



Washington State
School Seismic Safety Assessments Project

NAPAVINE JR/SR HIGH SCHOOL ANNEX BUILDING Napavine School District

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 Napavine Junior Senior High School – Annex Building Napavine School District

June 2021

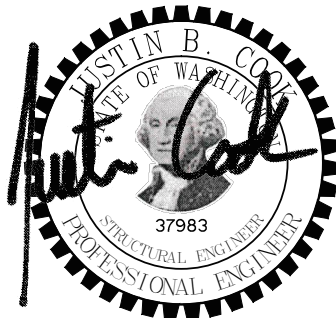
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EXECUTIVE SUMMARY

This report documents the findings of a seismic evaluation of the Napavine Junior Senior High School Annex Building in Napavine, Washington. The school currently enrolls approximately 390 high school students. The Annex Building, originally constructed in 1955, is a one-story wood-frame structure constructed on level ground. Additions to the building were made in 1973. Overall, the building contains several classrooms, a laboratory, and administrative spaces. The rectangular building is approximately 150 feet by 71 feet, with a roof height of about 15 feet and a total area of approximately 11,300 square feet. The building wall construction consists of wood stud walls and wood siding. It appears that some of the original openings have been infilled, but it is unclear whether the infills provide any additional support in either the vertical or lateral directions. The walls are connected to the roof system, which consists of premanufactured wood trusses with plywood sheathing. The floors are concrete slabs. Gravity loads are transferred into the ground through wood stud walls into a continuous wall footing system. Lateral loads are transferred into the ground from the wood-sheathed diaphragm to the wood-framed shear walls and into the foundation system. No seismic upgrades to the structural system appear to have been made since the original construction.

DCI Engineers 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: inadequate load path and inadequate unblocked diaphragms. Other nonstructural deficiencies include the presence of tall narrow contents and fall-prone contents.

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 adding blocking to the diaphragm and fastening the unsupported panel edges with additional diaphragm nailing. The recommendations for nonstructural upgrades are to verify independent support of light fixtures to the structure in ACT ceilings and to brace tall narrow contents, such as bookshelves and other topple-prone shelving, by anchoring them to backing walls.

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 \$988K and \$1.85M, with the baseline estimated total cost being \$1.24M.

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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
GWB	Gypsum Wallboard
GC/CM	General Contractor/Construction Manager
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
OSB	Oriented Strand Board
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

- Farwest Homes, March 20, 1973, existing drawings titled, "1973 Annex Addition," Napavine School District, Napavine, Lewis County, Washington.

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 the Washington 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 from the list of schools with the intent of representing a variety of regions, building uses, construction eras, and construction materials.

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 seismic performance objectives.

The seismic evaluation consists of a Tier 1 screening for the structural systems performed in accordance with ASCE 41-17.

1.2 Scope of Services

The project is being performed in several distinct and overlapping phases of work. The scope of this report is outlined 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 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 identified building 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 available existing drawings, 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 selected to receive a conceptual upgrade design will have a report prepared that will include an introduction summarizing the overall findings and recommendations and 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

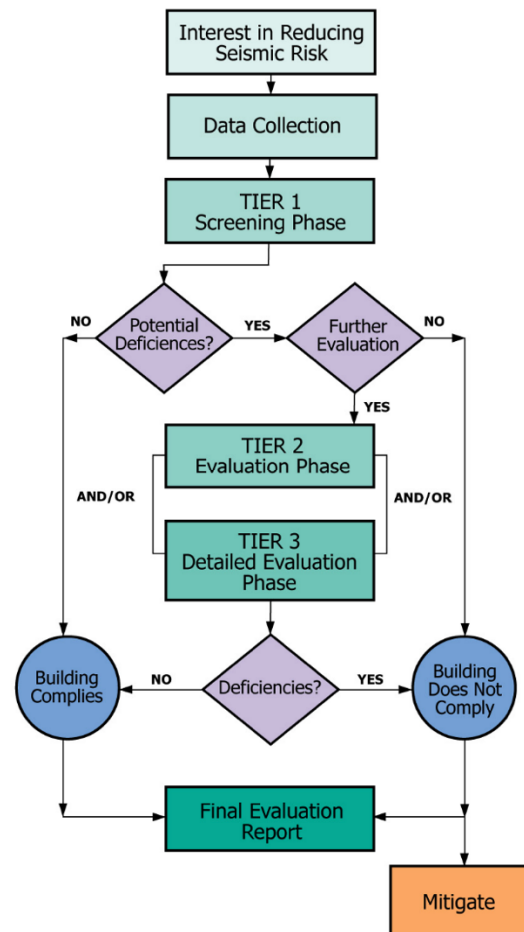


Figure 2-1. Flow Chart and Description of ASCE 41 Seismic Evaluation Procedure.

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 DNR-WGS measured the time-averaged shear-wave velocity at each site to 30 meters (100 feet) below the ground surface, V_{s30} . This measured shear-wave velocity was used to determine the site class. The site class for this building was determined to be **Site Class C**.

2.2.2 Napavine Junior Senior 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 ($\text{Force} = \text{mass} \times \text{acceleration}$). Ground acceleration 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 0.891 g, and the design 1-second period spectral acceleration, S_{D1} , is 0.465 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) and the Basic Safety Earthquake – 2E (BSE-2E) seismic hazard levels. 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.

Table 2.2.1-1 provides the spectral accelerations for the 225-year, 975-year, and 2,475-year return interval events specific to Napavine Junior Senior 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	0.480 g	0.2 Seconds	0.891 g	0.2 Seconds	0.989 g	0.2 Seconds	1.336 g
1.0 Seconds	0.180 g	1.0 Seconds	0.465 g	1.0 Seconds	0.490 g	1.0 Seconds	0.698 g

2.2.3 Napavine Junior Senior High School Annex Structural Performance Objective

The Annex 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 DNR direction, 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 Annex building is classified in ASCE 41 Table 3-1 as a wood-framed shear wall building with flexible diaphragms, **W2**. Wood-framed buildings (W2) include those where the floor and roof is composed of wood trusses, posts, and beams. Seismic forces are resisted by flexible diaphragms and exterior walls sheathed with plywood, OSB, or straight or diagonal wood sheathing. Wall openings, where present, are framed by post and beam systems.

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: 1955
Building Code: 1952 UBC (Assumed)

Number of Stories: 1
Floor Area: 11,274 SF

FEMA Building Type: W2
ASCE 41 Level of Seismicity: High
Site Class: C
Structural Drawings Available: Partial



The Napavine Junior Senior High School Annex Building is a one-story wood frame structure located in Napavine, Washington. The Annex Building, originally constructed in 1955, is a one-story wood-frame structure constructed on level ground. Additions to the building were made in 1973. Overall, the building contains several classrooms, a laboratory, and administrative spaces. The rectangular building is constructed on level ground, with a footprint of approximately 150 feet by 71 feet and an approximate roof height of 15 feet. The total area of the building is approximately 11,300 square feet. The structural system of the building does not appear to be substantially altered since the time of the original construction.

The building wall construction consists of wood stud walls and wood siding. It appears that some of the original openings have been infilled, but it is unclear whether the infills provide any additional support in either the vertical or lateral directions. The walls are connected to the roof system, which consists of premanufactured wood trusses with plywood sheathing. The floors are concrete slabs. Gravity loads are transferred into the ground through wood stud walls into a continuous wall footing system. Lateral loads are transferred into the ground from the wood-sheathed diaphragm to the wood-framed shear walls and into the foundation system.

3.1.2 Building Use

The Annex Building has multiple classrooms, class laboratories, storage room, and various administrative spaces, used by an enrollment of approximately 400 students.

3.1.3 Structural System

Table 3.1.3-1. Structural System Descriptions.

Structural System	Description
Structural Roof	The roof system is composed of wooden gable trusses with a plywood-sheathed diaphragm.
Structural Floor(s)	The structural floor is a 4-inch concrete floor slab.
Foundations	The load bearing walls and shear walls are supported by continuous strip footings.
Gravity System	The gravity system is composed of wooden gable trusses and wood-stud walls.
Lateral System	The lateral system is composed of wood shear walls and a plywood-sheathed diaphragm.

3.1.4 Structural System Visual Condition

Table 3.1.4-1. Structural System Condition Descriptions.

Structural System	Description
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Foundations	Unknown.
Gravity System	No visible signs of corrosion, damage, or deterioration.
Lateral System	No visible signs of corrosion, damage, or deterioration.

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
Load Path	This evaluation cannot be visually verified, but is likely non-compliant. Further investigation should be performed prior to retrofit. Additional shear wall anchoring or other direct connection between the roof diaphragm and the shear walls may be appropriate to mitigate seismic risk.
Diagonally Sheathed and Unblocked Diaphragms	Diaphragm is unblocked with spans greater than 40 feet in locations. Further investigation should be performed prior to retrofit. Diaphragm strengthening through the addition of blocking or additional diaphragm nailing may be appropriate to mitigate seismic risk.

3.2.2 Structural Checklist Items Marked as “U”known

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
Liquefaction	“Low to moderate” 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. The structure appears to be located on a relatively flat site.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.

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
CF-2 Tall Narrow Contents. HR-not required; LS-H; PRMH.	It did not appear that contents taller than 6 feet were adequately restrained. Restraining contents by bracing top of contents to nearest backing wall or providing overturning base restraint may be appropriate to mitigate seismic risk.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	A number of bookshelves appear to support heavy items that do not appear well secured. Heavy items on upper shelves should be restrained by netting or cabling to mitigate seismic risk.

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
LF-1 Independent Support. HR-not required; LS-MH; PRMH.	No existing drawings and inadequate access to verify. Further investigation should be performed.

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 Roof Diaphragm Blocking

The load path was determined to be noncompliant based on the lack of blocking between framing members at the walls. The lack of blocking results in a lack of in-plane lateral resistance between the wall and the diaphragm. To mitigate any seismic risk, it is recommended that 2x blocking be installed between the roof trusses at the exterior walls. The blocking should be attached to the diaphragm with adequate diaphragm edge nailing. It should be attached to the double top plate with A35 clips spaced at 24-inches on center. The ceiling and roofing should be removed and replaced as required.

4.1.2 Add Plywood Sheathing to Existing Interior Walls

The unblocked diaphragm was determined to be inadequate for inadequate spans. After calculating the current diaphragm deflections, it was determined that it would be necessary to provide additional diaphragm support. It is recommended that plywood sheathing be added to the interior walls spanning from east to west. Additionally, cripple walls should span between these interior walls and the diaphragm to create an adequate load path from the diaphragm to the new shear walls. This will help reduce the diaphragm deflections, as well as provide additional shear strength to the building. Simpson HDU Holdowns should also be added at the ends of each of the new shear walls to resist any uplift and overturning forces. Further investigation should be done prior to retrofit to determine whether any of the selected interior walls currently provide any lateral resistance.

4.2 Foundation 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 Washington State liquefaction mapping, the building is located on soils classified with a very low susceptibility to liquefaction. Future seismic upgrade projects should consider conducting 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 soils 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

The building is not located in a tsunami inundation zone according to Washington State DNR tsunami inundation mapping. It is not necessary to consider tsunamis when planning seismic upgrades to this building.

4.4 Nonstructural Recommendations and Considerations

Table 4.2.3-1 identifies nonstructural deficiencies that do not meet the performance objective selected for the Napavine Junior Senior High School Annex Building. 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. 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.

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.

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 building should be performed prior to the start of any demolition work.

Roof Diaphragm Blocking

The existing metal roofing will need to be removed to provide access for nailing new diaphragm blocking to the existing roof sheathing along the roof perimeter and to provide nailing at new east-west cripple walls. The roof should be replaced with metal roofing, vapor barrier, ½-inch coverboard, and continuous rigid R-38 insulation. The thicker roof section will require new wood fascia, gutters, and downspouts.

Attachment of the blocking to the top plate will require removal and replacement of approximately 3 feet of suspended ceiling system along the entire building perimeter. It may be difficult to match the existing acoustic ceiling tiles. The age and condition of the tiles should be evaluated to determine whether it may be best to replace all existing ceiling tiles as a part of an overall modernization project.

Add Plywood Sheathing to Existing Interior Walls

To accommodate installation of new plywood sheathing and cripple walls at the east-west interior walls, wall finishes, casework, and the existing ceiling and lighting should be removed. New GWB is recommended for the walls. Existing electrical outlets, switches, and other items will need to be reinstalled to accommodate the thickness of the new plywood sheathing. Paint and new rubber base should be installed to match adjacent wall finishes. The ceiling should be replaced with a suspended acoustical ceiling system. Given the limited scope of work, existing lighting may be reinstalled, or LED lighting might be considered to reduce energy consumption. Existing casework should be reinstalled.

Contents and Furnishings

Buildings often contain various tall and narrow furniture, such as shelving and storage units, that are freestanding away from any backing walls. High book shelving, for example, can be highly susceptible to toppling if not anchored properly to the backing walls or to each other, and can become a life safety hazard. It is recommended that maintenance and facility staff verify that the tops of the shelving units are braced or anchored to the nearest backing wall or provide overturning base restraint. Heavy items weighing more than 20 pounds on upper shelves or cabinet furniture should also be restrained by netting or cabling to avoid becoming falling hazards to students or faculty below.

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 Upgrades Costs

An opinion of probable project costs of the concept-level seismic upgrade recommendations provided in this report is included in Appendix C. The scope of work to develop the probable costs is based on input from 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 –20% to +50%.

