted powdered samples from the above referenced project. The purpose of the testing was to determine material properties and to use this information to assist future remedial work, etc. This report includes test results, and a brief summary of results.

LABORATORY TESTING

CHLORIDE CONTENT TESTING

Chloride content tests were performed on concrete powder samples in accordance ASTM C1218 –*Standard Test Method for Water-Soluble Chloride in Mortar and Concrete*. Powdered samples were sieved with a #20 sieve and the retained sample was then pulverized to pass a #20 sieve. This test method involves digesting a small amount of the sample followed by titrating the resulting sample with a silver nitrate solution. Nine submitted samples were tested. Test results are reported in Table 1.

pH TESTING ON POWDER SAMPLES

pH tests were performed on the nine submitted samples. Powdered samples were sieved with a #20 sieve and the retained sample was then pulverized to pass a #20 sieve. Testing was performed by wetting the test samples to create a slurry and tested with a spot probe manufactured by Hanna instruments. Results are shown in Table 2.

SUMMARY

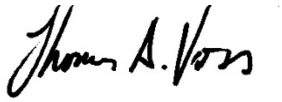
A brief summary of the laboratory testing is as follows:

1. All of the chloride content tests were below the threshold to initiate corrosion.

If you have any questions, please call.

Very truly yours,

SCIENTIFIC CONSTRUCTION LABORATORIES, INC.



Thomas A. Voss
Civil Engineer

TABLE 1. CHLORIDE TESTING				
Sample No.	Location	% Chloride by Weight of Concrete (at three depths)		
		0.0″ to 0.5″	0.5″ to 1.0″	1.0″ to 1.5″
1	North Wall Pass 1	0.0025	0.0065	0.0015
2	Oxnard CCC East Wall	0.0052	0.0033	0.0028
3	West Wall Pass 2	0.0032	0.0051	0.0032

TABLE 2. pH TESTING				
Sample No.	Location	pH (at three depths)		
		0.0″ to 0.5″	0.5″ to 1.0″	1.0″ to 1.5″
1	North Wall Pass 1	11.1	11.5	11.6
2	Oxnard CCC East Wall	11.0	11.3	11.4
3	West Wall Pass 2	11.2	11.3	11.3

APPENDIX C. OTHER STRUCTURES

The structures described above in Sections 3.1 through 3.5 were selected for condition assessment via confined space entry. Photographic documentation from topside was also collected for some of the other structures at the OWTP. These consisted of the ASTs, SSTs, and FEB that were out of service at the time, as well as the other three PCs. This section presents highlights of those observations relative to the detailed findings presented in Sections 3.1 through 3.5.

Activated Sludge Tank 1A

The condition of AST 1A was generally similar to that of AST 1B (Section 3.3). Significant differences and notable observations are as shown in Photo C-1 through Photo C-4.

Photo C-1. Cracking on edge of walkway.

Photo C-2. Cracking on edge of walkway.

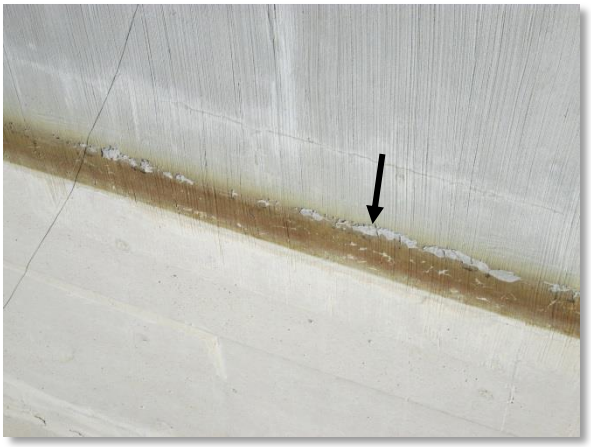


Photo C-3. Deteriorating mortar overlay at top of west wall.

Photo C-4. Spalling concrete adjacent to expansion joint.

Activated Sludge Tank 1C

The condition of AST 1C was generally similar to that of AST 1B (Section 3.3). Significant differences and notable observations are as shown in Photo C-5 through Photo C-8.

