PHASE 2

Washington State
School Seismic Safety Assessments Project

QUILCENE HIGH SCHOOL MAIN BUILDING

Quilcene School District #48

SEISMIC UPGRADES CONCEPT DESIGN REPORT

June 2021

PREPARED FOR

PREPARED BY

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WASHINGTON STATE SCHOOL SEISMIC SAFETY ASSESSMENTS PROJECT

SEISMIC UPGRADES CONCEPT DESIGN REPORT

Quilcene K-12 School – High School Building

Quilcene School District 48

June 2021

Prepared for:

State of Washington
Department of Natural Resources and Office of Superintendent of Public Instruction

Prepared by:

Brian Y. Matsumoto, P.E., S.E.
Reid Middleton, Inc.

Reid Middleton

728 134th Street SW, Suite 200
Everett, WA 98204
425-741-3800
File No. 262019.082
www.reidmiddleton.com

Contributions by:

DYKEMAN PRODIMS

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EXECUTIVE SUMMARY

This report documents the findings of a seismic evaluation of the Quilcene High School Building in Quilcene, Washington. This school building is a two-story 7,860-square-foot concrete structure with a wood-framed second floor and roof originally constructed in 1935. There was a major renovation project in 1975; however, it did not include any structural or seismic improvements. The exterior walls of the building are 38-foot-tall and 8-inch-thick exterior concrete walls, and the second floor and roof-framing systems consists of diagonal wood shiplap on wood framing. The space is utilized primarily as a mixture of classroom and administrative spaces. The lateral system consists of diagonal shiplap floor and roof diaphragms spanning to exterior concrete shear walls.

Reid Middleton performed a Tier 1 screening in accordance with the ASCE 41-17 standard *Seismic Evaluation and Retrofit of Existing Buildings*. The evaluation included field observations and review of record drawings to verify the existing construction. The structural seismic evaluation indicated that the building has multiple seismic deficiencies; the most susceptible ones being insufficient shear walls in the north-south direction, no apparent out-of-plane concrete wall anchorage, and insufficient second floor and roof diaphragm capacity.

Conceptual seismic upgrade recommendations for the structural systems are provided to improve the performance of the building to meet the Life Safety structural performance objective criteria of ASCE 41-17. Sketches for the concept-level seismic upgrades are provided in Appendix B. The structural upgrades include overlaying the existing diagonal shiplap diaphragms at the second floor and roof with wood structural sheathing, providing positive out-of-plane wall anchorage to the exterior walls, and providing additional shear strength in the north-south direction with thickened concrete shear walls at the ends of the east and west exterior walls. The recommendations for nonstructural seismic improvements are to laminate or replace the large overhead glazing that can shatter during an earthquake and become sharp and dangerous overhead hazards and to remove and replace the decommissioned stair at the north end of the building.

An opinion of probable construction costs is provided in Appendix C. It is our opinion that the total cost (construction costs plus soft costs) to upgrade the structure would range between $1.59M and $2.99M with the baseline estimated total cost being $1.99M.

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Acronyms

AACE	Association for the Advancement of Cost Engineering
ADA	Americans with Disabilities Act
ASCE	American Society of Civil Engineers
A-E	Architect-Engineer
BPOE	Basic Performance Objective for Existing Buildings
BSE	Basic Safety Earthquake
CMU	Concrete Masonry Unit
CP	Collapse Prevention
DNR	Department of Natural Resources
DCR	Demand-to-Capacity Ratio
EERI	Earthquake Engineering Research Institute
EPAT	EERI Earthquake Performance Assessment Tool
FEMA	Federal Emergency Management Agency
GC/CM	General Contractor / Construction Manager
GWB	Gypsum Wallboard
IBC	International Building Code
ICOS	Information and Condition of Schools
IEBC	International Existing Building Code
IO	Immediate Occupancy
LS	Life Safety
MCE	Maximum Considered Earthquake
MEP	Mechanical/Electrical/Plumbing
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
OSPI	Office of Superintendent of Public Instruction
PBEE	Performance-Based Earthquake Engineering
PR	Position Retention
ROM	Rough Order-of-Magnitude
SSSSC	School Seismic Safety Steering Committee
UBC	Uniform Building Code
URM	Unreinforced Masonry
USGS	United States Geological Survey
WF	Wide Flange
WGS	Washington Geological Survey
WSSSSAP	Washington State School Seismic Safety Assessments Project

Reference List

Codes and References

2018 IBC, *2018 International Building Code,* prepared by the International Code Council, Washington, D.C.

AACE International Recommended Practice No. 56R-08, 2020, *Cost Estimate Classification System*, prepared by the Association for the Advancement of Cost Engineering International, Fairmont, West Virginia.

ASCE 7-16, 2017, *Minimum Design Loads for Buildings and Other Structures*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

ASCE 41-17, 2017, *Seismic Evaluation and Retrofit of Existing Buildings*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

FEMA E-74, 2011, *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide*, prepared by Applied Technology Council, Redwood City, California.

Structural Engineers of Northern California, 2017, Earthquake Performance Rating System ASCE 41-13 Translation Procedure: The Buildings Ratings Committee, a sub-committee of the Existing Buildings Committee of The Structural Engineers Association of Northern California.

Structural Engineers of Northern California, 2015, Earthquake Performance Rating System User's Guide: The Buildings Ratings Committee, a sub-committee of the Existing Buildings Committee of The Structural Engineers Association of Northern California.

Drawings

No original construction drawings or structural drawings were available for review for the seismic evaluation and development of this conceptual seismic upgrade report; only limited architectural and electrical drawings from the 1975 modernization were available. Structural system descriptions and seismic deficiencies are based on limited field observation only and the engineers' experience with buildings of similar construction type and vintage.

1.0 Introduction

1.1 Background

In 2018-2019, the Washington Geological Survey (WGS), a division of the Department of Natural Resources (DNR), led a Washington State School Seismic Safety Assessments Project (WSSSSAP) that seismically and geologically screened 222 school buildings and 5 fire stations across Washington State to better understand the current level of seismic risk of Washington State's public-school buildings. This first phase of the WSSSSAP was executed with the help of Washington State's Office of Superintendent of Public Instruction (OSPI) and Reid Middleton, along with their team of structural engineers, architects, and cost estimators.

Building upon the success of Phase 1, WGS, OSPI, and Reid Middleton's team embarked on Phase 2 of this project to seismically and geologically screen another 339 school buildings and 2 fire stations, mostly located in the high-seismic risk regions of Washington State. Similar to Phase 1, the two main components of Phase 2 of this seismic safety assessments project are: (1) geologic site characterization, and (2) the seismic assessment of buildings. As a part of the seismic assessments, Tier 1 screening of structural systems and nonstructural assessments were performed in accordance with the American Society of Civil Engineers' (ASCE) Standard 41-17 *Seismic Evaluation and Retrofit of Existing Buildings*. Concept-level seismic upgrades were developed to address the identified deficiencies of a select number of school buildings to evaluate seismic upgrade strategies, feasibilities, and implementation costs.

Seventeen school buildings were selected in consultation with WGS and OSPI to receive concept-level seismic upgrade designs utilizing the ASCE 41 Tier 1 evaluation results. This report documents the concept-level seismic upgrade design for one of those school buildings. The concept-level seismic upgrades will include structural and nonstructural seismic upgrade recommendations, with concept-level sketches and rough order-of-magnitude (ROM) construction costs determined for each building. The 17 school buildings were selected out of the 560 schools seismically screened in Phase 1 and Phase 2 of this study, and were selected based on age, construction type, past buildings upgrades (or lack thereof), and future plans by the school districts to keep these buildings in service for the next 15 to 20 years.

The overall goal of the project is to provide a better understanding of the current seismic risk of our state's K-12 school buildings and what needs to be done to improve the buildings in accordance with ASCE 41 to meet Life Safety seismic performance objectives.

1.2 Scope of Services

The project is being performed in several distinct and overlapping phases of work. The scope of this report is as listed in the following sections.

1.2.1 Information Review

1. Project Research: Reid Middleton and their project team researched available school building records, such as relevant site data and record drawings, in advance of the field investigations. This research included searching school building records and contacting the districts and/or the Office of Superintendent of Public Instruction (OSPI) to obtain building plans, seismic reports, condition reports, or related construction information useful for the project.

2. Site Geologic Data: Site geological data provided by the WGS, including site shear wave velocities, was utilized to determine the project Site Class in accordance with ASCE 41, which is included in the Tier 1 checklists and concept-level seismic upgrades design work.

1.2.2 Field Investigations

1. Field Investigations: Each of the identified buildings was visited to observe the building's age, condition, configuration, and structural systems for the purposes of the ASCE 41 Tier 1 seismic evaluations. This task included confirmation of general information in building records or layout drawings and visual observation of the structural condition of the facilities. Engineer field reports, notes, photographs, and videos of the facilities were prepared and utilized to record and document information gathered in the field investigation work.

2. Limitations Due to Access: Field observation efforts were limited to areas and building elements that were readily observable and safely accessible. Observations requiring access to confined spaces, potential hazardous material exposure, access by unsecured ladder, work around energized equipment or mechanical hazards, access to areas requiring Occupational Safety and Health Administration (OSHA) fall-protection, steep or unstable slopes, deteriorated structural assemblies, or other conditions deemed potentially unsafe by the engineer were not performed. Removal of finishes (e.g., gypsum board, lath and plaster, brick veneer, roofing materials) for access to concealed conditions or to expose elements that could not otherwise be visually observed and assessed was not performed. Material testing or sampling was not performed. The ASCE 41 checklist items that were not documented due to access limitations are noted.

1.2.3 Seismic Evaluations and Conceptual Upgrades Design

1. Seismic Evaluations: Limited seismic assessments of the structural and nonstructural systems of the school buildings were performed in accordance with ASCE 41-17 Tier 1 Evaluation Procedures.

2. Conceptual Upgrades Design: Further seismic evaluation work was performed to provide concept-level seismic retrofits and/or upgrade designs for the selected school buildings based on the results of the Tier 1 seismic evaluations. The concept-level seismic upgrades design work included narrative descriptions of proposed seismic retrofits and/or

upgrade schemes and concept sketches depicting the extent and type of recommended structural upgrades.

3. Architectural Review: The seismic upgrade concept developed by the structural engineers was reviewed by Dykeman Architects for general guidance and consideration of the architectural aspects of the seismic upgrade. The architects discussed the seismic upgrade concepts with the structural engineer and reviewed existing drawings that were available, pictures taken during the engineer's field investigations, and the ASCE 41 Tier 1 Screening reports. However, field visits by the architect and meetings with the school district and facilities personnel to discuss phasing and programming requirements were not included in the project scope of work. The architectural considerations are discussed in Section 4.4 Nonstructural Recommendations and Considerations. These conceptual designs were reviewed with high-level recommendations. Future planning for seismic improvements should include further review with a design team.

4. Cost Estimating: Through the concept-level seismic upgrades report process, ProDims, LLC, provided opinions of probable construction costs for the concept-level seismic upgrade designs for the selected school buildings. These concept-level seismic upgrade designs and the associated opinions of probable construction costs are intended to be representative samples that can be extrapolated to estimate the overall capital needs of seismically upgrading Washington State schools.

1.2.4 Reporting and Documentation

1. Conceptual Upgrade Design Reports: Buildings that were selected to receive a conceptual upgrade design will have a report prepared that will include an introduction summarizing the overall findings and recommendations, along with individual sections documenting each building's seismic evaluation, list of deficiencies, conceptual seismic upgrade sketches and opinions of probable construction costs.

2. Building Photography: Photos were taken of each building during on-site walkthroughs to document the existing building configurations, conditions, and structural systems. These are available upon request through DNR/WGS.

3. Existing Drawings: Select and available existing drawings and other information were collected during the evaluation process. These are available upon request through DNR/WGS.

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2.0 Seismic Evaluation Procedures and Criteria

2.1 ASCE 41 Seismic Evaluation and Retrofit Overview

The current standard for seismic evaluation and retrofit (upgrades) of existing buildings is ASCE 41-17. ASCE 41 provides screening and evaluation procedures used to identify potential seismic deficiencies that may require further investigation or hazard mitigation. It presents a three-tiered review process, implemented by first following a series of predefined checklists and "quick check" structural calculations. Each successive tier is designed to perform an increasingly refined evaluation procedure for seismic deficiencies identified in previous tiers in the process. The flow chart in Figure 2.1 illustrates the evaluation process.

TIER 1 – Screening Phase
- Checklists of evaluation statements to quickly identify potential deficiencies
- Requires field investigation and/or review of record drawings
- Analysis limited to "Quick Checks" of global elements
- May proceed to Tier 2, Tier 3, or rehabilitation design if deficiencies are identified

TIER 2 – Evaluation Phase
- "Full Building" or "Deficiency Only" evaluation
- Address all Tier 1 seismic deficiencies
- Analysis more refined than Tier 1, but limited to simplified linear procedures
- Identify buildings not requiring rehabilitation

TIER 3 – Detailed Evaluation Phase
- Component-based evaluation of entire building using reduced ASCE 41 forces
- Advanced analytical procedures available if Tier 1 and/or Tier 2 evaluations are judged to be overly conservative
- Complex analysis procedures may result in construction savings equal to many times their cost

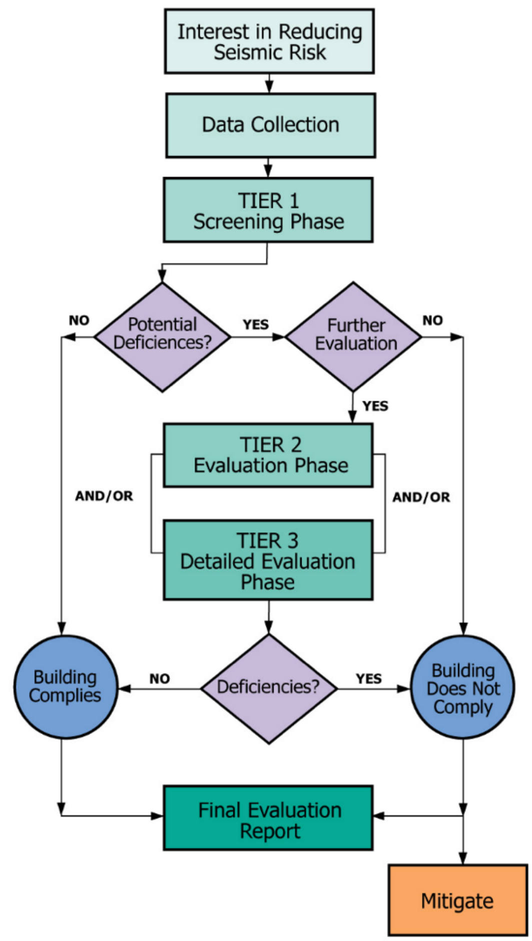

Figure 2-1. Flow Chart and Description of ASCE 41 Seismic Evaluation Procedure.

The Tier 1 checklists in ASCE 41 are specific to each common building type and contain seismic evaluation statements based on observed structural damage in past earthquakes. These checklists screen for potential seismic deficiencies by examining the lateral-force-resisting systems and details of construction that have historically caused poor seismic performance in similar buildings. Tier 1 screenings include basic "Quick Check" analyses for primary components of the lateral system. Tier 1 screenings also include prescriptive checks for proper seismic detailing of connections, diaphragm spans and continuity, and overall system configuration.

Tier 2 evaluations then follow with more-detailed structural and seismic calculations and assessments to either confirm the potential deficiencies identified in the Tier 1 review or demonstrate their adequacy. A Tier 3 evaluation involves an even more detailed analysis and advanced structural and seismic computations to review each structural component's seismic demand and capacity. A Tier 3 evaluation is similar in scope and complexity to the types of analyses often required to design a new building in accordance with the International Building Code (IBC), with a comprehensive analysis aimed at evaluating each component's seismic performance. Generally, Tier 3 evaluations are not practical for typical and regular-type buildings due to the rigorous and complicated calculations and procedures. As indicated in the Scope of Services, this evaluation included a Tier 1 screening of the structural systems.

2.2 Seismic Evaluation and Retrofit Criteria

Performance-Based Earthquake Engineering (PBEE) can be defined as the engineering of a structure to resist different levels of earthquake demand in order to meet the needs and performance objectives of building owners and other stakeholders. ASCE 41 employs a PBEE design methodology that allows building owners, design professionals, and the local building code authorities to establish seismic hazard levels and performance goals for individual buildings.

2.2.1 Site Class Definition

The building site class definition quantifies the site soil's propensity to amplify or attenuate earthquake ground motion propagating from underlying rock. Site class has a direct impact on the seismic design forces utilized to design and evaluate a structure. There are six distinct site classes defined in ASCE 7-16, Site Class A through Site Class F, that range from hard rock to soils that fail such as liquefiable soils. Buildings located on soft or loose soils will typically sustain more damage than similar buildings located on stiff soils or rock, all other things being equal. The Washington State Department of Natural Resources measured the time-averaged shear-wave velocity at each site to 30 meters (100 feet) below the ground surface, Vs30. This measured shear-wave velocity was used to determine the site class. The site for this building was determined to be **Site Class C**.

2.2.2 Quilcene High School Seismicity

Seismic hazards for the United States have been quantified by the United States Geological Survey (USGS). The information has been used to create seismic hazard maps, which are currently used in building codes to determine the design-level earthquake magnitudes for building design.

The Level of Seismicity is categorized as Very Low, Low, Moderate, or High based on the probabilistic ground accelerations. Ground accelerations and mass generate inertial (seismic) forces within a building (Force = mass x acceleration). Ground acceleration therefore is the parameter that classifies the level of seismicity. From geographic region to region, as the ground accelerations increase, so does the level of seismicity (from low to high). Where this building is located, the design short-period spectral acceleration, S_{DS}, is 1.113 g, and the design 1-second period spectral acceleration, S_{D1}, is 0.505 g. Based on ASCE 41 Table 2-4, the Level of Seismicity for this building is classified as **High**.

The ASCE 41 Basic Performance Objective for Existing Buildings (BPOE) makes use of the Basic Safety Earthquake – 1E (BSE-1E) seismic hazard level and the Basic Safety Earthquake – 2E (BSE-2E). The BSE-1E earthquake is defined by ASCE 41 as the probabilistic ground motion with a 20 percent probability of exceedance in 50 years, or otherwise characterized as a ground motion acceleration with a probabilistic 225-year return period. The BSE-2E earthquake is defined by ASCE 41 as the probabilistic ground motion with a 5 percent probability of exceedance in 50 years, or otherwise characterized as a ground motion acceleration with a probabilistic 975-year return period. The BSE-2N seismic hazard level is the Maximum Considered Earthquake (MCE) ground motion used in current codes for the design of new buildings and is also used in ASCE 41 to classify the Level of Seismicity for a building. The BSE-2N has a statistical ground motion acceleration with 2 percent probability of exceedance in 50 years, or otherwise characterized as a ground motion acceleration with a probabilistic 2,475-year return period. Lastly, the BSE-1N seismic hazard is taken as two-thirds of the BSE-2N seismic parameters and are intended to match the spectral accelerations for the design of new buildings in accordance with ASCE 7.

Table 2.2.1-1 provides the spectral accelerations for the 225-year, 975-year, and 2,475-year return interval events specific to Quilcene High School that are considered in this study.

Table 2.2.1-1. Spectral Acceleration Parameters (Site Class C).

BSE-1E 20%/50 (225-year) Event		BSE-1N 2/3 of 2,475-year Event		BSE-2E 5%/50 (975-year) Event		BSE-2N 2%/50 (2,475-year) Event	
0.2 Seconds	0.669 g	0.2 Seconds	1.113 g	0.2 Seconds	1.276 g	0.2 Seconds	1.67
1.0 Seconds	0.239 g	1.0 Seconds	0.505 g	1.0 Seconds	0.561 g	1.0 Seconds	0.757 g

2.2.3 Quilcene High School Structural Performance Objective

This school building is an Educational Group E occupancy (Risk Category III) structure and has not been identified as a critical structure requiring immediate use following an earthquake. However, Risk Category III buildings are structures that represent a substantial hazard to human life in the event of failure. According to ASCE 41, the BPOE for Risk Category III structures is the Damage Control structural performance level at the BSE-1E seismic hazard level and the Limited Safety structural performance level at the BSE-2E seismic hazard level. The ASCE 41 Tier 1 evaluations were conducted in accordance with ASCE 41 requirements and ASCE 41 seismic performance levels. Concept-level upgrades were developed for the **Life Safety** structural performance level at the **BSE-1N** seismic hazard level in accordance with the project scope of work and the project legislative language.

At the Life Safety performance level, the building may sustain damage while still protecting occupants from life-threatening injuries and allowing occupants to exit the building. Structural and nonstructural components may be extensively damaged, but some margin against the onset of partial or total collapse remains. Injuries to occupants or persons in the immediate vicinity may occur during an earthquake; however, the overall risk of life-threatening injury as a result of structural damage is anticipated to be low. Repairs may be required before reoccupying the building, and, in some cases, repairs may be economically unfeasible.

Knowledge Factor

A knowledge factor, k, is an ASCE 41 prescribed factor that is used to account for uncertainty in the as-built data considering the selected Performance Objective and data collection processes (availability of existing drawings, visual observation, and level of materials testing). No in-situ testing of building materials was performed; however, some material properties and existing construction information were provided in the existing record drawings. If the concept design is developed further, additional materials tests and site investigations will be required to substantiate assumptions about the existing framing systems.

ASCE 41 Classified Building Type

Use of ASCE 41 for seismic evaluations requires buildings to be classified from a group of common building types historically defined in previous seismic evaluation standards (ATC-14, FEMA 310, and ASCE 31-03). The school is classified in ASCE 41 Table 3-1 as a concrete shear wall structure with flexible diaphragms, **C2a**. Concrete shear wall buildings (C2a) include those that have bearing shear walls constructed of reinforced concrete with elevated floor and roof framing structural systems consisting of wood framing.

2.3 Report Limitations

The professional services described in this report were performed based on available record drawing information and limited visual observation of the structure. No other warranty is made as to the professional advice included in this report. This report provides an overview of the seismic evaluation results and does not address programming and planning issues. This report has been prepared for the exclusive use of DNR/WGS and is not intended for use by other parties, as it may not contain sufficient information for purposes of other parties or their uses.

3.0 Building Description & Seismic Evaluation Findings

3.1 Building Overview

3.1.1 Building Description

Original Year Built: 1935
Building Code: unknown

Number of Stories: 2
Floor Area: 7,860 SF

FEMA Building Type: C2a
ASCE 41 Level of Seismicity: High
Site Class: D

The Quilcene School, in Jefferson County serves approximately 650 students. Constructed in 1935, Quilcene High School serves Grades 9 through 12 and is a two-story, 7,860-square-foot reinforced concrete building with wood-framed floors and roof. There was a major improvement project in 1975; however, it appears that it did not include any structural or seismic improvements. According to facilities staff, a torch down roof was added in 1996, and a small platform lift was added in 2017 at the south end of the building. The footprint of the Quilcene High School building is 54.5 feet by 72 feet. The exterior walls are constructed of 8-inch concrete with both floors and roof diaphragms consisting of diagonal wood shiplap over wood joists. Based on limited drawings from 1975, it appears the ceiling framing of the second floor is structural and may be supporting portions of roof framing. The building has a central corridor running north and south and is surrounded primarily by classrooms and administrative spaces.

3.1.2 Building Use

The building has multiple classrooms, various administrative spaces, and a boiler room.

3.1.3 Structural System

Table 3.1.3-1. Structural System Descriptions.

Structural System	Description
Structural Roof	Original construction drawings were not available, and existing conditions could not be observed during our site visit. Based on a 2006 study and survey, the structural roof system is assumed to be diagonal wood shiplap on wood 2x joists spanning in the east-west direction. Limited existing drawings from the 1975 improvement

Table 3.1.3-1. Structural System Descriptions.

Structural System	Description
	project indicate a structurally framed ceiling above the second floor (a few feet below the roof), which may support some of the roof framing.
Structural Floor(s)	The second floor consists of straight wood flooring on diagonal shiplap on 2x joists spanning in the east-west direction. Based on a 2006 study and survey, the first floor system is assumed to be wood flooring on wood sleepers on a concrete slab on grade.
Foundations	Foundations are not visible but appear to be shallow concrete footings.
Gravity System	The gravity system consists of wood-frame construction supported on interior wood girders and columns and exterior 8-inch reinforced concrete bearing walls.
Lateral System	The lateral-force-resisting-system consists of reinforced concrete exterior shear walls and diagonal shiplap diaphragms.

3.1.4 Structural System Visual Condition

Table 3.1.4-1. Structural System Condition Descriptions.

Structural System	Description
Structural Roof	The structural roof system appears to be in satisfactory condition with some evidence of deterioration of roof framing per discussion with maintenance personnel.
Structural Floor(s)	The structural floor system appears to be in satisfactory condition.
Foundations	Foundations are not visible but appear to be in satisfactory condition with no visible indications of damage or distress.
Gravity System	The gravity system appears to be in satisfactory condition.
Lateral System	The lateral-force-resisting system appears to be in satisfactory condition.

3.2 Seismic Evaluation Findings

3.2.1 Structural Seismic Deficiencies

The structural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is provided based on this evaluation.

Table 3.2.1-1. Identified Structural Seismic Deficiencies Based on Tier 1 Checklists.

Deficiency	Description
Shear Stress Check	The concrete shear walls are non-compliant in the north-south direction but are less than 100 pounds per square inch in the east-west direction. Further investigation should be performed. Additional shear walls or shear wall infills of the east and west exterior shear walls would be appropriate to mitigate seismic risk.
Wall Anchorage at Flexible Diaphragms	Likely noncompliant in pre-benchmark reinforced concrete building. Further investigation should be performed. Additional diaphragm shear wall anchoring may be appropriate to mitigate seismic risk.
Transfer to Shear Walls	Likely non-compliant in pre-benchmark reinforced concrete building. Further investigation should be performed. Additional diaphragm shear wall anchoring may be appropriate to mitigate seismic risk.
Deflection Compatibility	Secondary component details such as exterior concrete wall pier reinforcement and confinement are unknown. Further investigation should be performed. Added lateral system stiffness in the north-south direction or secondary component strengthening such as fiber wrap may be appropriate to mitigate seismic risk.
Cross Ties	Likely non-compliant in pre-benchmark reinforced concrete building. Further investigation may be appropriate. Diaphragm reinforcement may be appropriate to mitigate seismic risk.
Diagonally Sheathed and Unblocked Diaphragms	Diagonally sheathed diaphragm spans to the exterior concrete shear walls approximately 54 feet in the north-south direction and 72 feet in the east-west direction. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.

3.2.2 Structural Checklist Items Marked as "U"nknown

Where building structural component seismic adequacy was unknown due to lack of available information or limited observation, the structural checklist items were marked as "unknown". These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown structural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is provided based on the evaluation.

Table 3.2.2-1. Identified Structural Checklist Items Marked as Unknown.

Deficiency	Description
Load Path	Original drawings are not available, and therefore the load path from the wood shiplap diaphragms to the exterior concrete shear walls is unknown. This should be further investigated for adequacy to transfer seismic forces from the diaphragms to the shear walls.
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. Low liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Reinforcing Steel	The reinforcement ratio is unknown. Further investigation should be completed. Wall strengthening using carbon fiber or shear wall addition may be appropriate to mitigate seismic risk.
Foundation Dowels	The foundation detail is unknown due to unavailable original construction drawings. Further investigation should be performed. Additional foundation wall anchoring may be appropriate to mitigate seismic risk.
Straight Sheathing	Compliant for the second floor diaphragms, as this was observed to have diagonal shiplap. The roof diaphragm, however, was not visually accessible and should be further investigated. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.
Spans	Compliant for the second diaphragms, as this was observed to have diagonal shiplap diaphragms. The roof diaphragm, however, was not visually accessible and should be further investigated. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.

3.2.3 Nonstructural Seismic Deficiencies

Table 3.2.3-1 summarizes the seismic deficiencies in the nonstructural systems. The Tier 1 screening checklists are provided in Appendix A.

Table 3.2.3-1. Identified Nonstructural Seismic Deficiencies based on Tier 1 Checklists.

Deficiency	Description
CG-8 Overhead Glazing. HR- not required; LS-MH; PR- MH.	Glazing information is unknown. Most windows have two panes of glazing that appear to be less than 16 square feet, except above the entry and stair. Based on the age of the building, it is likely that the glazing on the windows are laminated or detailed to remain in the frame. Many individual panes are likely to be below this threshold. Further investigation should be completed. Replacing applicable glazing planes or applying a laminating film may be appropriate to mitigate seismic risk.
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	This building does not have canopies. However, there is a decommissioned egress steel-framed stair and upper landing at the north end of the building that is blocked off due to stair safety. The connection of this stair and landing to the existing building is unknown and consideration should be given to remove this decommissioned stair to mitigate seismic risk as it directly over the north exit doors.

3.2.4 Nonstructural Checklist Items Marked as "U"nknown

Where building nonstructural component seismic adequacy was unknown due to lack of available information or limited observation, the nonstructural checklist items were marked as "unknown". These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown nonstructural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is provided based on the evaluation.

Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

Table 3.2.4-1. Identified Nonstructural Checklist Items Marked as Unknown.

Deficiency	Description
LSS-3 Emergency Power. HR-not required; LS-LMH;PR-LMH.	Use of emergency power was not verified with maintenance or facility staff. Evaluation of emergency power equipment may be appropriate to mitigate seismic risk.

Table 3.2.4-1. Identified Nonstructural Checklist Items Marked as Unknown.

Deficiency	Description
HM-1 Hazardous Material. Equipment. HR-LMH; LS-LMH; PR-LMH.	It is unknown if equipment is mounted on vibration isolators. Further investigation may be appropriate to mitigate seismic risk.
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	It is unknown whether the building has hazardous materials. There may be gas lines present. Further investigation of mechanical piping should be performed. Bracing and anchoring of piping may be appropriate to mitigate seismic risk.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	It is unknown if the structure contains natural gas or other hazardous materials. Further investigation of mechanical piping should be performed. Providing shutoff valves may be appropriate to mitigate seismic risk.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	It is unknown whether the building has hazardous materials. There may be gas lines present. Further investigation of mechanical piping should be performed. Flexible coupling for piping and ductwork may be appropriate to mitigate seismic risk.
LF-1 Independent Support. HR-not required; LS-MH; PR- MH.	This was not observed during the site visit, and it is unknown how much the light fixtures weigh. However, this can be further investigated by facility staff to see if light fixtures are independently supported to the floor or roof structure above at diagonally opposite corners on the light fixture. Adding wires for suspending the light fixtures may be appropriate to mitigate seismic risk.
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	There did not appear to be any hollow-clay or unreinforced masonry walls around stair enclosures, but this should be further investigated or verified by facilities staff.
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	There appears to be connections from the exterior stairs to the north exterior wall of the structure. It is unknown if these are post-installed anchors. However, this stair is blocked off due to stair safety. Consideration should be given to remove this decommissioned stair to mitigate seismic risk, as it directly over the north exit doors.
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Not able to verify during site investigation. Further investigation should be performed to see if this occurs. Bracing or anchoring of equipment may be appropriate to mitigate seismic risk.
ME-2 In-Line Equipment. HR-not required; LS-H; PR- H.	Not able to verify during site investigation. Further investigation should be performed. Bracing or anchoring of equipment may be appropriate to mitigate seismic risk.

4.0 Recommendations and Considerations

4.1 Seismic-Structural Upgrade Recommendations

Concept-level seismic upgrade recommendations to improve the lateral-force-resisting system were developed. The sketches in Appendix B depict the concept-level structural upgrade recommendations outlined in this section. The following concept recommendations are intended to address the structural deficiencies noted in Table 3.2.1-1. This concept-level seismic upgrade design represents just one of several alternative seismic upgrade design solutions and is based on preliminary seismic evaluation and analysis results. Final analysis and design for seismic upgrades must include a more detailed seismic evaluation of the building in its present or future configuration. Proposed seismic upgrades include the following.

4.1.1 Concrete Shear Walls at Corners of East and West Exterior Walls

The east and west exterior concrete walls that laterally support the building in the north-south direction have insufficient shear strength for a current code level event. It is recommended that these existing shear wall lines be strengthened with new concrete shear walls at each end as shown in Figure 1 in Appendix B. These new concrete shear walls would require the infill of the end bay window openings at each floor and will need to be supported on strengthened foundations.

4.1.2 Diaphragm Strengthening

The existing roof and floor diaphragms consists of 1x diagonal shiplap over 2x joists spanning in the east-west direction. At the roof, it is recommended to remove the existing roofing and overlay the existing diagonal shiplap with 1/2-inch wood structural panel diaphragm. At the second floor, the existing diagonal shiplap is also overlaid with thin straight-sheathed wood flooring. It is also recommended that the diagonal shiplap be overlaid with a 1/2-inch wood structural panel diaphragm either by removing the straight-sheathed wood flooring or installing the wood structural panel diaphragm over the existing wood flooring as well. Based on limited available drawings from the 1975 improvement project and previous documentation from a 2006 study and survey, it appears that the framing of the second floor ceiling is structural and supports portions of the wood-framed roof above. Therefore, it is also recommended that this ceiling framing also be sheathed as a diaphragm to resist out-of-plane loading from the exterior concrete walls. Without knowing the pony wall support configuration of the existing roof framing above, it is recommended that the second floor ceiling framing be sheathed with 1/2-inch wood structural panel to the underside of framing. See Figures 1 through 3 of Appendix B for extents. The roof sheathing overlay can be done as part of a future re-roofing project where over 90% of the cost is to remove and replace the roofing system.

4.1.3 Out-of-Plane Wall Anchorage

Based on the year of original construction it is not likely that the exterior concrete walls are tied to the floor and roof framing system with direct out-of-plane wall anchorage connections. It is recommended that the existing concrete walls on each side of the building be anchored to the diaphragms at the second floor, second floor ceiling, and roof with Simpson LTT or HTT tension ties. See Figures 1 through 3 of Appendix B for the recommended spacing of the anchors. The LTT/HTT tensions ties would fasten directly to the incoming wood floor, ceiling, or roof framing and would be anchored to the existing concrete wall with epoxy-grouted anchor rods.

Original drawings are not available; however, limited observation of exploratory demolition provided by the school district determined that the existing second floor framing spans in the east-west direction and bears on the horizontal leg of a steel ledger connected to the concrete wall. There also appears to be a rim joist bearing on this steel ledger. Should this building receive a future seismic upgrade or modernization, additional exploratory investigation should be performed to determine the floor and roof framing to exterior concrete wall connections on each side of the building. See Figures 1 through 3 of Appendix B for additional information.

4.1.4 In-Plane Shear Transfer to Shear Walls

As previously mentioned in Section 4.1.3 above, original drawings are not available, and the load path of the diaphragm connections to the exterior concrete shear walls is unknown. Based on limited field observation, however, it appears that there is an existing rim joist or ledger alongside the inside face of the concrete walls. It is recommended that this rim joist or wood ledger be connected to the exterior concrete walls with heavy-duty concrete screws such as Simpson Titen HD screws to complete the diaphragm to shear wall load path. See Figures 1 through 3 of Appendix B for additional information. This work should be done concurrent with the out-of-plane wall anchorage upgrades.