The estimated total cost (construction costs plus soft costs) to mitigate the deficiencies identified in the Tier 1 checklists of the Napavine Junior Senior High School Annex Building ranges between approximately \$988K and \$1.85M (-20%/+50%). The baseline estimated total cost to seismically upgrade this building is approximately \$1.24M. On a per-square-foot basis, the baseline seismic upgrade cost is estimated to be approximately \$109 per square foot in 4Q 2022 dollars, with a range between \$87 per square foot and \$164 per square foot.

4.5.1 Opinion of Probable Construction Costs

This conceptual opinion of construction costs 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 4.5.2.

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 opinion 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 project 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 on 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 Opinion of Escalation Rates

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)	
Napavine Annex Building	W2	High / C	Structural					
			Life Safety	11,274 SF	\$45 - \$84 (\$504K) - (\$945K)	\$56 (\$630K)		
			Nonstructural					
			Life Safety	11,274 SF	\$18 - \$33 (\$202K) - (\$378K)	\$22 (\$252K)		
			Total					
				11,274 SF	\$62 - \$117 (\$706K) - (\$1.32M)	\$78 (\$882K)		
Estimated Soft Costs:							\$353K	
Total Estimated Project Costs:							\$1.24M	

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. Napavine, Napavine Junior Senior High School, Annex

1.1 Building Description

Building Name:	Annex
Facility Name:	Napavine Junior Senior High School
District Name:	Napavine
ICOS Latitude:	46.577151
ICOS Longitude:	-122.904116
ICOS Building ID:	58513
ASCE 41 Bldg Type:	W2
Enrollment:	400
Gross Sq. Ft. :	11274
Year Built:	1955
Number of Stories:	1
S _{XS} BSE-2E:	0.989
S _{X1} BSE-2E:	0.49
ASCE 41 Level of Seismicity:	High
Site Class:	C
V _{S30} (m/s):	375
Liquefaction Potential:	very low
Tsunami Risk:	No
Structural Drawings Available:	Partial
Evaluating Firm:	WRK Engineers



** Liquefaction Potential and Tsunami Risk is based on publicly available state geologic hazard mapping.*

The Napavine Junior/Senior High School annex is a one-story wood frame structure constructed in 1973. The building is constructed on level ground and located in Napavine, Washington. The building is rectangular shaped and approximately 150 feet by 71 feet with an approximate roof height of 15 feet. The structural system of the building does not appear to be substantially altered since the time of the original construction.

The building wall construction consists of wood stud walls and wood siding. The walls are connected to the roof system which consists of premanufactured wood trusses with plywood sheathing. The floors are concrete slabs. Gravity loads are transferred into the ground through wood stud walls into a continuous wall footing system.

1.1.1 Building Use

The building includes classrooms, class laboratories, storage rooms and office spaces.

1.1.2 Structural System

Table 1-1. Structural System Description of Napavine Junior Senior High School

Structural System	Description
Structural Roof	The roof system is composed of wooden gable trusses with a plywood-sheathed diaphragm.
Structural Floor(s)	The structural floor is a 4-inch concrete floor slab.
Foundations	The load bearing walls and shear walls are supported by continuous wall footings.
Gravity System	The gravity system is composed of wooden gable trusses and wood-stud walls.
Lateral System	The lateral system is composed of wood shear walls and a plywood-sheathed diaphragm.

1.1.3 Structural System Visual Condition

Table 1-2. Structural System Condition Description of Napavine Junior Senior High School

Structural System	Description
Structural Roof	No visible signs of corrosion, damage, or deterioration.
Structural Floor(s)	No visible signs of corrosion, damage, or deterioration.
Foundations	Unknown.
Gravity System	No visible signs of corrosion, damage, or deterioration.
Lateral System	No visible signs of corrosion, damage, or deterioration.



Figure 1-1. Central Hallway of the Building

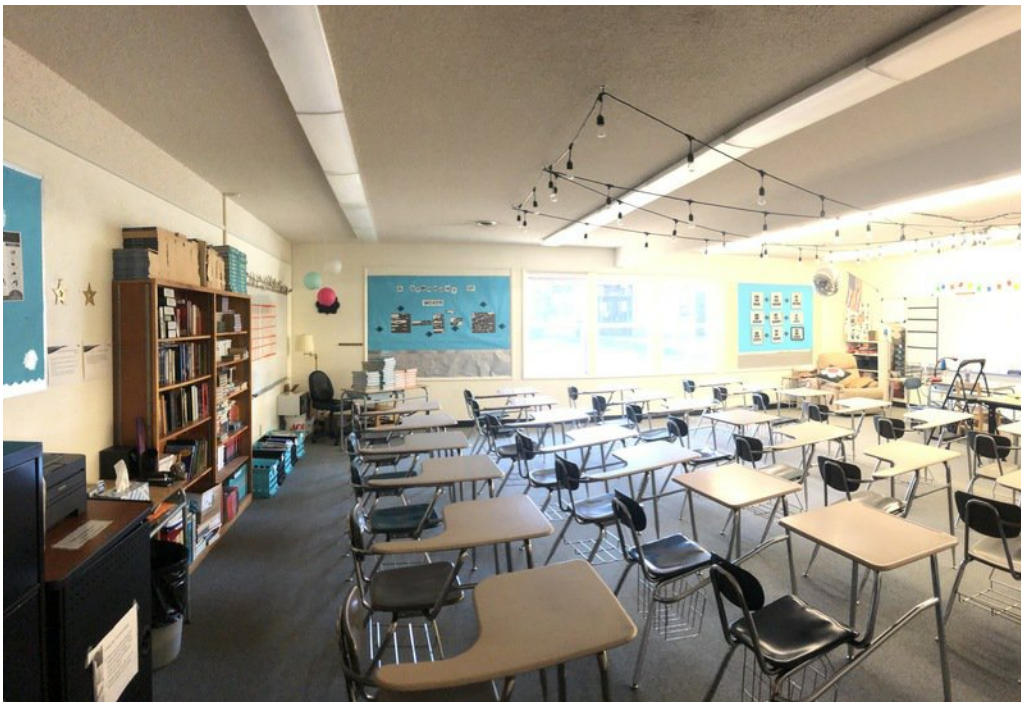


Figure 1-2. Unbraced Shelves and Storage Units to the Left



Figure 1-3. Movable Partition Wall to the Right



Figure 1-4. Suspended Ceiling in the Hallway



Figure 1-5. Gypsum Board Ceiling in a Typical Classroom



Figure 1-6. Building South Wall



Figure 1-7. Building Exterior Wall



Figure 1-8. Building West Wall

1.1.4 Earthquake Performance Rating System - Structural Safety Rating

The seismic evaluation items from the ASCE 41 Tier 1 seismic evaluation checklist have been translated to a Structural Safety star-rating using the *EPRS ASCE 41-13 Translation Procedure*. There are two other safety sub-ratings using the *EPRS Translation Procedure*: a Geologic safety sub-rating and a Nonstructural safety sub-rating, that are not included below.

The structural safety star-rating below is a preliminary rating based on the information available for this study. The geologic checklist items have been excluded from the structural safety star-rating. If a building's structural safety star-rating is to be improved, it may also be necessary to further assess the geologic conditions of the building site. Determining the final star-rating of a building is intended to be an iterative process and preliminary ratings will often times be conservative until more field investigation, structural analysis, and engineering judgment is performed by a structural engineer. The intent in providing a preliminary star-rating as part of this study is to provide school districts with the action lists below to further improve the seismic performance and safety of the buildings that were assessed. The tables below indicate the Unknown (U) or Noncompliant (NC) structural seismic evaluation items that should be mitigated or further investigated to improve the Earthquake Performance Rating System (EPRS) structural safety rating for this building.




1-STAR	★	Risk of Collapse in Multiple or Widespread Locations (Expected performance as a whole would lead to multiple or widespread conditions known to be associated with earthquake-related collapse resulting in injury, entrapment, or death.)
2-STAR	★★	Risk of Collapse in Isolated Locations (Expected performance in certain locations within or adjacent to the building would lead to conditions known to be associated with earthquake-related collapse resulting in injury, entrapment, or death.)
3-STAR	★★★	Loss of Life Unlikely (Expected performance results in conditions that are unlikely to cause severe structural damage or loss of life). A 3-star rating meets the Tier 1 Life Safety (LS) structural performance objective.
4-STAR	★★★★	Serious Injuries Unlikely (Expected performance results in conditions that are associated with limited structural damage and are unlikely to cause serious injuries).
5-STAR	★★★★★	Injuries and Entrapment Unlikely (Expected performance results in conditions that are associated with minimal structural damage and are unlikely to cause injuries or keep people from exiting the building). A 5-star rating meets the Tier 1 Immediate Occupancy (IO) structural performance objective.

Table 1-3. Identified Seismic Evaluation Items to Address for an improved  2-STAR Rating

Evaluation Item	Tier 1 Screening	Description
Load Path	Noncompliant	This evaluation cannot be visually verified, but is likely non-compliant. Further investigation should be performed prior to retrofit. Additional shear wall anchoring or other direct connection between the roof diaphragm and the shear walls may be appropriate to mitigate seismic risk.

Note: All of the evaluation items in Table 3 need to be assessed as Compliant (C) in order to achieve a 2-Star Structural Safety Rating.

Table 1-4. Additional Seismic Evaluation Items to Mitigate or Further Investigate for an improved  3-STAR Rating

Evaluation Item	Tier 1 Evaluation	Description
Diagonally Sheathed and Unblocked Diaphragms	Noncompliant	Diaphragm is unblocked with spans greater than 40 feet in locations. Further investigation should be performed prior to retrofit. Diaphragm strengthening through the addition of blocking or additional diaphragm nailing may be appropriate to mitigate seismic risk.

Note: Tables 3 and 4 are cumulative. All of the evaluation items in Table 4 need to be assessed as Compliant (C) in addition to all of the evaluation items in Table 3 being assessed as Compliant (C), in order to achieve a 3-Star Structural Safety Rating.

The Structural Safety star-rating contained in this report is based on ASCE 41 Tier 1 Screening Checklists only. These seismic screening checklists are often the first step employed by structural engineers when trying to determine the seismic vulnerabilities of existing buildings and to begin a process of mitigating these seismic vulnerabilities. School district facilities management personnel and their design consultants should be able to take advantage of this information to help inform and address seismic risks in existing or future renovation, repair, or modernization projects.

It is important to note that information used for these school seismic screenings was limited to available construction drawings and limited site observations by our team of licensed structural engineers. In some cases, construction drawings were not available for review. Due to the limited scope of the study, our team of engineers were not able to perform more-detailed investigations above ceilings, behind wall finishes, in confined spaces, or in other areas obstructed from view. In many cases, further investigation and engineering analysis may find that items marked as unknown or noncompliant may not require seismic mitigation if it is shown that the existing structure is acceptable in its current state. In these cases, further investigation and engineering analysis should be conducted ahead of a seismic upgrade construction project, especially when a building is marked as having many unknown items.

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 1-5. Identified Structural Seismic Deficiencies for Napavine Napavine Junior Senior High School Annex

Deficiency	Description
Load Path	This evaluation cannot be visually verified, but is likely non-compliant. Further investigation should be performed prior to retrofit. Additional shear wall anchoring or other direct connection between the roof diaphragm and the shear walls may be appropriate to mitigate seismic risk.
Diagonally Sheathed and Unblocked Diaphragms	Diaphragm is unblocked with spans greater than 40 feet in locations. Further investigation should be performed prior to retrofit. Diaphragm strengthening through the addition of blocking or additional diaphragm nailing may be appropriate to mitigate seismic risk.

1.2.2 Structural Checklist Items Marked as Unknown

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 1-6. Identified Structural Checklist Items Marked as Unknown for Napavine Napavine Junior Senior High School Annex

Unknown Item	Description
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. very 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. The structure appears to be located on a relatively flat site.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.

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 1-7. Identified Nonstructural Seismic Deficiencies for Napavine Napavine Junior Senior High School Annex

Deficiency	Description
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	It did not appear that contents taller than 6 feet were adequately restrained. Restraining contents by bracing top of contents to nearest backing wall or providing overturning base restraint may be appropriate to mitigate seismic risk.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	A number of bookshelves appear to support heavy items that do not appear well secured. Heavy items on upper shelves should be restrained by netting or cabling to mitigate seismic risk.

1.3.2 Nonstructural Checklist Items Marked as Unknown

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 1-8. Identified Nonstructural Checklist Items Marked as Unknown for Napavine Napavine Junior Senior High School Annex

Unknown Item	Description
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	No existing drawings and inadequate access to verify. Further investigation should be performed.

Napavine, Napavine Junior Senior High School, Annex

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			This evaluation cannot be visually verified, but is likely non-compliant. Further investigation should be performed prior to retrofit. Additional shear wall anchoring or other direct connection between the roof diaphragm and the shear walls may be appropriate to mitigate seismic risk.
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		There are no immediately adjacent structures. It appears that the sections of the building are positively connected with no seismic joints.
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 were no interior mezzanines observed in the building.

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		The building is a single-story structure.

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	The building is a single-story structure.
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				Vertical elements appear to be continuous to the foundation.
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	The building is a single-story structure.
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	The building is a single-story structure.
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	The building has a flexible diaphragm, which typically is not stiff enough to develop torsional effects.

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. very 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. The structure appears to be located on a relatively flat site.
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				Building walls have favorable aspect ratios.
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				All foundation elements are continuous around the perimeter of the structure and are interconnecting.