Photo C-5. Cracking on top surface of walkway.

Photo C-6. Gaps in sealant in expansion joint in walkway.

Photo C-7. Cracking at southeast corner of basin.

Photo C-8. Spalling concrete adjacent to expansion joint.

Primary Clarifier 2

The condition of PC 2 was generally similar to that of PC 1 (Section 3.4). PC 2 was in service, so most of the interior was not visible. The concrete damage at the top of the effluent towers was more severe, as shown in Photo C-9 and Photo C-10.

Photo C-9. Broken concrete at top of effluent tower (repaired).

Photo C-10. Broken concrete at top of effluent tower.

Primary Clarifier 3

The condition of PC 3 was generally similar to that of PC 1 (Section 3.4). PC 3 was in service, so most of the interior was not visible. Significant differences and notable observations are as shown in Photo C-11 and Photo C-12.

Photo C-11. Grating on top of effluent tower not seated properly, reportedly due to corrosion products.

Photo C-12. Effluent tower separating from clarifier wall.

Primary Clarifier 4

The condition of PC 4 was generally similar to that of PC 1 (Section 3.4). PC 4 was in service, so most of the interior was not visible. Significant differences and notable observations are as shown in Photo C-13 through Photo C-18.

Photo C-13. Spalling on edge of landing at top of stairs.

Photo C-14. Spalling on edge of landing at top of stairs.

Photo C-15. Broken and missing concrete at top of effluent tower.

Photo C-16. Broken concrete at top of effluent tower.

Photo C-17. Apparent broken welds on catwalk.

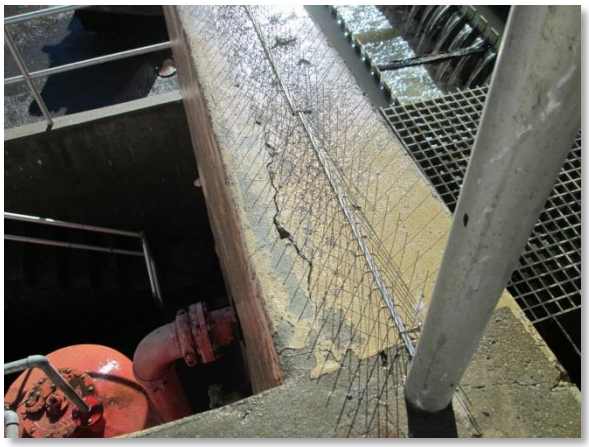


Photo C-18. Crack in top of wall.

East Flow Equalization Basin

The condition of the East FEB was generally similar to that of the West FEB (Section 3.1). Significant differences and notable observations are as shown in Photo C-19 through Photo C-24.

Photo C-19. Spalling on column.

Photo C-20. Typical crack in east wall (appears to pass through wall).

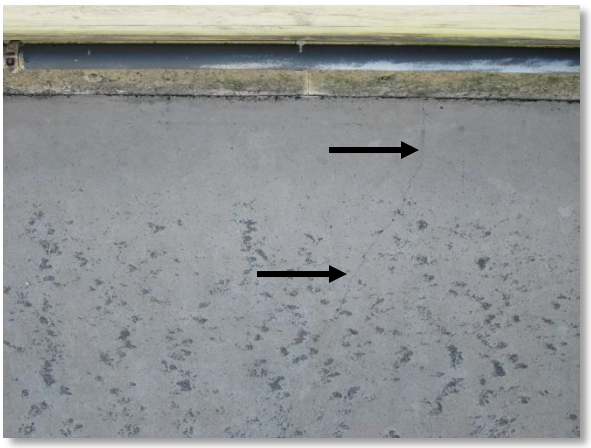


Photo C-21. Crack in floor near east wall (north is to left in photo).