4.2 Foundations and Geotechnical Considerations

A detailed geotechnical analysis of the site soils was not included in the scope of this study. As a result, the geotechnical seismic effects on the existing building and its foundations, such as the presence of liquefiable soils and allowable soil bearing pressures, are unknown at this time. However, based on state of Washington liquefaction mapping, the building is located on soils classified with a low susceptibility to liquefaction. Future seismic upgrade projects should consider doing a geotechnical investigation to verify that the underlying soils are not susceptible to liquefaction and to determine the nature of the liquefaction hazard and the characteristics of the site soils. Foundation mitigation and ground improvement may be required and the recommended geotechnical investigation could have a major impact on the scope of work required for seismic retrofit

Liquefaction is the tendency of certain soils to saturate and lose strength during strong earthquake shaking, causing it to flow and deform similar to a liquid. Liquefaction, when it occurs, drastically decreases the soil bearing capacity and tends to lead to large differential settlement of soil across a building's footprint. Liquefaction can also cause soils to spread laterally and can dramatically affect a building's response to earthquake motions, all of which can significantly compromise the overall stability of the building and possibly lead to isolated or widespread collapse in extreme cases. Existing foundations damaged as a result of liquefiable soils also make the building much more difficult to repair after an earthquake.

Buildings that are not founded on a raft foundation or deep foundation system (such as grade beams and piles), and those with conventional strip footings and isolated spread footings that are not interconnected well with tie beams, are especially vulnerable to liquefiable soils. Mitigation techniques used to improve structures in liquefiable soils vary based on the type and amount of liquefiable soils and may include ground improvements to densify the soil (aggregate piers, compaction piling, jet grouting), installation of deep foundations (pin piling, augercast piling, micro-piling), and installation of tie beams between existing footings.

4.3 Tsunami Considerations

Tsunami analysis was outside the scope of this project. However, based on Washington State Department of Natural Resources tsunami inundation mapping, the location of the building is within the expected tsunami inundation zone for a Cascadia Subduction Zone earthquake. While there is significant uncertainty surrounding tsunami inundation heights, the mapping indicates that there is a likelihood of tsunami inundation at the building location.

It may be worthwhile to conduct a detailed tsunami study prior to performing building seismic upgrades. Since tsunamis can cause significant infrastructure damage and also pose a significant risk to life safety, it can often be more cost effective to build a new school outside of the tsunami inundation zone rather than seismically upgrade the existing building. Alternatively, seismically upgrading the facility could allow occupants to safely evacuate and reach locations away from the tsunami inundation zone. Construction of a tsunami vertical evacuation structure may be another alternative to provide safe refuge from a tsunami. In any case, it is recommended that a detailed tsunami evacuation plan be used that gives people a high likelihood of successfully escaping a tsunami regardless of whether the plan is to reach higher ground or take refuge in a vertical evacuation structure. A detailed tsunami study could comparatively evaluate different options and provide recommendations on appropriate actions to take.

4.4 Nonstructural Recommendations and Considerations

Table 3.2.3-1 identifies several nonstructural deficiencies that do not meet the performance objective selected for Quilcene High School. It is recommended that these deficiencies be addressed to provide nonstructural performance consistent with the performance of the upgraded structural lateral-force-resisting system. As-built information for the existing nonstructural systems, such as fire sprinklers, mechanical ductworks, and piping, are not available for review. Only limited visual observation of the systems was performed during field investigation due to limited access or visibility to observe existing conditions. The conceptual mitigation strategies provided in this study are preliminary only. The final analysis and design for seismic rehabilitation should include a detailed field investigation.

4.4.1 Architectural Systems

This section addresses existing construction that, while not posing specific hazards during a seismic event, would be affected by the seismic improvements proposed.

For any remodel project of an existing building, the International Existing Building Code (IEBC) would be applicable. The intent of the IEBC is to provide flexibility to permit the use of alternative approaches to achieve compliance with minimum requirements to safeguard the public health, safety, and welfare insofar as they are affected by the work being done.

Energy Code

Elements of the exterior building envelope being affected by the seismic work would also be required to be brought up to the current Washington State Energy Code per Chapter 5, where applicable.

Accessibility

It should also be noted that, as a part of any upgrade to existing buildings, the IEBC will require that any altered primary function spaces (classrooms, gyms, entrances, offices) and routes to these spaces, be made accessible to the current accessibility standards of the Americans with Disabilities Act (ADA), unless technically infeasible. This would include but is not limited to accessible restrooms, paths of travel, entrances and exits, parking, signage, and fire alarm systems. Under no circumstances should the facility be made less accessible. The IEBC does, however, have exceptions for areas that do not contain a primary function (storage room, utility rooms) and states that costs of providing the accessible route are not required to exceed 20 percent of the costs of the alterations affecting the area of Primary Function. As with any major renovation and modernization, an ADA study would be recommended to determine the extent to which an existing facility needs to be improved to be in compliance with the ADA.

Hazardous Materials Survey

It is recommended that all existing construction be surveyed for the presence of hazardous materials. Elements such as floor tile, adhesive, and pipe insulation could contain asbestos. Lead may be present in paint and light fixtures may contain PCB ballasts. A hazardous materials survey and abatement of the buildings should be performed prior to the start of any demolition work.

Concrete Shear Walls at Corners of East and West Exterior Walls

A new shotcrete wall and foundation will require excavation, backfill, and landscape restoration in the area where footings are installed. The new 8-inch shotcrete walls, which would wrap the exterior corners of the building, should be finished with an exterior finish system to match the existing concrete walls. Where windows are shown to be infilled with concrete, that section of wall, to the next nearest perpendicular wall or window, should be furred out with metal studs, R-21 insulation and 5/8-inch gypsum wallboard. Electrical devices, toilet fixtures, and fixed casework will need to be removed and reinstalled in and adjacent to the furred-out walls. Paint and new rubber base should be installed to match adjacent wall finishes. New mechanical louvers should be reinstalled in their current locations in the new shear walls, unless a more appropriate location can be found.

Diaphragm Strengthening

Installation of a new plywood roof diaphragm, out-of-plane anchors, and ledger connections will require removal of the existing roofing material to allow installation of new plywood sheathing. A new roof consisting of a vapor barrier, continuous rigid R-38 insulation, coverboard, and membrane roofing is recommended. It is assumed that the existing parapet flashing may be re-used.

The second-floor suspended ceiling system and lighting will need to be removed in its entirety to access the underside of the roof and allow for installation of plywood sheathing, out-of-plane anchors, and ledger connections. The ceiling should be replaced with suspended acoustical ceiling system, including LED lighting, in conformance with the current energy code.

Second-floor hardwood flooring, base, and casework will need to be removed to allow for installation of new plywood sheathing. We recommend that the hardwood flooring be salvaged for re-use. The hardwood flooring could be re-installed in the building, or new carpet could be installed, at the Owner's option. New rubber base will be required. Existing casework should be reinstalled.

Out-of-Plane Wall Anchorage and In-Plane Shear Transfer

It is recommended that the out-of-plane anchorage and in-plane shear connections be installed in conjunction with the shear diaphragm work at the roof and second floor ceiling described above. Where out-of-plane anchors are shown at the second floor, a 4-foot minimum section of suspended ceiling tiles should be removed to allow access for installation. The tiles should be protected and reinstalled.

Removal and Replacement of Exterior Steel Stair

Where the exterior steel stair is removed, attachment points should be grouted and painted to match the existing paint color. We recommend removing the second floor door and replacing it with a window.

4.4.2 Mechanical Systems

The main seismic concerns for mechanical equipment are sliding, swinging, and overturning. Inadequate lateral restraint or anchorage can shift equipment off its supports, topple equipment to the ground, or dislodge overhead equipment, making them falling hazards. Investigation of above-ceiling mechanical equipment and systems was not part of this study, but an initial investigation for the presence of mechanical equipment bracing can be performed by maintenance and facility staff to see if equipment weighing more than 20 pounds with a center of mass more than 4 feet above the adjacent floor level is laterally braced. If bracing is not present, and the equipment poses a falling hazard to students and faculty below, further investigation is recommended by a structural engineer.

4.5 Opinion of Probable Conceptual Seismic Upgrade Costs

An opinion of probable project costs of the concept-level seismic upgrade recommendations provided in this report is included in Appendix C. The input of the scope of work to develop the probable costs is the Tier 1 checklists and the preliminary concept-level seismic upgrades design recommendations and sketches. These preliminary concept-level design sketches depict a design concept that could be implemented to improve the seismic safety of the building structure. It is important to note the preliminary seismic upgrades design concept is based on the results of the Tier 1 seismic screening checklists and engineering design judgement and has not been substantiated by detailed structural analyses and calculations.

For this preliminary opinion of probable costs the estimate of construction costs of the preliminary scope of work is developed based on current 1st Quarter (1Q) 2021 costs. Costs are then escalated to 4Q 2022 at 6% per year of the baseline cost estimate. Costs are developed based on the Tier 1 checklist, concept-level seismic upgrade design sketches, and project narratives.

A range of the cost estimate of -20% (low) to +50% (high) is used to develop the range of the construction cost estimate for the concept-level scope of work. The -20% to +50% range guidance is from Table 1 of the AACE International Recommended Practice 56R-08, *Cost Estimate Classification System*. This estimate is classified as a Class 5 based on the level of design of 0% to 2%. The range of a Class 5 construction cost estimate based on the AACE guidance selected for this estimate is a -20% to +50%.

The estimated total cost (construction costs plus soft costs) to mitigate the deficiencies identified in the Tier 1 checklists of the Quilcene High School Building ranges between approximately $1.59M and $2.99M (-20%/+50%). The baseline estimated total cost to seismically upgrade this building is approximately $1.99M. On a per-square-foot basis, the baseline seismic upgrade cost is estimated to be approximately $253per square foot in 4Q 2022 dollars, with a range between $202 per square foot and $380 per square foot.

4.5.1 Opinion of Probable Construction Costs

This conceptual opinion of construction cost includes labor, materials, equipment, and scope contingency, general contractor general conditions, home office overhead, and profit. This is based on a public sector design-bid-build project delivery method. Project delivery methods such as negotiated, state of Washington GC/CM, and design-build are not the basis of the construction costs. Owner's soft costs are described below in Section 4.1.2.

The cost is developed in 1Q 2021 costs. The costs are then escalated to 4Q 2022 using an escalation rate of 6.0% per year. If the mid-point of construction will occur at a date earlier or later than 4Q 2022, then it is appropriate to adjust the escalation to the revised mid-point of construction. Construction costs excluded from the estimate are site work, phasing of construction, additional building modifications not directly related to the seismic scope of work, off hours labor costs, accelerated schedule overtime labor costs, replacement/relocation/additional FF+E, and building code changes that occur after this report.

For project budget planning purposes, it is highly recommended that the opinion of probable project costs is determined including: the overall construction budget of the seismic upgrade and additional scope of work for the building via the services of an A/E design team to study the proposed seismic mitigation strategies to refine the concept-level seismic upgrades design approach contained in this report, determine the construction timeline to adjust the escalation costs, define the construction phasing, if any, and the project soft costs.

4.5.2 Opinion of Probable A-E Design Budgets and Owner's Additional Project Costs (Soft Costs)

Additional owner's project costs would likely include owner's project administration costs, including project management, financing/bond costs, administration/contract/accounting costs, review of plans, value engineering studies, building permits, bidding costs, equipment, fixtures, furnishings and technology, and relocation of the school staff and students during construction. These costs are known as soft costs.

These soft costs have been included in the opinion of probable costs at 40% of the baseline probable construction cost for the seismic upgrade of this building.
The soft costs used for the projects that total to 40% are:
A+E Design - 10%
QA/QC Testing - 2%
Project Administration - 2%
Owner Contingency - 11%
Average Washington State Sales Tax - 9%
Building Permits - 6%

It is typical for soft costs to vary from owner to owner. Based upon our team members' experience on K-12 school projects in the state of Washington, it is our opinion that an allowance of 40% of the average probable construction cost is a reasonable and appropriate soft cost recommendation for planning purposes. We also recommend that each owner develop their own soft costs as part of their budgeting process and not rely solely on this recommended percentage.

4.5.3 Escalation Rate

A 6.0%/year construction cost escalation rate is used for planning purposes for the conceptual estimates. The rate is compounded annually to the projected midpoint of construction. This rate is representative of the escalation based on the previous five years of market experience of construction costs throughout the state of Washington and is projected going forward for these projects. This rate is calculated to the 4th Quarter of 2022 as an allowance for planning purposes. The actual construction schedule for the project is to be determined and we recommend the escalation cost be revised based on revised construction schedule using the 6%/year rate.

Table 4.5.3-1. Seismic Upgrades Opinion of Probable Construction Costs.

Building	FEMA Bldg Type	ASCE 41 Level of Seismicity / Site Class	Structural Performance Objective	Bldg Gross Area	Estimated Seismic Upgrade Cost Range $/SF (Total)	Estimated Seismic Upgrade Cost/SF (Total)
Quilcene High School Bldg	C2a	High / D	**Structural**			
			Life Safety	7,860 SF	$71 ($556K) - $132 ($1.04M)	$89 ($696K)
			Nonstructural			
			Life Safety	7,860 SF	$74 ($582K) - $139 ($1.09M)	$92 ($727K)
			Total			
				7,860 SF	$145 ($1.14M) - $271 ($2.13M)	$181 ($1.42M)
					Estimated Soft Costs:	$569K
					Total Estimated Project Costs:	**$1.99M**

·W: Wood-Framed; URM: Unreinforced Masonry; RM: Reinforced Masonry; C: Reinforced Concrete; PC: Precast concrete; S: Steel-framed

Appendix A: ASCE 41 Tier 1 Screening Report

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1. Quilcene, Quilcene High And Elementary School, High School

1.1 Building Description

Building Name:	High School
Facility Name:	Quilcene High And Elementary School
District Name:	Quilcene
ICOS Latitude:	47.823
ICOS Longitude:	-122.875
ICOS County/District ID:	16048
ICOS Building ID:	15982
ASCE 41 Bldg Type:	C2a
Enrollment:	206
Gross Sq. Ft. :	7,856
Year Built:	1935
Number of Stories:	2
S_{XS} BSE-2E:	0.966
S_{X1} BSE-2E:	0.551
ASCE 41 Level of Seismicity:	High
Site Class:	C
V_{S30}(m/s):	514
Liquefaction Potential:	low
Tsunami Risk:	Moderate
Structural Drawings Available:	No
Evaluating Firm:	Reid Middleton, Inc.

The Quilcene School, in Jefferson County, serves approximately 650 students from K-12. Constructed in 1935, Quilcene High School serves grades 9-12 and is a 2-story, 7,860 square foot reinforced concrete building with wood frame floors and roof. There was a major improvement project in 1975 however it appears that it did not include any structural or seismic improvements. According to facilities staff, a torch down roof added in 1996. and a small platform lift was added in 2017 at the south end of the building. The footprint of the Quilcene High School building is 54'-6" by 72'-0". The exterior walls are constructed of 8-inch concrete with both floors and roof diaphragms consisting of diagonal wood shiplap over wood joists. Based on limited drawings from 1975, it appears the ceiling framing of the 2nd floor is structural and may be supporting portions of roof framing. The building has a central corridor running North and South and is surrounded primarily by classrooms and admin spaces.

1.1.1 Building Use

Quilcene High School building contains classrooms and administrative spaces.

1.1.2 Structural System

Table 1.1-1. Structural System Description of Quilcene High And Elementary School

Structural System	Description
Structural Roof	Original construction drawings were not available and existing conditions could not be observed during our site visit. Based on a 2006 Study and Survey, the structural roof system is assumed to be diagonal wood shiplap on wood 2x joists spanning in the east-west direction. Limited existing drawings from the 1975 improvement project indicate a structurally framed ceiling above the 2nd floor (a few feet below the roof) which may support some of the roof framing.
Structural Floor(s)	The second floor consist of straight wood flooring on diagonal shiplap on 2x joists spanning in the east-west direction. Based on a 2006 Study and Survey, the 1st floor system is assumed to be wood flooring on wood sleepers on a concrete slab on grade.
Foundations	Foundations are not visible but appear to be shallow concrete footings.
Gravity System	The gravity system consists of wood frame construction supported on interior wood girders and columns and exterior 8-inch reinforced concrete bearing walls.
Lateral System	The lateral-force-resisting-system consists of reinforced concrete exterior shear walls and diagonal shiplap diaphragms.

1.1.3 Structural System Visual Condition

Table 1.1-2. Structural System Condition Description of Quilcene High And Elementary School

Structural System	Description
Structural Roof	The structural roof system appears to be in satisfactory condition with some evidence of deterioration of roof framing per discussion with maintenance personnel.
Structural Floor(s)	The structural floor system appears to be in satisfactory condition.
Foundations	Foundations are not visible but appear to be in satisfactory condition with no visible indications of damage or distress.
Gravity System	The gravity system appears to be in satisfactory condition.
Lateral System	The lateral force resisting system appears to be in satisfactory condition.

Photos:

Figure 1-1. High School, Partial West Elevation

Figure 1-2. High School, North Elevation with Decommissioned Steel Stair

Figure 1-3. High School, East Elevation

Figure 1-4. High School, South Elevation

Figure 1-5. High School, Main Entry

Figure 1-6. High School, Typical Concrete Framing

Figure 1-7. High School, Typical Classroom

Figure 1-8. High School, Typical Framing Above Ceiling

1.2 Seismic Evaluation Findings

1.2.1 Structural Seismic Deficiencies

The structural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation.

Table 1-3. Identified Structural Seismic Deficiencies for Quilcene Quilcene High And Elementary School High School

Deficiency	Description
Shear Stress Check	The concrete shear walls are non-compliant in the north-south direction but are less than 100 psi in the east-west direction. Further investigation should be performed. Additional shear walls or shear wall infills of the east and west exterior shear walls would be appropriate to mitigate seismic risk.
Wall Anchorage at Flexible Diaphragms	Likely noncompliant in pre-benchmark reinforced concrete building. Further investigation should be performed. Additional diaphragm shear wall anchoring may be appropriate to mitigate seismic risk.
Transfer to Shear Walls	Likely non compliant in pre-benchmark reinforced concrete building. Further investigation should be performed. Additional diaphragm shear wall anchoring may be appropriate to mitigate seismic risk.
Deflection Compatibility	Secondary component details such as exterior concrete wall pier reinforcement and confinement are unknown. Further investigation should be performed. Added lateral system stiffness in the north-south direction or secondary component strengthening such as fiber wrap may be appropriate to mitigate seismic risk.
Cross Ties	Likely non-compliant in pre-benchmark reinforced concrete building. Further investigation may be appropriate. Diaphragm reinforcement may be appropriate to mitigate seismic risk.
Diagonally Sheathed and Unblocked Diaphragms	Diagonally sheathed diaphragm spans to the exterior concrete shear walls approximately 54 feet in the north-south direction and 72 feet in the east-west direction. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.

1.2.2 Structural Checklist Items Marked as 'U'nknown

Where building structural component seismic adequacy was unknown due to lack of available information or limited observation, the structural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown structural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

Table 1-4. Identified Structural Checklist Items Marked as Unknown for Quilcene Quilcene High And Elementary School High School

Unknown Item	Description
Load Path	Original drawings are not available and therefore the load path from the wood shiplap diaphragms to the exterior concrete shear walls is unknown. This should be further investigated for adequacy to transfer seismic forces from the diaphragms to the shear walls.
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. Low liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Reinforcing Steel	The reinforcement ratio is unknown. Further investigation should be completed. Wall strengthening using carbon fiber or shear wall addition may be appropriate to mitigate seismic risk.
Foundation Dowels	The foundation detail is unknown due to unavailable original construction drawings. Further investigation should be performed. Additional foundation wall anchoring may be appropriate to mitigate seismic risk.
Straight Sheathing	Compliant for the 2nd floor diaphragms as this was observed to have diagonal shiplap. Roof diaphragm however was not visually accessible and should be further investigated. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.
Spans	Compliant for the 2nd floor diaphragms as this was observed to have diagonal shiplap diaphragms. Roof diaphragm however was not visually accessible and should be further investigated. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.

1.3.1 Nonstructural Seismic Deficiencies

The nonstructural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is also provided based on this evaluation. Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

Table 1-5. Identified Nonstructural Seismic Deficiencies for Quilcene Quilcene High And Elementary School High School

Deficiency	Description
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing information is unknown. Most windows have 2 panes of glazing that appear to be less than 16 sf, except above the entry and stair. Based on the age of the building, it is likely that the glazing on the windows are laminated or detailed to remain in the frame. Many individual panes are likely to be below this threshold. Further investigation should be completed. Replacing applicable glazing planes or applying a laminating film may be appropriate to mitigate seismic risk.
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	This building does not have canopies. However there is a decommissioned egress steel framed stair and upper landing at the north end of the building that is blocked off due to stair safety. The connection of this stair and landing to the existing building is unknown and consideration should be given to remove and replace this decommissioned stair to mitigate seismic risk as it directly over the north exit doors.

1.3.2 Nonstructural Checklist Items Marked as 'U'nknown

Where building nonstructural component seismic adequacy was unknown due to lack of available information or limited observation, the nonstructural checklist items were marked as “unknown”. These items require further investigation if definitive determination of compliance or noncompliance is desired. The unknown nonstructural checklist items identified during the Tier 1 evaluation are summarized below. Commentary for each unknown item is also provided based on the evaluation.

Some nonstructural deficiencies may be able to be mitigated by school district staff. Other nonstructural components that require more substantial mitigation may be more appropriately included in a long-term mitigation strategy. Some typical conceptual details for the seismic upgrade of nonstructural components can be found in the FEMA E-74 Excerpts appendix.

Table 1-6. Identified Nonstructural Checklist Items Marked as Unknown for Quilcene Quilcene High And Elementary School High School

Unknown Item	Description
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Use of emergency power was not verified with maintenance or facility staff. Evaluation of emergency power equipment may be appropriate to mitigate seismic risk.
HM-1 Hazardous Material Equipment. HR-LMH; LS-LMH; PR-LMH.	It is unknown if equipment is mounted on vibration isolators. Further investigation may be appropriate to mitigate seismic risk.
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Unknown whether the building has hazardous materials. There may be gas lines present. Further investigation of mechanical piping should be performed. Bracing and anchoring of piping may be appropriate to mitigate seismic risk.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	It is unknown if the structure contains natural gas or other hazardous materials. Further investigation of mechanical piping should be performed. Providing shutoff valves may be appropriate to mitigate seismic risk.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Unknown whether the building has hazardous materials. There may be gas lines present. Further investigation of mechanical piping should be performed. Flexible coupling for piping and ductwork may be appropriate to mitigate seismic risk.
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	This was not observed during the site visit and it is unknown how much the light fixtures weigh. However this can be further investigated by facility staff to see if light fixtures are independently supported to the floor or roof structure above at diagonally opposite corners on the light fixture. Adding wires for suspending the light fixtures may be appropriate to mitigate seismic risk.
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	There did not appear to be any hollow-clay or unreinforced masonry walls around stair enclosures but this should be further investigated or verified by facilities staff.
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	There appears to be a connection from the exterior stairs to the north exterior wall of the structure. It is unknown if they are post-installed anchors. However this stair is blocked off due to stair safety. Consideration should be given to remove this decommissioned stair to mitigate seismic risk as it directly over the north exit doors.
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Not able to verify during site investigation. Further investigation should be performed to see if this occurs. Bracing or anchoring of equipment may be appropriate to mitigate seismic risk.
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Not able to verify during site investigation. Further investigation should be performed. Bracing or anchoring of equipment may be appropriate to mitigate seismic risk.

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17-2 Collapse Prevention Basic Configuration Checklist

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

Low Seismicity

Building System - General

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Load Path	The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation. (Tier 2: Sec. 5.4.1.1; Commentary: Sec. A.2.1.10)				X	Original drawings are not available and therefore the load path from the wood shiplap diaphragms to the exterior concrete shear walls is unknown. This should be further investigated for adequacy to transfer seismic forces from the diaphragms to the shear walls.
Adjacent Buildings	The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Tier 2: Sec. 5.4.1.2; Commentary: Sec. A.2.1.2)	X				It does not appear that there are any immediately adjacent structures.
Mezzanines	Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Tier 2: Sec. 5.4.1.3; Commentary: Sec. A.2.1.3)			X		There are no interior mezzanine levels.

Building System - Building Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Weak Story	The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Tier 2: Sec. 5.4.2.1; Commentary: Sec. A.2.2.2)	X				There does not appear to be a weak story irregularity.
Soft Story	The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Tier 2: Sec. 5.4.2.2; Commentary: Sec. A.2.2.3)	X				There does not appear to be a soft story irregularity.

Vertical Irregularities	All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Tier 2: Sec. 5.4.2.3; Commentary: Sec. A.2.2.4)	X				Compliant based on visual observations.
Geometry	There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 5.4.2.4; Commentary: Sec. A.2.2.5)	X				There are no changes to the horizontal dimension of the seismic force-resisting system.
Mass	There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 5.4.2.5; Commentary: Sec. A.2.2.6)	X				There does not appear to be a mass irregularity.
Torsion	The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Tier 2: Sec. 5.4.2.6; Commentary: Sec. A.2.2.7)	X				There does not appear to be any torsion irregularity.

Moderate Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)

Geologic Site Hazards

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Liquefaction	Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.1)				X	The liquefaction potential of site soils is unknown at this time given available information. Low liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.2)				X	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Surface fault rupture and surface displacement at the building site are not anticipated. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.3)				X	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.

High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)

Foundation Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Overturning	The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6Sa. (Tier 2: Sec. 5.4.3.3; Commentary: Sec. A.6.2.1)	X				This building has base/height ratio greater than 0.6Sa.
Ties Between Foundation Elements	The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Tier 2: Sec. 5.4.3.4; Commentary: Sec. A.6.2.2)			X		Site Class C.

17-24 Collapse Prevention Structural Checklist for Building Types C2 and C2a

Building record drawings have been reviewed, when available, and a non-destructive field investigation has been performed for the subject building. Each of the required checklist items are marked Compliant (C), Noncompliant (NC), Not Applicable (N/A), or Unknown (U). Items marked Compliant indicate conditions that satisfy the performance objective, whereas items marked Noncompliant or Unknown indicate conditions that do not. Certain statements might not apply to the building being evaluated.

Low and Moderate Seismicity

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Complete Frames	Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Tier 2: Sec. 5.5.2.5.1; Commentary: Sec. A.3.1.6.1)			X		
Redundancy	The number of lines of shear walls in each principal direction is greater than or equal to 2. (Tier 2: Sec.5.5.1.1; Commentary: Sec. A.3.2.1.1)	X				
Shear Stress Check	The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.2 (0.69 MPa) or $2\sqrt{f'c}$. (Tier 2: Sec.5.5.3.1.1; Commentary: Sec. A.3.2.2.1)		X			The concrete shear walls are non-compliant in the north-south direction but are less than 100 psi in the east-west direction. Further investigation should be performed. Additional shear walls or shear wall infills of the east and west exterior shear walls would be appropriate to mitigate seismic risk.
Reinforcing Steel	The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Tier 2: Sec.5.5.3.1.3; Commentary: Sec. A.3.2.2.2)				X	The reinforcement ratio is unknown. Further investigation should be completed. Wall strengthening using carbon fiber or shear wall addition may be appropriate to mitigate seismic risk.

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT

Wall Anchorage at Flexible Diaphragms	Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Tier 2: Sec.5.7.1.1; Commentary: Sec. A.5.1.1)		X			Likely noncompliant in pre-benchmark reinforced concrete building. Further investigation should be performed. Additional diaphragm shear wall anchoring may be appropriate to mitigate seismic risk.
Transfer to Shear Walls	Diaphragms are connected for transfer of seismic forces to the shear walls. (Tier 2: Sec.5.7.2; Commentary: Sec. A.5.2.1)		X			Likely non compliant in pre-benchmark reinforced concrete building. Further investigation should be performed. Additional diaphragm shear wall anchoring may be appropriate to mitigate seismic risk.
Foundation Dowels	Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation. (Tier 2: Sec.5.7.3.4; Commentary: Sec. A.5.3.5)				X	The foundation detail is unknown due to unavailable original construction drawings. Further investigation should be performed. Additional foundation wall anchoring may be appropriate to mitigate seismic risk.

High Seismicity **(Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)**

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Deflection Compatibility	Secondary components have the shear capacity to develop the flexural strength of the components. (Tier 2: Sec.5.5.2.5.2; Commentary: Sec. A.3.1.6.2)		X			Secondary component details such as exterior concrete wall pier reinforcement and confinement are unknown. Further investigation should be performed. Added lateral system stiffness in the north-south direction or secondary component strengthening such as fiber wrap may be appropriate to mitigate seismic risk.
Flat Slabs	Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints. (Tier 2: Sec.5.5.2.5.3; Commentary: Sec. A.3.1.6.3)			X		

Coupling Beams	The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. (Tier 2: Sec.5.5.3.2.1; Commentary: Sec. A.3.2.2.3)			X		

Diaphragms (Stiff or Flexible)

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Diaphragm Continuity	The diaphragms are not composed of split-level floors and do not have expansion joints. (Tier 2: Sec.5.6.1.1; Commentary: Sec. A.4.1.1)	X				
Openings at Shear Walls	Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Tier 2: Sec.5.6.1.3; Commentary: Sec. A.4.1.4)	X				

Flexible Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Cross Ties	There are continuous cross ties between diaphragm chords. (Tier 2: Sec.5.6.1.2; Commentary: Sec. A.4.1.2)		X			Likely non-compliant in pre-benchmark reinforced concrete building. Further investigation may be appropriate. Diaphragm reinforcement may be appropriate to mitigate seismic risk.
Straight Sheathing	All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered. (Tier 2: Sec.5.6.2; Commentary: Sec. A.4.2.1)				X	Compliant for the 2nd floor diaphragms as this was observed to have diagonal shiplap. Roof diaphragm however was not visually accessible and should be further investigated. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.
Spans	All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing. (Tier 2: Sec.5.6.2; Commentary: Sec. A.4.2.2)				X	Compliant for the 2nd floor diaphragms as this was observed to have diagonal shiplap diaphragms. Roof diaphragm however was not visually accessible and should be further investigated. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.

Diagonally Sheathed and Unblocked Diaphragms	All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4 to-1. (Tier 2: Sec.5.6.2; Commentary: Sec. A.4.2.3)		X			Diagonally sheathed diaphragm spans to the exterior concrete shear walls approximately 54 feet in the north-south direction and 72 feet in the east-west direction. Diaphragm reinforcement with wood structural panel overlaid onto existing shiplap would be appropriate to mitigate seismic risk.
Other Diaphragms	Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec.5.6.5; Commentary: Sec. A.4.7.1)	X				Wood diaphragms only.

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Uplift at Pile Caps	Pile caps have top reinforcement, and piles are anchored to the pile caps. (Tier 2: Sec.5.7.3.5; Commentary: Sec. A.5.3.8)			X		Assumed shallow foundations.

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17-38 Nonstructural Checklist

Notes:
C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.
Performance Level: HR = Hazards Reduced, LS = Life Safety, and PR = Position Retention.
Level of Seismicity: L = Low, M = Moderate, and H = High

Life Safety Systems

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LSS-1 Fire Suppression Piping. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping is anchored and braced in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.1)			X		This building does not have a fire suppression system.
LSS-2 Flexible Couplings. HR-not required; LS-LMH; PR-LMH.	Fire suppression piping has flexible couplings in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.2)			X		This building does not have a fire suppression system.
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Equipment used to power or control Life Safety systems is anchored or braced. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.1)				X	Use of emergency power was not verified with maintenance or facility staff. Evaluation of emergency power equipment may be appropriate to mitigate seismic risk.
LSS-4 Stair and Smoke Ducts. HR-not required; LS-LMH; PR-LMH.	Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.1)			X		This building does not have a pressurized stair.
LSS-5 Sprinkler Ceiling Clearance. HR-not required; LS-MH; PR-MH.	Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Tier 2: Sec. 13.7.4; Commentary: Sec. A.7.13.3)			X		This building does not have a fire suppression system.
LSS-6 Emergency Lighting. HR-not required; LS-not required; PR-LMH	Emergency and egress lighting equipment is anchored or braced. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.1)			X		Not required for life safety performance level.

Hazardous Materials

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
HM-1 Hazardous Material Equipment. HR-LMH; LS-LMH; PR-LMH.	Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.2)				X	It is unknown if equipment is mounted on vibration isolators. Further investigation may be appropriate to mitigate seismic risk.

HM-2 Hazardous Material Storage. HR-LMH; LS-LMH; PR-LMH.	Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Tier 2: Sec. 13.8.3; Commentary: Sec. A.7.15.1)			X		Containers with hazardous materials was not observed during our site visit. However presence of hazardous materials should be verified by facilities staff.
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)				X	Unknown whether the building has hazardous materials. There may be gas lines present. Further investigation of mechanical piping should be performed. Bracing and anchoring of piping may be appropriate to mitigate seismic risk.
HM-4 Shutoff Valves. HR-MH; LS-MH; PR-MH.	Piping containing hazardous material, including natural gas, has shutoff valves or other devices to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.3)				X	It is unknown if the structure contains natural gas or other hazardous materials. Further investigation of mechanical piping should be performed. Providing shutoff valves may be appropriate to mitigate seismic risk.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Hazardous material ductwork and piping, including natural gas piping, have flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.15.4)				X	Unknown whether the building has hazardous materials. There may be gas lines present. Further investigation of mechanical piping should be performed. Flexible coupling for piping and ductwork may be appropriate to mitigate seismic risk.
HM-6 Piping or Ducts Crossing Seismic Joints. HR-MH; LS-MH; PR-MH.	Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5, 13.7.6; Commentary: Sec. A.7.13.6)			X		The building does not appear to contain seismic joints, isolation planes, or independent structures.

Partitions

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft (3.0 m) in Low or Moderate Seismicity, or at most 6 ft (1.8 m) in High Seismicity. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.1)			X		Partitions do not appear to consist of unreinforced masonry or hollow-clay tile.
P-2 Heavy Partitions Supported by Ceilings. HR-LMH; LS-LMH; PR-LMH.	The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		Partitions do not appear to consist of masonry or hollow-clay tile.
P-3 Drift. HR-not required; LS-MH; PR-MH.	Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.2)			X		Partitions do not appear to consist of rigid cementitious material.
P-4 Light Partitions Supported by Ceilings. HR-not required; LS-not required; PR-MH.	The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.2.1)			X		Not required for life safety performance level.
P-5 Structural Separations. HR-not required; LS-not required; PR-MH.	Partitions that cross structural separations have seismic or control joints. (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.3)			X		There are no structural separations in this building.
P-6 Tops. HR-not required; LS-not required; PR-MH.	The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft (1.8 m). (Tier 2: Sec. 13.6.2; Commentary: Sec. A.7.1.4)			X		Not required for life safety performance level.

Ceilings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)			X		Original wood lath with plaster was observed to be fastened directly to underside of 2nd floor framing or structurally framed 2nd floor ceiling above.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)			X		Suspended GWB ceilings were not observed in the building.