17-6 Collapse Prevention Structural Checklist for Building Type W2

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
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				There are (2) or more lines of shear walls present in each direction.
Shear Stress Check	The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the following values: Structural panel sheathing – 1,000 lb/ft; Diagonal sheathing – 700 lb/ft; Straight sheathing – 100 lb/ft; All other conditions – 100 lb/ft. (Tier 2: Sec. 5.5.3.1.1; Commentary: Sec. A.3.2.7.1)	X				Per the Quick Check procedure, the shear stress is compliant.
Stucco (Exterior Plaster) Shear Walls	Multi-story buildings do not rely on exterior stucco walls as the primary seismic-force-resisting system. (Tier 2: Sec. 5.5.3.6.1; Commentary: Sec. A.3.2.7.2)			X		The building is a single-story structure.
Gypsum Wallboard or Plaster Shear Walls	Interior plaster or gypsum wallboard is not used for shear walls on buildings more than one story high with the exception of the uppermost level of a multi-story building. (Tier 2: Sec. 5.5.3.6.1; Commentary: Sec. A.3.2.7.3)			X		The building is a single-story structure.
Narrow Wood Shear Walls	Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. (Tier 2: Sec. 5.5.3.6.1; Commentary: Sec. A.3.2.7.4)	X				It appears that shear walls have an aspect ratio less than 2-to-1.
Walls Connected Through Floors	Shear walls have an interconnection between stories to transfer overturning and shear forces through the floor. (Tier 2: Sec. 5.5.3.6.2; Commentary: Sec. A.3.2.7.5)			X		The building is a single-story structure.
Hillside Site	For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope have an aspect ratio less than 1-to-1. (Tier 2: Sec. 5.5.3.6.3; Commentary: Sec. A.3.2.7.6)			X		Building located on a level site.
Cripple Walls	Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels. (Tier 2: Sec. 5.5.3.6.4; Commentary: Sec. A.3.2.7.7)			X		There does not appear to be any cripple walls.

Openings	Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces. (Tier 2: Sec. 5.5.3.6.5; Commentary: Sec. A.3.2.7.8)				X		No walls with openings greater than 80% of the length.
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Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Wood Posts	There is a positive connection of wood posts to the foundation. (Tier 2: Sec. 5.7.3.3; Commentary: Sec. A.5.3.3)			X		It does not appear that there are any wood posts at the foundation.
Wood Sills	All wood sills are bolted to the foundation. (Tier 2: Sec. 5.7.3.3; Commentary: Sec. A.5.3.4)	X				It appears that wood sills are bolted to the foundation.
Girder-Column Connection	There is a positive connection using plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 5.7.4.1; Commentary: Sec. A.5.4.1)			X		There does not appear to be any girder-column connections.

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

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Wood Sill Bolts	Sill bolts are spaced at 6 ft (1.8 m) or less with acceptable edge and end distance provided for wood and concrete. (Tier 2: Sec. 5.7.3.3; Commentary: Sec. A.5.3.7)	X				Sill bolts appear to be spaced less than 6 ft on center and specified to be in the center of the wood sill plate.

Diaphragms

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				The diaphragms do not appear to have expansion joints or to be composed of split-level floors.
Roof Chord Continuity	All chord elements are continuous, regardless of changes in roof elevation. (Tier 2: Sec. 5.6.1.1; Commentary: Sec. A.4.1.3)	X				Diaphragm roof chord elements observed are continuous.
Diaphragm Reinforcement at Openings	There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. (Tier 2: Sec. 5.6.1.5; Commentary: Sec. A.4.1.8)			X		No openings larger than 50% of the building width in either major plan dimension.
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		No straight sheathed diaphragms.
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				Diaphragm has wood structural panel sheathing overlay.

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 have aspect ratios less than or equal to 4-to-1. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.3)		X		Diaphragm is unblocked with spans greater than 40 feet in locations. Further investigation should be performed prior to retrofit. Diaphragm strengthening through the addition of blocking or additional diaphragm nailing may be appropriate to mitigate seismic risk.
Other Diaphragms	The 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			Diaphragms consist of wood material.

Napavine, Napavine Junior Senior High School, Annex

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		The 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		The 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		The building does not have emergency power.
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		The building is a single-story structure.
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		The 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		

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		No hazardous material-containing equipment observed.
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		Breakable containers with hazardous contents were not observed.
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		Did not observe any piping or ductwork conveying hazardous materials.

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		Did not observe any piping or ductwork conveying hazardous materials.
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		Did not observe any piping or ductwork conveying hazardous materials.
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 have seismic joints

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		URM partitions were not observed.
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		No masonry or hollow-clay tile partitions supported by an integrated ceiling system observed in the building.
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		No rigid cementitious partitions were observed.
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		
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		
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		

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 ft ² (1.1 m ²) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)			X		No suspended lath and plaster ceilings observed.
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 ft ² (1.1 m ²) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)			X		No suspended gypsum board ceilings observed.
C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft ² (13.4 m ²) 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		
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 ft ² (13.4 m ²) 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		
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		
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 ft ² (13.4 m ²) 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		
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 ft ² (232.3 m ²) 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		

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	No existing drawings and inadequate access to verify. Further investigation should be performed.
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		
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		

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/ft ² (0.48 kN/m ²) 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 exterior 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 does not have any exterior cladding components.

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 is a single-story structure.
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 exterior cladding components.
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 exterior cladding components.
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 exterior cladding components.
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 exterior cladding components.
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 ft ² (1.5 m ²) 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		The building does not have any exterior cladding components.

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 ft ² (0.25 m ²), 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		The building does not have any 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		The building does not have any 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		The building does not have any 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		The building does not have any 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		The building does not have any 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		The building does not have any 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		
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		

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-to-thickness 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		There are no URM parapets or cornices.

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				Canopies appeared to be well fastened to structure.
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		There are no concrete parapets.
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, parapets, signs and other ornamentation or appendages.

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		There are no URM chimneys.
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		There are no masonry chimneys.

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 are no stairs.

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 are no stairs.
---	---	--	--	--	---	--	----------------------

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		Does not appear that there are any industrial storage racks taller than 12 feet 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			It did not appear that contents taller than 6 feet were adequately restrained. Restraining contents by bracing top of contents to nearest backing wall or providing overturning base restraint may be appropriate to mitigate seismic risk.
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			A number of bookshelves appear to support heavy items that do not appear well secured. Heavy items on upper shelves should be restrained by netting or cabling to mitigate seismic risk.
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		
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		
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		

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		There was equipment in the mechanical rooms that did not appear to be braced. Bracing or anchoring for fall prone 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		The building does not appear to have any equipment weighing more than 75lbs.
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		No equipment taller than 6 feet was observed.
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		
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		
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		
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		
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		
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		

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		
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		
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		
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		

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 ft ² (0.56 m ²) 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		
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		
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		

Elevators

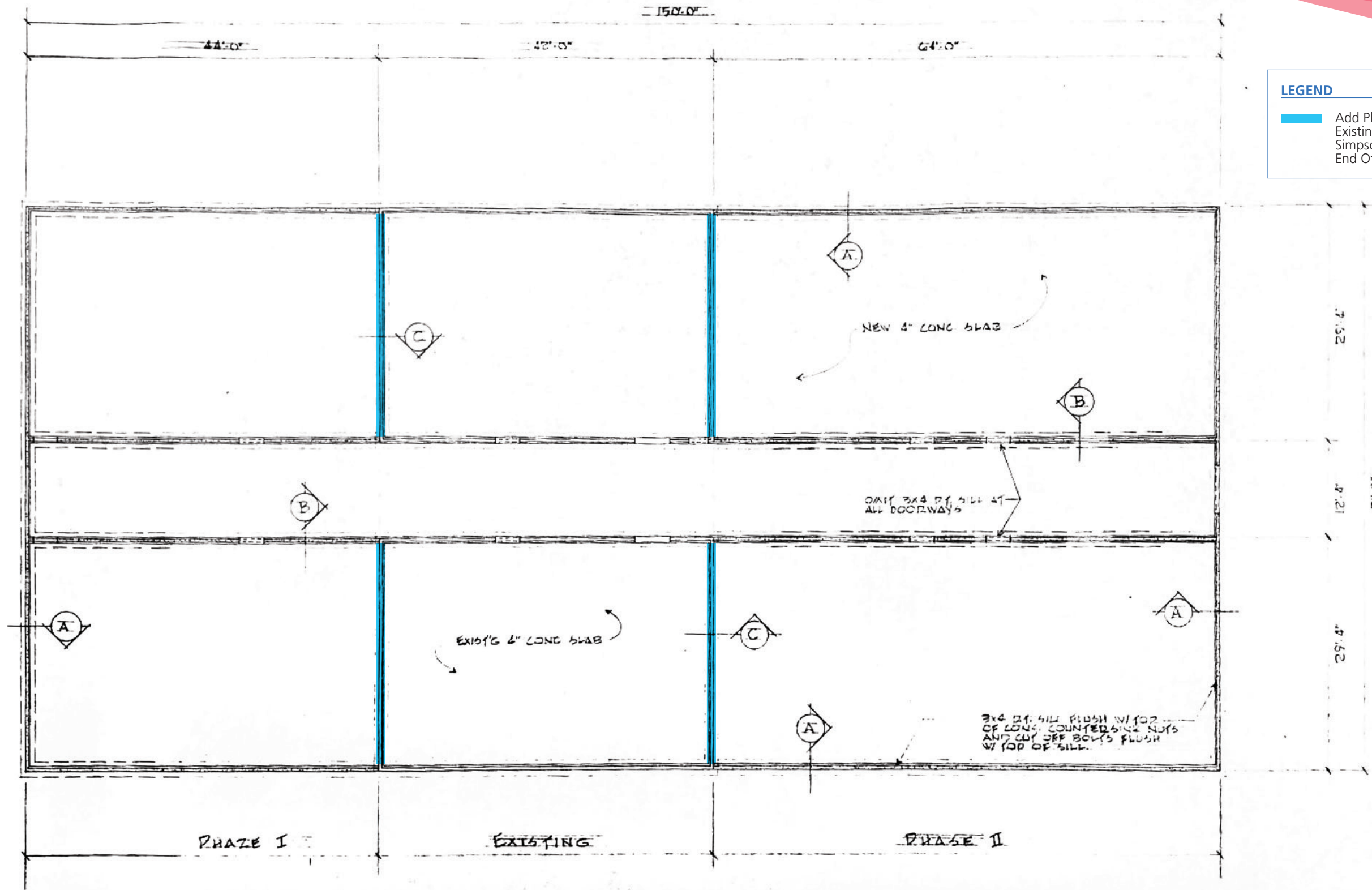
EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
EL-1 Retainer Guards. HR-not required; LS-H; PR-H.	Sheaves and drums have cable retainer guards. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.1)			X		The building does not have any elevators.
EL-2 Retainer Plate. HR-not required; LS-H; PR-H.	A 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		The building does not have any elevators.

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		
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		
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		
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		
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		
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		
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		

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Appendix B: Concept-Level Seismic Upgrade Figures

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LEGEND

- █ Add Plywood Sheathing To Existing Interior Walls, Add Simpson HDU Hold Downs At End Of Each Wall



Figure 2 – Conceptual Foundation Plan

LEGEND

- Attach Roof Sheathing To New Cripple Walls Below With Adequate Panel Edge Nailing To Transfer Shear Loads To The New Shear Walls
- Install New Blocking At All Exterior Walls, Nail Existing Plywood Roof Sheathing To The New Blocking With Panel Edge Nailing & Attach Blocking To Existing Exterior Wall Top Plate With A35 At 24" OC