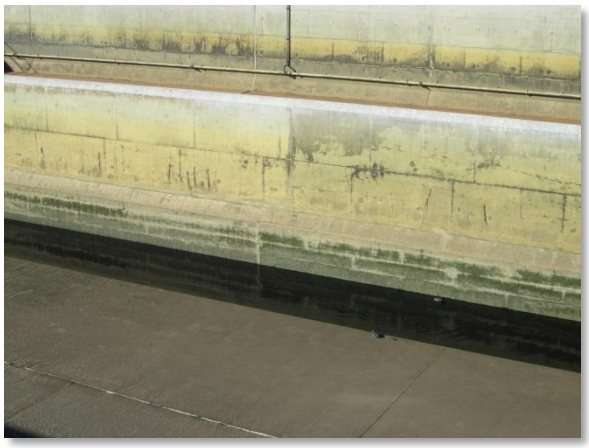


Photo C-22. Spalling over vertical bars in west (dividing) wall.

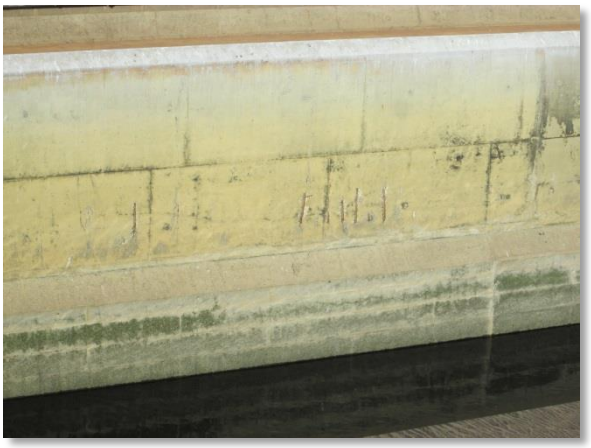


Photo C-23. Spalling over vertical bars in west (dividing) wall.

Photo C-24. Weeds growing from sealant in east wall.

Secondary Sedimentation Tank 1

The condition of SST 1 was generally similar to that of SST 2 (Section 3.2). Significant differences and notable observations are as shown in Photo C-25 and Photo C-26.

Photo C-25. Cracking in slab over west end of basin.

Photo C-26. Cracking in slab over west end of basin (more extensive than SST 2).

Secondary Sedimentation Tank 11

The condition of SST 11 was generally similar to that of SST 2 (Section 3.2). Significant differences and notable observations are as shown in Photo C-27.

Photo C-27. Cracking in east wall above inlet tee.

Secondary Sedimentation Tank 12

The condition of SST 12 was generally similar to that of SST 2 (Section 3.2). Significant differences and notable observations are as shown in Photo C-28 through Photo C-31.

Photo C-28. Vertical cracks every few feet along length of north wall (similar to SST 2).

Photo C-29. Gaps in expansion joint sealant with possible seepage.

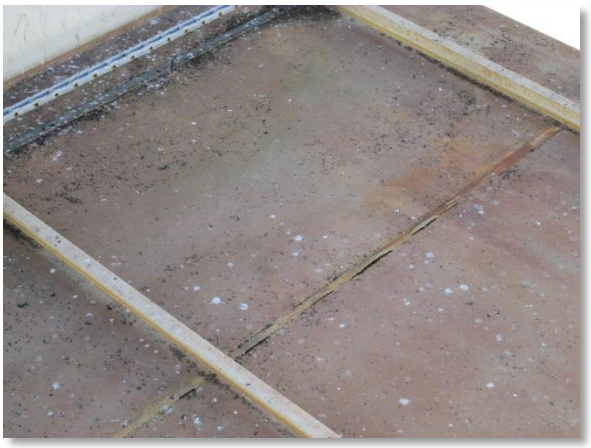


Photo C-30. Gaps in expansion joint sealant.

Photo C-31. Plants growing from gap behind fill concrete at east wall.

Secondary Sedimentation Tank 17

The condition of SST 17 was generally similar to that of SST 2 (Section 3.2). Significant differences and notable observations are as shown in Photo C-32 and Photo C-33.

Photo C-32. Weeds growing from expansion joints.

Photo C-33. Weeds growing from expansion joints.

Secondary Sedimentation Tank 18

The condition of SST 18 was generally similar to that of SST 2 (Section 3.2). Significant differences and notable observations are as shown in Photo C-34 through Photo C-36.

Photo C-34. Weeds growing from expansion joints.

Photo C-35. Weeds growing from expansion joints.

Photo C-36. Spalling on underside of platform at southeast corner.