C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.2)			X		Not required for life safety performance level.
C-4 Edge Clearance. HR-not required; LS-not required; PR-MH.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in. (13 mm); in High Seismicity, 3/4 in. (19 mm). (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.4)			X		Not required for life safety performance level.
C-5 Continuity Across Structure Joints. HR-not required; LS-not required; PR-MH.	The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.5)			X		Not required for life safety performance level.
C-6 Edge Support. HR-not required; LS-not required; PR-H.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) are supported by closure angles or channels not less than 2 in. (51 mm) wide. (Tier 2: Sec. 13.6.4 ; Commentary: Sec. A.7.2.6)			X		Not required for life safety performance level.
C-7 Seismic Joints. HR-not required; LS-not required; PR-H.	Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2,500 ft2 (232.3 m2) and has a ratio of long-to-short dimension no more than 4-to-1. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.7)			X		Not required for life safety performance level.

Light Fixtures

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Tier 2: Sec. 13.6.4, 13.7.9; Commentary: Sec. A.7.3.2)				X	This was not observed during the site visit and it is unknown how much the light fixtures weigh. However this can be further investigated by facility staff to see if light fixtures are independently supported to the floor or roof structure above at diagonally opposite corners on the light fixture. Adding wires for suspending the light fixtures may be appropriate to mitigate seismic risk.
LF-2 Pendant Supports. HR-not required; LS-not required; PR-H.	Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft. Unbraced suspended fixtures are free to allow a 360-degree range of motion at an angle not less than 45 degrees from horizontal without contacting adjacent components. Alternatively, if rigidly supported and/or braced, they are free to move with the structure to which they are attached without damaging adjoining components. Additionally, the connection to the structure is capable of accommodating the movement without failure. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.3)			X		Not required for life safety performance level.
LF-3 Lens Covers. HR-not required; LS-not required; PR-H.	Lens covers on light fixtures are attached with safety devices. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.4)			X		Not required for life safety performance level.

Cladding and Glazing

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CG-1 Cladding Anchors. HR-MH; LS-MH; PR-MH.	Cladding components weighing more than 10 lb/ft2 (0.48 kN/m2) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m) (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.1)			X		The building does not have any heavy cladding components.

CG-2 Cladding Isolation. HR-not required; LS-MH; PR-MH.	For steel or concrete moment-frame buildings, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.3)			X		The building is not a steel or concrete moment frame building.
CG-3 Multi-Story Panels. HR-MH; LS-MH; PR-MH.	For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.4)			X		The building does not have any multi-story panels.
CG-4 Threaded Rods. HR-not required; LS-MH; PR-MH.	Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.9)			X		The building does not have any panel connections.
CG-5 Panel Connections. HR-MH; LS-MH; PR-MH.	Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.5)			X		The building does not have any cladding panels.
CG-6 Bearing Connections. HR-MH; LS-MH; PR-MH.	Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.6)			X		The building does not have any bearing connections.
CG-7 Inserts. HR-MH; LS-MH; PR-MH.	Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.7)			X		The building does not have any concrete cladding.

CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft2 (1.5 m2) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Tier 2: Sec. 13.6.1.5; Commentary: Sec. A.7.4.8)		X			Glazing information is unknown. Most windows have 2 panes of glazing that appear to be less than 16 sf, except above the entry and stair. Based on the age of the building, it is likely that the glazing on the windows are laminated or detailed to remain in the frame. Many individual panes are likely to be below this threshold. Further investigation should be completed. Replacing applicable glazing planes or applying a laminating film may be appropriate to mitigate seismic risk.

Masonry Veneer

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft2 (0.25 m2), and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in. (914 mm); for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (610 mm). (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.1)			X		This building does not have masonry veneer.
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.2)			X		This building does not have masonry veneer.
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.3)			X		This building does not have masonry veneer.
M-4 Unreinforced Masonry Backup. HR-LMH; LS-LMH; PR-LMH.	There is no unreinforced masonry backup. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.2)			X		This building does not have masonry veneer.
M-5 Stud Tracks. HR-not required; LS-MH; PR-MH.	For veneer with coldformed steel stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. (610 mm) on center. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.)			X		This building does not have masonry veneer.

M-6 Anchorage. HR-not required; LS-MH; PR-MH.	For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.1)			X		This building does not have masonry veneer.
M-7 Weep Holes. HR-not required; LS-not required; PR-MH.	In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.6)			X		This building does not have masonry veneer.
M-8 Openings. HR-not required; LS-not required; PR-MH.	For veneer with cold-formed-steel stud backup, steel studs frame window and door openings. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.2)			X		This building does not have masonry veneer.

Parapets, Cornices, Ornamentation, and Appendages

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PCOA-1 URM Parapets or Cornices. HR-LMH; LS-LMH; PR-LMH.	Laterally unsupported unreinforced masonry parapets or cornices have height-tothickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.1)			X		This building does not have unreinforced masonry parapets.
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft (3.0 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft (1.8 m). (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.2)		X			This building does not have canopies. However there is a decommissioned egress steel framed stair and upper landing at the north end of the building that is blocked off due to stair safety. The connection of this stair and landing to the existing building is unknown and consideration should be given to remove and replace this decommissioned stair to mitigate seismic risk as it directly over the north exit doors.
PCOA-3 Concrete Parapets. HR-H; LS-MH; PR-LMH.	Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.3)			X		Based on 1975 MEP upgrade building section, it appears parapet is about 18 inches tall and therefore has a height to thickness ratio of 2.25.

PCOA-4 Appendages. HR-MH; LS-MH; PR-LMH.	Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft (1.8 m). This evaluation statement item does not apply to parapets or cornices covered by other evaluation statements. (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.4)	X				There does not appear to be any cornices, signs and other ornamentation or appendages. There appears to be concrete parapets. However, the concrete parapets are likely to have vertical reinforcement.

Masonry Chimneys

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
MC-1 URM Chimneys. HR-LMH; LS-LMH; PR-LMH.	Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.1)			X		No unreinforced masonry chimney in the building.
MC-2 Anchorage. HR-LMH; LS-LMH; PR-LMH.	Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Tier 2: Sec. 13.6.7; Commentary: Sec. A.7.9.2)			X		No unreinforced masonry chimney in the building.

Stairs

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out of plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Tier 2: Sec. 13.6.2, 13.6.8; Commentary: Sec. A.7.10.1)				X	There did not appear to be any hollow-clay or unreinforced masonry walls around stair enclosures but this should be further investigated or verified by facilities staff.
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	The connection between the stairs and the structure does not rely on post-installed anchors in concrete or masonry, and the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.4.3.1 for moment-frame structures or 0.5 in. for all other structures without including any lateral stiffness contribution from the stairs. (Tier 2: Sec. 13.6.8; Commentary: Sec. A.7.10.2)				X	There appears to be a connection from the exterior stairs to the north exterior wall of the structure. It is unknown if they are post-installed anchors. However this stair is blocked off due to stair safety. Consideration should be given to remove this decommissioned stair to mitigate seismic risk as it directly over the north exit doors.

Contents and Furnishings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CF-1 Industrial Storage Racks. HR-LMH; LS-MH; PR-MH.	Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/RMI MH 16.1 as modified by ASCE 7, Chapter 15. (Tier 2: Sec. 13.8.1; Commentary: Sec. A.7.11.1)			X		There were no high storage racks observed in the building.
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Contents more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.2)			X		There were no tall-narrow contents observed during our site visit however this item can be verified by facilities staff as it is commonly noncompliant for contents meeting the criteria. If this occurs, brace tops of topple prone shelving and storage cabinets to nearest backing wall.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Equipment, stored items, or other contents weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level are braced or otherwise restrained. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.3)			X		There were no fall-prone contents observed during our site visit however this item can be verified by facilities staff as it is commonly noncompliant for contents meeting the criteria. If this occurs, heavy items on upper shelves or on top of cabinets should be taken down or restrained by netting or cabling to avoid becoming falling hazards.
CF-4 Access Floors. HR-not required; LS-not required; PR-MH.	Access floors more than 9 in. (229 mm) high are braced. (Tier 2: Sec. 13.6.10; Commentary: Sec. A.7.11.4)			X		Access floor systems were not observed.
CF-5 Equipment on Access Floors. HR-not required; LS-not required; PR-MH.	Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Tier 2: Sec. 13.7.7 13.6.10; Commentary: Sec. A.7.11.5)			X		Access floor systems were not observed.
CF-6 Suspended Contents. HR-not required; LS-not required; PR-H.	Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.6)			X		Not required for life safety performance level.

Mechanical and Electrical Equipment

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Equipment weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level, and which is not in-line equipment, is braced. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.4)				X	Not able to verify during site investigation. Further investigation should be performed to see if this occurs. Bracing or anchoring of equipment may be appropriate to mitigate seismic risk.
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Equipment installed in line with a duct or piping system, with an operating weight more than 75 lb (34.0 kg), is supported and laterally braced independent of the duct or piping system. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.5)				X	Not able to verify during site investigation. Further investigation should be performed. Bracing or anchoring of equipment may be appropriate to mitigate seismic risk.
ME-3 Tall Narrow Equipment. HR-not required; LS-H; PR-MH.	Equipment more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.6)			X		There were no tall-narrow equipment observed in occupied spaces during our site visit. This item can be verified by facilities staff in non-occupied rooms and mechanical spaces. Brace tops of equipment taller and slender equipment to the nearest backing wall or provide overturning base restraint.
ME-4 Mechanical Doors. HR-not required; LS-not required; PR-MH.	Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Tier 2: Sec. 13.6.9; Commentary: Sec. A.7.12.7)			X		Mechanically operated doors were not observed during our site visit.
ME-5 Suspended Equipment. HR-not required; LS-not required; PR-H.	Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.8)			X		Not required for life safety performance level.
ME-6 Vibration Isolators. HR-not required; LS-not required; PR-H.	Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.9)			X		Not required for life safety performance level.
ME-7 Heavy Equipment. HR-not required; LS-not required; PR-H.	Floor supported or platform-supported equipment weighing more than 400 lb (181.4 kg) is anchored to the structure. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.10)			X		Not required for life safety performance level.
ME-8 Electrical Equipment. HR-not required; LS-not required; PR-H.	Electrical equipment is laterally braced to the structure. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.11)			X		Not required for life safety performance level.

ME-9 Conduit Couplings. HR-not required; LS-not required; PR-H.	Conduit greater than 2.5 in. (64 mm) trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Tier 2: Sec. 13.7.8; Commentary: Sec. A.7.12.12)			X		Not required for life safety performance level.

Piping

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PP-1 Flexible Couplings. HR-not required; LS-not required; PR-H.	Fluid and gas piping has flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.2)			X		Not required for life safety performance level.
PP-2 Fluid and Gas Piping. HR-not required; LS-not required; PR-H.	Fluid and gas piping is anchored and braced to the structure to limit spills or leaks. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)			X		Not required for life safety performance level.
PP-3 C-Clamps. HR-not required; LS-not required; PR-H.	One-sided C-clamps that support piping larger than 2.5 in. (64 mm) in diameter are restrained. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.5)			X		Not required for life safety performance level.
PP-4 Piping Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.6)			X		This building does not have seismic or isolation joints.

Ducts

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
D-1 Duct Bracing. HR-not required; LS-not required; PR-H.	Rectangular ductwork larger than 6 ft2 (0.56 m2) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft (9.2 m). The maximum spacing of longitudinal bracing does not exceed 60 ft (18.3 m). (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.2)			X		Not required for life safety performance level.
D-2 Duct Support. HR-not required; LS-not required; PR-H.	Ducts are not supported by piping or electrical conduit. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.3)			X		Not required for life safety performance level.
D-3 Ducts Crossing Seismic Joints. HR-not required; LS-not required; PR-H.	Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.4)			X		This building does not have seismic or isolation joints.

Elevators

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
EL-1 Retainer Guards. HR-not required; LS-H; PR-H.	Sheaves and drums have cable retainer guards. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.1)			X		Platform lift was not investigated and is assumed to not have sheaves, drums, and cabling for its operation.
EL-2 Retainer Plate. HR-not required; LS-H; PR-H.	A retainer plate is present at the top and bottom of both car and counterweight. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.2)			X		Platform lift was not investigated and is assumed to not have counterweights and cabling for its operation.
EL-3 Elevator Equipment. HR-not required; LS-not required; PR-H.	Equipment, piping, and other components that are part of the elevator system are anchored. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.3)			X		Not required for life safety performance level.
EL-4 Seismic Switch. HR-not required; LS-not required; PR-H.	Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.4)			X		Not required for life safety performance level.
EL-5 Shaft Walls. HR-not required; LS-not required; PR-H.	Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.5)			X		Not required for life safety performance level.
EL-6 Counterweight Rails. HR-not required; LS-not required; PR-H.	All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.6)			X		Not required for life safety performance level.
EL-7 Brackets. HR-not required; LS-not required; PR-H.	The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.7)			X		Not required for life safety performance level.
EL-8 Spreader Bracket. HR-not required; LS-not required; PR-H.	Spreader brackets are not used to resist seismic forces. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.8)			X		Not required for life safety performance level.
EL-9 Go-Slow Elevators. HR-not required; LS-not required; PR-H.	The building has a go-slow elevator system. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.9)			X		Not required for life safety performance level.

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Appendix B: Concept-Level Seismic Upgrade Figures

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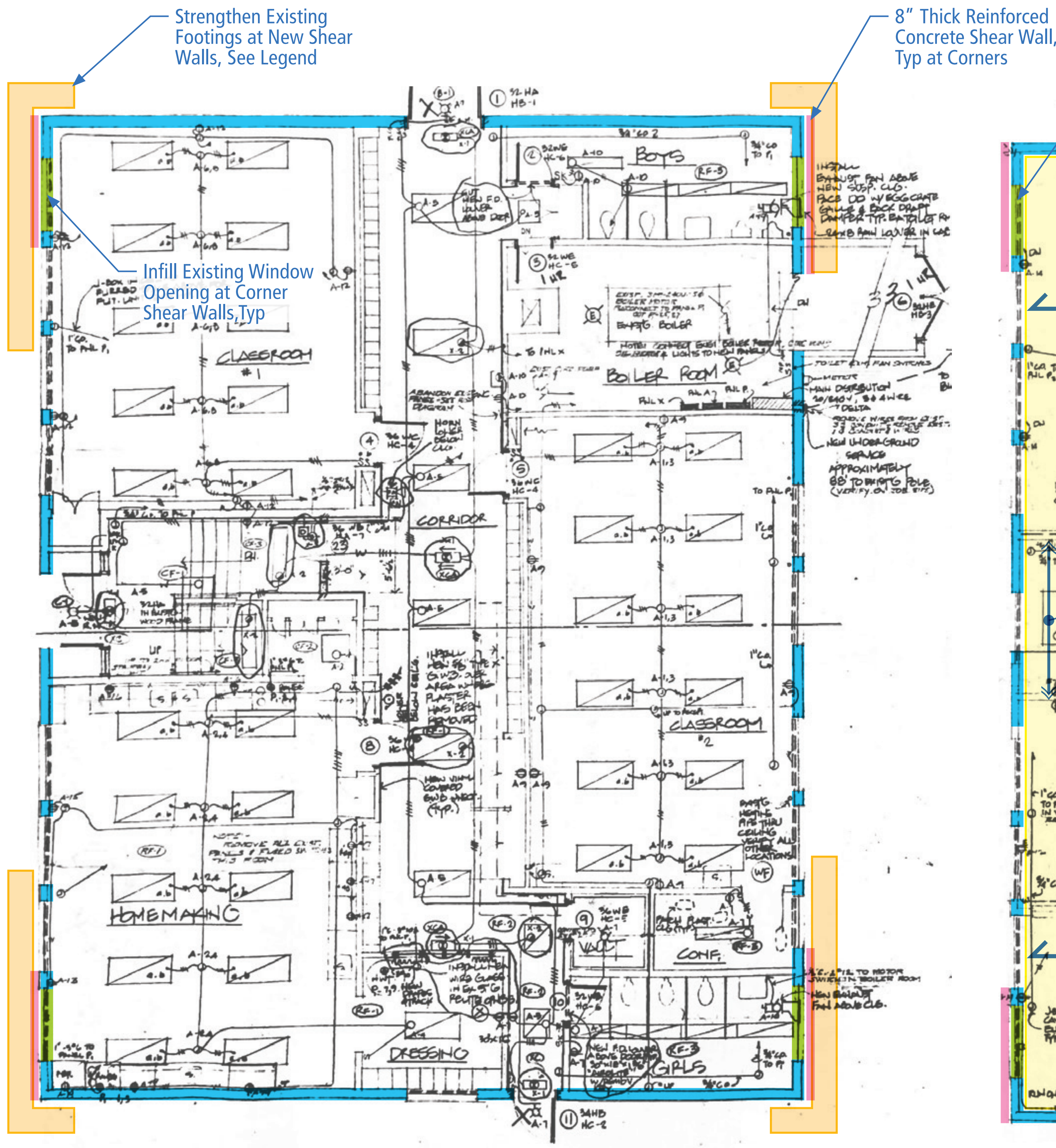
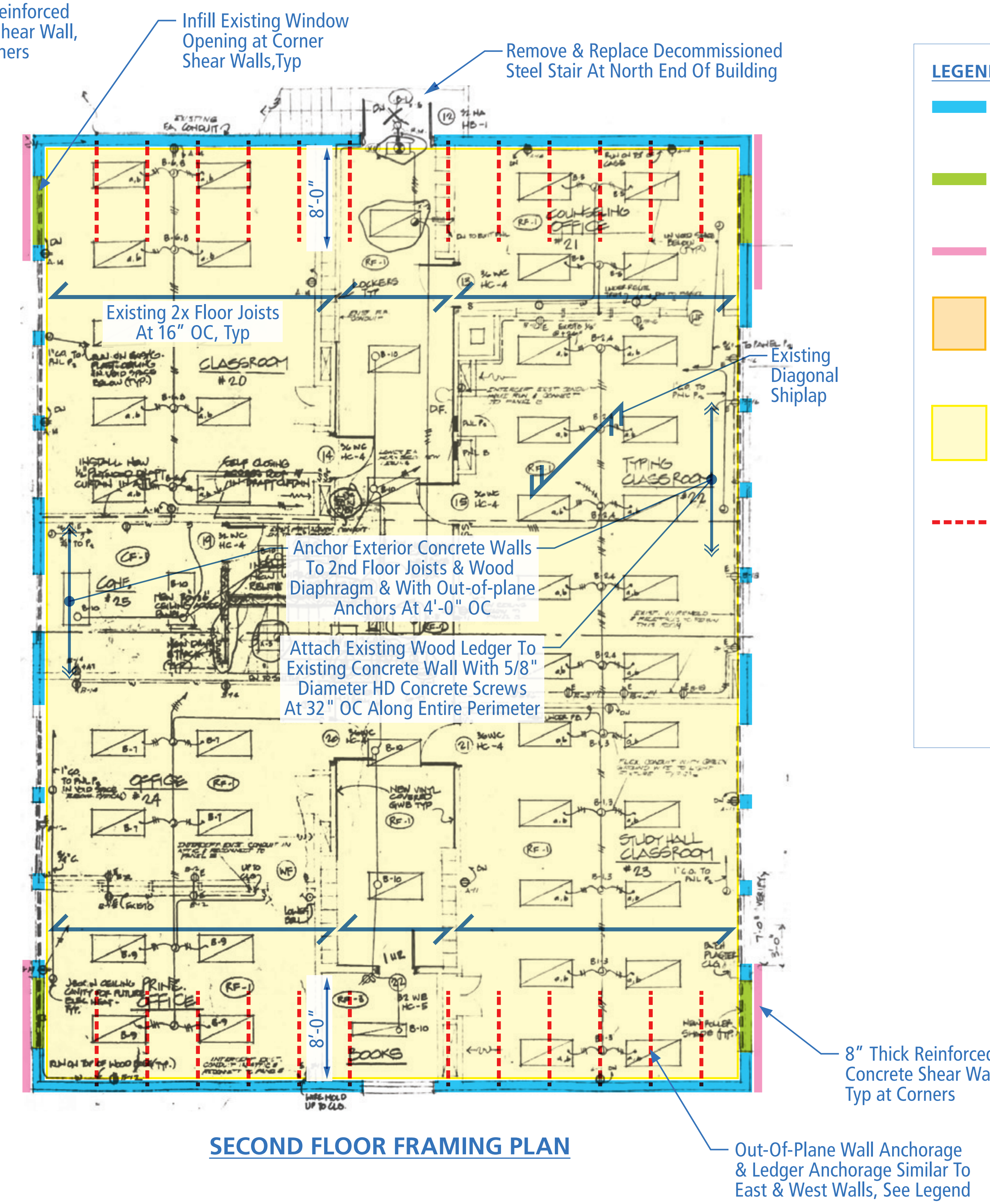
PHASE 2



FOUNDATION/FIRST FLOOR FRAMING PLAN



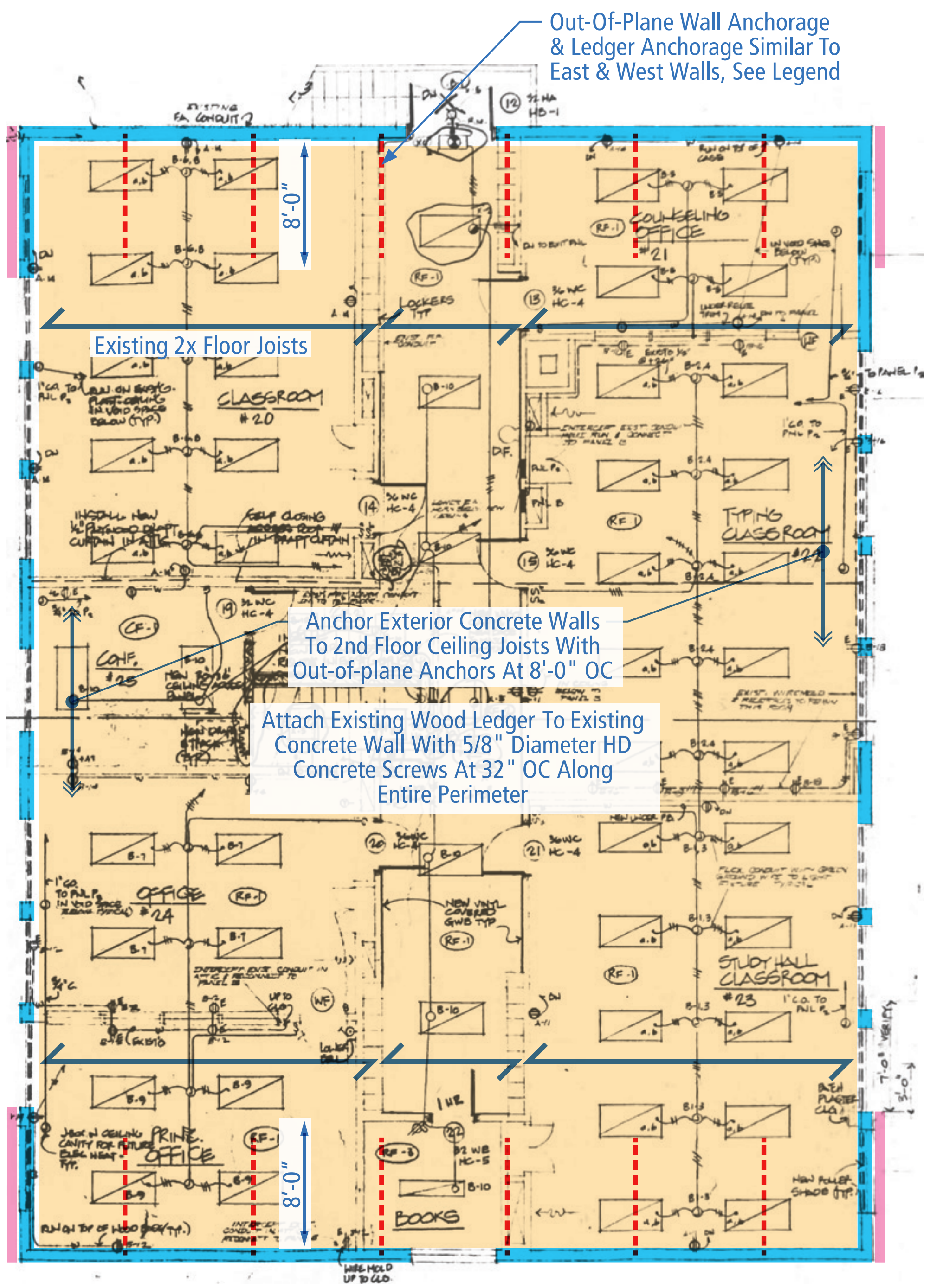
SECOND FLOOR FRAMING PLAN

LEGEND

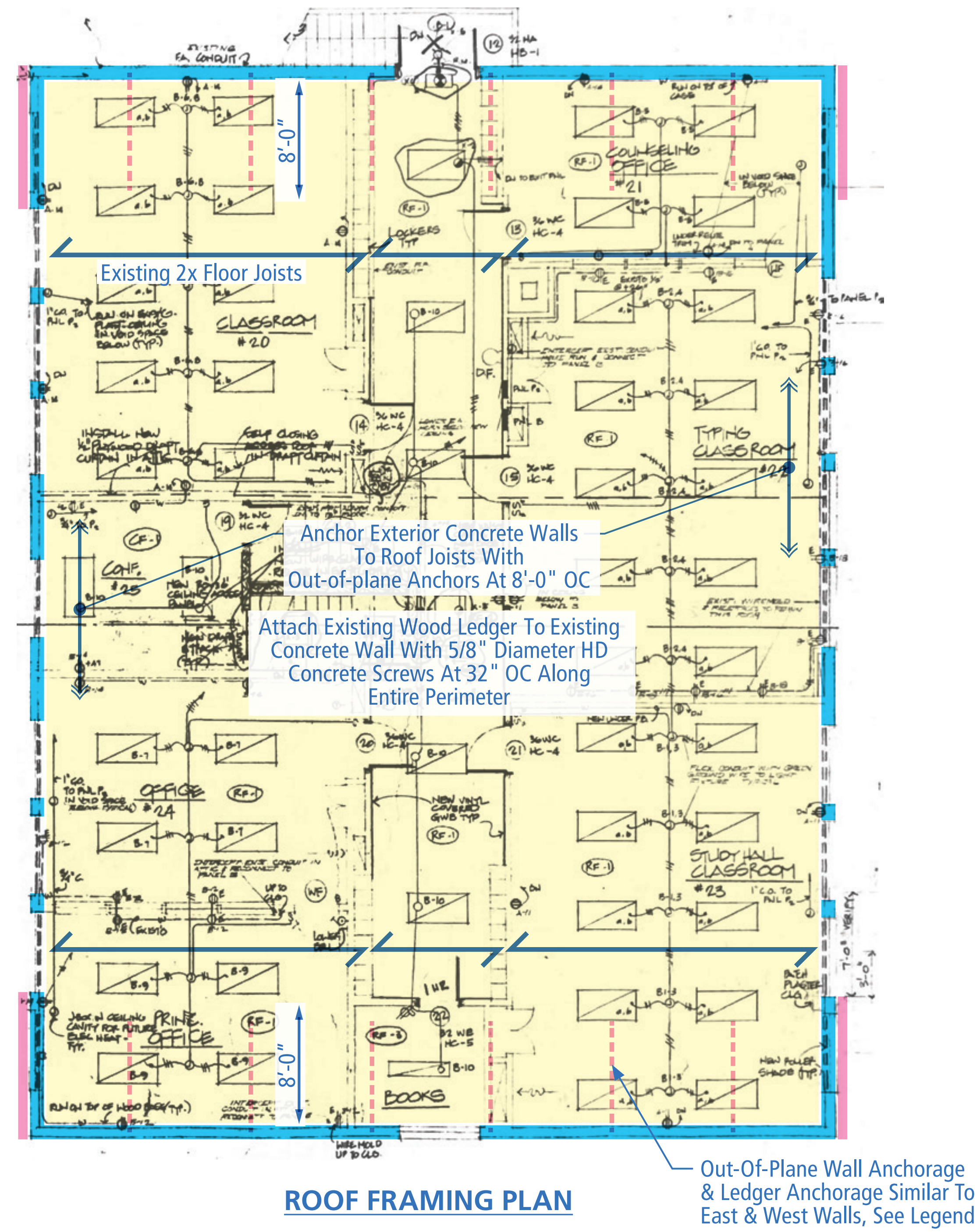
- Existing 8" Thick Concrete Wall, Typ With 12" Wide Piers Between Windows
- Infill Existing Window Opening With 8" Reinforced Concrete
- 8" Thick Reinforced Concrete Shear Wall
- Strengthen Existing Footing At Shotcrete Walls With 3' Wide X 2'-0" DP Reinforced Footing & Epoxy Doweled To Existing Footing
- Remove Existing Wood Flooring & Overlay Existing Diagonal Shiplap With 1/2" Plywood With 10D At 4" OC Panel Edge Nailing
- Anchor Exterior Concrete Walls To 2nd Floor Diaphragm & With LTT Out-Of-Plane Wall Anchors At 4'-0" OC To New 4x Blocking Between Existing Floor Joists With Metal Strapping (8'-0" Min) & Attach Existing Wood Ledger To Existing Concrete Wall With 5/8" Diameter HD Concrete Screws At 32" OC Along Entire Perimeter

N

Figure 1 – Foundation/First Floor & Second Floor Framing Plans



SECOND FLOOR CEILING FRAMING PLAN



ROOF FRAMING PLAN

LEGEND

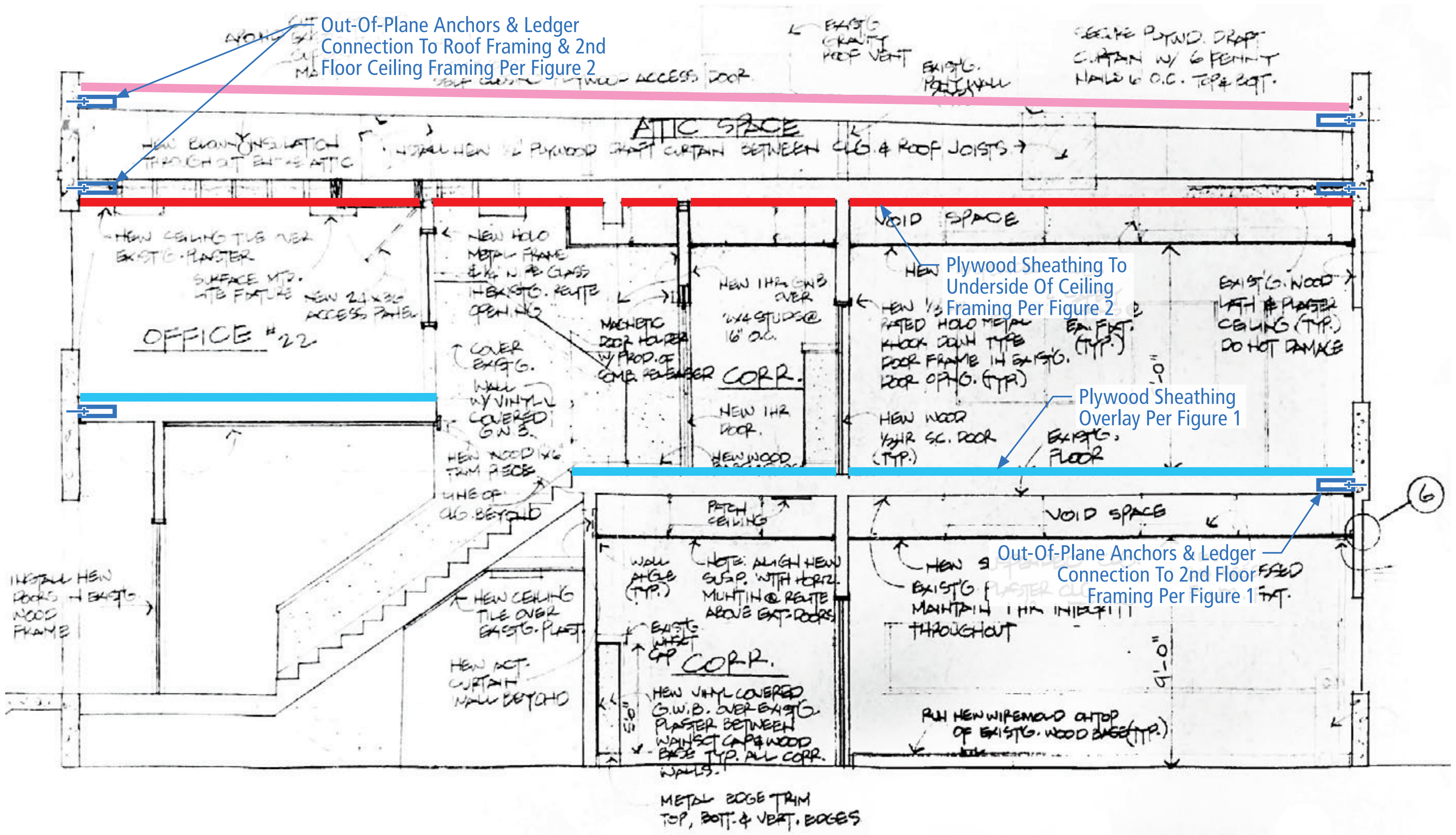
- Existing 8" Thick Concrete Wall, Typ With 12" Wide Piers Between Windows Per Level Below
- 8" Thick Reinforced Concrete Shear Wall Per Level Below
- Remove Existing Wood Lath & Plaster & Replace With 1/2" Wood Structural Panel Sheathing Nailed To Underside Of 2x Ceiling Joists
- Anchor Exterior Concrete Walls To 2nd Floor Ceiling Diaphragm With LTT Out-Of-Plane Wall Anchors At 8'-0" OC To New 4x Blocking Between Existing Floor Joists With Metal Strapping (8'-0" Min)
- Attach Existing Wood Ledger To Existing Concrete Wall With 5/8" Diameter HD Concrete Screws At 32" OC Along Entire Perimeter
- Remove Existing Roofing & Overlay Existing Diagonal Shiplap With 1/2" Plywood With 10D Nails At 4" OC
- Anchor Exterior Concrete Walls To Roof Diaphragm With LTT Out-Of-Plane Wall Anchors At 8'-0" OC To New 4x Blocking Between Existing Roof Joists With Metal Strapping (8'-0" Min)
- Attach Existing Wood Ledger To Existing Concrete Wall With 5/8" Diameter HD Concrete Screws At 32" OC Along Entire Perimeter

N

Figure 2 – Second Floor Ceiling & Roof Framing Plans

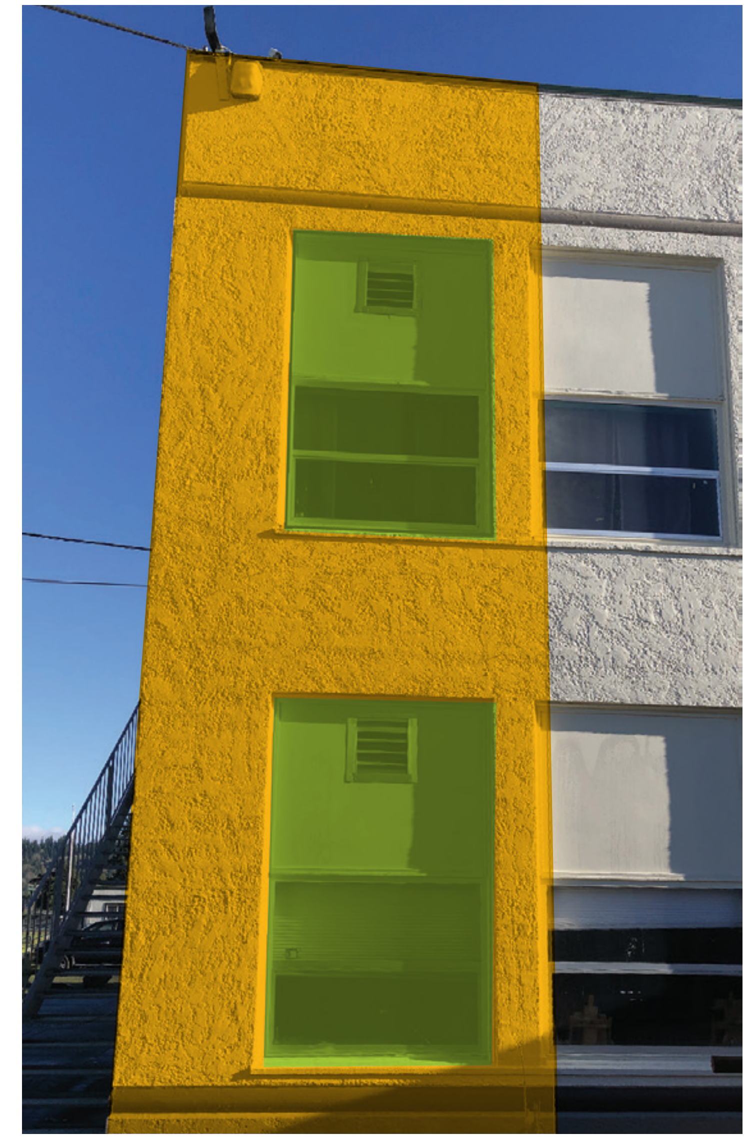
LEGEND

- Plywood Sheathing Overlay Per Figure 2
- Plywood Sheathing To Underside Of Ceiling Framing Per Figure 2
- Plywood Sheathing Overlay Per Figure 1
- Window Infill, See Figure 1
- New Concrete Shear Wall, See Figure 1



BUILDING SECTION

From 1975 Improvements Project



CONCRETE WALL ELEVATION

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Appendix C: Opinion of Probable Construction Costs

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PRODIMS
PROJECT MANAGEMENT SERVICES

520 Kirkland Way, Suite 301
Kirkland, WA 98033
tel: (425) 828-0500
fax: (425) 828-0700
www.prodims.com

Name:	**Wa State School Seismic Safety Assessment Phase 2**
Second Name:	**Quilcene High School**
Location:	**Quilcene, WA**
Design Phase:	**ROM Cost Estimates**
Date of Estimate:	**March 7, 2021**
Date of Revision:	**April 12, 2021**
Month of Cost Basis:	**1Q, 2021**

Quilcene High School

Master Estimate Summary

Project Name	Construction Cost Type	Estimated Construction Cost
Quilcene High School	Structural Costs	$695,534
Quilcene High School	Non-Structural Costs	$726,895
TOTAL ESTIMATED CONSTRUCTION COST →		**$1,422,429**

Soft Costs	Soft Costs % Construction Cost	Estimated Soft Costs
Project Soft Cost Allowance	40.0%	**$568,972**
		Sum of the Above
TOTAL ESTIMATED PROJECT COST →		**$1,991,401**

Estimate Assumptions:

The ROM Construction Cost estimates are based on the Concept Design Report for the Project.
Construction Escalation is not included. Costs are current as of the month of Cost Basis noted above right.