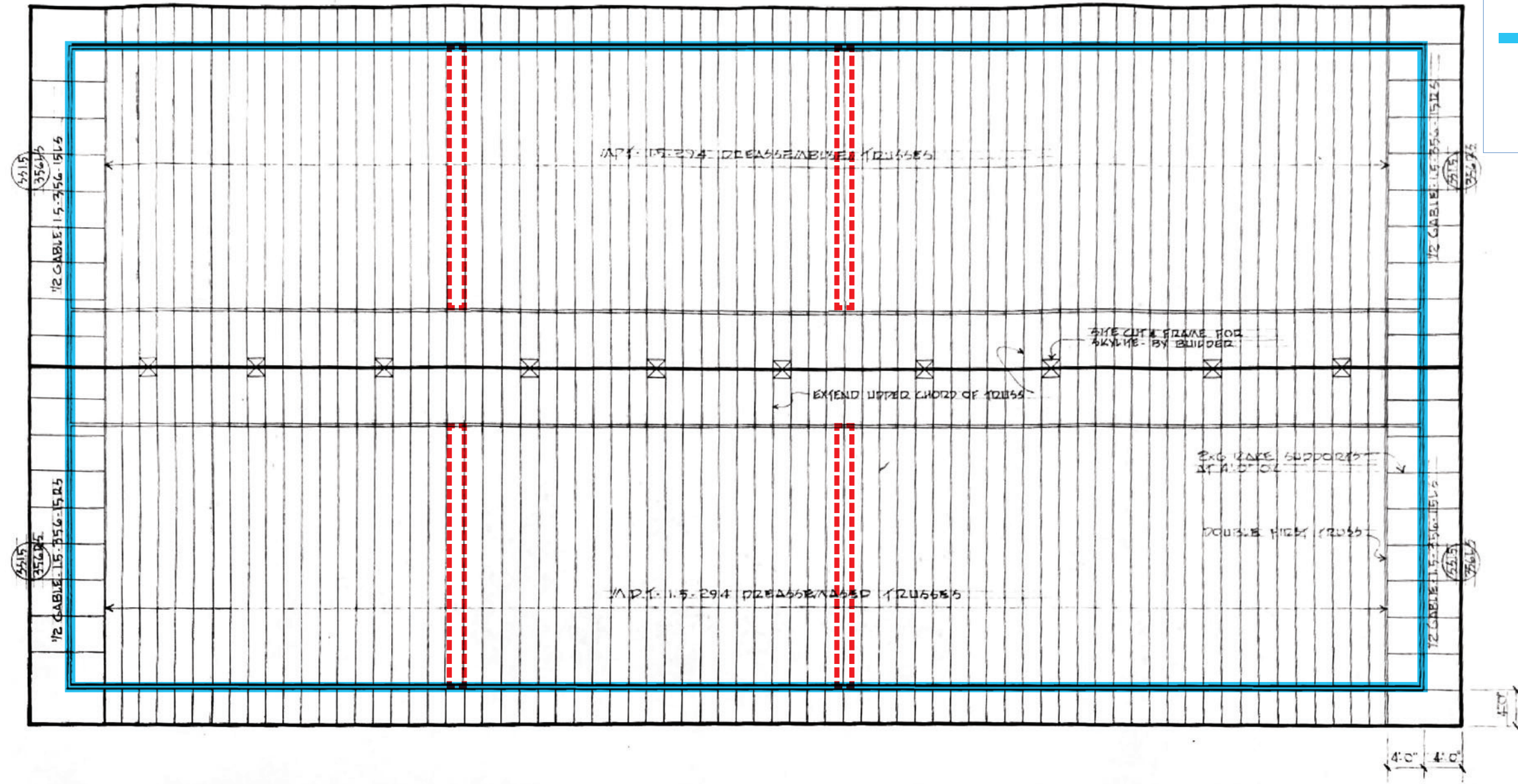


Figure 1 - Conceptual Roof Framing Plan

Appendix C: Opinion of Probable Construction Costs

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

Napavine JSHS Annex Building

Master Estimate Summary

Project Name	Construction Cost Type	Estimated Construction Cost
Napavine JSHS Annex Building	Structural Costs	\$630,006
Napavine JSHS Annex Building	Non-Structural Costs	\$252,003
TOTAL ESTIMATED CONSTRUCTION COST →		\$882,009

Soft Costs	Soft Costs % Construction Cost	Estimated Soft Costs
Project Soft Cost Allowance	40.0%	\$352,804
		Sum of the Above
TOTAL ESTIMATED PROJECT COST →		\$1,234,812

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.



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Structural Costs

Napavine JSHS Annex Building

Wa State School Seismic
 Name: **Safety Assessment Phase 2**

	Areas	sqft
Napavine JSHS Annex Building Second Name:	Building Area	11,300
Location: Napavine, WA		
Design Phase: ROM Cost Estimates		
Date of Estimate: March 12, 2021		
Date of Revision: April 12, 2021		
Month of Cost Basis: 1Q, 2021	Total Areas	11,300

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below \$ 428,018

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	\$ 42,802	\$ 470,820
General Conditions	10.0%	\$ 42,802	\$ 513,621
Home Office Overhead	5.0%	\$ 21,401	\$ 535,022
Profit	6.0%	\$ 25,681	\$ 560,703
Escalation Included-Costs in 4Q, 2022 Dollars	12.4%	\$ 69,303	\$ 630,006
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 --—————>	\$ 630,006	\$ 55.75
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --—————>	\$ 504,005	\$ 44.60
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --—————>	\$ 945,009	\$ 83.63

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											
	Hold Down System - Nail to Wood Studs, Epoxy Anchor Bolt	8 each		\$ 128.76	\$ 1,030.08	\$ 93.24	\$ 745.92	\$ 13.32	\$ 106.56	\$ 235.32	\$ 1,882.56
Superstructure											
Upper Floor Systems											
	New Shearwall with 1/2" Plywood Sheathing At Existing Wood Stud Walls - Connect Above - Remove GWB and Reinstall	1,770 sqft		\$ 1.19	\$ 2,099.04	\$ 0.58	\$ 1,033.86	\$ 0.11	\$ 187.97	\$ 1.88	\$ 3,320.87
Roof Systems											
	2X Blocking Installed at Roof Perimeter with A35 Clip at 24" o.c.	442 lnft		\$ 4.02	\$ 1,776.84	\$ 1.98	\$ 875.16	\$ 0.36	\$ 159.12	\$ 6.36	\$ 2,811.12
	2X Cripple Wall Over Existing Interior Walls - Nail to Roof Sheathing	118 lnft		\$ 9.38	\$ 1,106.84	\$ 4.62	\$ 545.16	\$ 0.84	\$ 99.12	\$ 14.84	\$ 1,751.12
Roofing System											
	Remove Roofing System Down to Plywood Deck	13,200 sqft		\$ 4.04	\$ 53,295.00	\$ 0.21	\$ 2,805.00	\$ 0.26	\$ 3,366.00	\$ 4.51	\$ 59,466.00
	New Metal Roofing System with R-38 Rigid Insulation, Flashing and Trim and Downspout Roof Drainage System	13,200 sqft		\$ 8.78	\$ 115,830.00	\$ 10.73	\$ 141,570.00	\$ 1.17	\$ 15,444.00	\$ 20.67	\$ 272,844.00
Interior Wall/Door/Casework/Specialties Systems											
	Remove and Reinstall Floor Finish Systems-Allow 50% of the Floor Area	5,650 sqft		\$ 3.01	\$ 16,989.55	\$ 1.84	\$ 10,412.95	\$ 0.29	\$ 1,644.15	\$ 5.14	\$ 29,046.65
	Remove and Reinstall Wall Finish Systems-Allow 30% of the Floor Area	3,390 sqft		\$ 2.79	\$ 9,458.10	\$ 1.71	\$ 5,796.90	\$ 0.27	\$ 915.30	\$ 4.77	\$ 16,170.30
	Remove Ceiling and Reinstall New ACT Ceiling Systems-Allow 50% of the Floor Area	5,650 sqft		\$ 4.22	\$ 23,820.40	\$ 2.58	\$ 14,599.60	\$ 0.41	\$ 2,305.20	\$ 7.21	\$ 40,725.20
Subtotal of the Direct Cost of Construction											\$ 428,018



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Non-Structural Costs

Napavine JSHS Annex Building

Wa State School Seismic	Areas	sqft
Name: Safety Assessment Phase 2		
Second Name: Napavine JSHS Annex Building	Building Area	11,300
Location: Napavine, WA		
Design Phase: ROM Cost Estimates		
Date of Estimate: March 12, 2021		
Date of Revision: April 12, 2021		
Month of Cost Basis: 1Q, 2021	Total Areas	11,300

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below \$ 171,207

	Percentage of Previous Subtotal	Amount		Running Subtotal
Scope Contingency	10.0%	\$ 17,121	\$	188,328
General Conditions	10.0%	\$ 17,121	\$	205,449
Home Office Overhead	5.0%	\$ 8,560	\$	214,009
Profit	6.0%	\$ 10,272	\$	224,281
Escalation Included-Costs in 4Q, 2022 Dollars	12.4%	\$ 27,721	\$	252,003
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 --—————→	\$ 252,003		\$ 22.30
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --—————→	\$ 201,602		\$ 17.84
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --—————→	\$ 378,004		\$ 33.45

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*												
M/E/P/FP Systems												
	Mechanical/Electrical/Fire Protection Systems *	11,300 sqft		\$ 7.86	\$ 88,833.89	\$ 6.43	\$ 72,682.27	\$ 0.86	\$ 9,690.97	\$ 15.15	\$ 171,207.13	
*Allows 40 percent of existing nonstructural systems M/E/P/FP require upgrades/replacement.												
Subtotal of the Direct Cost of Construction				Napavine JSHS Annex Building								\$ 171,207

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Appendix D: Earthquake Performance Assessment Tool (EPAT) Worksheet

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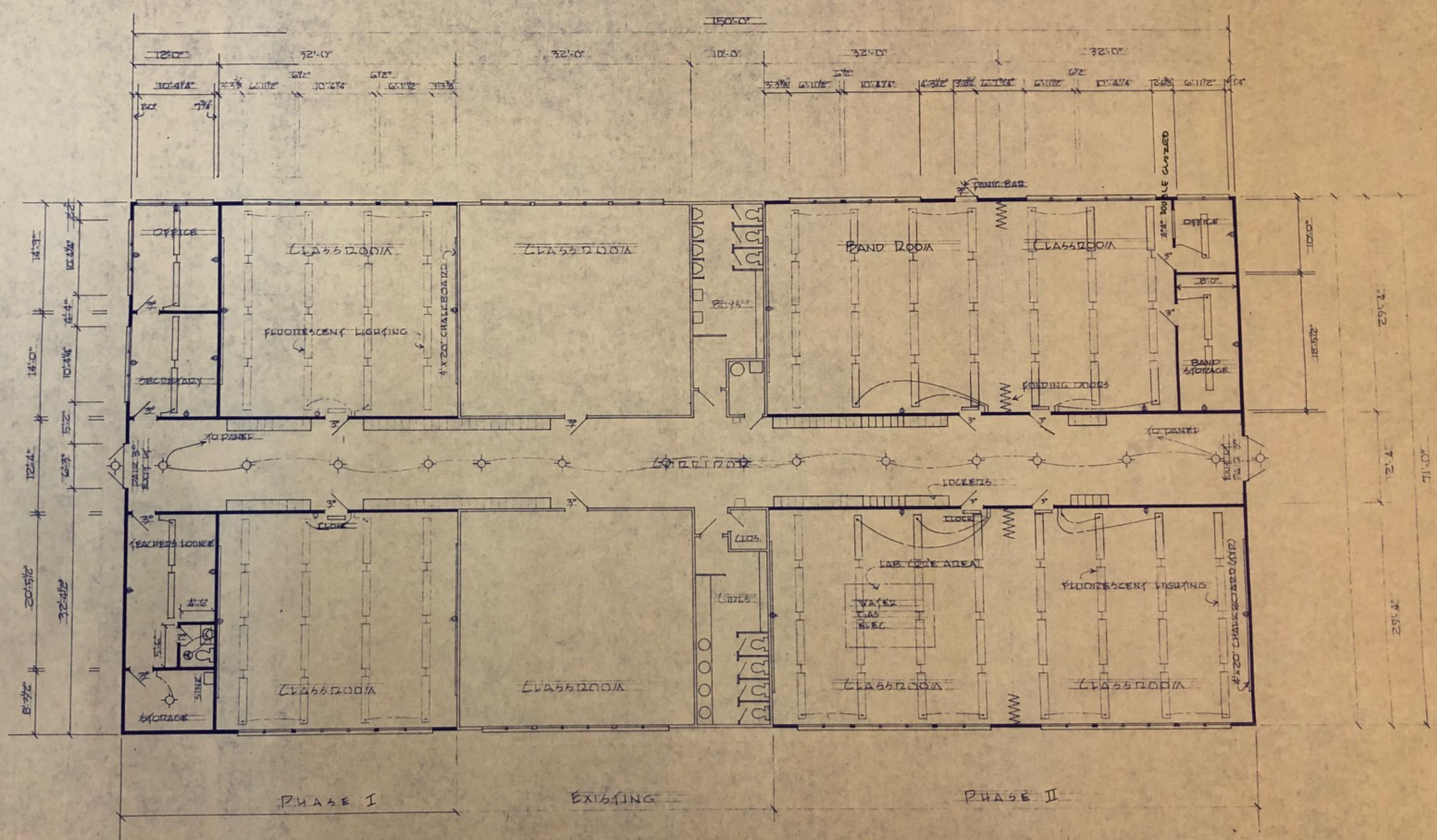
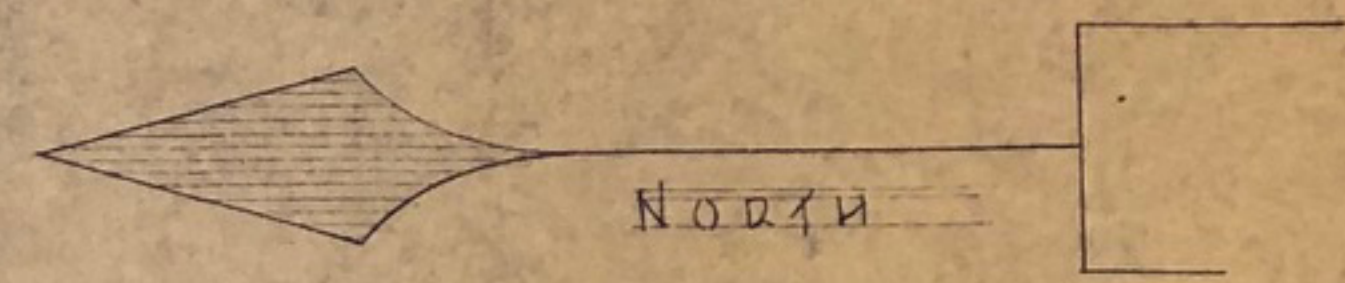
Washington Schools Earthquake Performance Assessment Tool (EPAT) RESULTS SUMMARY

District Name	Napavine		Existing Building Life Safety Risk & Priority for Retrofit or Replacement	
School Name	Napavine Junior Senior High School			
Building Name	Annex			
Building Data				
HAZUS Building Type	W2	Wood, Commercial & Industrial (>5,000 SF)		
Year Built	1955	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	High	Frequency and severity of earthquakes at this site		
Percentile S _s Among WA K-12 Campuses	48%	Earthquake ground shaking hazard is higher than 48% of WA campuses.		
Site Class (Soil or Rock Type)	C	Very Dense Soil and Soft Rock		
Liquefaction Potential	Very Low	Liquefaction increases the risk of major damage to a building		
Combined Earthquake Hazard Level	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	49%	43%	Moderate-High	Red
Life Safety Retrofit Building	9.7%	3.3%	Very Low	Green
Current Code Building	7.5%	1.9%	Very Low	Green
1. 2/3rds of the 2% in 50 year ground motion		4. Based on probability of Complete Damage State.		
2. Percentage of building replacement value.		5. Most likely post-earthquake damage state per ATC-20.		
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.				
Source for the Data Entered into the Tool				
Building Evaluated By:	Brian Knight			
Person(s) Who Entered Data in EPAT:	Rami Sabra, Reid Middleton			
User Overrides of Default Parameters:	Building Design Code Year, Latitude, Longitude, Site Class, Liquefaction			

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Appendix E: Napavine Junior Senior High School Annex Building Existing Drawings

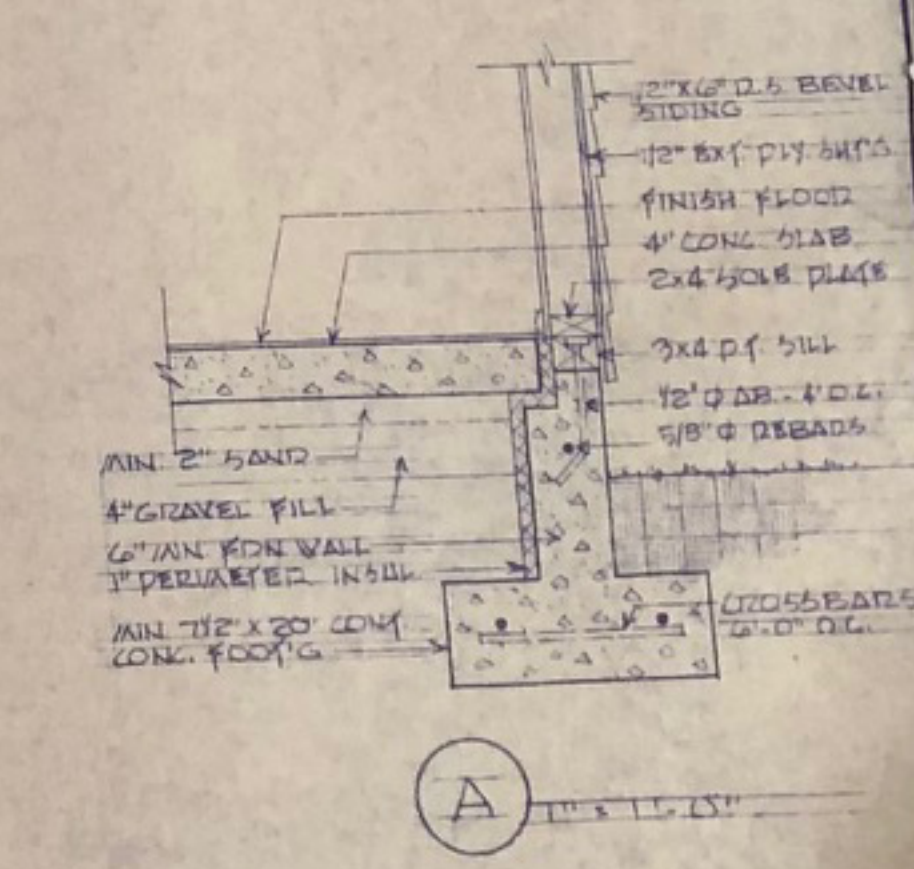
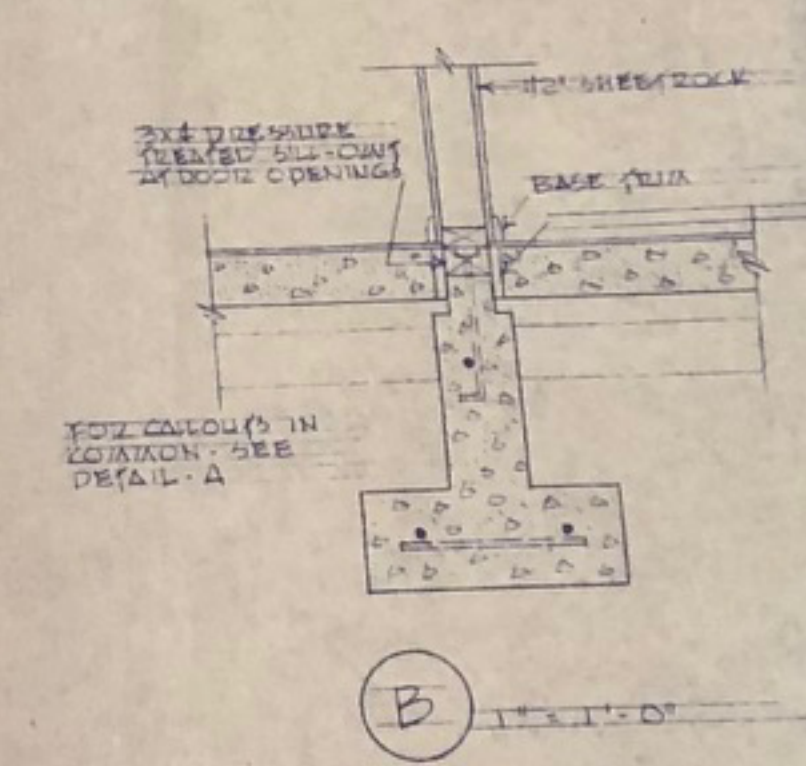
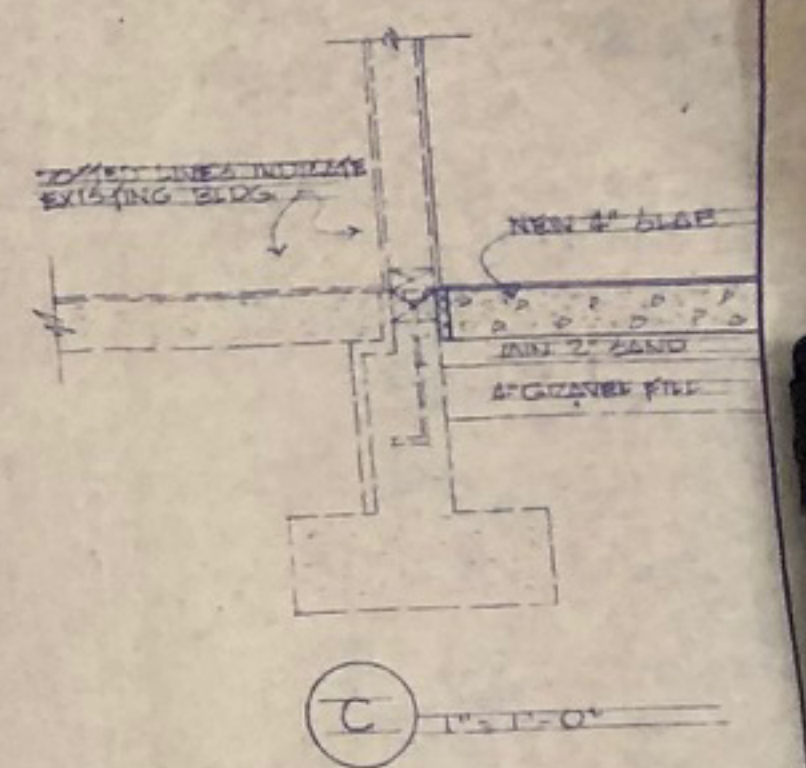
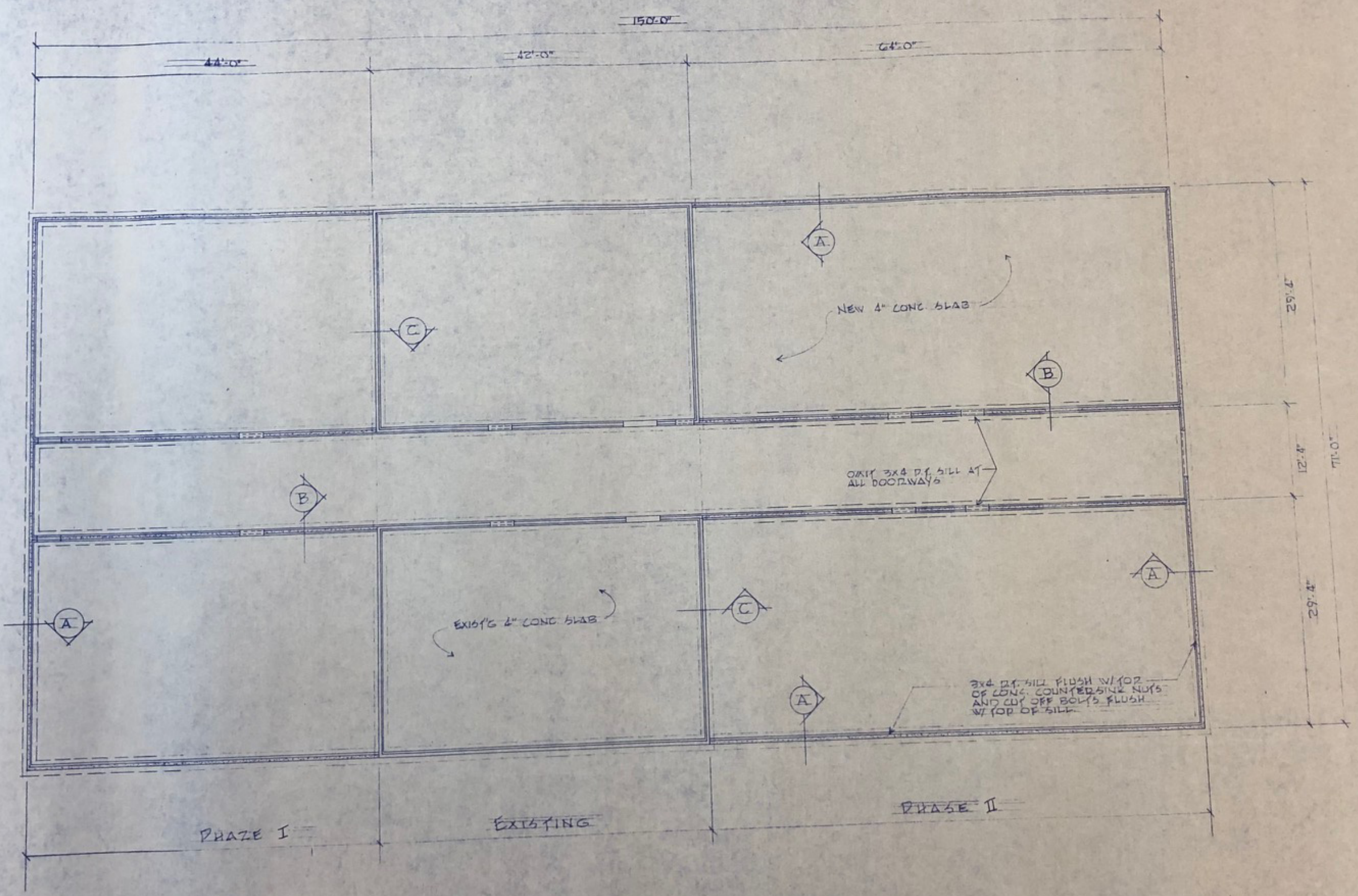
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LOAD PLAN
1" = 12'-0"

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FOUNDATION PLAN
 1/8" = 1'-0"

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CHEHALIS MANUFACTURED BY WEST COAST MILLS WASHINGTON

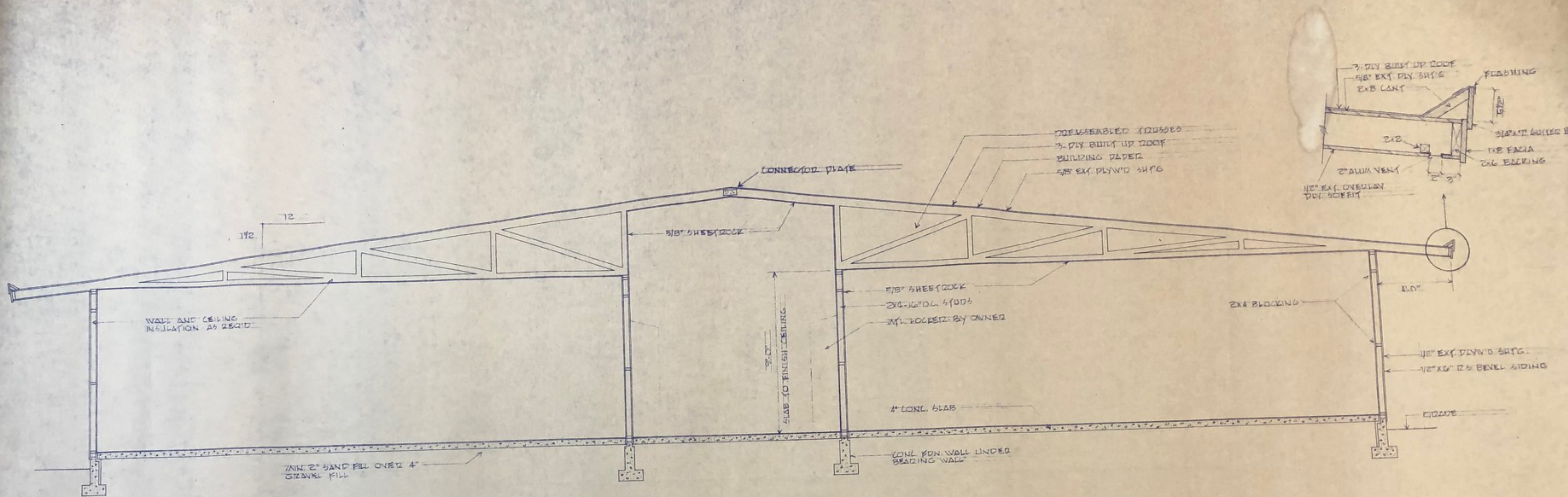
FOUNDATION PLAN & DETAILS

MODEL	REVISIONS	DATE	BY
JOHN R.	1-29-73	3-20-73	
	6-12-73		

NADAVINE SCHOOL DIST.