Estimate Qualifications:

The ROM estimates are not be relied on solely for proforma development and financial decisions.
Further design work is required to determine construction budgets.
All Buildings Estimated to the 5' foot line for Utilities, All Sitework is estimated to go with any combination of the buildings and alternatives.
The ROM estimates do not include any Hazardous Material Abatement/Disposal.
For Construction Cost Markups they are additive, not cumulative. Percentages are added to the previous subtotal rather than the direct cost subtotal.
Owner Soft Costs Allowance are: A/E design fees, QA/QC, Project Administration, Owners Project Contingency, Average Washington State Sale Tax and
Estimated labor is based on an 8 hour per day shift 5 days a week. Accelerated schedule work of overtime has not been included.
Estimated labor is based on working on unoccupied facility without phased construction.
Estimate is based on a competitive public bid with at least 3 bona fide submitted and unrescinded general contractor bids.
Estimate is based on a competitive public bid with a minimum 6 week bidding schedule and no significant addendums within 2 weeks of bid opening.
State of Washington General Contractor/ Construction Manager (GC/CM) contracts typically raises construction costs. It is Not Included in this estimate.
Estimated construction cost is for the entire project. This estimate is not intended to be used for other projects.
Please consult the cost estimator for any modifications to this estimate. Unilaterally adding and deleting markups, scope of work, schedule, specifications, plans and bid forms could incorrectly restate the project construction cost.
Construction reserve contingency for change orders is not included in the estimate.
Sole source supply of materials and/ or installers typically results in a 40% to 100% premium on costs over open specifications.

PRODIMS

520 Kirkland Way, Suite 301
Kirkland, WA 98033
Phone: 425-828-0500 Fax: 425-828-0700
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Structural Costs

Quilcene High School

Name:	Wa State School Seismic Safety Assessment Phase 2	Areas	sqft
Second Name:	Quilcene High School	1st Floor Building Area	3,930
Location:	Quilcene, WA	2nd Floor Building Area	3,930
Design Phase:	ROM Cost Estimates		
Date of Estimate:	March 7, 2021		
Date of Revision:	April 12, 2021		
Month of Cost Basis:	1Q, 2021	Total Areas	7,860

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below $ 472,537

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	$ 47,254	$ 519,790
General Conditions	10.0%	$ 47,254	$ 567,044
Home Office Overhead	5.0%	$ 23,627	$ 590,671
Profit	6.0%	$ 28,352	$ 619,023
Escalation Included to 4Q, 2022	12.4%	$ 76,511	$ 695,534
Washington State Sales Tax - Included in Soft Costs			

Total Markups Applied to the Direct Cost 47.19%
Markups are multiplied on each subtotal- They are not multiplied from the direct cost

		$/sqft
TOTAL ESTIMATED CONSTRUCTION COST--→	**$ 695,534**	**$ 88.49**
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --→	**$ 556,427**	**$ 70.79**
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --→	**$ 1,043,302**	**$ 132.74**

Please see the Master Summary for Assumptions and Qualifications for ROM Cost Estimates

Direct Cost of Construction

WBS	Description	Quantity	U of M	Labor	Labor Total	Material	Material Total	Equipment	Equipment Total	Total $/U of M	Direct Cost
1 - Seismic Retrofit											
Foundations											
	Spread Footings System- Excavation, Backfill, Formwork, Concrete, Reinforcing and Detailing	22.2	cuyd	$ 716.25	$ 15,916.67	$ 238.75	$ 5,305.56	$ 57.30	$ 1,273.33	$ 1,012.30	$ 22,495.56
Substructure											
	Demo/Reinstall Exterior Paving System for New Footings Installation.	520	sqft	$ 9.90	$ 5,148.00	$ 8.10	$ 4,212.00	$ 1.08	$ 561.60	$ 19.08	$ 9,921.60
Superstructure											
Upper Floor Systems											
	Shotcrete 8" Thick Shear Wall with Rebar Including Drill and Epoxy in Rebar	36.1	cuyd	$ 543.75	$ 19,618.90	$ 181.25	$ 6,539.63	$ 43.50	$ 1,569.51	$ 768.50	$ 27,728.05
	Add 1/2" Plywood Sheathing to Strengthen Floor Diaphragm at First Floor	3,930	sqft	$ 0.96	$ 3,756.29	$ 0.81	$ 3,199.81	$ 0.11	$ 417.37	$ 1.88	$ 7,373.47
	Wall to Joist Anchorage - Allow a LTT with Nails to Joist with 5/8" Dia Epoxy Anchor Bolt with Nut and Washer	70	each	$ 210.80	$ 14,756.00	$ 99.20	$ 6,944.00	$ 18.60	$ 1,302.00	$ 328.60	$ 23,002.00
	Wall to Joist Anchorage - Allow a LTT with Nails to 4X Blocking and CM Strapping with Nails with 5/8" Dia Epoxy Anchor Bolt with Nut and Washer	30	each	$ 285.60	$ 8,568.00	$ 134.40	$ 4,032.00	$ 25.20	$ 756.00	$ 445.20	$ 13,356.00
	Install New 1/2" Plywood Directly to Bottom of Second Floor Joists	3,930	sqft	$ 1.74	$ 6,822.48	$ 1.06	$ 4,181.52	$ 0.17	$ 660.24	$ 2.97	$ 11,664.24
	Add 5/8" Dia "Titen" Type Screws through Existing Ledger into Existing Concrete Wall at 32" o.c.	101	each	$ 21.56	$ 2,177.56	$ 6.44	$ 650.44	$ 1.68	$ 169.68	$ 29.68	$ 2,997.68
Roof Systems											
	Add 5/8" Dia "Titen" Type Screws through Existing Ledger into Existing Concrete Wall at 32" o.c.	101	each	$ 21.56	$ 2,177.56	$ 6.44	$ 650.44	$ 1.68	$ 169.68	$ 29.68	$ 2,997.68
	Add 1/2" Plywood Sheathing at Existing Roof	3,930	sqft	$ 0.94	$ 3,704.03	$ 0.51	$ 1,994.48	$ 0.09	$ 341.91	$ 1.54	$ 6,040.41
	Wall to Joist Anchorage - Allow a LTT with Nails to Joist with 5/8" Dia Epoxy Anchor Bolt with Nut and Washer	30	each	$ 210.80	$ 6,324.00	$ 99.20	$ 2,976.00	$ 18.60	$ 558.00	$ 328.60	$ 9,858.00

WBS	Description	Quantity	U of M	Labor	Labor Total	Material	Material Total	Equipment	Equipment Total	Total $/U of M	Direct Cost
	Wall to Joist Anchorage - Allow a LTT with Nails to 4X Blocking and CM Strapping with Nails with 5/8" Dia Epoxy Anchor Bolt with Nut and Washer	6	each	$ 285.60	$ 1,713.60	$ 134.40	$ 806.40	$ 25.20	$ 151.20	$ 445.20	$ 2,671.20
Roofing System											
	Remove Roofing System Down to Plywood Deck	7,860	sqft	$ 4.04	$ 31,734.75	$ 0.21	$ 1,670.25	$ 0.26	$ 2,004.30	$ 4.51	$ 35,409.30
	New Membrane Roofing System with R-38 Rigid Insulation, Flashing and Trim and Downspout Roof Drainage System	7,860	sqft	$ 8.78	$ 68,971.50	$ 10.73	$ 84,298.50	$ 1.17	$ 9,196.20	$ 20.67	$ 162,466.20
Interior Wall/Door/Casework/Specialties Systems											
	Remove and Reinstall Floor Finish Systems-Allow 100% of the Floor Area	7,860	sqft	$ 3.01	$ 23,635.02	$ 1.84	$ 14,485.98	$ 0.29	$ 2,287.26	$ 5.14	$ 40,408.26
	Remove and Reinstall Wall Finish Systems-Allow 100% of the Floor Area	7,860	sqft	$ 2.79	$ 21,929.40	$ 1.71	$ 13,440.60	$ 0.27	$ 2,122.20	$ 4.77	$ 37,492.20
	Remove Ceiling and Reinstall New ACT Ceiling Systems-Allow 100% of the Floor Area	7,860	sqft	$ 4.22	$ 33,137.76	$ 2.58	$ 20,310.24	$ 0.41	$ 3,206.88	$ 7.21	$ 56,654.88
Subtotal of the Direct Cost of Construction				**Quilcene High School**							**$ 472,537**

520 Kirkland Way, Suite 301
Kirkland, WA 98033
Phone: 425-828-0500 Fax: 425-828-0700
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Non-Structural Costs

Name:	Wa State School Seismic Safety Assessment Phase 2	Areas	sqft
Second Name:	Quilcene High School	1st Floor Building Area	3,930
Location:	Quilcene, WA	2nd Floor Building Area	3,930
Design Phase:	ROM Cost Estimates		
Date of Estimate:	March 7, 2021		
Date of Revision:	April 12, 2021		
Month of Cost Basis:	1Q, 2021	Total Areas	7,860

Quilcene High School

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below $ 493,843

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	$ 49,384	$ 543,227
General Conditions	10.0%	$ 49,384	$ 592,611
Home Office Overhead	5.0%	$ 24,692	$ 617,303
Profit	6.0%	$ 29,631	$ 646,934
Escalation Included to 4Q, 2022	12.4%	$ 79,961	$ 726,895
Washington State Sales Tax - Included in Soft Costs			

Total Markups Applied to the Direct Cost 47.19%
Markups are multiplied on each subtotal- They are not multiplied from the direct cost

		$/sqft
TOTAL ESTIMATED CONSTRUCTION COST--→	**$ 726,895**	**$ 92.48**
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --→	**$ 581,516**	**$ 73.98**
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --→	**$ 1,090,343**	**$ 138.72**

Please see the Master Summary for Assumptions and Qualifications for ROM Cost Estimates

Direct Cost of Construction

WBS	Description	Quantity	U of M	Labor	Labor Total	Material	Material Total	Equipment	Equipment Total	Total $/U of M	Direct Cost
	2- Non- Structural Demo/Restoration*										
	Superstructure										
	Stair Systems										
	Remove and Replace Exterior Steel Stair	1	flgt	$ 9,246.00	$ 9,246.00	$ 10,854.00	$ 10,854.00	$ 1,206.00	$ 1,206.00	$ 21,306.00	$ 21,306.00
	Exteriors, Interiors and M/E/P/FP systems										
	Interior Wall/Door/Casework/Specialties Systems										
	Mechanical/Electrical/Fire Protection Systems *	7,860	sqft	$ 31.19	$ 245,184.15	$ 25.52	$ 200,605.21	$ 3.40	$ 26,747.36	$ 60.12	$ 472,536.72

*Allows 100 percent of existing nonstructural systems M/E/P/FP require upgrades/replacement.

Subtotal of the Direct Cost of Construction	**Quilcene High School**	**$ 493,843**

Appendix D: Earthquake Performance Assessment Tool (EPAT) Worksheet

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Washington Schools Earthquake Performance Assessment Tool (EPAT)
RESULTS SUMMARY

District Name	Quilcene	**Existing Building Life Safety Risk & Priority for Retrofit or Replacement**
School Name	Quilcene High And Elementary School	
Building Name	High School	Very High

Building Data

HAZUS Building Type	C2	Concrete Shear Walls
Year Built	1935	These parameters determine the capacity of the existing building to withstand earthquake forces.
Building Design Code	<1973 UBC	
Existing Building Code Level	Pre	
Geographic Area	Puget Sound	
Severe Vertical Irregularity	No	Buildings with irregularities have greater earthquake damage than otherwise similar buildings that are regular.
Moderate Vertical Irregularity	No	
Plan Irregularity	No	

Seismic Data

Earthquake Ground Shaking Hazard Level	Very High	Frequency and severity of earthquakes at this site
Percentile S_s Among WA K-12 Campuses	77%	Earthquake ground shaking hazard is higher than 77% of WA campuses.
Site Class (Soil or Rock Type)	C	Very Dense Soil and Soft Rock
Liquefaction Potential	Low	Liquefaction increases the risk of major damage to a building
Combined Earthquake Hazard Level	Very High	Earthquake ground shaking and liquefaction potential

Severe Earthquake Event (Design Basis Earthquake Ground Motion)[1]

Building State	**Building Damage Estimate**[2]	**Probability Building is not Repairable**[3]	**Life Safety**[4] **Risk Level**	**Most Likely Post-Earthquake Tagging**[5]
Existing Building	78%	78%	Very High	Red
Life Safety Retrofit Building	21%	13%	Low	Green/Yellow
Current Code Building	17%	8.8%	Very Low	Green/Yellow

1. 2/3rds of the 2% in 50 year ground motion
2. Percentage of building replacement value.
3. Probability building is in the Extensive or Complete damage states. For existing buildings, the probability that the building is not economically repairable may be higher: some buildings in the Moderate Damage state are also likely to be demolished.
4. Based on probability of Complete Damage State.
5. Most likely post-earthquake damage state per ATC-20.

Source for the Data Entered into the Tool

Building Evaluated By:	DNR, Reid Middleton
Person(s) Who Entered Data in EPAT:	Brian Matsumoto, Reid Middleton
User Overrides of Default Parameters:	Building Design Code Year, Latitude, Longitude, Site Class, Liquefaction, Geographic Region

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Appendix E: Existing Drawings

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BUILDING CONDITION SUMMARY REPORT February 2006

School: Quilcene High School (Building E)
Address: 294715 HWY 101
City: Quilcene
County: Jefferson

Approximate Acreage: 10 (whole campus)
Building Size: 7,846 sq. ft. (per OSPI)

CONSTRUCTION HISTORY:

Original building constructed in 1935
Upgrade of Mechanical and Electrical Systems in 1975

SURROUNDING SITE DESCRIPTION AND UTILIZATION:

Building is at the rear of the school campus. Although not a completely accessible building, the High School has a centralized campus location with good access to other buildings and the site.

BUILDING UTILIZATION:

Building has 6 classrooms for High School grades. Other spaces are used as offices.

GENERAL BUILDING SYSTEM DESCRIPTION AND CONDITION:

Foundation: Concrete.

Floor: 1st floor – Wood planks on sleepers over concrete slab on grade.
2nd floor – 2 x 14 wood joists at 16" o.c. with two layers of wood planks

Interior Walls: Wood studs

Exterior Walls: 8" thick concrete with 2" wood furring on interior face.

Windows: Aluminum hopper sash with insulated panels above. Single glazing.

Roof: 2 x 12 wood joists at 16" o.c. with 1x wood planking. 2nd floor ceiling is structural, as it supports sloped roof. Torch Down roof added in 1996

STRUCTURAL ANALYSIS:

The building does not appear to have any structural problems at this time. However it does not meet current seismic resistant codes.

MECHANICAL /ELECTRICAL SYSTEMS:

Plumbing Some pipes are exposed
Toilets are floor mounted type and very old
Restrooms on 1st floor only

HVAC Steam Radiators on 1st floor.
Pipes are not insulated and run through the attic
Central oil fired boiler at 1st floor boiler room
System controlled by thermostat to Johnson Controls

Electrical Systems Power Distribution: New service and panel added in 1975
Main distribution 800A
Panels are circuit breaker type
Some original wiring remains

Lighting: Fluorescent

Fire alarm: One fire alarm horn provided at each level.

Smoke Detector provided at stair doors.

Pull stations not at each exit.

Exit Lights: Provided with directional arrows.

Emergency Power: Not provided at this time

Intercom: None

Clocks: None

FACILITY DEFICIENCIES:

1. This 2-story school should be of fire rated construction or have a proper fire sprinkler system.
2. Building exiting at 2nd floor is not per code requirements. A second exit stair should be added.
3. Building is not Accessible per code. There is no elevator to second floor.
4. Building insulation is not adequate.
5. Seismic resistance not up to current codes.
6. Fire Alarm should be upgraded.
7. Building emergency power and lighting should be upgraded.
8. Roof should be replaced.
9. Corridor carpeting should be replaced.
10. Plumbing is corroded and should be replaced.
11. General electrical service and distribution should be upgraded.

PROGRAM/SPACE DEFICIENCIES:

1. Building condition layout and deficiencies precludes efficient and proper use.

BUIL_ .NG CONDITION EVALUATION FORM

JEFFERSON / QUILCENE #4 — County/School District
QUILCENE HIGH SCHOOL — School Name
BUILDING (E) — Building Name/#

COMPONENTS	SYSTEMS	RATINGS GOOD (1)	FAIR (2)	POOR (3)	UNSAT. (4)	COMBINED	COMMENTS
1.0 Exterior Building Condition	1.1 Foundation/Structure	**+12**	+8	+6	+4		
	1.2 Walls	**+8**	+5	+3	+1		
24 Component Score	1.3 Roof	+7	+5	**+2**	0		
	1.4 Windows/Doors	+2	+1	**0**	0		
	1.5 Trim	**+2**	+1	0	0		
2.0 Interior Building Condition	2.1 Floors	+8	+5	**+2**	0		
2 Component Score	2.2 Walls	+8	+5	+1	**0**		
	2.3 Ceilings	+5	+3	+1	**0**		
	2.4 Fixed Equipment	+2	+1	0	0		NONE < 2
3.0 Mechanical Systems Condition	3.1 Electrical	**+6**	+4	+2	0		
	3.2 Plumbing	+4	+2	+1	**0**		
10 Component Score	3.3 Heating	+6	+4	**+2**	+1		
	3.4 Cooling	+6	+4	+2	+1		NONE < 6
	3.5 Lighting	+4	+3	**+2**	0		
4.0 Safety/Building Code	4.1 Means of Exit	+6	+4	+2	**0**		
	4.2 Fire Control Capability	+4	+3	+2	**+1**		
3 Component Score	4.3 Fire Alarm System	+4	+3	+2	**+1**		
	4.4 Emergency Lighting	+2	+1	0	**0**		
	4.5 Fire Resistance	+4	+3	+2	**+1**		
	TOTALS	28	Ø	8	3		
5.0 Provisions for Handicapped		X	X	**X**	X		

Suitability Code and Definition (Circle Appropriate Code)

- 4 Building makes positive contribution to educational environment
- 3 Building suitable
- 2 Current use of space is compatible with intended use but needs remodeling
- **1** Current use of space is not compatible with intended use or design

Significant Location Factors / Overall Conclusions

Evaluator Signature [signature]

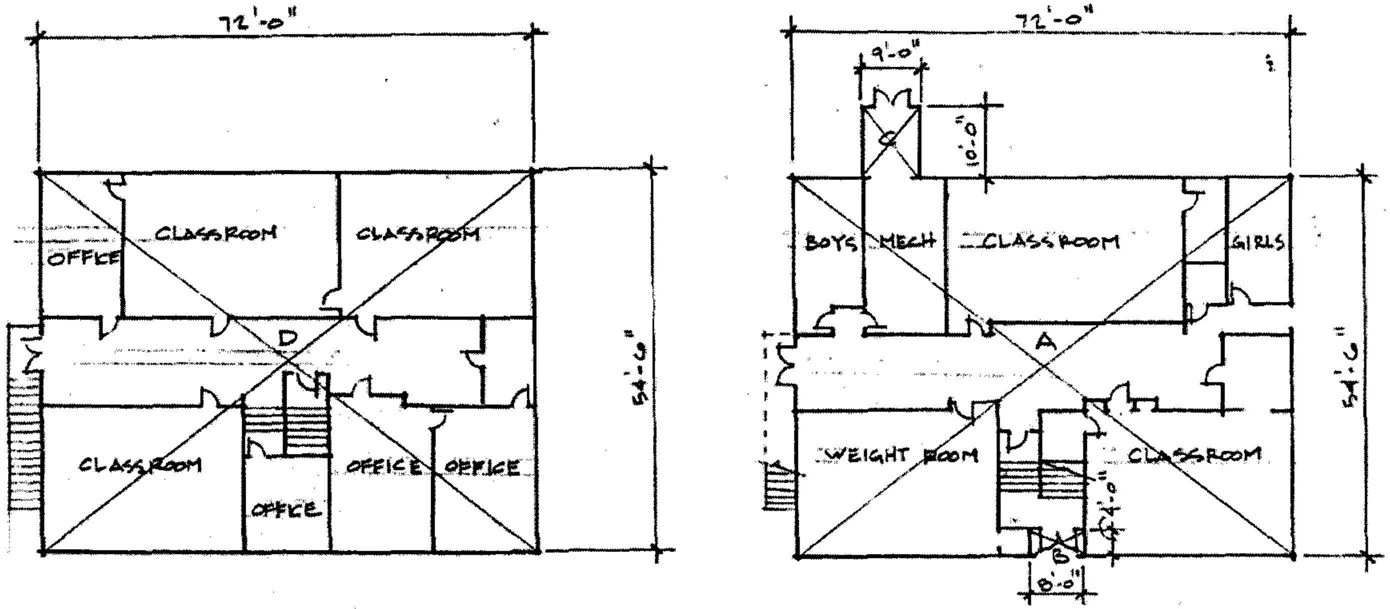
School Official Signature [signature]

TOTAL POSSIBLE 92

Date	Unadjusted Score	Adjusted Score
	39	42

(BCEF.WK1 2/15/92) ** Record Information on Building System Data Elements on Reverse Side. **

39 ÷ 92 = .423



SECOND FLOOR

FIRST FLOOR

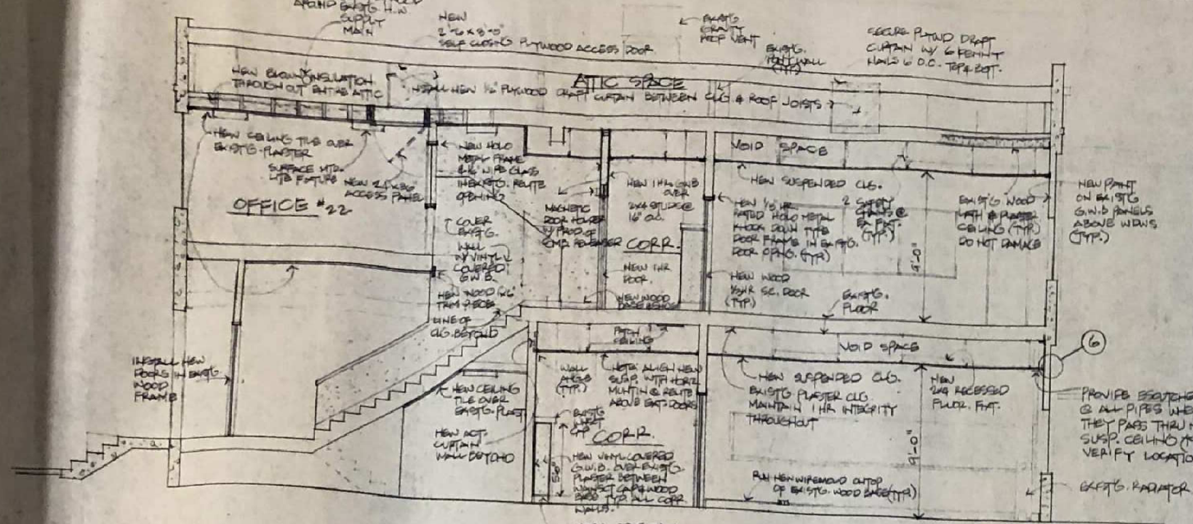
AREA SUMMARY

AREA	NAME	SQ.FT. SUBTOTAL	YEAR
A	1ST FL	3899	1935
B	ENTRY	<32>	1935
C	MECHANICAL	90	1935
D	2ND FL.	3,899	1935
	TOTAL	7,846 S.F.	

HIGH SCHOOL BUILDING

COFFMAN ENGINEERS

2005 STUDY & SURVEY — SLS
QUILCENE WA.
QUILCENE S.D. #48



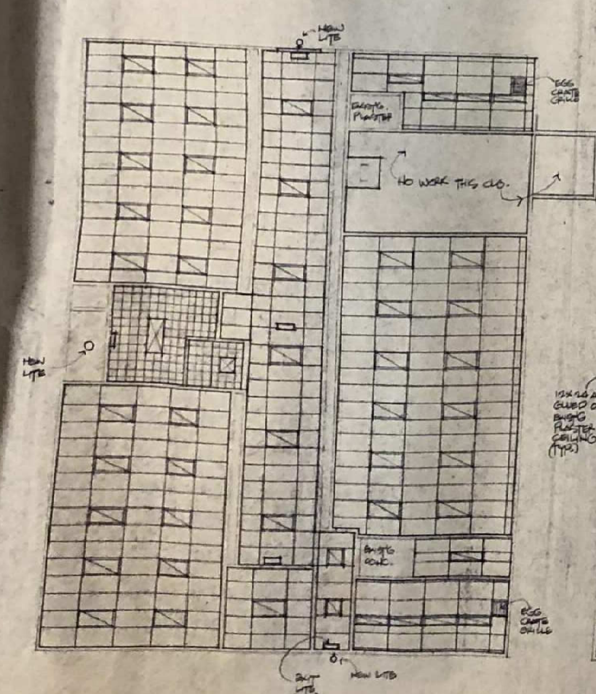
SECTION A-A
1/4"=1'-0"

GENERAL NOTES

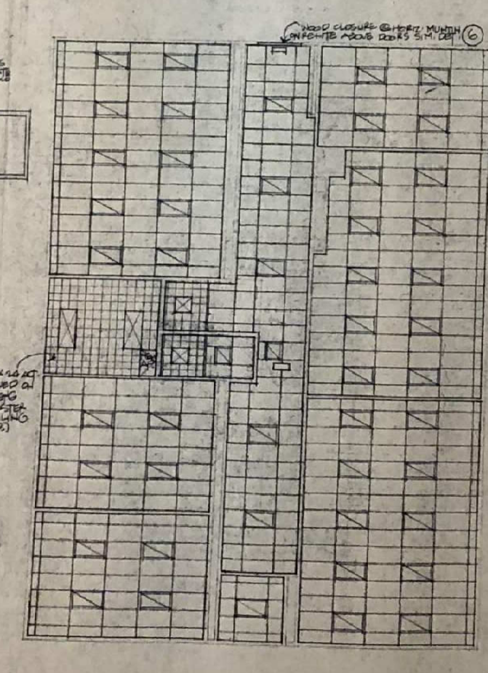
1. VERIFY ALL CONDITIONS & DIMENSIONS RESPECTING THE WORK
2. ALL EXISTING DOORS, FRAMES, RELIGHTS, LIGHT FIXTURES, BULBS, ETC. TO BE SALVAGED INTACT TO THE OWNER
3. CUT NEW OPENINGS IN EXISTING PLASTER WALLS CAREFULLY WITH A MASONRY TYPE POWER SAW SO AS NOT TO DAMAGE REMAINING ADJACENT PLASTER SURFACES.
4. DO NOT DRIVE NAILS OR SCREWS INTO EXISTING PLASTER. WHERE MECH. FASTENINGS MUST PASS THRU PLASTER THE PLASTER IS TO BE PRE-DRILLED WITH MASONRY TYPE BIT
5. IN THE EVENT EXPOSED EXISTING PLASTER SURFACES ARE DAMAGED DURING THE WORK, IT WILL BE THE RESPONSIBLE TRADES DUTY TO REPAIR & PAINT THE ENTIRE SURFACE. THE EXISTING ONE HOUR INTEGRITY IS TO BE MAINTAINED ON ALL PLASTER SURFACES
6. WHERE NEW VERTICAL SURFACE MOUNTED RACEWAY PASSES THRU EXIST'G BASE BOARDS, SHOES, OR OTHER HORIZONTAL WOOD TRIM THE WOOD IS TO BE CUT NEATLY, THE EDGES EASED & THE RAW EDGES PAINTED TO MATCH
7. CAULK ALL AROUND NEW HOLLOMETAL DOOR FRAMES.
8. REINSTALL EXISTING WOOD BASE & SHOE @ ALL NEW HOLLOMETAL DOOR FRAMES
9. PATCH ALL OPENINGS IN EXIST'G PLASTER CEILINGS OR WALLS WHERE NEW VINYL COVERED GWB. IS TO BE INSTALLED
10. SECURE ALL EYEBOLTS SUPPORTING SUSPENDED CEILING INTO CEILING JOISTS
11. COVER ALL BREAKS IN EXIST'G. PLASTER CEILING W/ TYPE X 5/8" G.W.B.
12. CUT NEW VINYL COVERED G.W.B INTO 5'-0" HEIGHTS FROM 10'-0" LENGTHS & INSTALL MATCHING METAL EDGE TRIM @ TOP UNDER EXIST'G. WOOD WAIST CAP & @ BOTTOM ABOVE EXIST'G. WOOD BASE & ALL EXPOSED EDGES

ELECTRICAL NOTES

1. ALL EXISTING SWITCHES, OUTLETS & LIGHT FIXTURES ARE TO BE ABANDONED EXCEPT THOSE SHOWN ON DRAWINGS. REMOVE EXISTING DEVICES & INSTALL NEW BLANK COVER PLATES ON EXISTING BOXES
2. ALL NEW CONDUIT OR SURFACE RACE WAY TO BE ATTACHED TO EXISTING PLASTER SURFACES ARE TO BE ATTACHED THRU PREDRILLED HOLES
3. ALL NEW FIXTURE CONTROL WIRING TO BE IN SURFACE MOUNTED RACEWAY & LOCATED UPON THE EXISTING SWITCH BOX WHERE POSSIBLE
4. LOWER ALL EXIST'G HORNS & BELLS SO THAT THEY WILL BE BENEATH THE NEW SUSPENDED CEILING
5. RUN ALL NEW SURFACE MOUNTED RACEWAY NORMAL TO WALLS & USE 90° TURNS ONLY. NO DIAGONAL RUNS OR SHORTCUTS PERMITTED.
6. RUN SURFACE MOUNTED RACEWAY BENEATH & ATTACHED TO CHALK BOARD OR TACKBOARD TRIM OR ON TOP OF WOOD BASEBOARD.
7. DEMOLITION OF EXISTING ITEMS ARE NOT SHOWN ON PLANS. VERIFY ON JOB SITE. REMOVE ALL WIRING THAT IS ACCESSIBLE. SALVAGE TO CONTRACTOR
8. ALL BOILER ROOM LIGHTS, MOTORS, OIL HEATER TO REMAIN IN SERVICE & ARE TO BE RE-CONNECTED TO NEW PANELS. REMOVE ABANDONED DISTRIBUTION, EXIST. SECONDARY SERVICES, BOTH 1 & 3 PHASE & ABANDONED SWITCHES. RELOCATE EXIST. BOILER ROOM SWITCHES THAT REMAIN IN SERVICE AS NECESSARY FOR NEW DISTRIBUTION & PANELS. VERIFY ALL ADVERSE CONDITIONS ON JOB SITE.
9. EXISTING FIRE ALARM SYSTEM TO BE REVISED FOR ADDED SMOKE DETECTORS & DOOR HOLDERS AS SPECIFIED. SALVAGE F.A. STATIONS TO OWNER
10. ALL LIGHT FIXTURES RECESSED IN SUSPENDED CEILING TO BE SECURED BY 2 SAFETY CHAINS

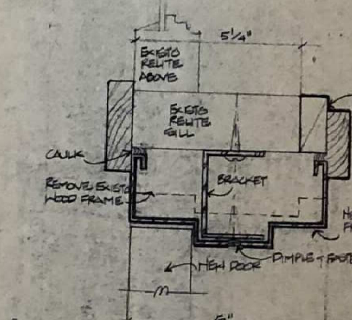


LOWER FLOOR REFLECTED CEILING PLAN
1/8"=1'-0"

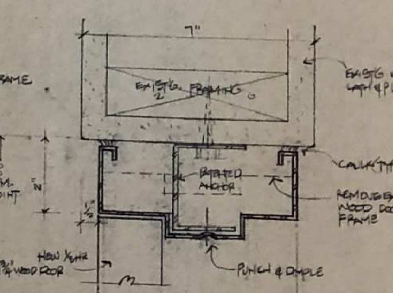


UPPER FLOOR REFLECTED CEILING PLAN
1/8"=1'-0"

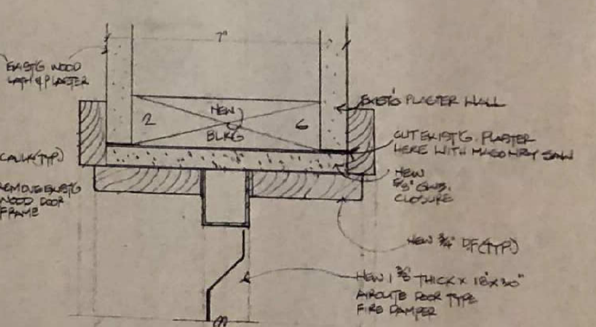
RECESSED FIXTURE
SURFACE MOUNTED FIXTURE



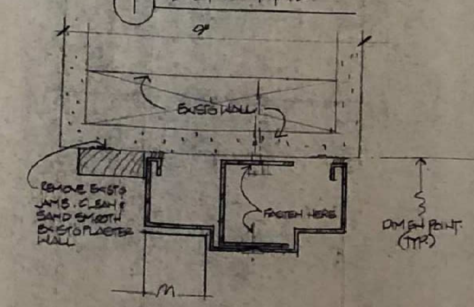
1 HEAD @ EXTERIOR DOORS 1 & 12



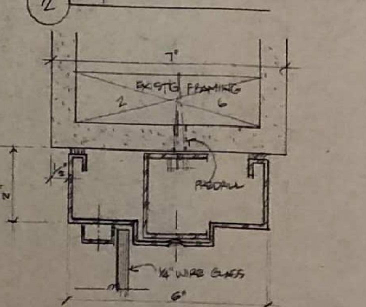
2 TYP. HEAD & JAMB @ INTERIOR



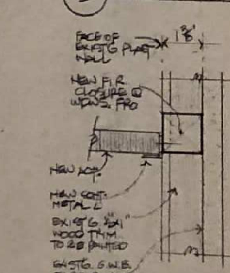
5 FIRE DAMPER @ TOILET ROOMS



3 JAMB @ EXTERIOR DOORS 1, 11, & 12
HEAD @ 12

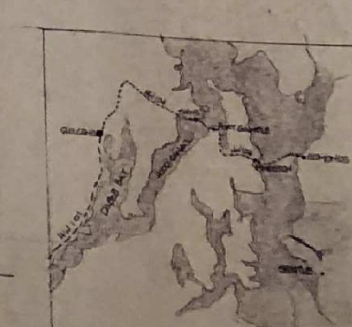


4 TYP. HEAD & JAMB INT. RELITE



6 NEW SUSP. CEIL'G. CLOSURE @ WDWS.

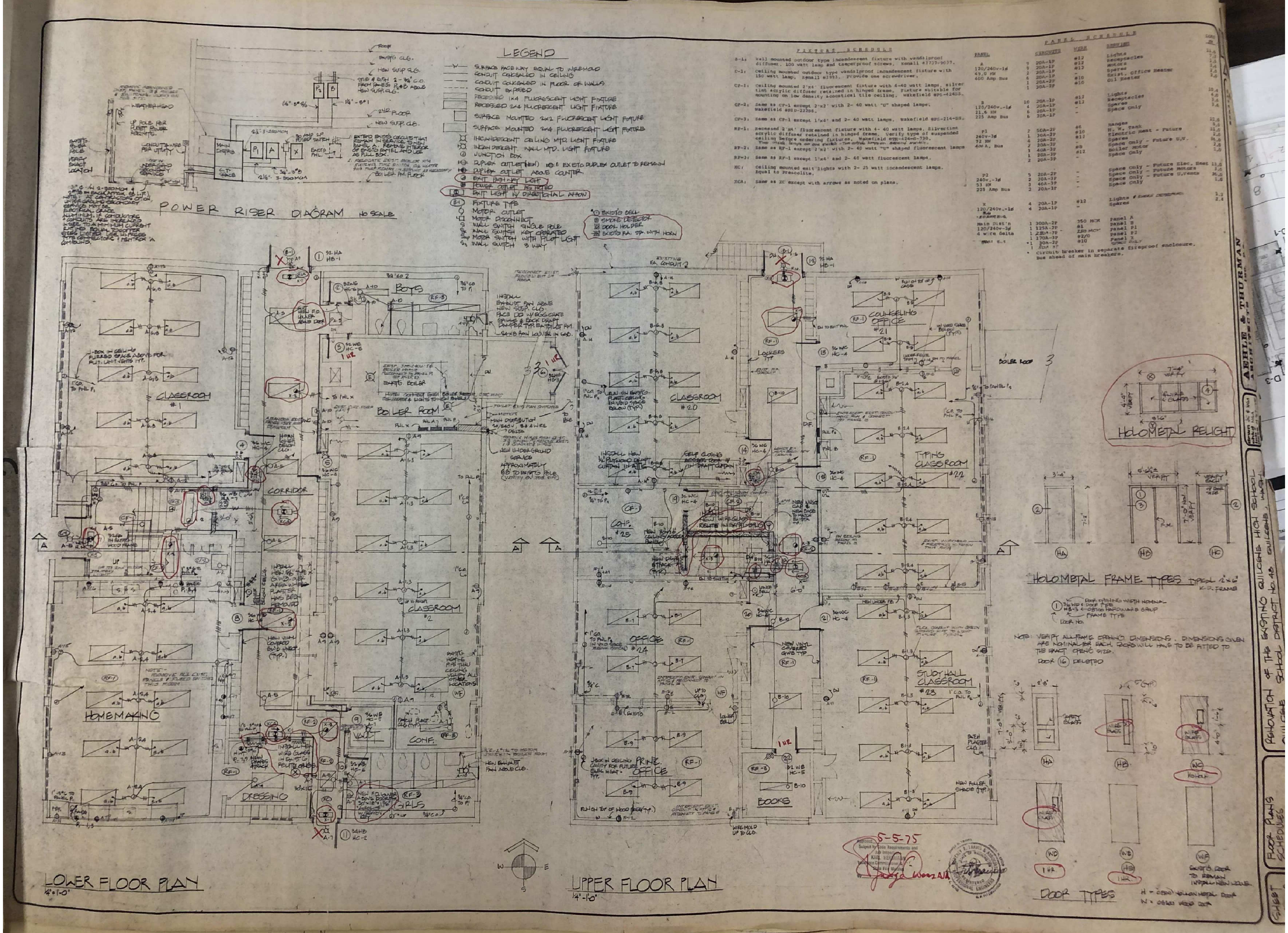
ALL DETAILS 1/2 SCALE



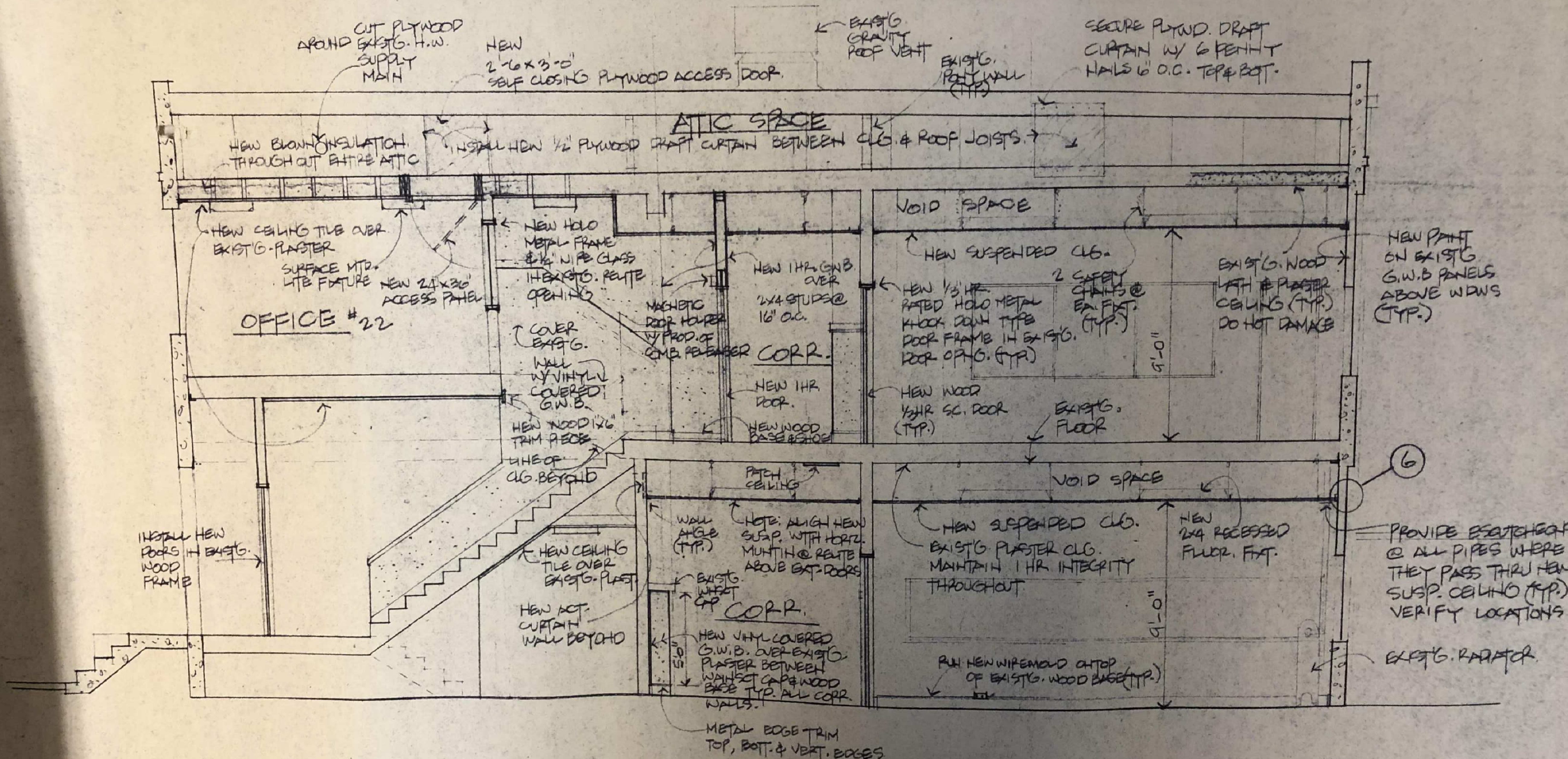
VICINITY MAP NO SCALE

AEHLE & THURMAN

PLOT PLAN



LEGEND
POWER RISER DIAGRAM NO SCALE
FIXTURE SCHEDULE
S-1: Wall mounted outdoor type incandescent fixture with vandalproof diffuser, 100 watt lamp and tamperproof screws. Kenall #3737-9037.
C-1: Ceiling mounted outdoor type vandalproof incandescent fixture with 150 watt lamp. Kenall #3993. Provide one screwdriver.
CF-1: Ceiling mounted 2'x4' fluorescent fixture with 4-40 watt lamps, silver tint acrylic diffuser retained in hinged frame. Fixture suitable for mounting on low density acoustical tile ceiling. Wakefield #PS-424SS.
CF-2: Same as CF-1 except 2'x2' with 2- 40 watt "U" shaped lamps. Wakefield #PSU-222SS.
CF-3: Same as CF-1 except 1'x4' and 2- 40 watt lamps. Wakefield #PS-214-SS.
RF-1: Recessed 2'x4' fluorescent fixture with 4- 40 watt lamps. Silvertint acrylic diffuser retained in hinged frame. Verify type of suspended ceiling before ordering fixtures. Wakefield #TH-424-G-730.
RF-2: Same as RF-1 except 2'x2' with 2- 40 watt "U" shaped fluorescent lamps
RF-3: Same as RF-1 except 1'x4' and 2- 40 watt fluorescent lamps.
XC: Ceiling mounted exit lights with 2- 25 watt incandescent lamps. Equal to Prescolite.
XCA: Same as XC except with arrows as noted on plans.
PANEL SCHEDULE
CLASSROOM #1
BOILER ROOM
CORRIDOR
BOYS
CLASSROOM #2
HOMEMAKING
DRESSING
GIRLS
VAULT
CONF.
CLASSROOM #20
COMP. #25
OFFICE #24
PRINC. OFFICE
BOOKS
COUNSELING OFFICE #21
TYPING CLASSROOM #22
STUDY HALL CLASSROOM #23
HOLOMETAL RELIGHT
HOLOMETAL FRAME TYPES
DOOR TYPES
LOWER FLOOR PLAN
UPPER FLOOR PLAN
5-5-75
AEHLE & THURMAN ARCHITECTS
RENOVATION OF THE EXISTING QUILCENE HIGH SCHOOL
QUILCENE SCHOOL DISTRICT No. 48 QUILCENE, WASH.
FLOOR PLANS SCHEDULES
SHEET



SECTION A-A
¼"=1'-0"

GENERAL NOTES.

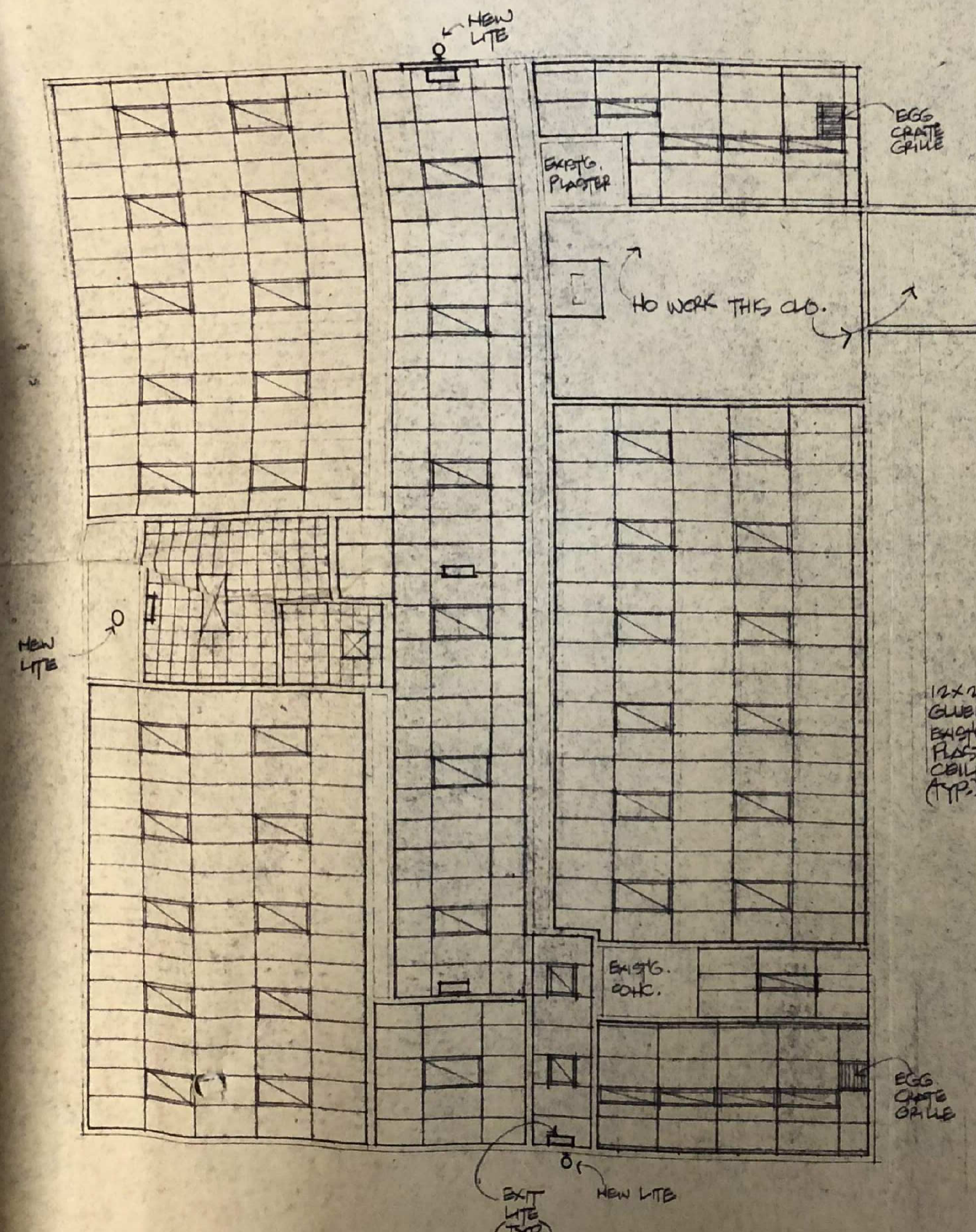
1. VERIFY ALL CONDITIONS & DIMENSIONS RESPECTING THE WORK.
2. ALL EXISTING DOORS, FRAMES, RELIGHTS, LIGHT FIXTURES, BULBS, ETC. TO BE SALVAGED INTACT TO THE OWNER.
3. CUT NEW OPENINGS IN EXISTING PLASTER WALLS CAREFULLY WITH A MASONRY TYPE POWER SAW SO AS NOT TO DAMAGE REMAINING ADJACENT PLASTER SURFACES.
4. DO NOT DRIVE NAILS OR SCREWS INTO EXISTING PLASTER, WHERE MECH. FASTENINGS MUST PASS THRU PLASTER. THE PLASTER IS TO BE PRE-DRILLED WITH MASONRY TYPE BIT.
5. IN THE EVENT EXPOSED EXISTING PLASTER SURFACES ARE DAMAGED DURING THE WORK, IT WILL BE THE RESPONSIBLE TRADES DUTY TO REPAIR & PAINT THE ENTIRE SURFACE. THE EXISTING ONE HOUR INTEGRITY IS TO BE MAINTAINED ON ALL PLASTER SURFACES.
6. WHERE NEW VERTICAL SURFACE MOUNTED RACEWAY PASSES THRU EXIST'G. BASE BOARDS, SHOES, OR OTHER HORIZONTAL WOOD TRIM. THE WOOD IS TO BE CUT NEATLY, THE EDGES EASED & THE RAW EDGES PAINTED TO MATCH
7. CAULK ALL AROUND NEW HOLOMETAL DOOR FRAMES.
7. CAULK ALL AROUND NEW HOLOMETAL DOOR FRAMES.
8. REINSTALL EXISTING WOOD BASE & SHOE @ ALL NEW HOLOMETAL DOOR FRAMES.
9. PATCH ALL OPENINGS IN EXIST'G. PLASTER CEILINGS OR WALLS WHERE NEW VINYL COVERED GWB. IS TO BE INSTALLED
10. SECURE ALL EYE BOLTS SUPPORTING SUSPENDED CEILING INTO CEILING JOISTS
11. COVER ALL BREAKS IN EXIST'G. PLASTER CEILING W/ TYPE X 5/8" G.W.B.
12. CUT NEW VINYL COVERED G.W.B INTO 5'-0" HEIGHTS FROM 10'-0" LENGTHS & INSTALL MATCHING METAL EDGE TRIM @ TOP UNDER EXIST'G. WOOD WNSCT CAP & @ BOTTOM ABOVE EXIST'G. WOOD BASE & ALL EXPOSED EDGES

ELECTRICAL NOTES

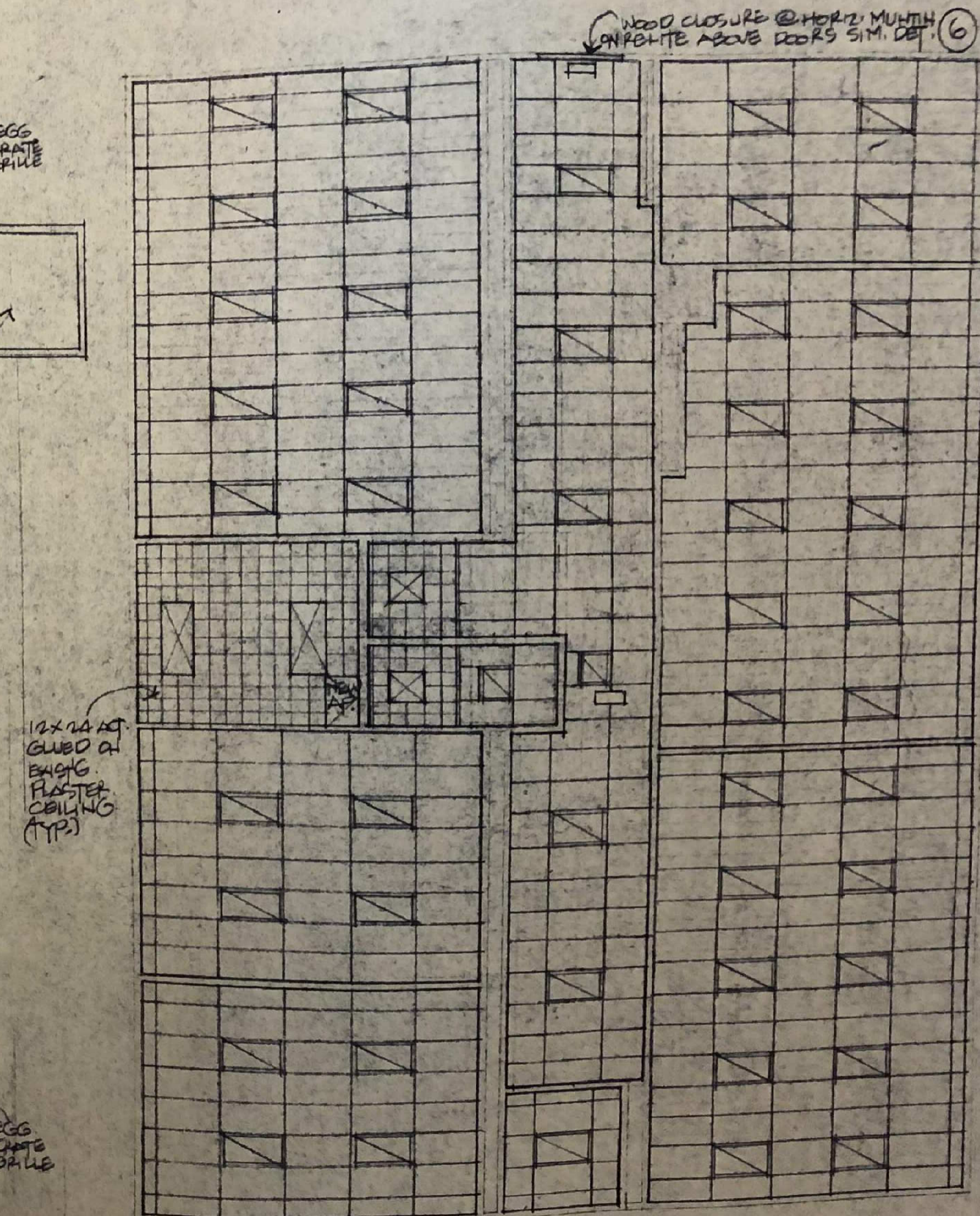
1. ALL EXISTING SWITCHES, OUTLETS & LIGHT FIXTURES ARE TO BE ABANDONED EXCEPT THOSE SHOWN ON DRAWINGS. REMOVE EXISTING DEVISES & INSTALL NEW BLANK COVER PLATES ON EXISTING BOXES
2. ALL NEW CONDUIT OR SURFACE RACE WAY TO BE ATTACED TO EXISTING PLASTER SURFACES ARE TO BE ATTACHED THRU PREDRILLED HOLES
3. ALL NEW FIXTURE CONTROL WIRING TO BE IN SURFACE MOUNTED RACEWAY & LOCATED UPON THE EXISTING SWITCH BOX WHERE POSSIBLE
4. LOWER ALL EXIST'G. HORNS, & BELLS SO THAT THEY WILL BE BENEATH THE NEW SUSPENDED CEILING.
5. RUN ALL NEW SURFACE MOUNTED RACEWAY NORMAL TO WALLS & USE 90° TURNS ONLY NO DIAGONAL RUNS OR SHORTCUTS PERMITTED.
6. RUN SURFACE MOUNTED RACEWAY BENEATH & ATTACHED TO CHALKBOARD OR TACKBOARD TRIM OR ON TOP OF WOOD BASEBOARD.
7. DEMOLITION OF EXISTING ITEMS ARE NOT SHOWN ON PLANS. VERIFY ON JOB SITE. REMOVE ALL WIRING THAT IS ACCESSIBLE. SALVAGE TO CONTRACTOR
8. ALL BOILER ROOM LIGHTS, MOTORS, OIL HEATER TO REMAIN IN SERVICE & ARE TO BE RE-CONNECTED TO NEW PANELS. REMOVE ABANDONED DISTRIBUTION, EXIST. SECONDARY SERVICES, BOTH 1 & 3 PHASE & ABANDONED SWITCHES. RELOCATE EXIST. BOILER ROOM SWITCHES THAT REMAIN IN SERVICE AS NECCESSARY FOR NEW DISTRIBUTION & PANELS. VERIFY ALL ADVERSE CONDITIONS ON JOB SITE.
9. EXISTING FIRE ALARM SYSTEM TO BE REVISED FOR ADDED SMOKE DETECTORS & DOOR HOLDERS AS SPECIFIED. SALVAGE F.A. STATIONS TO OWNER
10. ALL LIGHT FIXTURES RECESSED IN SUSPENDED CEILING TO BE SECURED BY 2 SAFETY CHAINS.

seattle

THURMAN



LOWER FLOOR REFLECTED CEILING PLAN
1/8" = 1'-0"



UPPER FLOOR REFLECTED CEILING PLAN
1/8" = 1'-0"

RECESSED FIXTURE

Appendix F: FEMA E-74 Nonstructural Seismic Bracing Excerpts

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Life Safety Systems

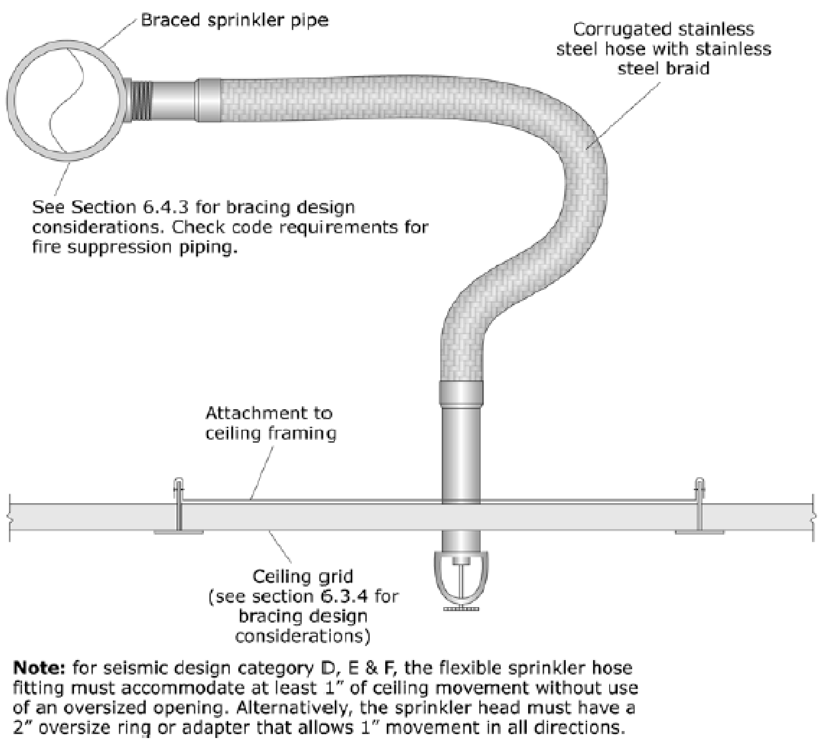


Figure G-1. Flexible Sprinkler Drop.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

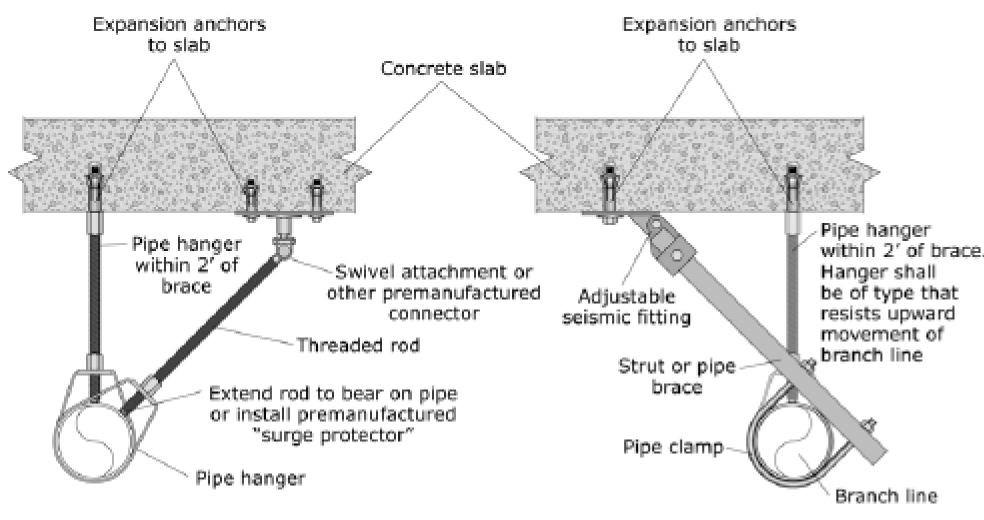


Figure G-2. End of Line Restraint.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Partitions

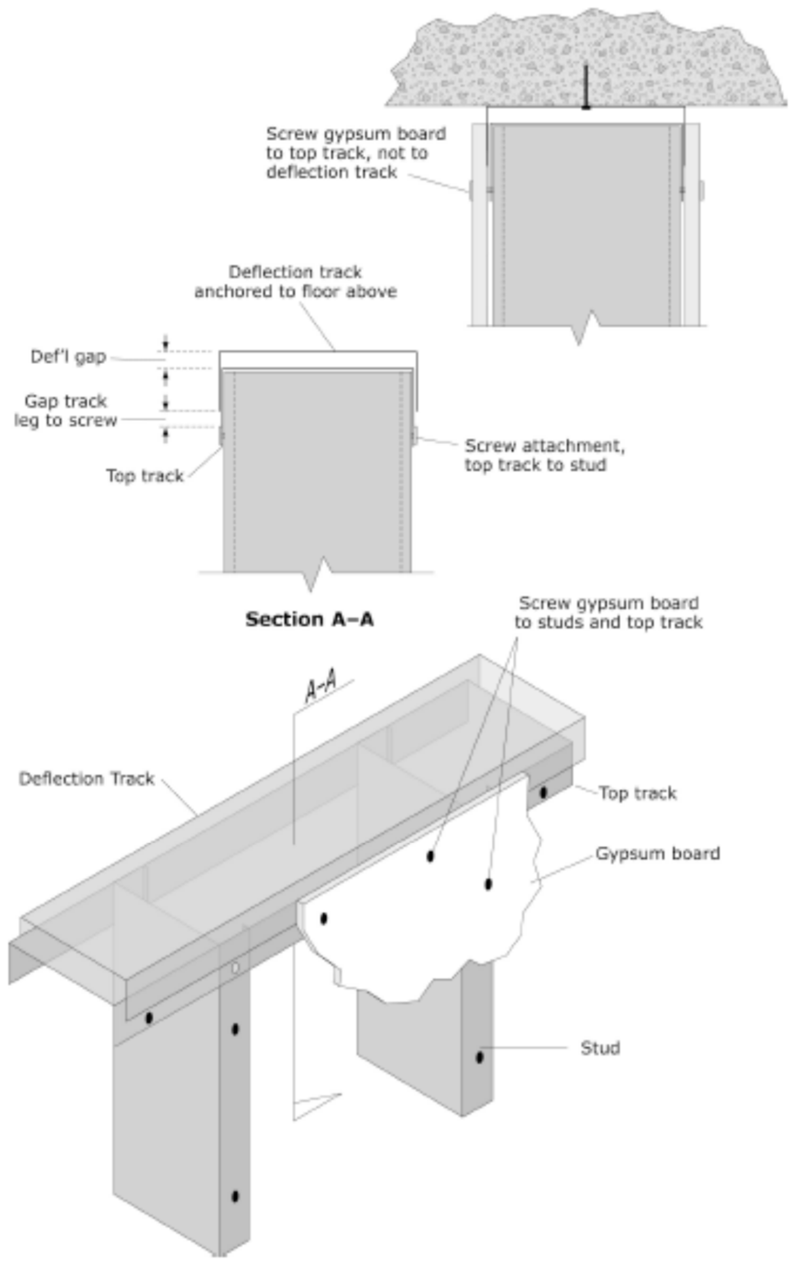


Figure G-3. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

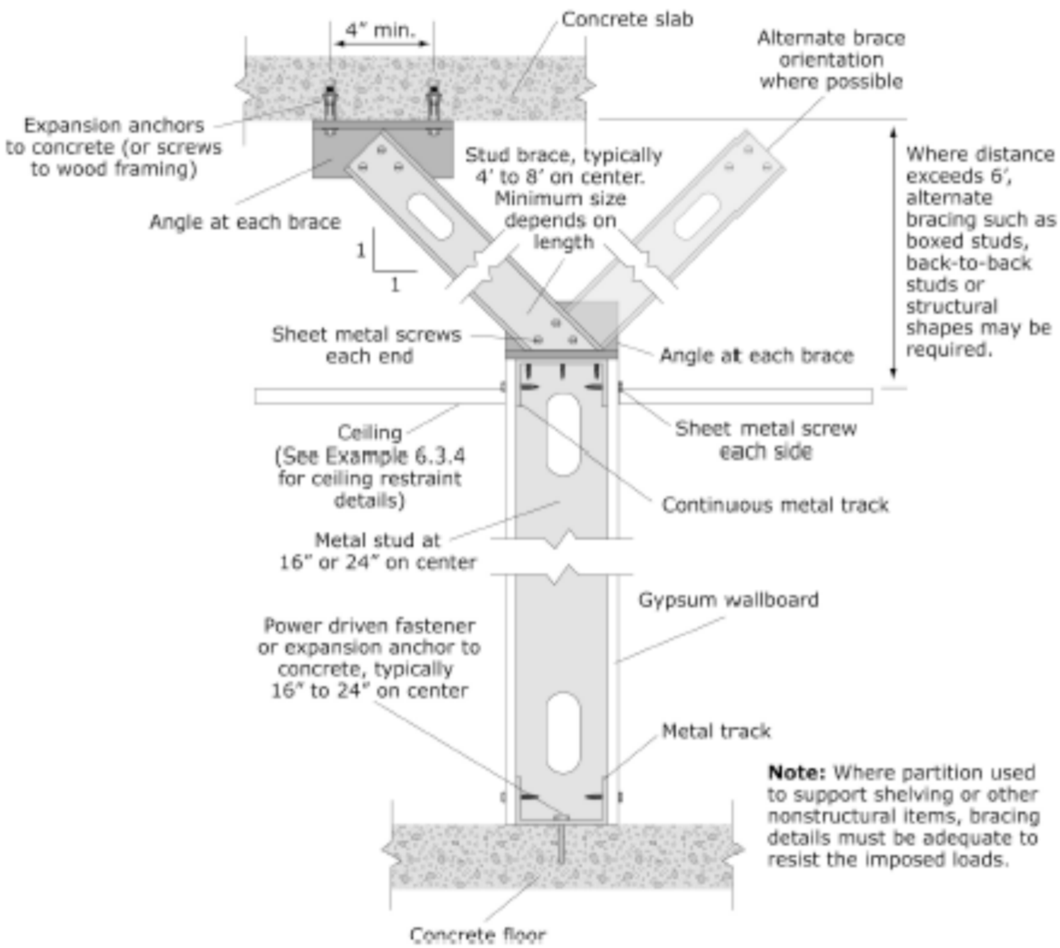


Figure G-4. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

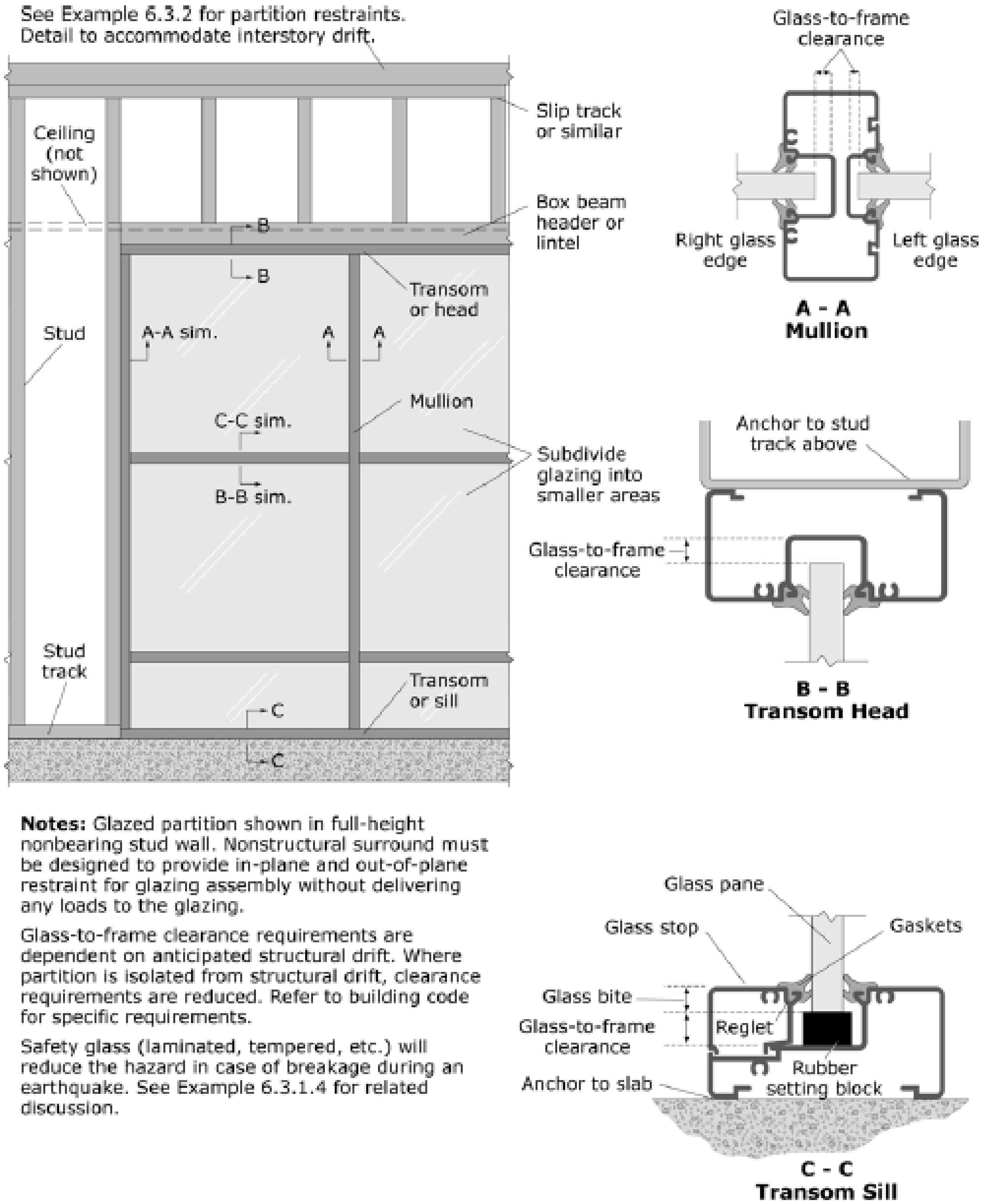


Figure G-5. Full-height Glazed Partition.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