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112
72

WALL AND CEILING
INSULATION AS REQ'D

CONNECTOR PLATE

5/8" SHEETROCK

COMPRESSED TRUSSES
3-PLY BUILT UP ROOF
BUILDING PAPER
5/8" EX. PLYWD SHEG

9'-0"
SLAB TO FINISH CEILING

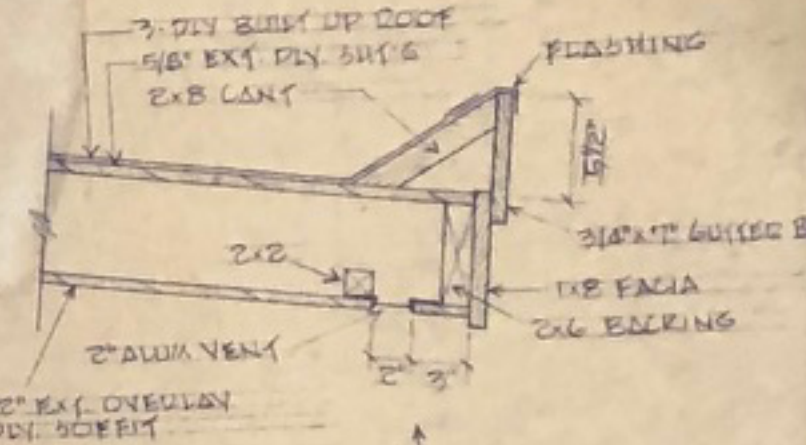
5/8" SHEETROCK
2x4-16" O.C. STUDS
2x4 BLOCKING BY OWNER

2x4 BLOCKING

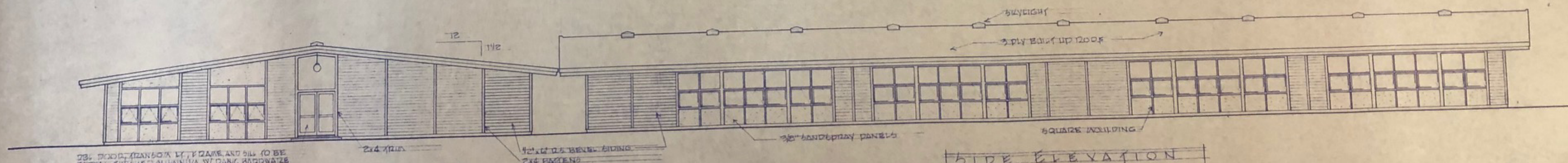
CONC. SLAB

CONC. FDN. WALL UNDER
BEADING WALL

MIN. 2" SAND FILL OVER 4"
GRAVEL FILL



BUILDING SECTION



78% DOOR, WINDOW, W.P. FRAME AND SILL TO BE
EXTRAL FINISH ALUMINUM W/ PAINT HARDWARE

2x4 TRIM

1/2" x 12" BEVEL SIDING
2x4 BATTENS

3/8" SANDPAPER PANELS

SQUARE SIDING

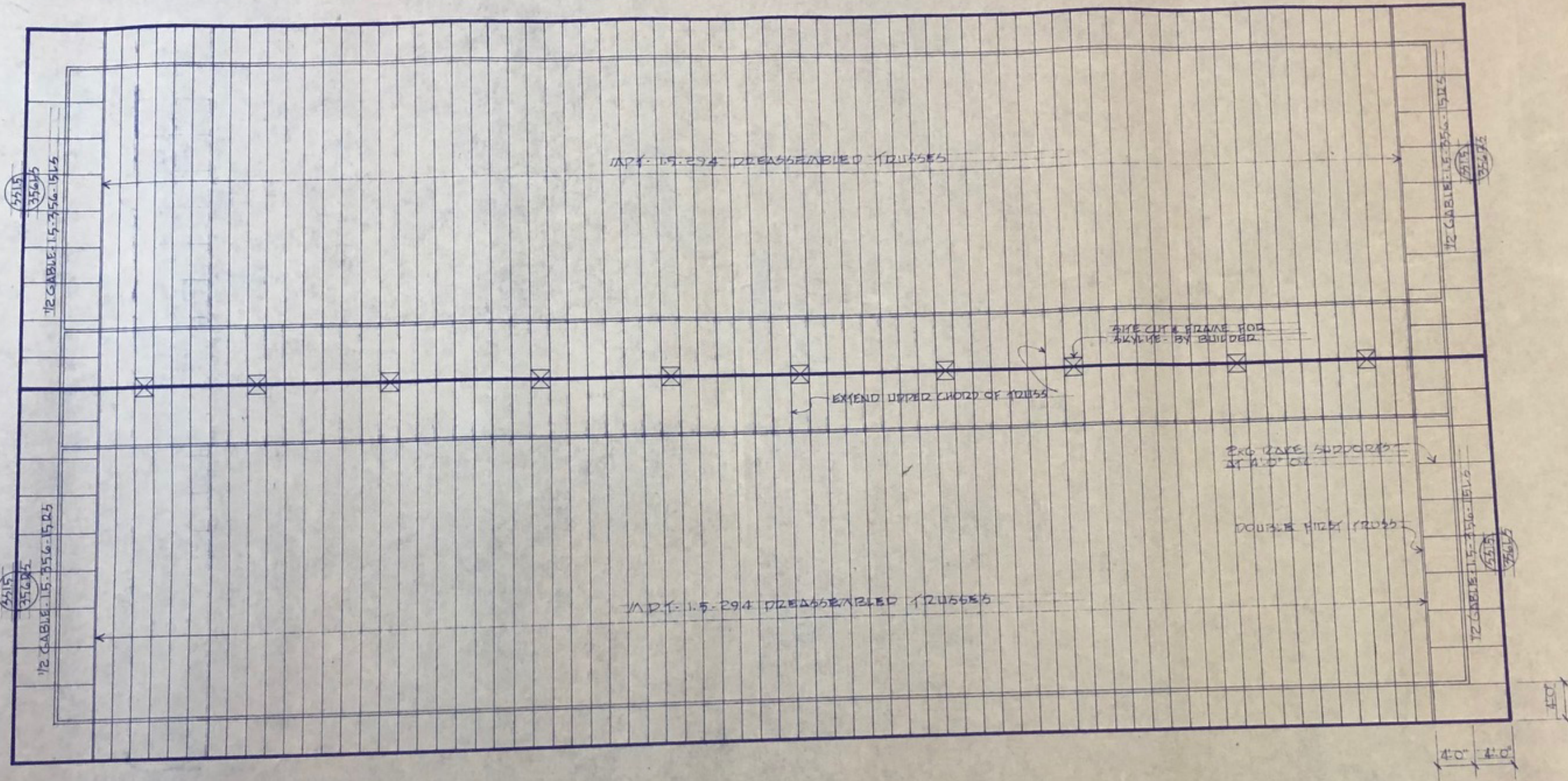
FRONT ELEVATION

SIDE ELEVATION

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	ELEVATIONS AND LISTS		
MODEL DRAWN BY JOHN D.	REVISIONS 1-29-73	SERIES DATE 3-24-73	

NAPAVINE SCHOOL DIST



ROOF FRAMING PLAN
8" x 11 1/2"

COPYRIGHT

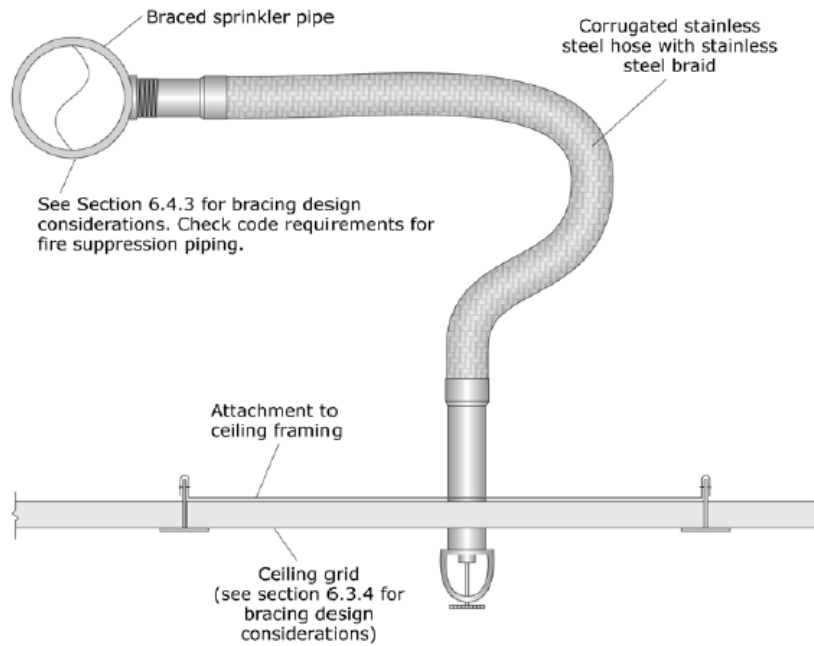
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ROOF FRAMING PLAN			
MODEL	REVISIONS	SERIES	DATE
JOHN D	4-24-73	3-26	

NAPINNE HOCCL DRY

Appendix F: FEMA E-74 Nonstructural Seismic Bracing Excerpts

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Life Safety Systems



Note: for seismic design category D, E & F, the flexible sprinkler hose fitting must accommodate at least 1" of ceiling movement without use of an oversized opening. Alternatively, the sprinkler head must have a 2" oversize ring or adapter that allows 1" movement in all directions.

Figure G-1. Flexible Sprinkler Drop.

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

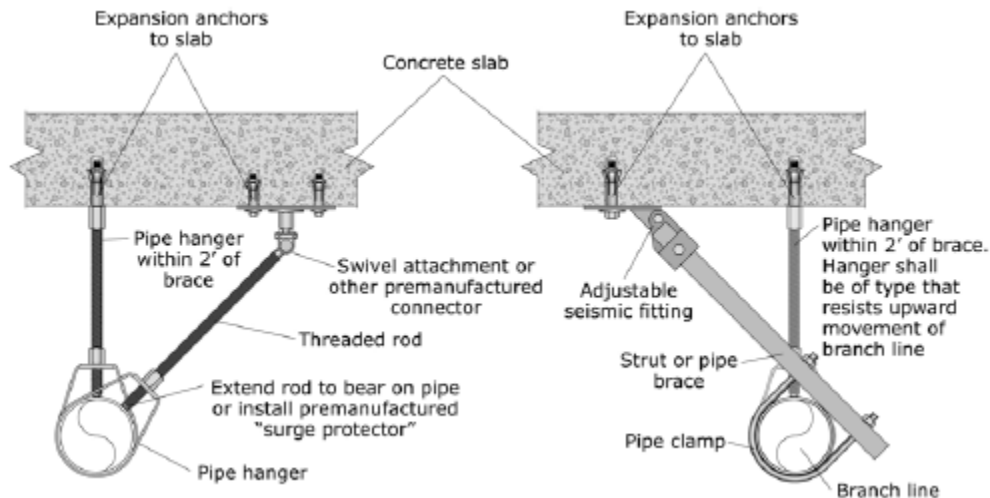


Figure G-2. End of Line Restraint.