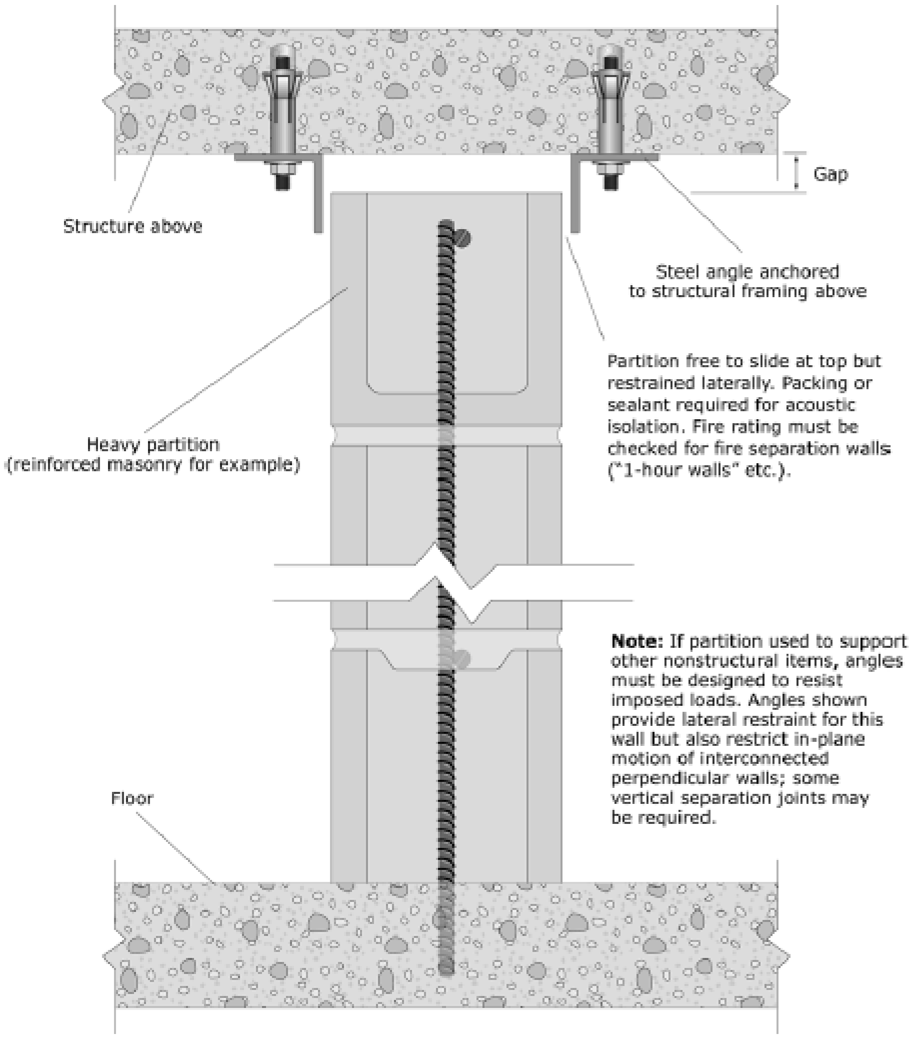


Figure G-6. Full-height Heavy Partition.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

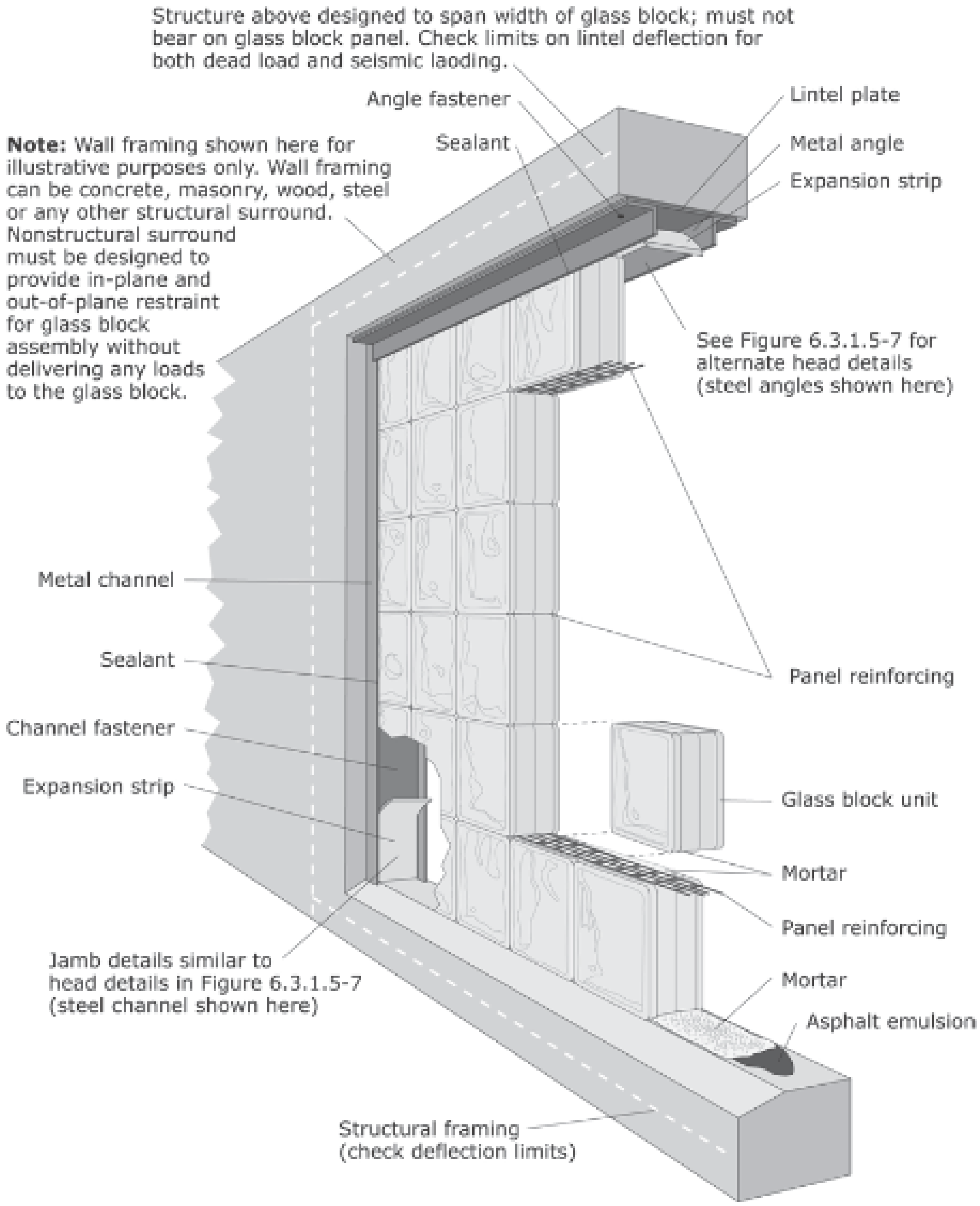


Figure G-7. Typical Glass Block Panel Details.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Ceilings

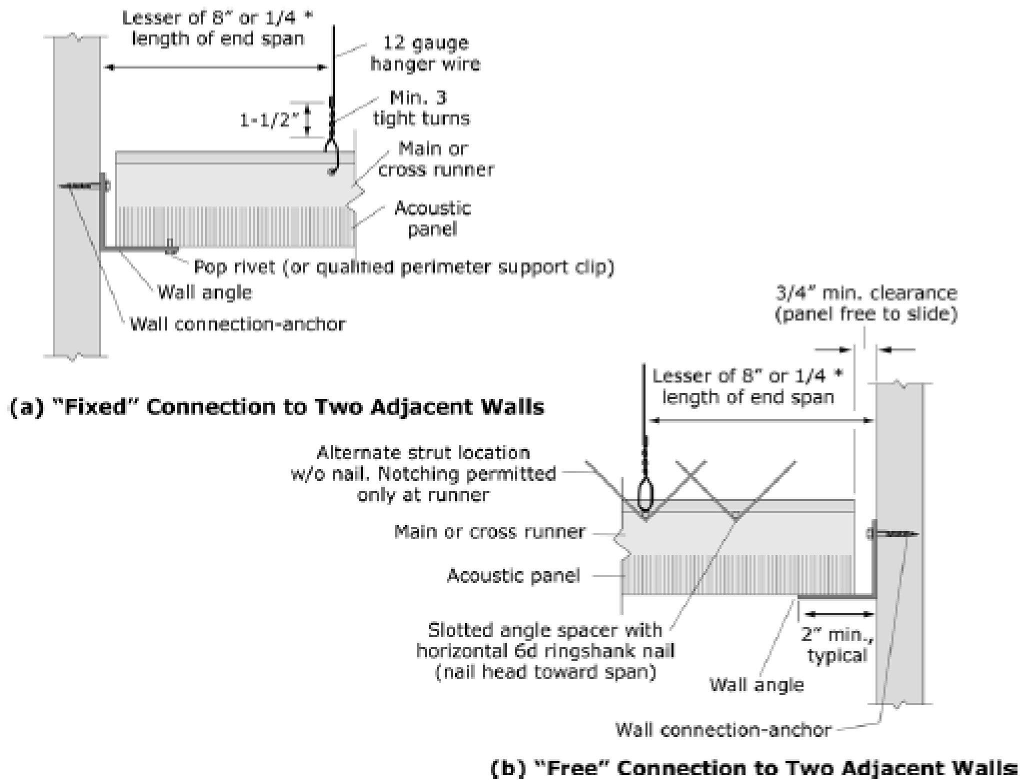
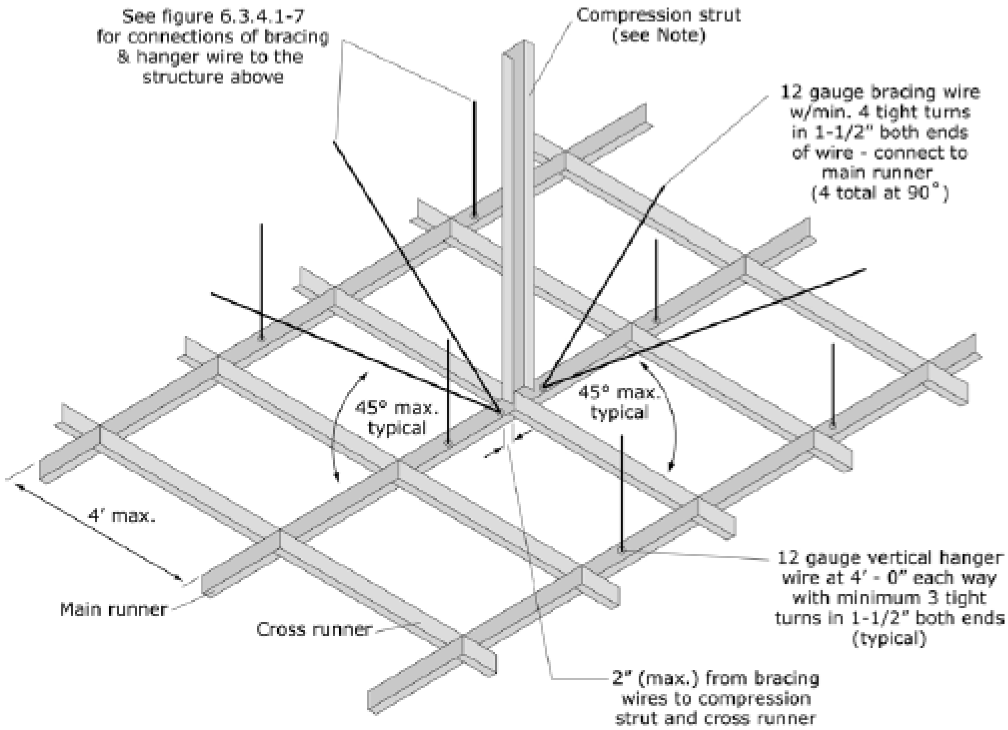


Figure G-8. Suspension System for Acoustic Lay-in Panel Ceilings – Edge Conditions.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Note: Compression strut shall not replace hanger wire. Compression strut consists of a steel section attached to main runner with 2 - #12 sheet metal screws and to structure with 2 - #12 screws to wood or 1/4" min. expansion anchor to structure. Size of strut is dependent on distance between ceiling and structure (l/r ≤ 200). A 1" diameter conduit can be used for up to 6', a 1-5/8" X 1-1/4" metal stud can be used for up to 10'

Per DSA IR 25-5, ceiling areas less than 144 sq. ft, or fire rated ceilings less than 96 sq. ft., surrounded by walls braced to the structure above do not require lateral bracing assemblies when they are attached to two adjacent walls. (ASTM E580 does not require lateral bracing assemblies for ceilings less than 1000 sq. ft.; see text.)

Figure G-9. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Assembly.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

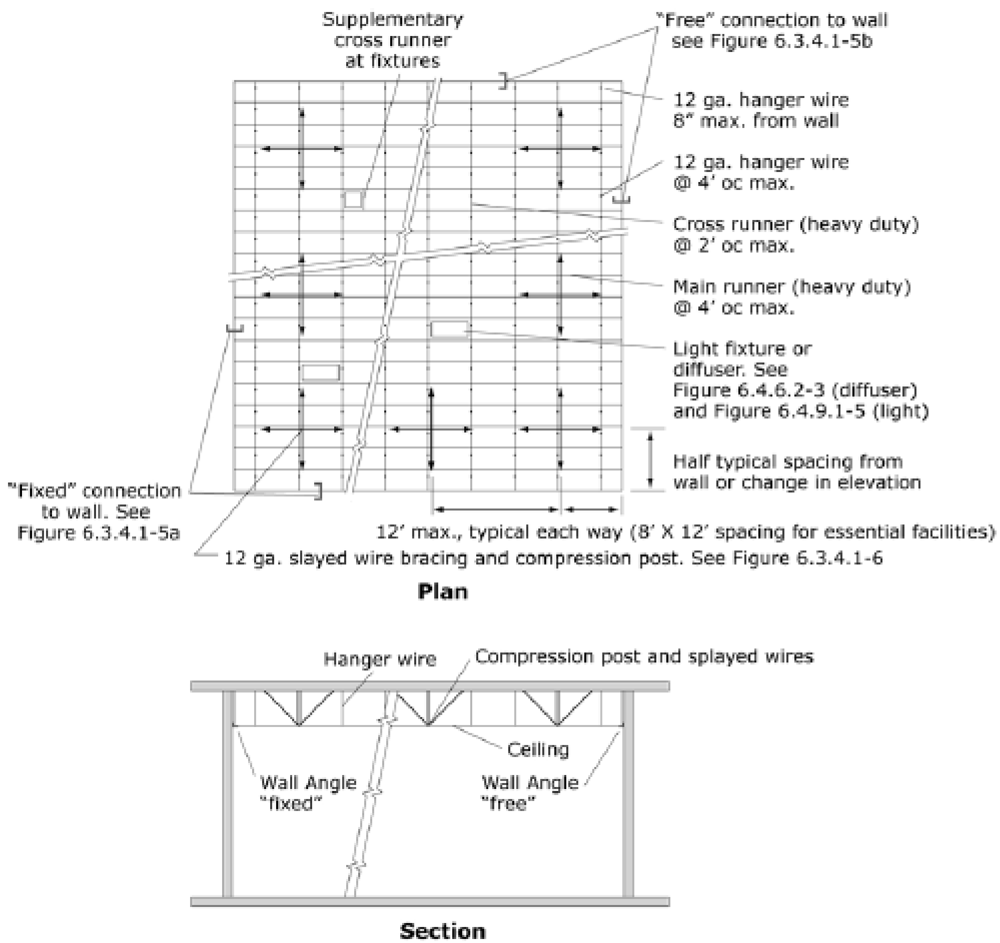


Figure G-10. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Layout.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

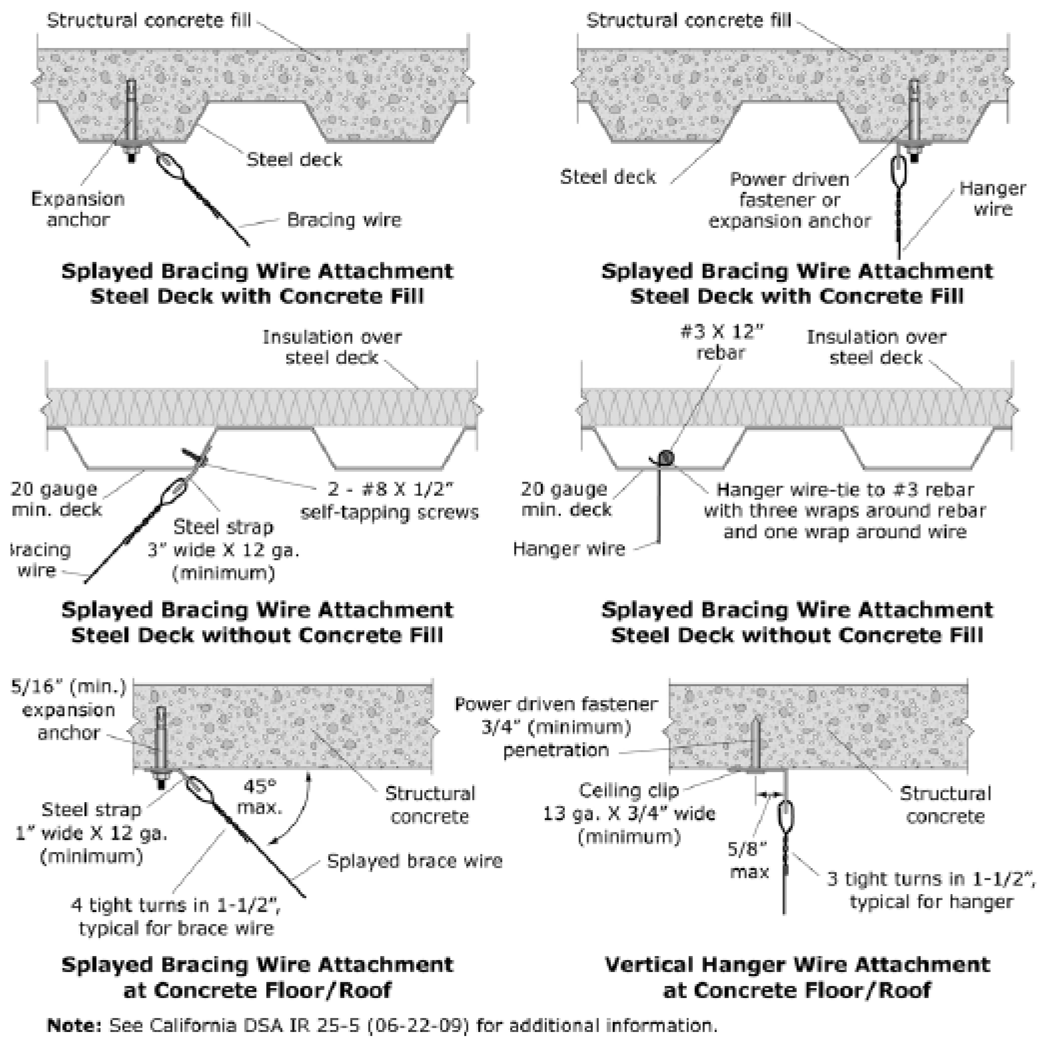
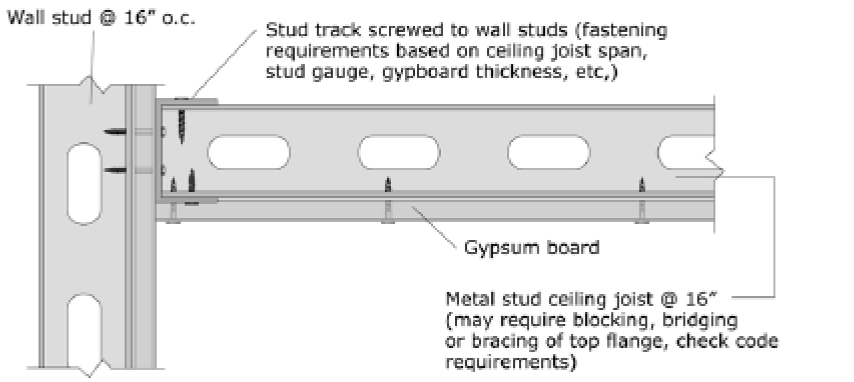
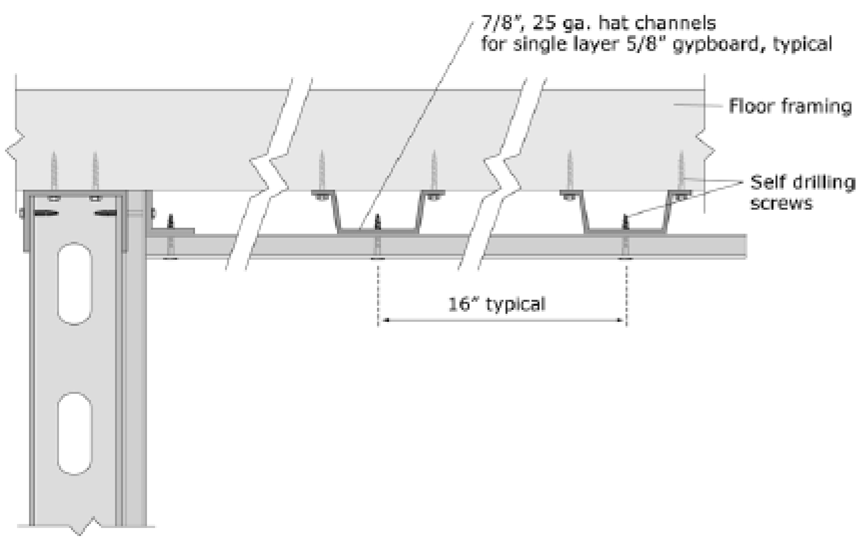


Figure G-11. Suspension System for Acoustic Lay-in Panel Ceilings – Overhead Attachment Details.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



a) Gypsum board attached directly to ceiling joists



b) Gypsum board attached directly to furring strips (hat channel or similar)

Note: Commonly used details shown; no special seismic details are required as long as furring and gypboard secured. Check for certified assemblies (UL listed, FM approved, etc.) if fire or sound rating required.

Figure G-12. Gypsum Board Ceiling Applied Directly to Structure.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

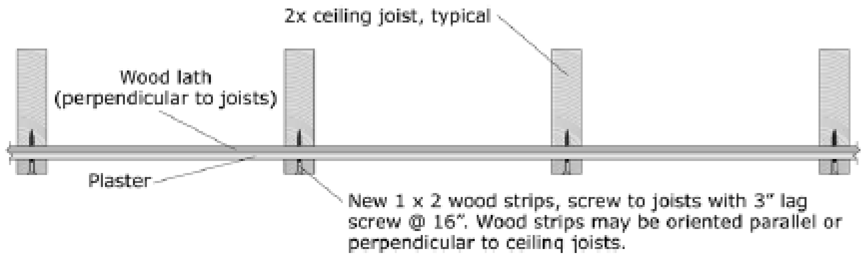


Figure G-13. Retrofit Detail for Existing Lath and Plaster.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

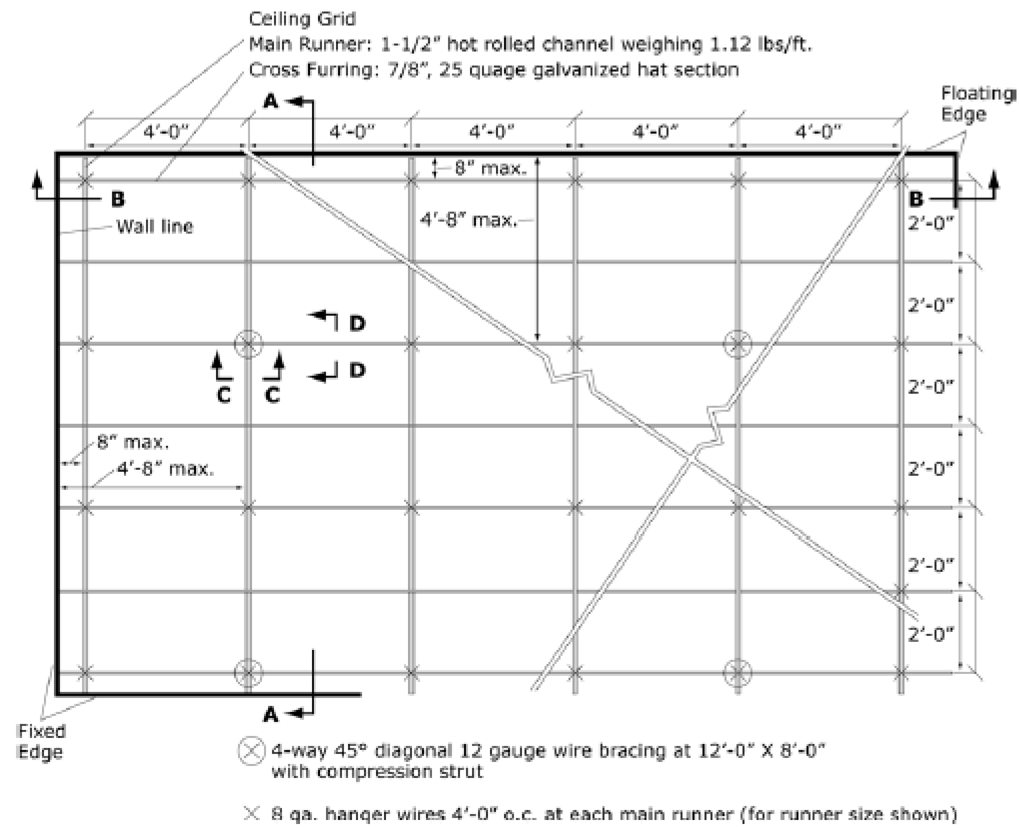


Figure G-14. Diagrammatic View of Suspended Heavy Ceiling Grid and Lateral Bracing.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

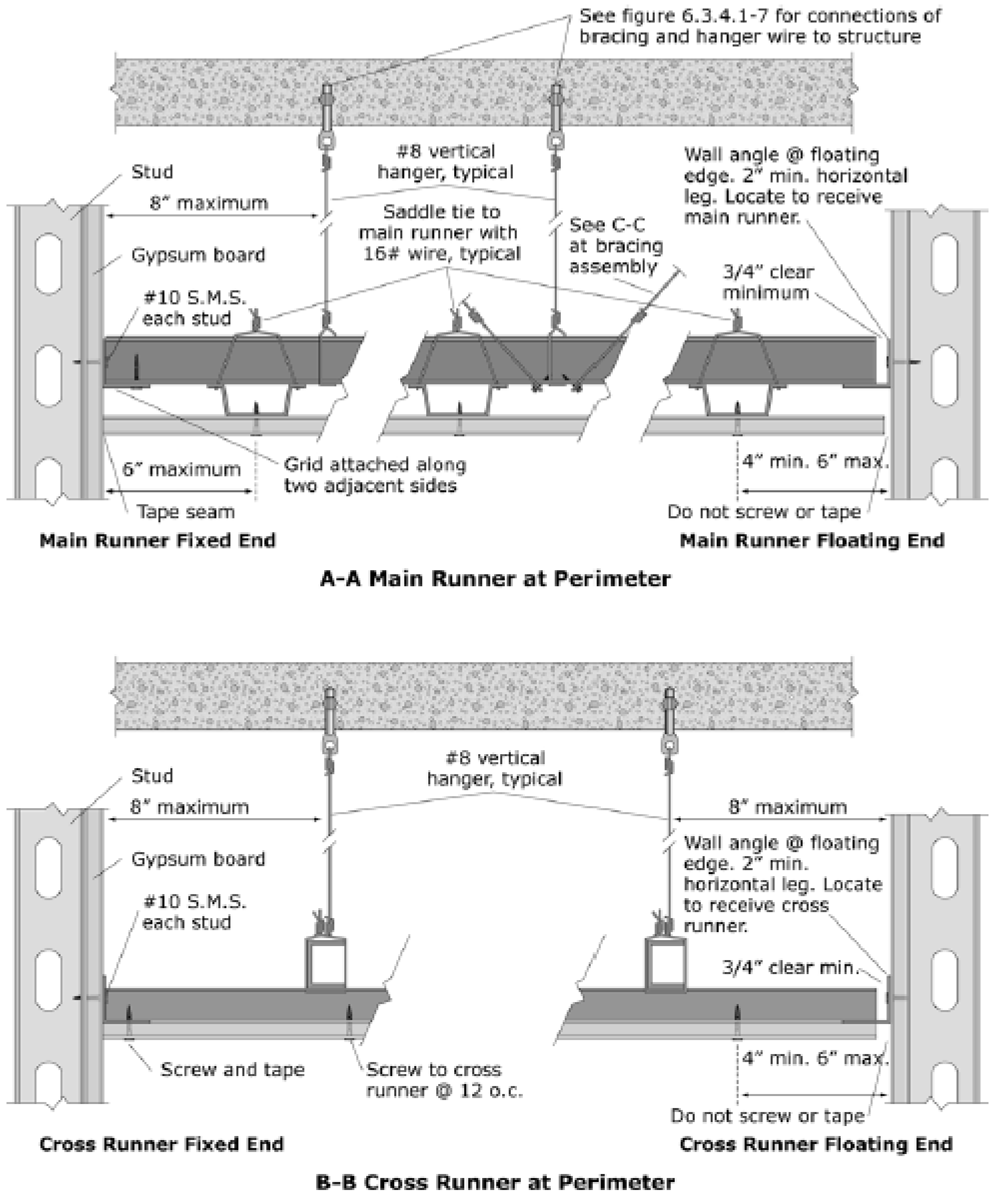
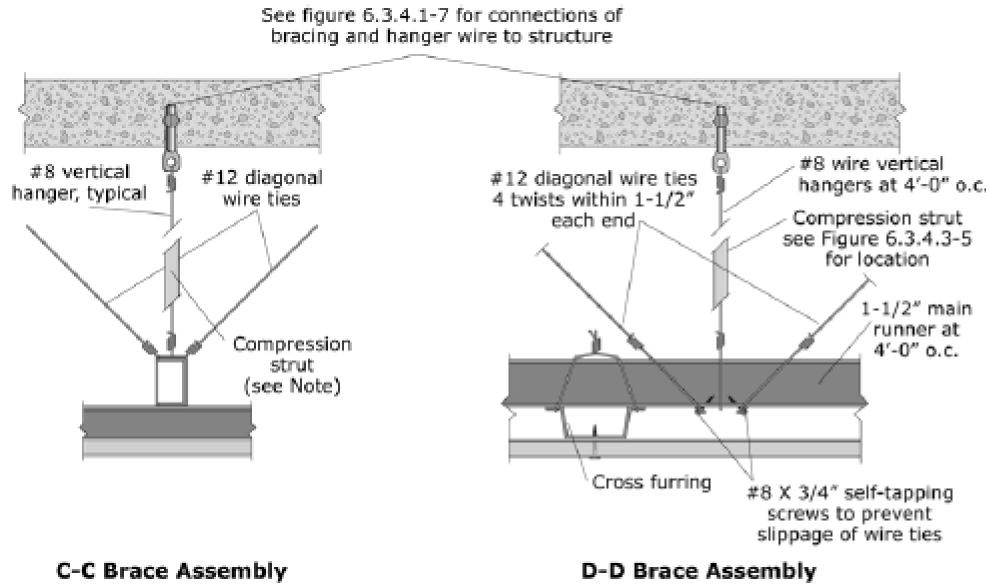


Figure G-15. Perimeter Details for Suspended Gypsum Board Ceiling.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Note: Compression strut shall not replace hanger wire. Compresion strut consists of a steel section attached to main runner with 2 - #12 sheet metal screws and to structure with 2 - #12 screws to wood or 1/4" min. expansion anchor to concrete. Size of strut is dependent on distance between ceiling and structure (l/r ≤ 200). A 1" diameter conduit can be used for up to 6', a 1-5/8" X 1-1/4" metal stud can be used for up to 10'. See figure 6.3.4.1-6 for example of bracing assembly.