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

Partitions

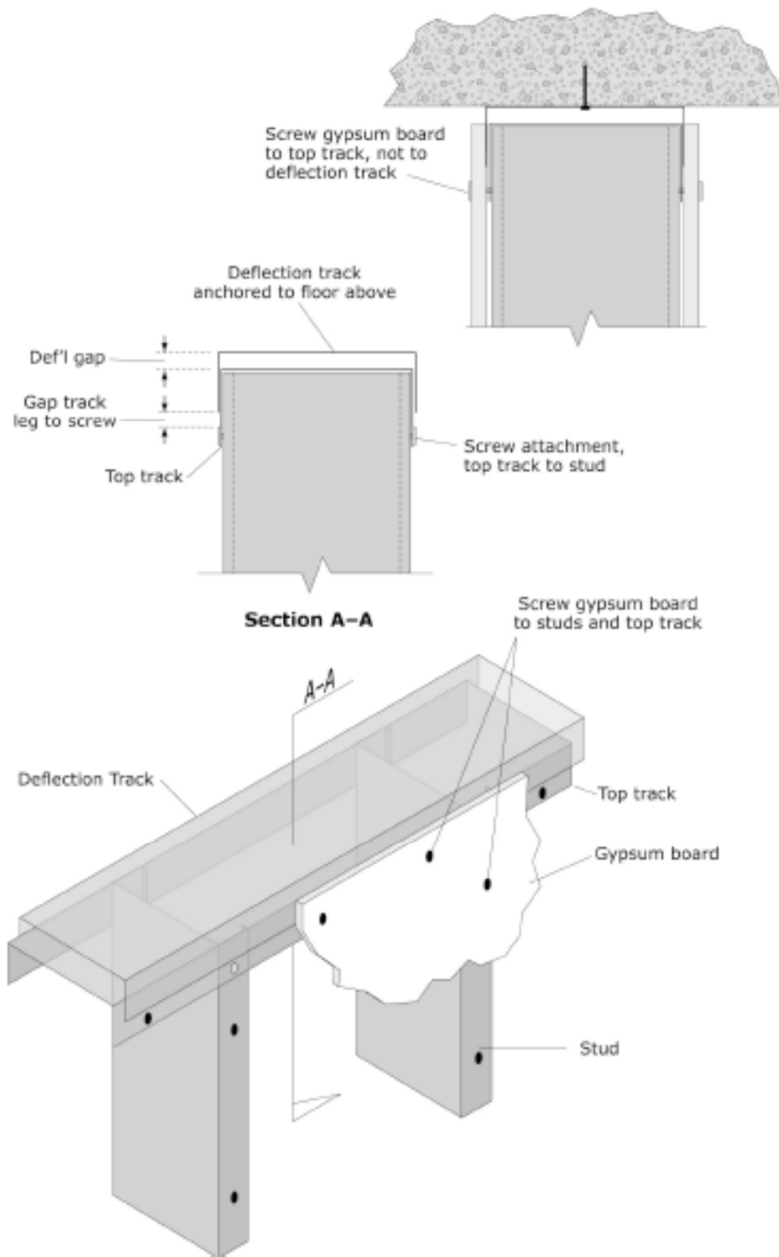


Figure G-3. Mitigation Schemes for Bracing the Tops of Metal Stud Partition Walls.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

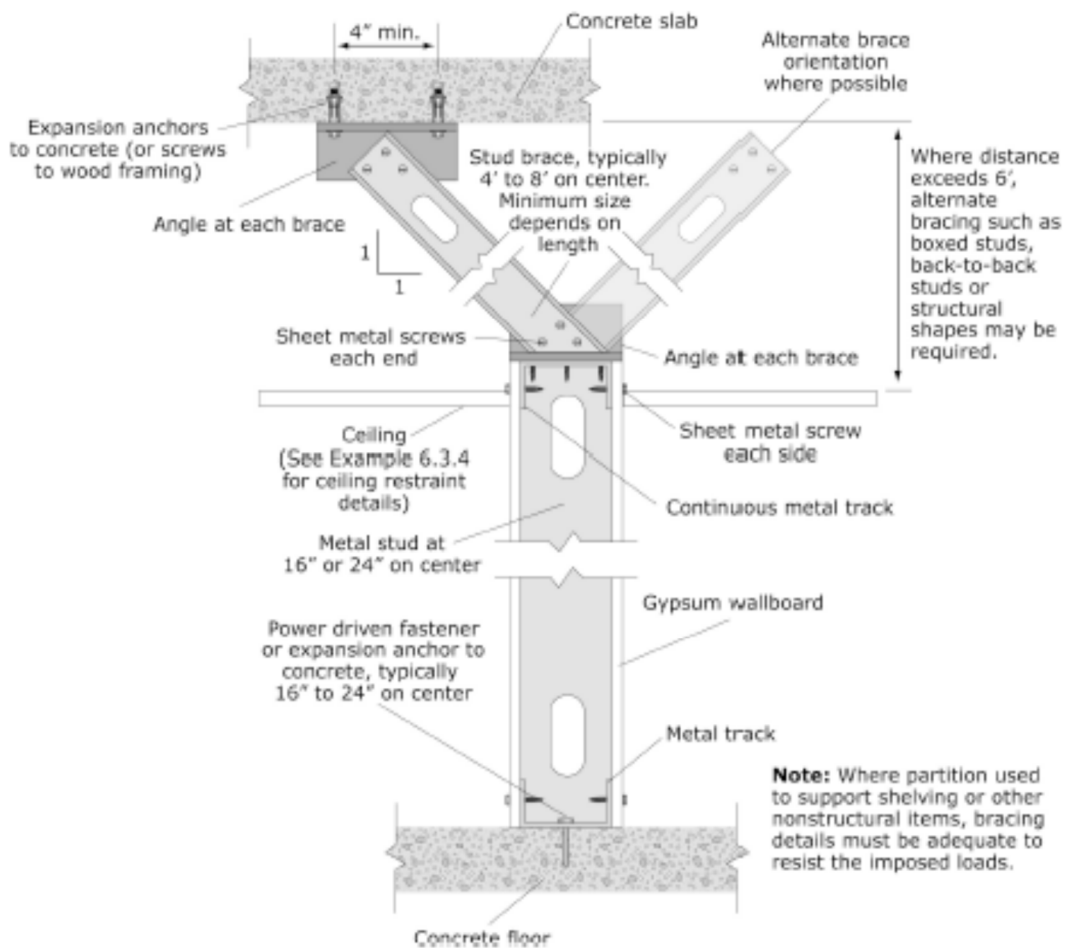


Figure G-4. Mitigation Schemes for Bracing the Tops of Metal Stud Partition Walls.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

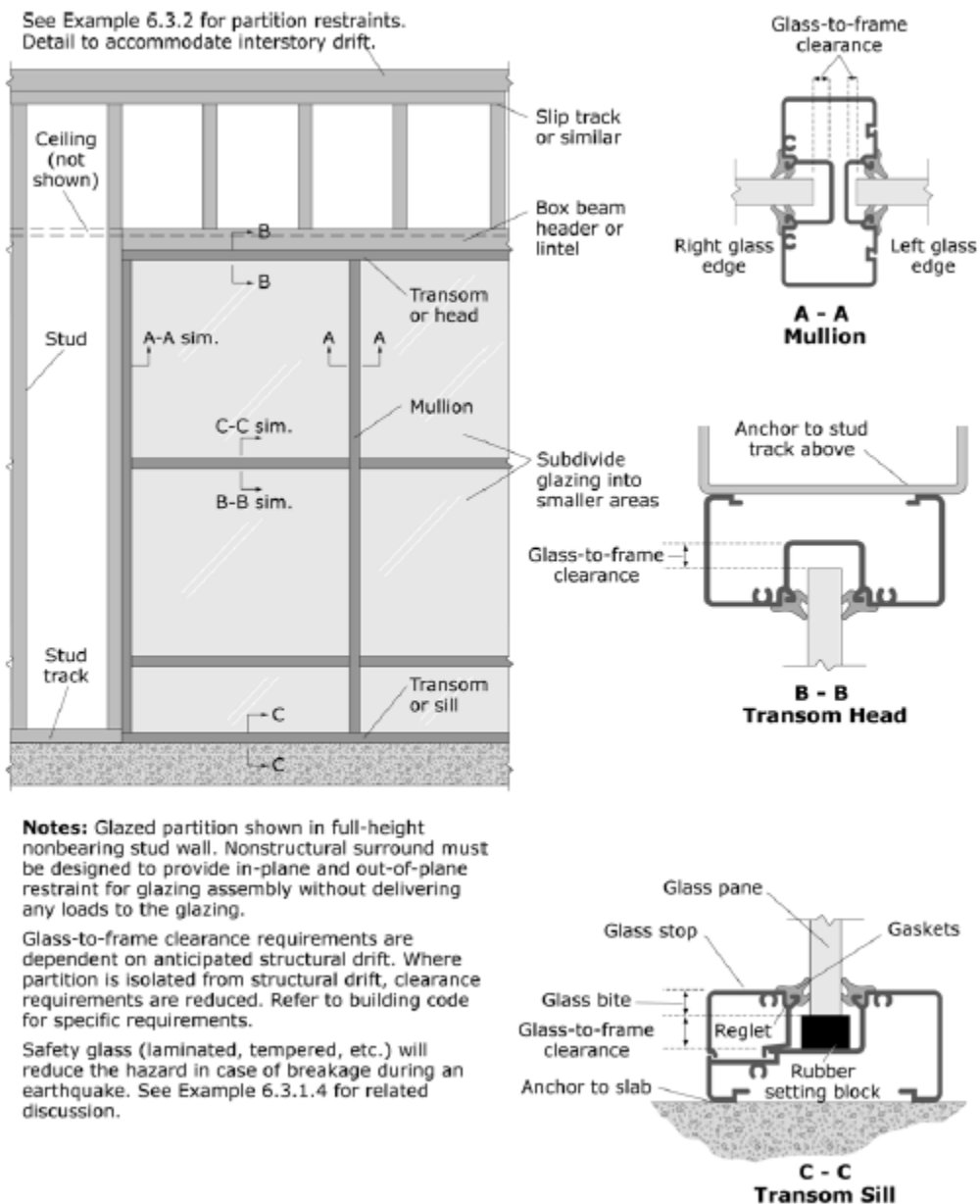


Figure G-5. Full-height Glazed Partition.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

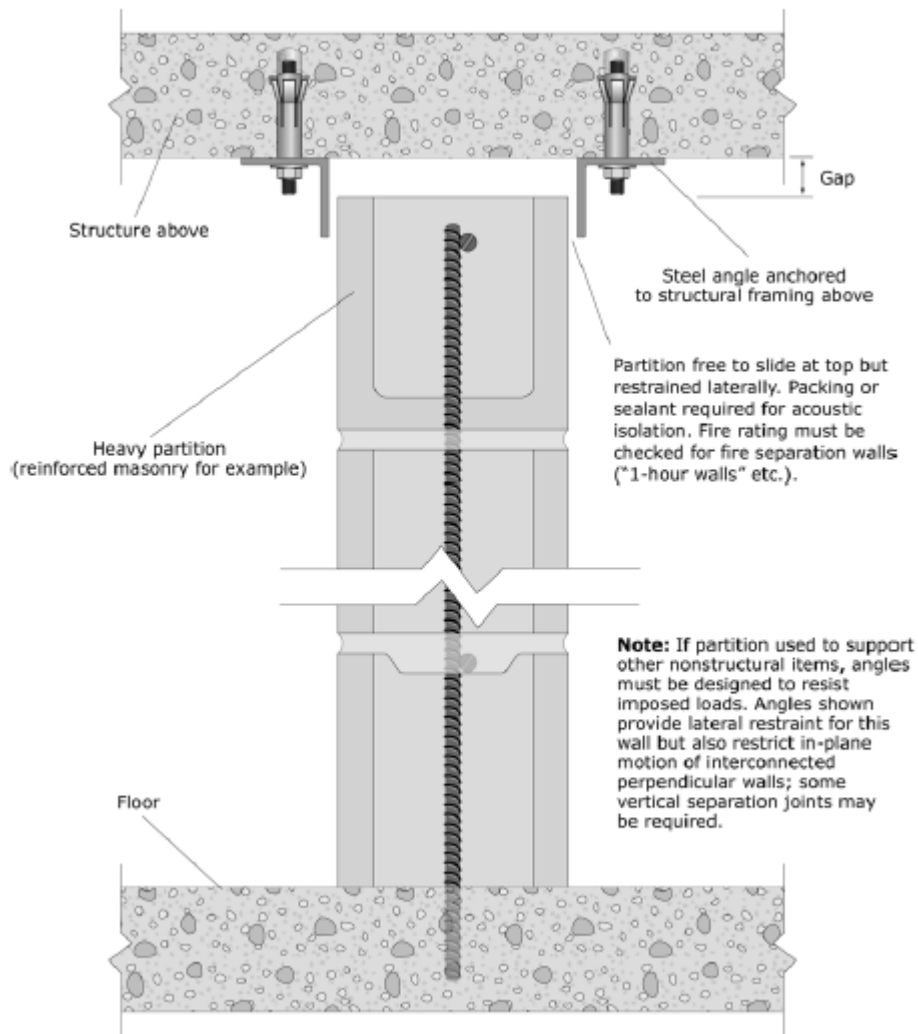


Figure G-6. Full-height Heavy Partition.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

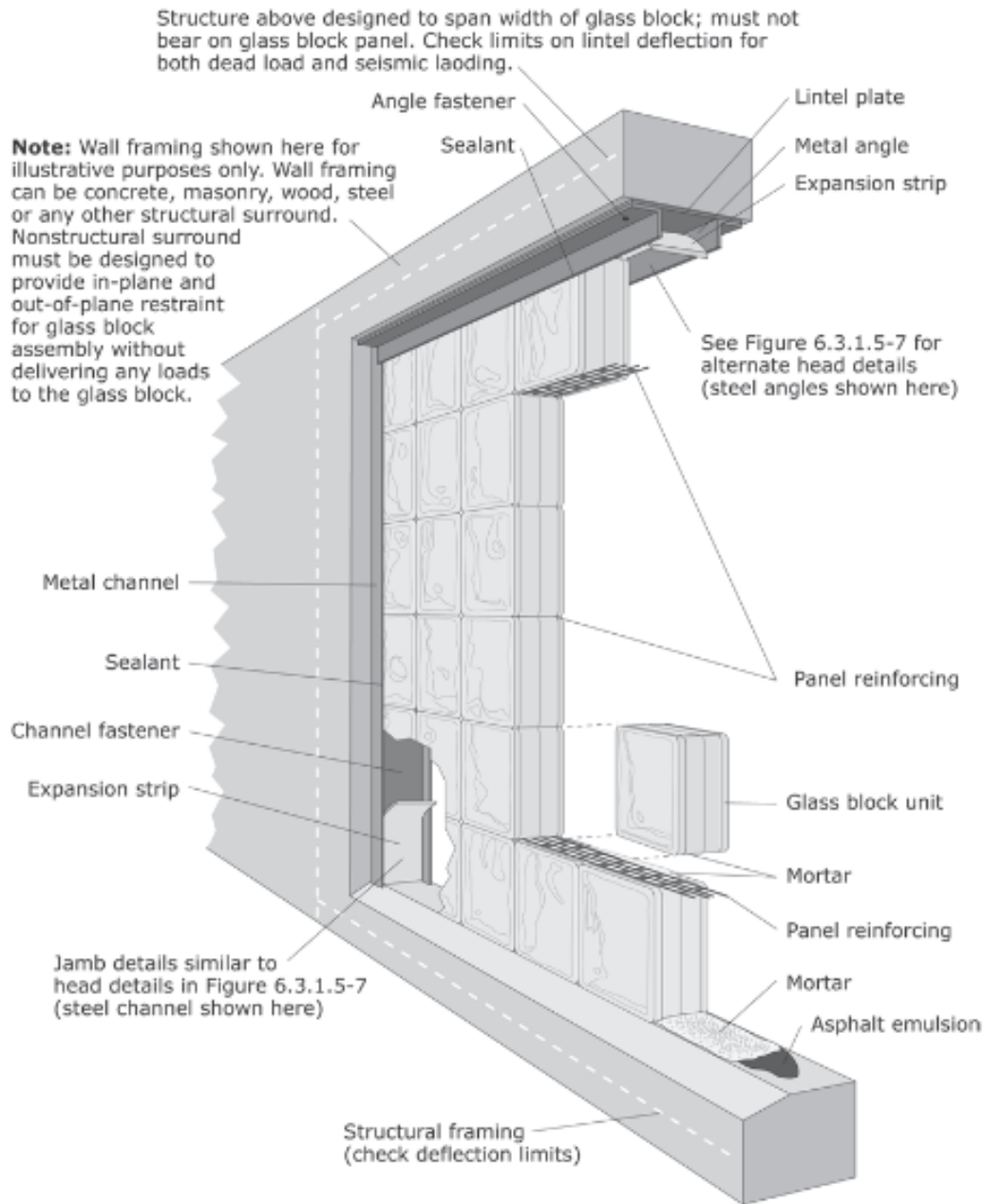


Figure G-7. Typical Glass Block Panel Details.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Ceilings