Figure G-16. Details for Lateral Bracing Assembly for Suspended Gypsum Board Ceiling.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Light Fixtures

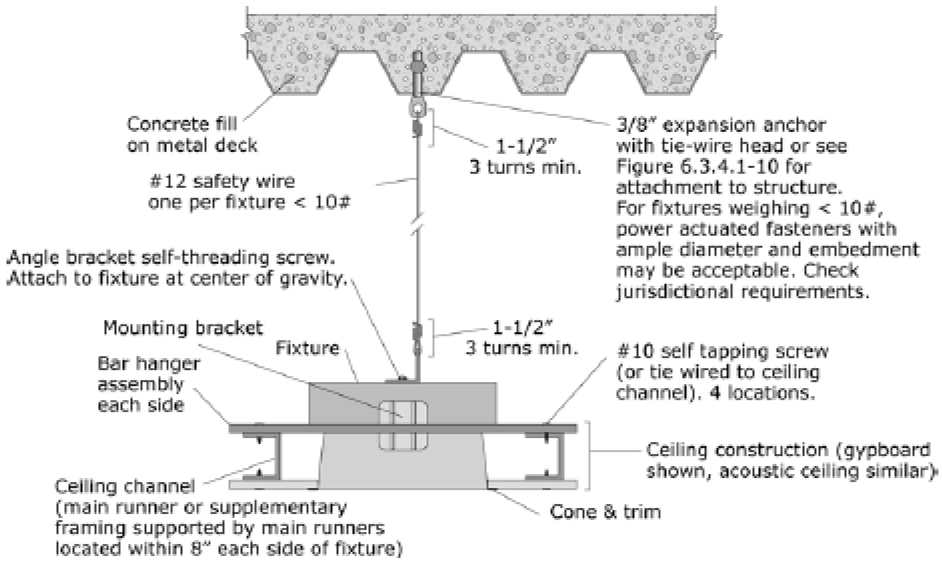


Figure G-17. Recessed Light Fixture in suspended Ceiling (Fixture Weight < 10 pounds).

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

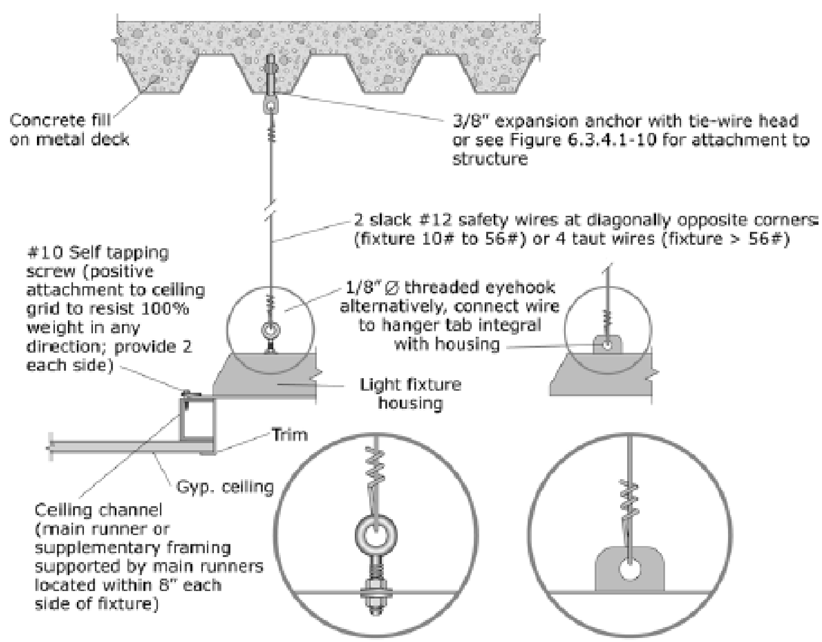


Figure G-18. Recessed Light Fixture in suspended Ceiling (Fixture Weight 10 to 56 pounds).

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Contents and Furnishings

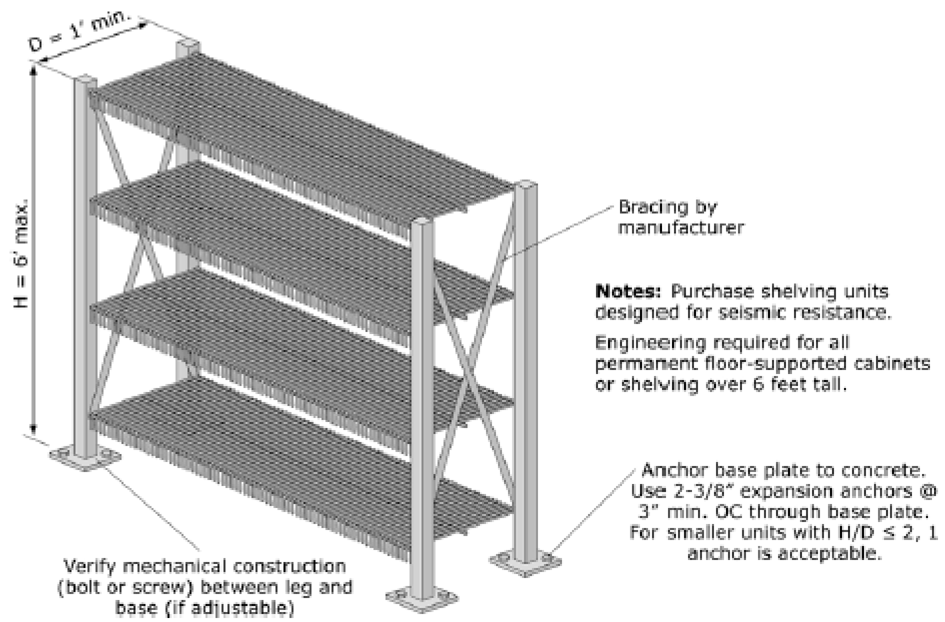


Figure G-19. Light Storage Racks.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

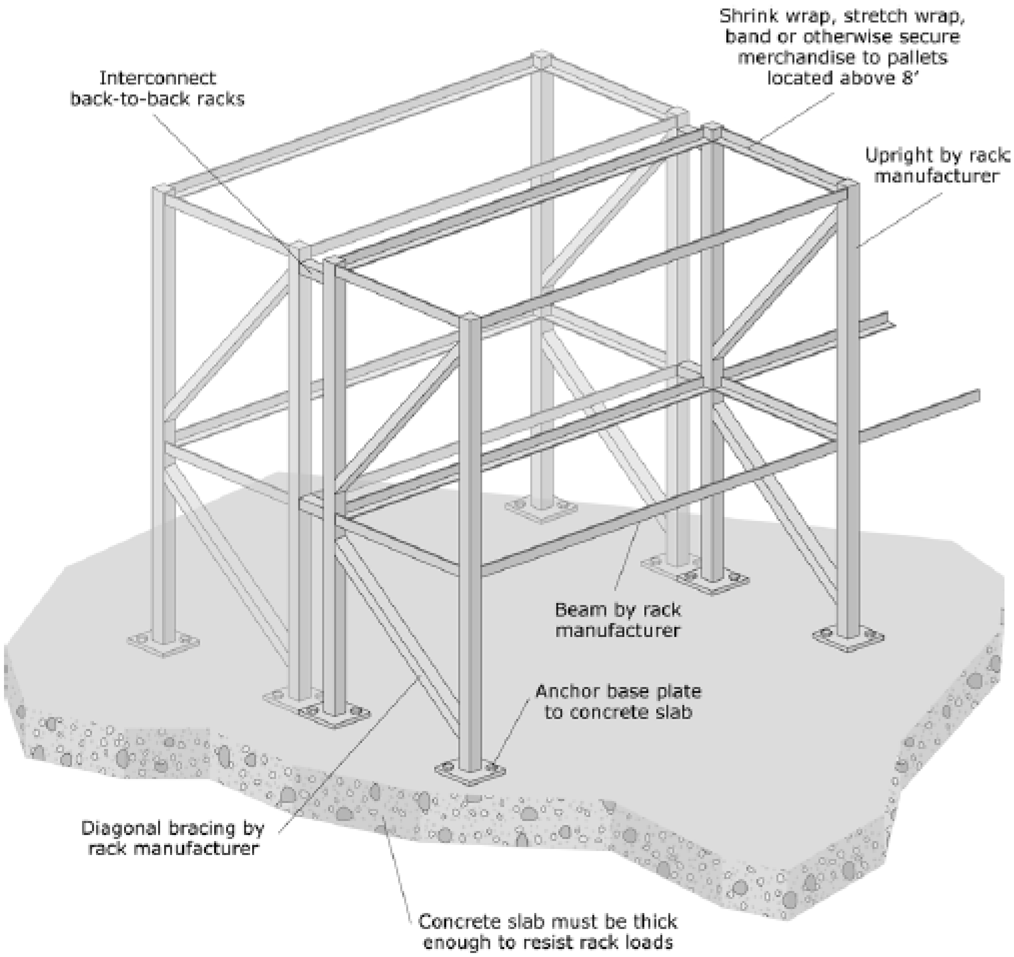


Figure G-20. Industrial Storage Racks.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

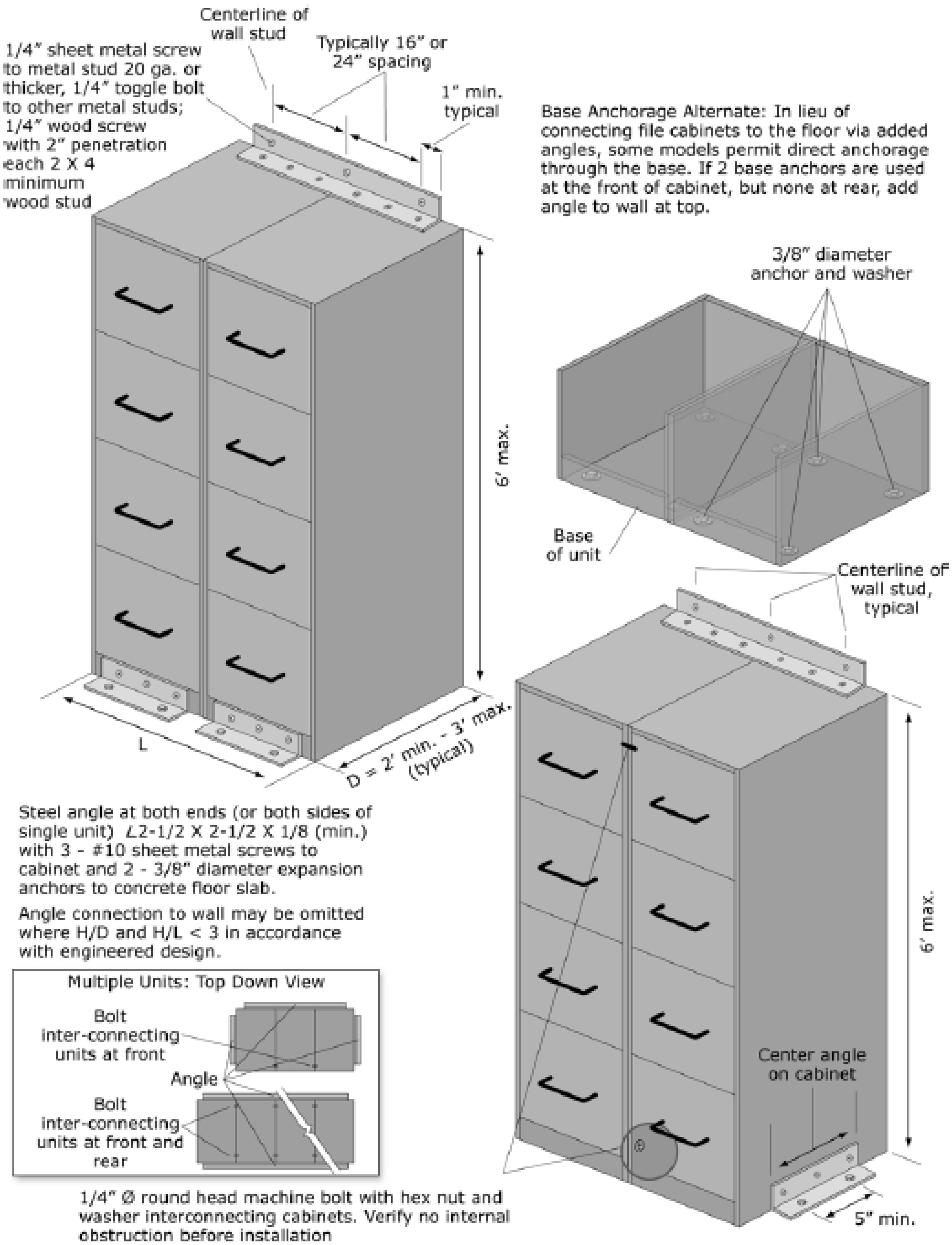


Figure G-21. Wall-mounted File Cabinets.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

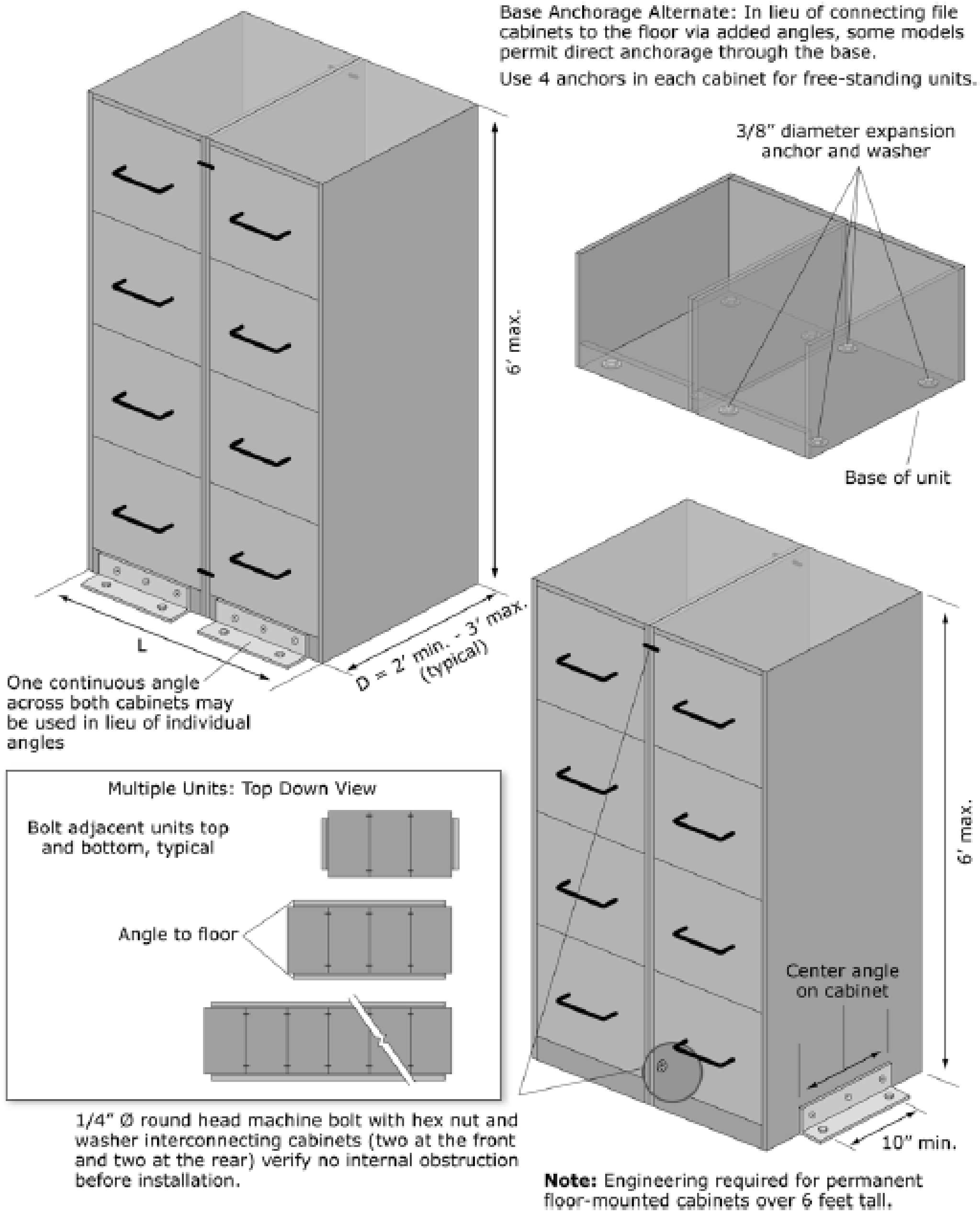


Figure G-22. Base Anchored File Cabinets.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

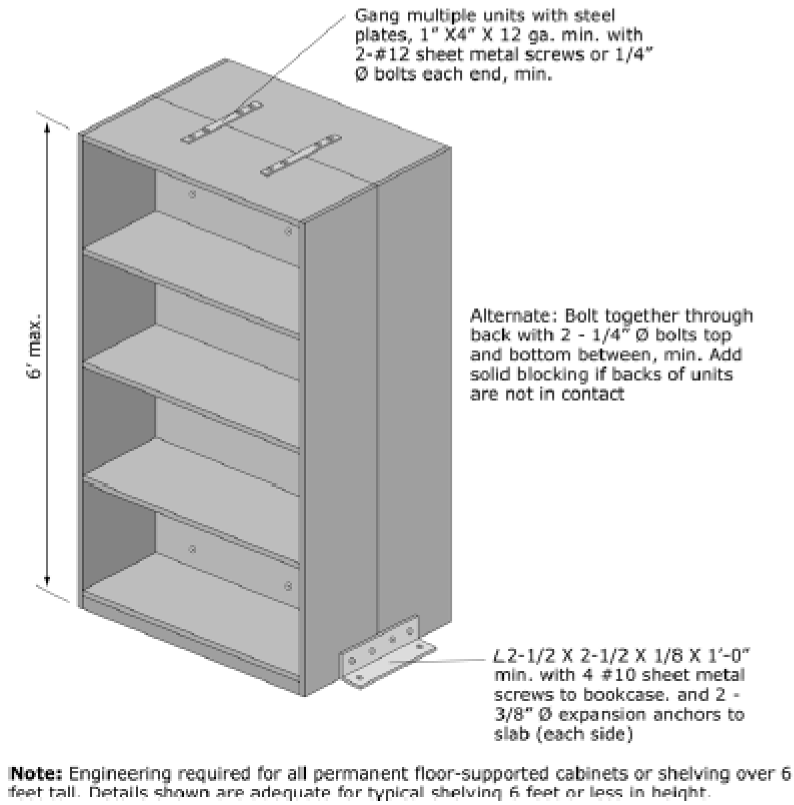


Figure G-23. Anchorage of Freestanding Book Cases Arranged Back to Back.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

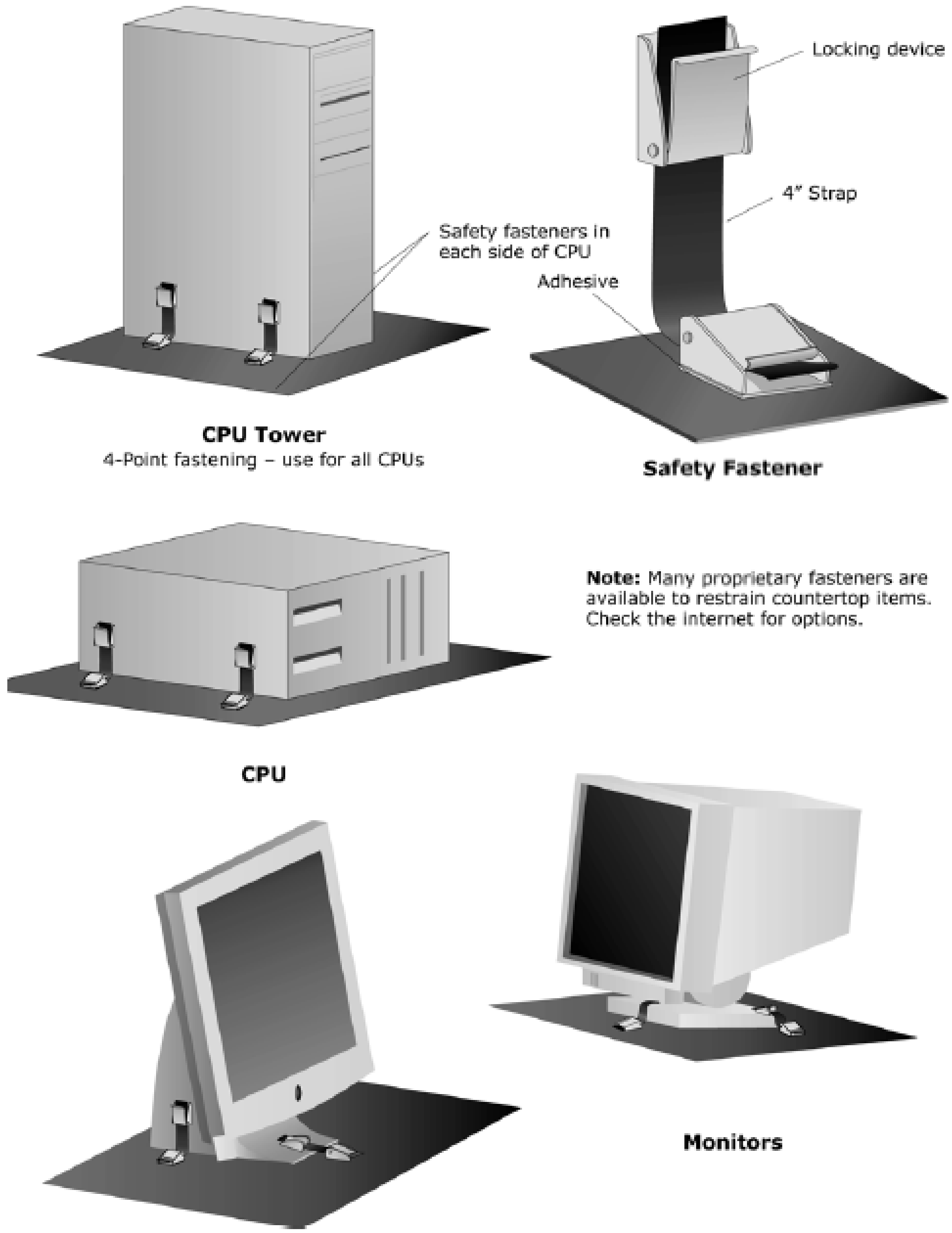
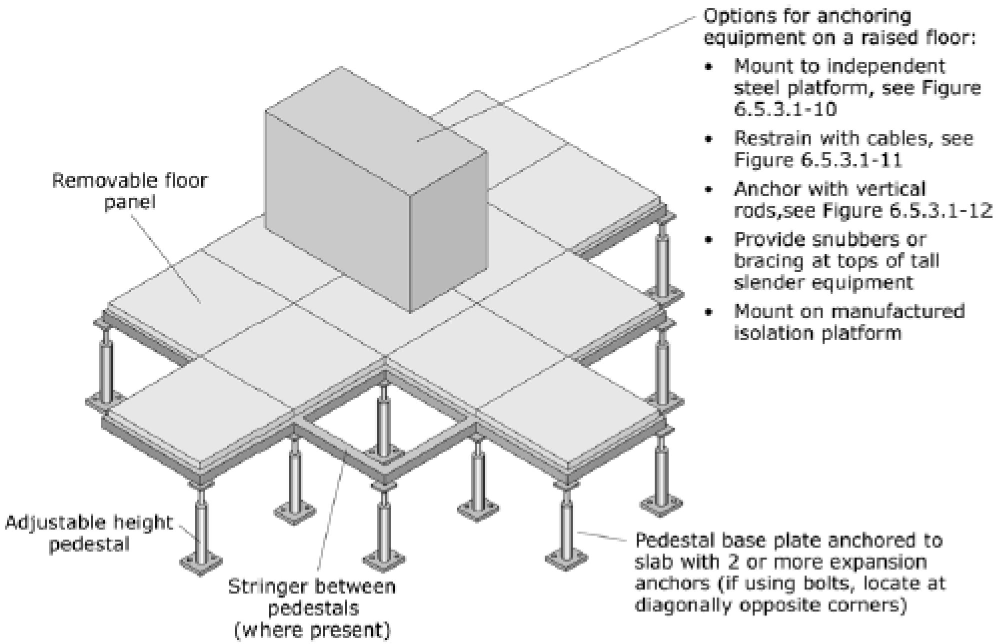
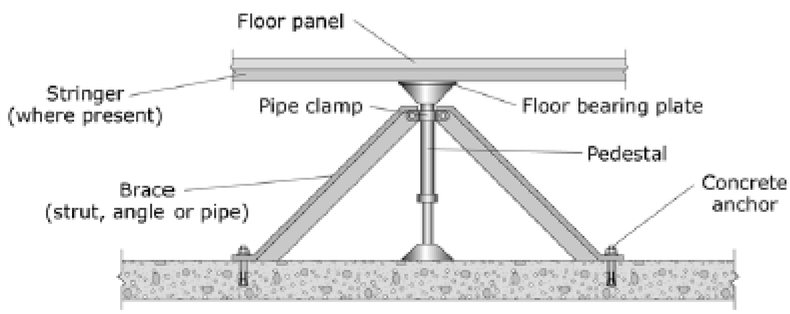


Figure G-24. Desktop Computers and Accessories.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Cantilevered Access Floor Pedestal



Braced Access Floor Pedestal
(use for tall floors or where pedestals are not strong enough to resist seismic forces)

Note: For new floors in areas of high seismicity, purchase and install systems that meet the applicable code provisions for "special access floors."

Figure G-25. Equipment Mounted on Access Floor.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

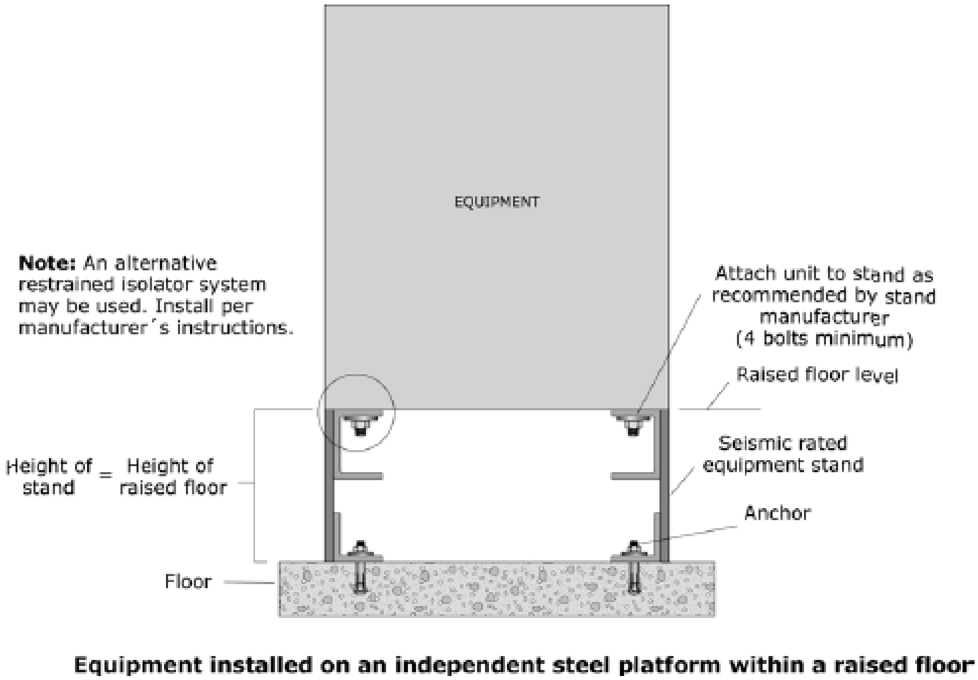


Figure G-26. Equipment Mounted on Access Floor – Independent Base.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

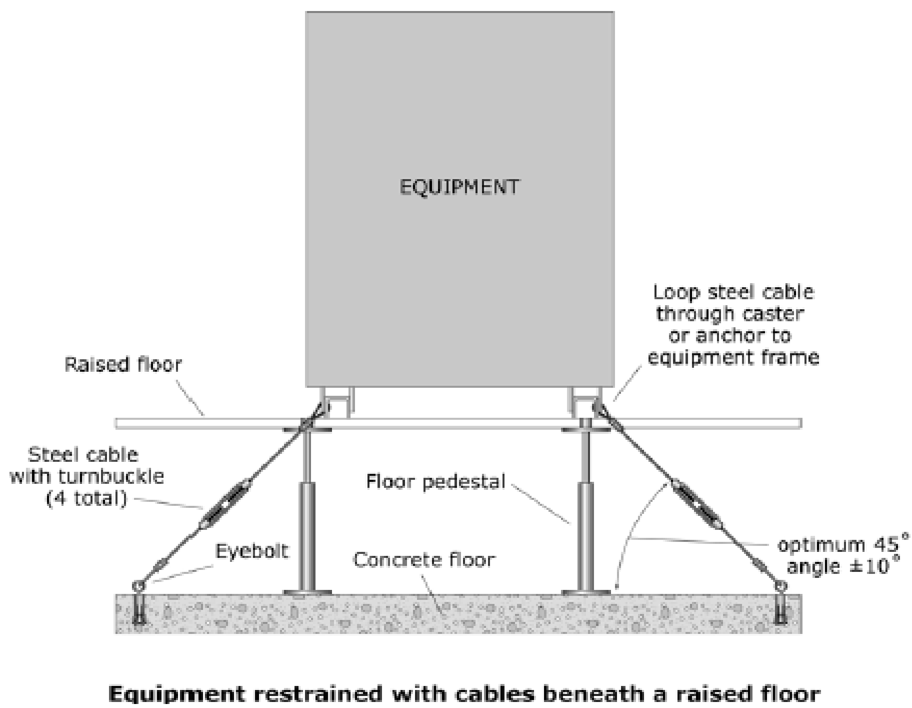


Figure G-27. Equipment Mounted on Access Floor – Cable Braced.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

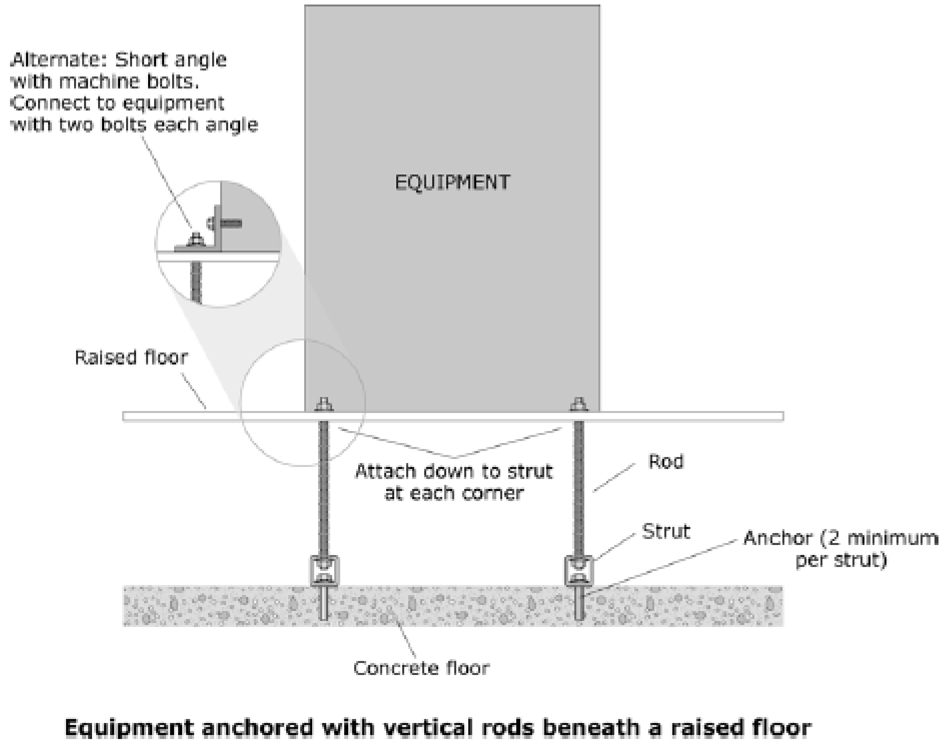
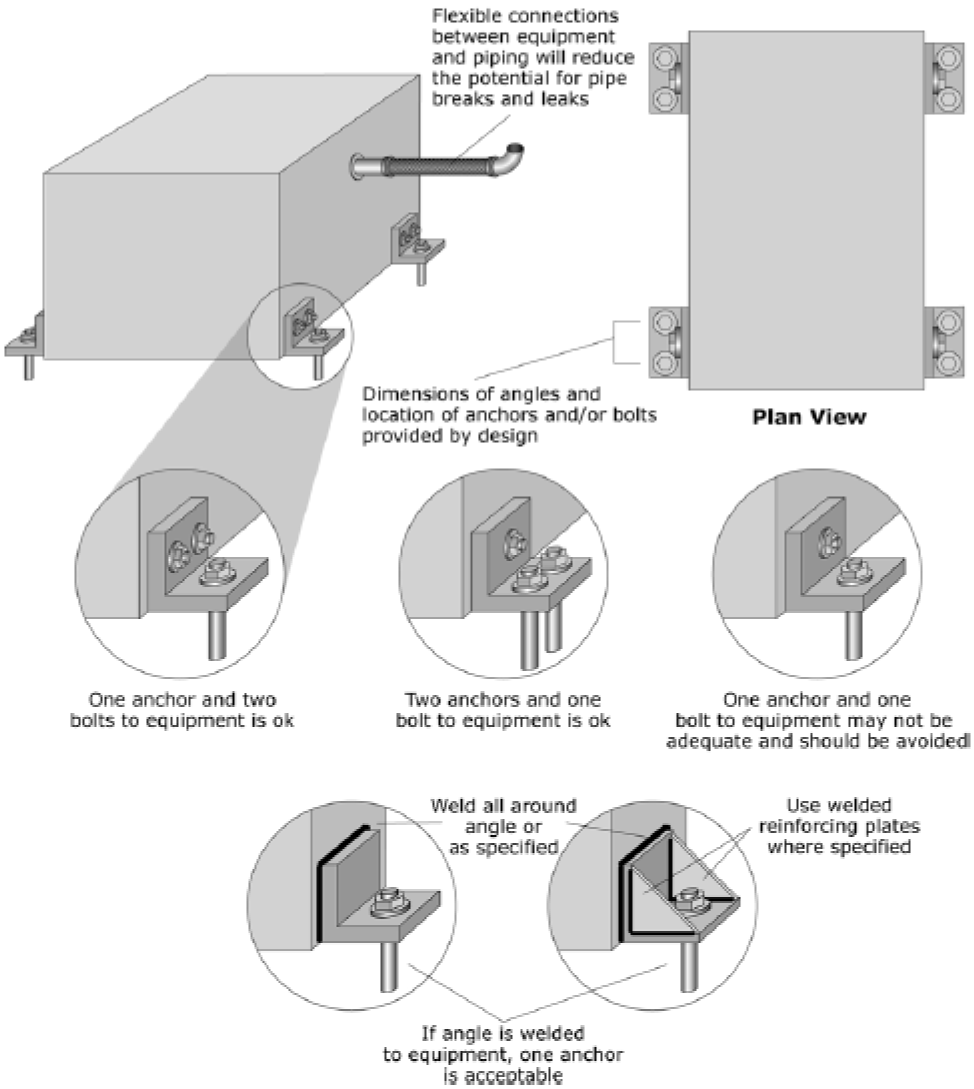


Figure G-28. Equipment Mounted on Access Floor – Tie-down Rods.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

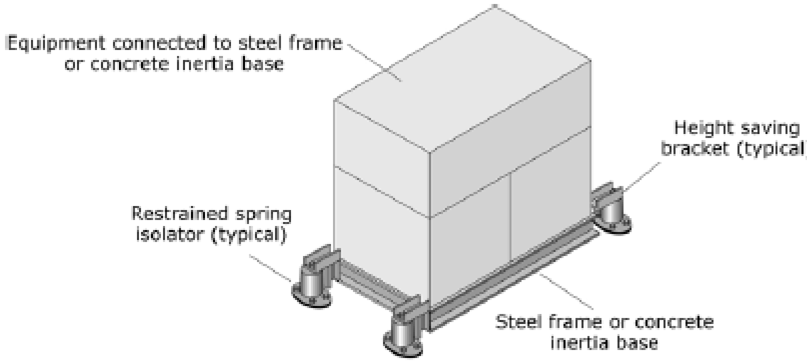
Mechanical and Electrical Equipment



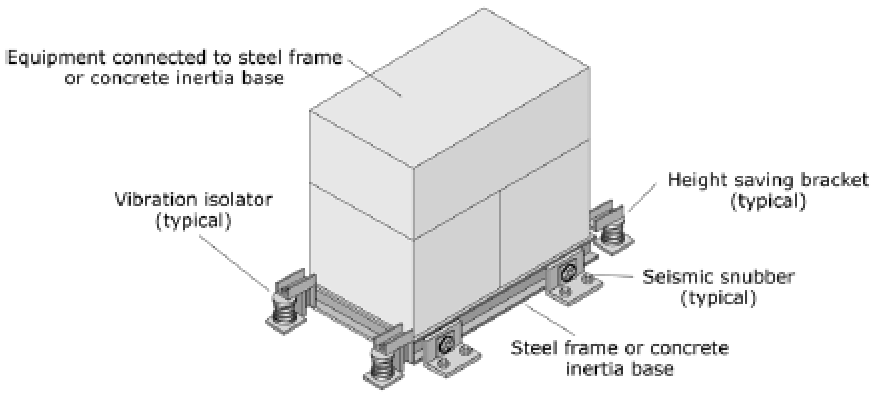
Note: Rigidly mounted equipment shall have flexible connections for the fuel lines and piping.

Figure G-29. Rigidly Floor-mounted Equipment with Added Angles.

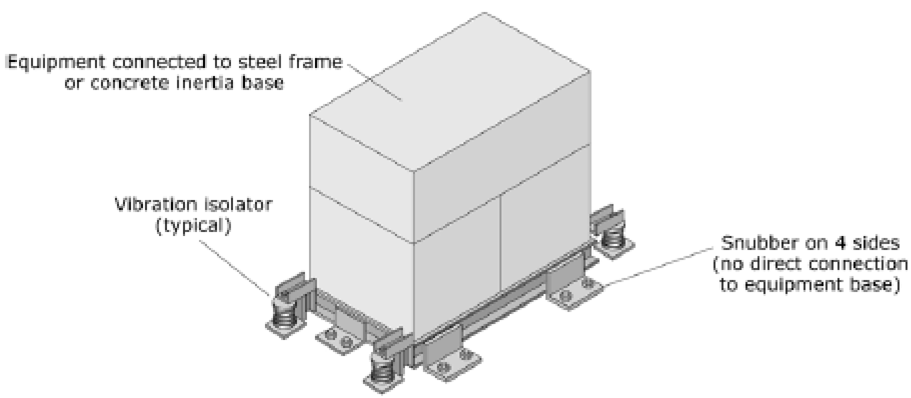
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Supplemental base with restrained spring isolators



Supplemental base with open springs and all-directional snubbers



Supplemental base with open springs and one-directional snubbers

Figure G-30. HVAC Equipment with Vibration Isolation.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

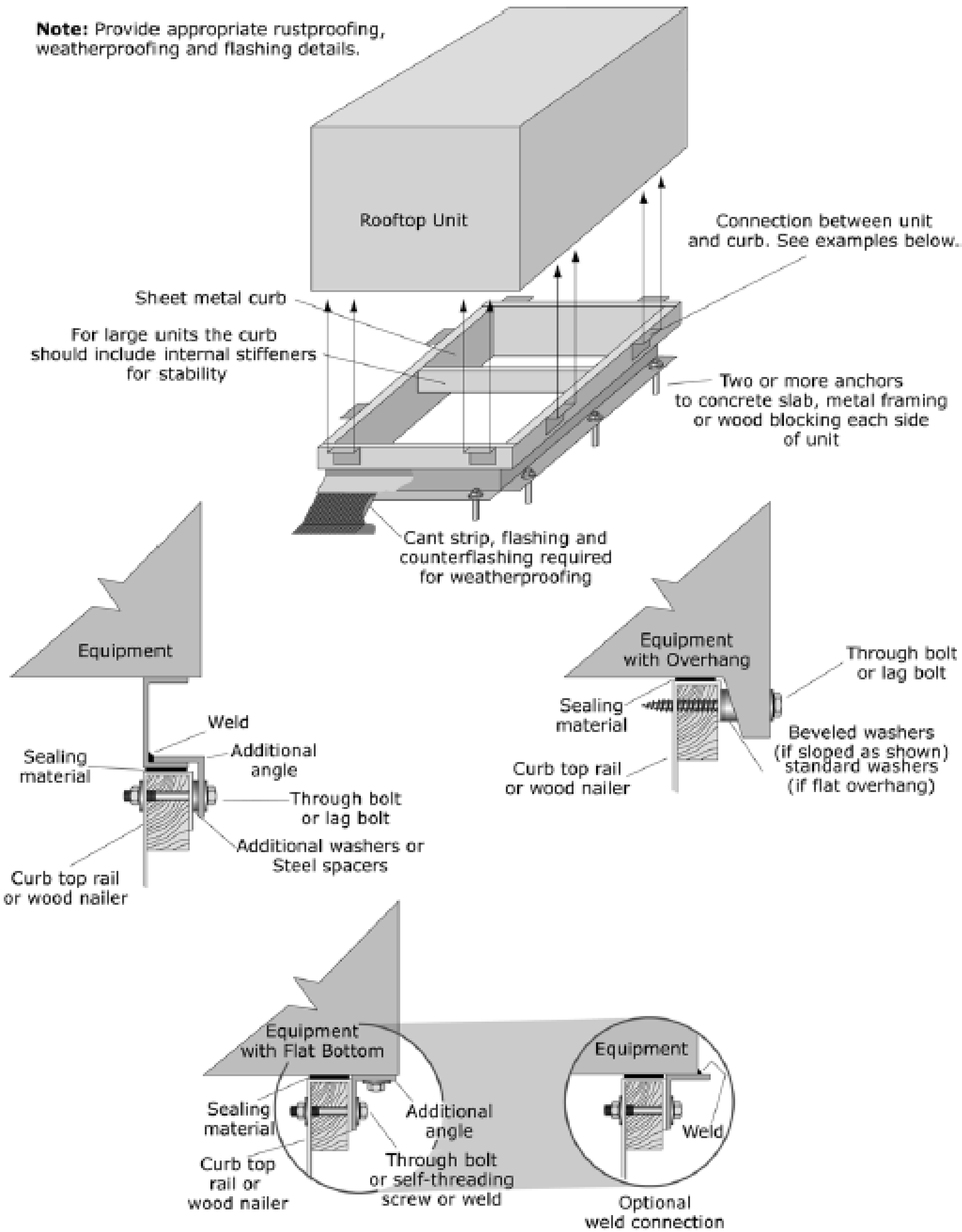


Figure G-31. Rooftop HVAC Equipment.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

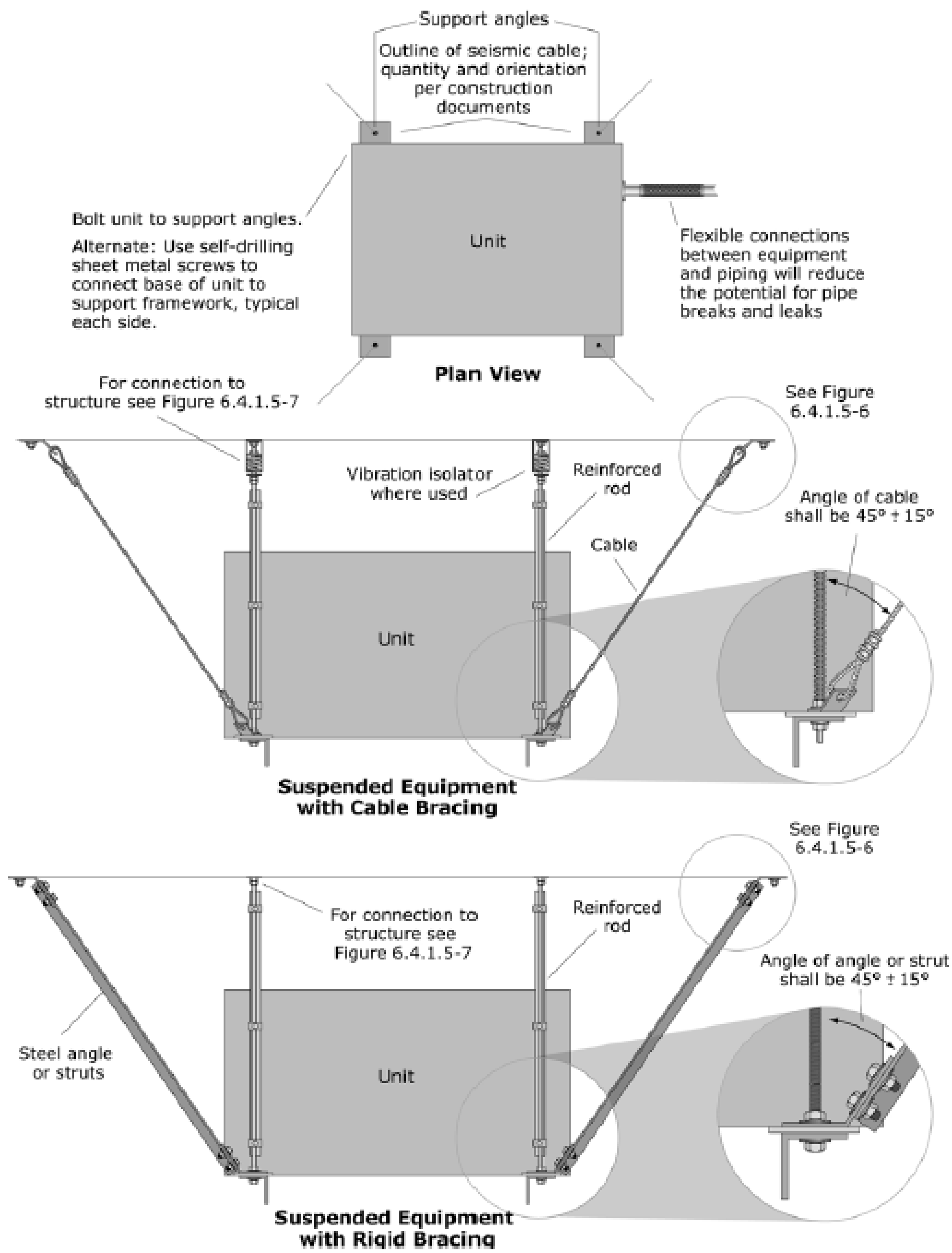


Figure G-32. Suspended Equipment.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

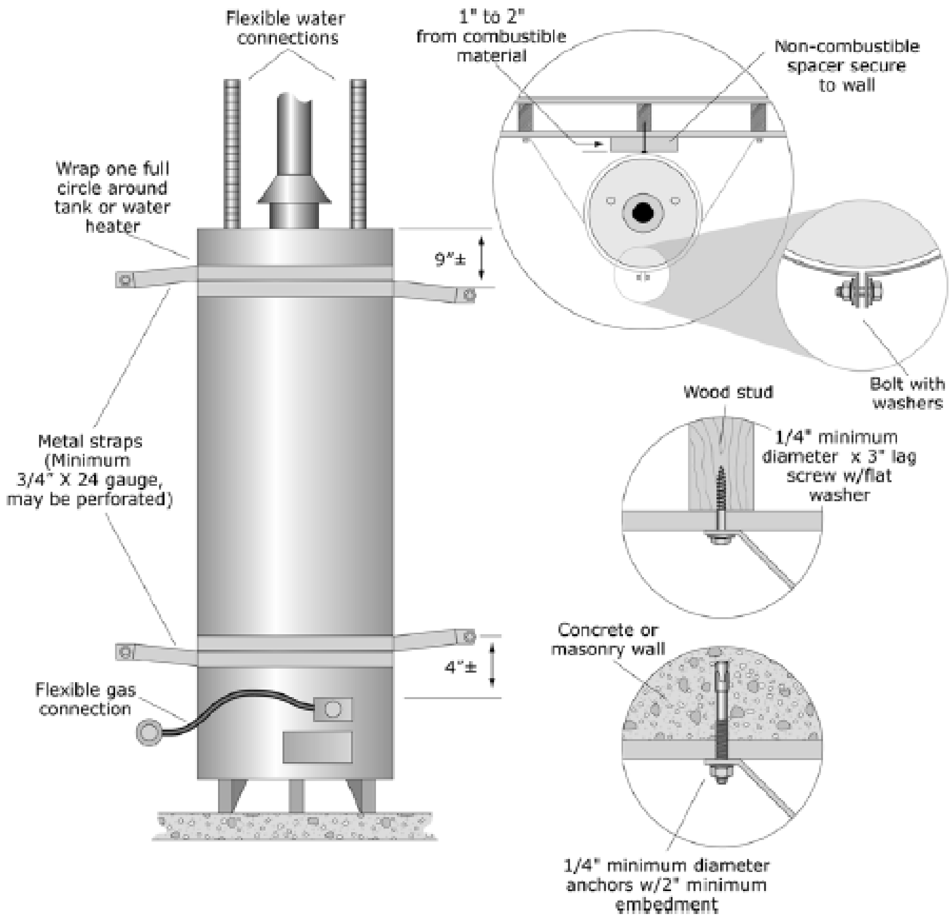


Figure G-33. Water Heater Strapping to Backing Wall.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

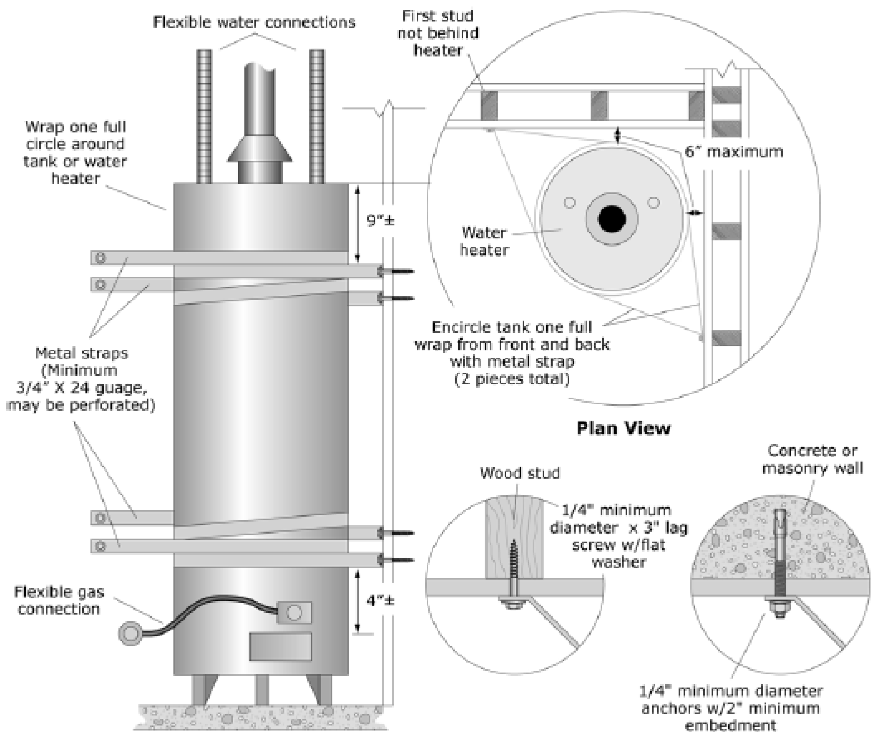


Figure G-34. Water Heater – Strapping at Corner Installation.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

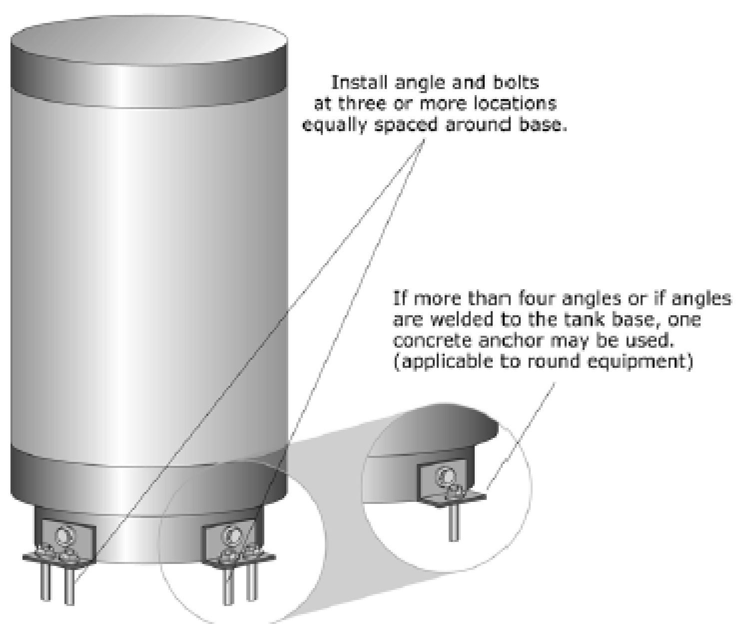


Figure G-35. Water Heater – Base Mounted.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

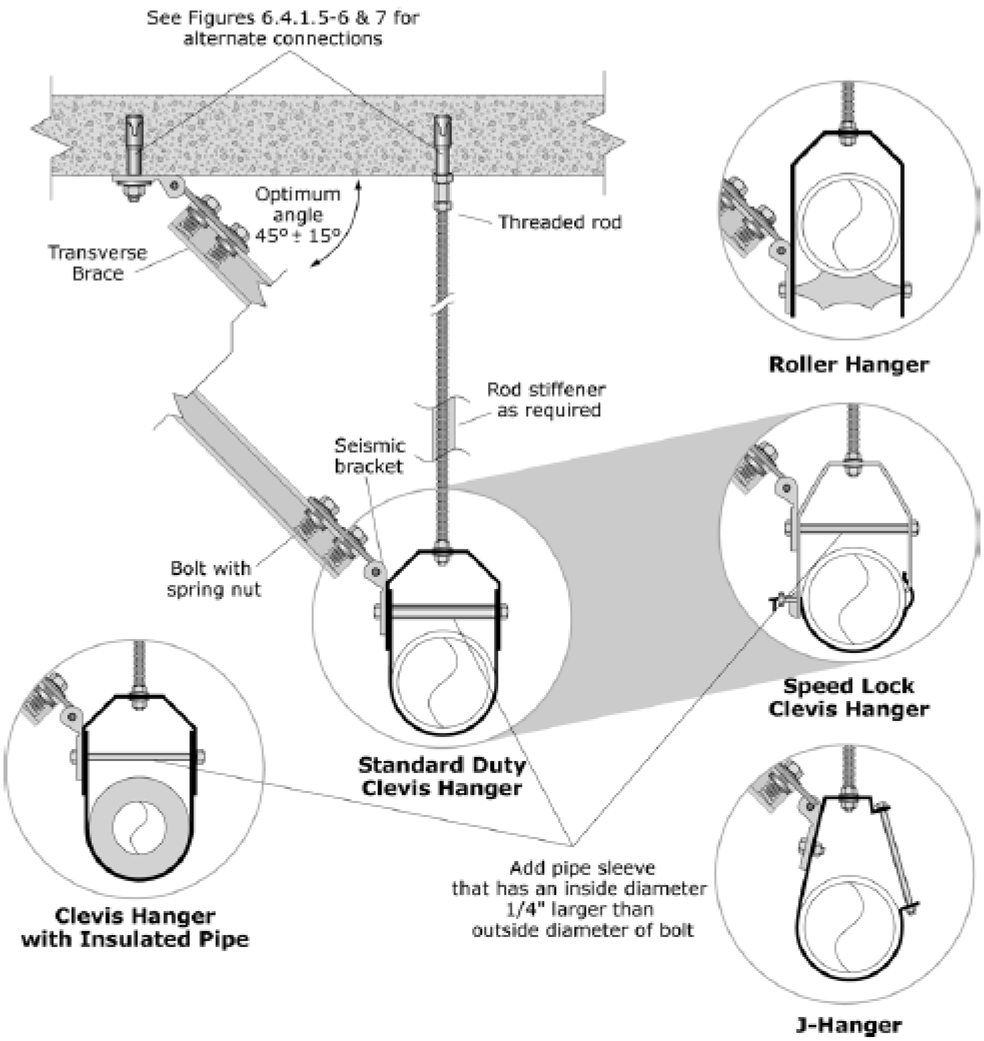


Figure G-36. Rigid Bracing – Single Pipe Transverse.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

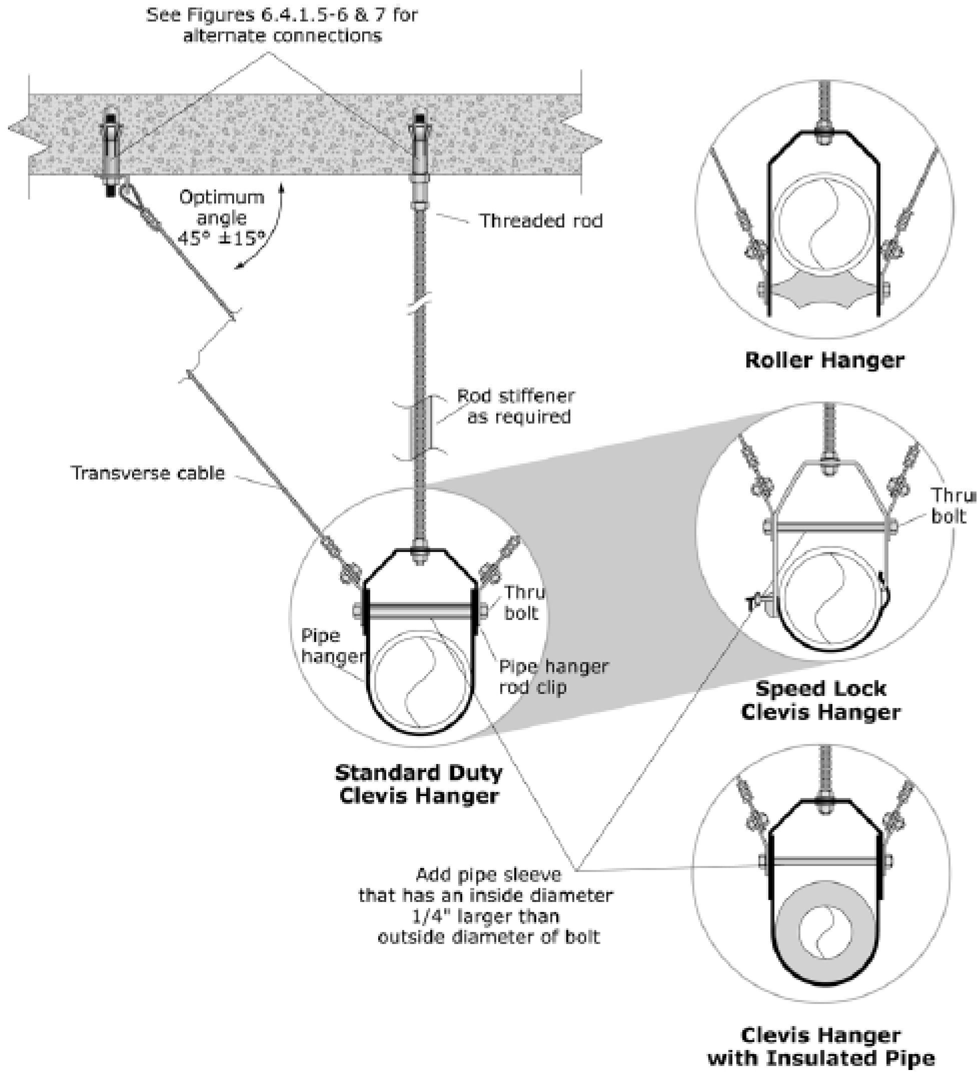


Figure G-37. Cable Bracing – Single Pipe Transverse.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Electrical and Communications

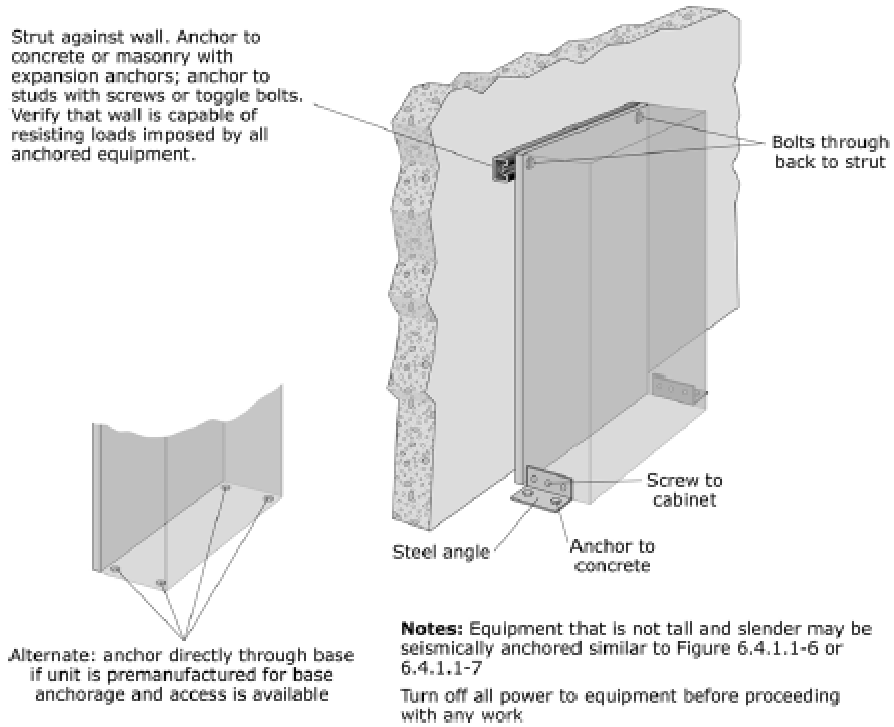


Figure G-38. Electrical Control Panels, Motor Controls Centers, or Switchgear.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

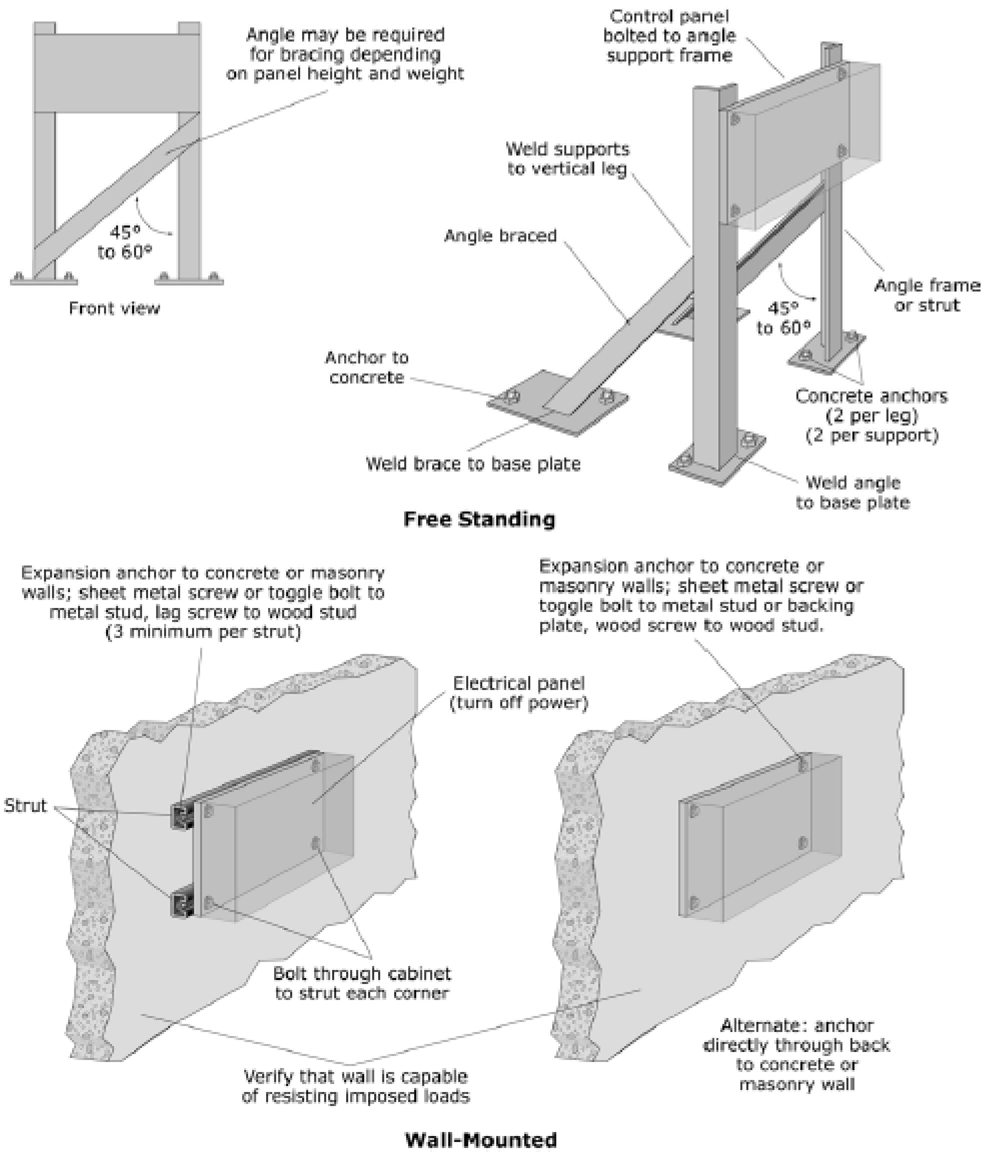


Figure G-39. Freestanding and Wall-mounted Electrical Control Panels, Motor Controls Centers, or Switchgear.

(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

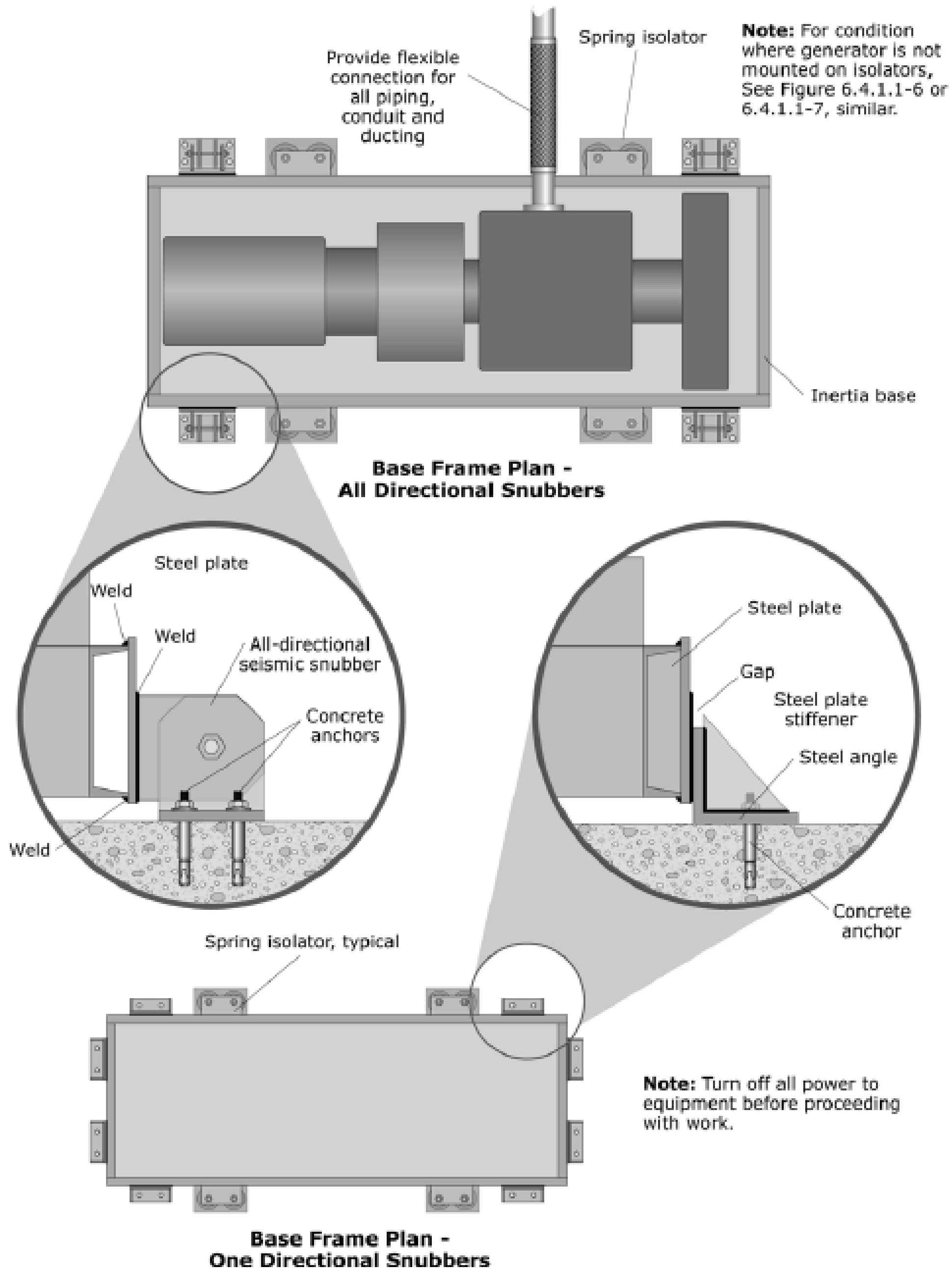


Figure G-40. Emergency Generator.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)