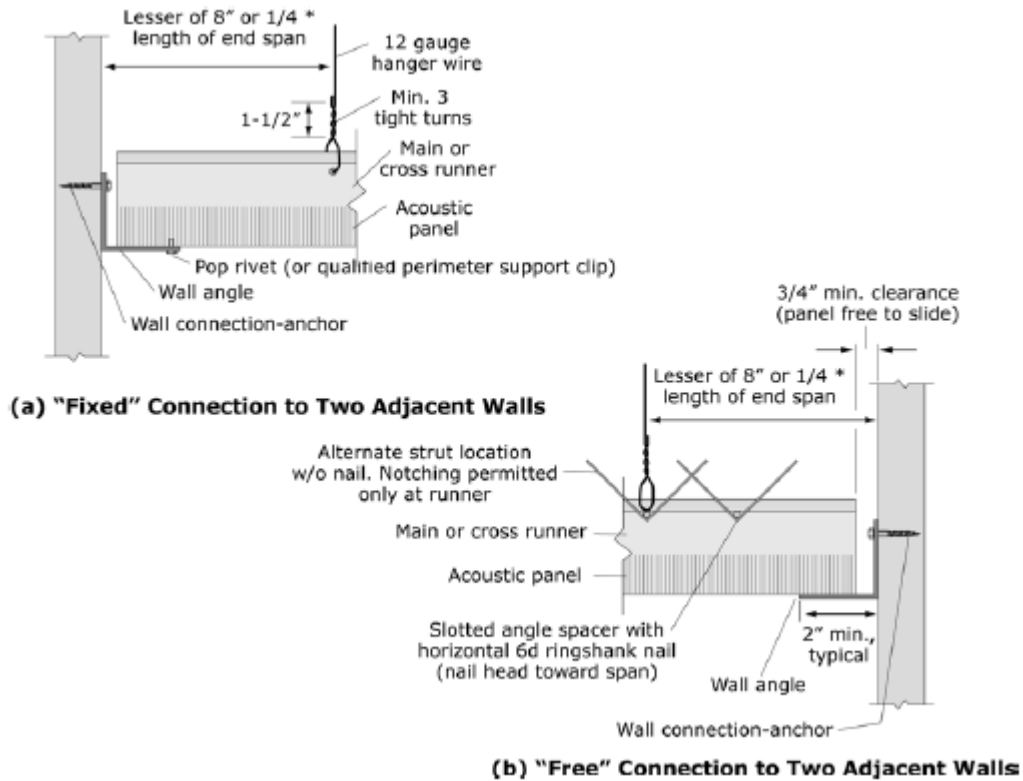
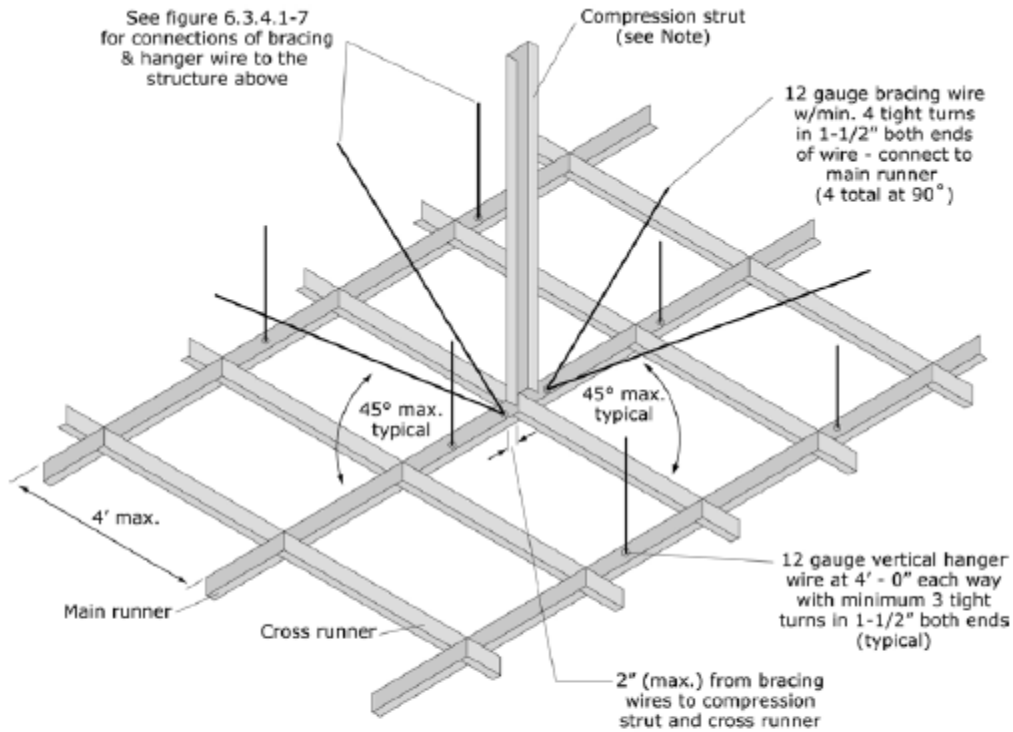


Figure G-8. Suspension System for Acoustic Lay-in Panel Ceilings – Edge Conditions.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



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 ($l/r \leq 200$). 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)

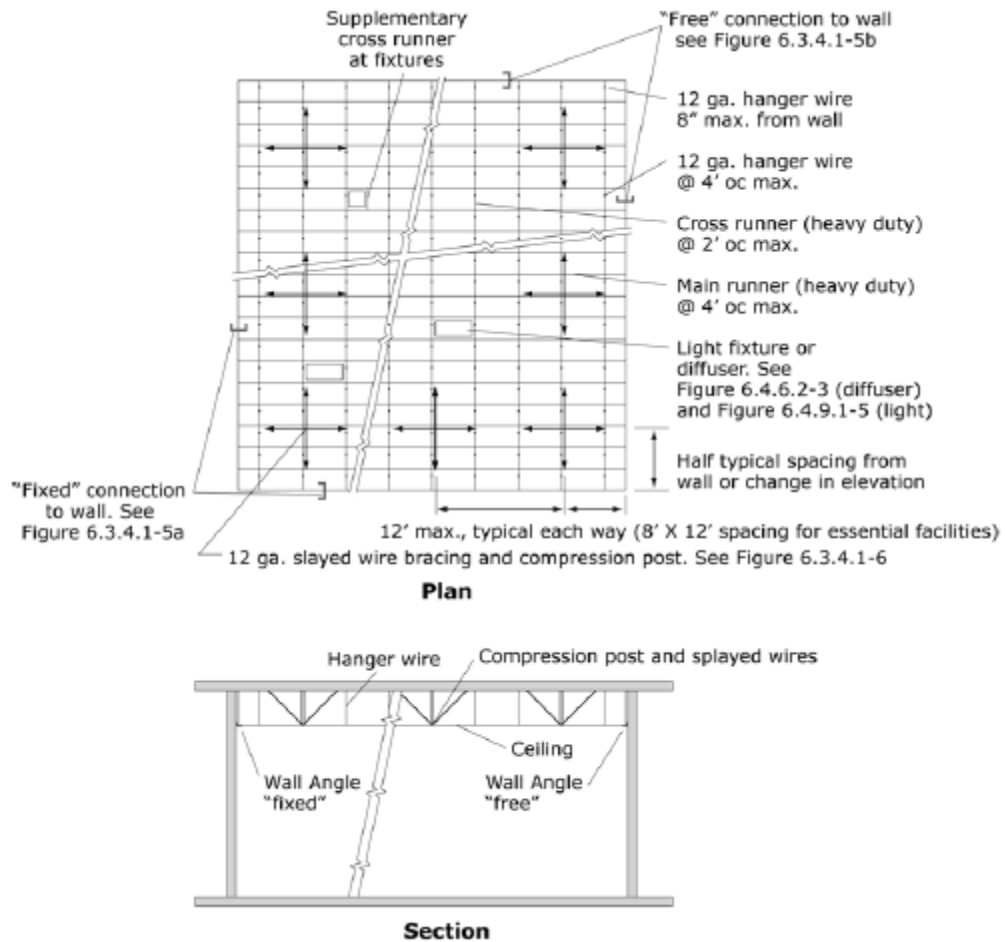


Figure G-10. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Layout.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

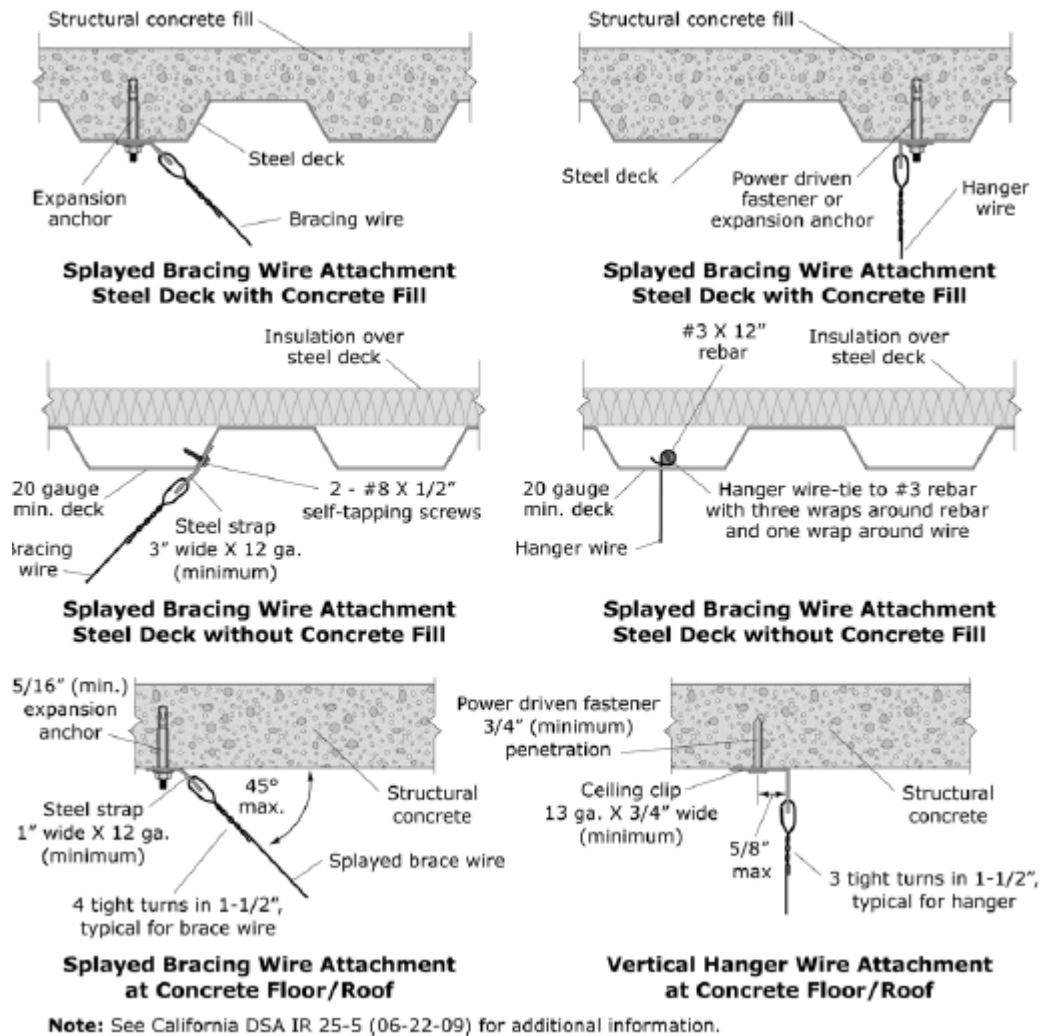
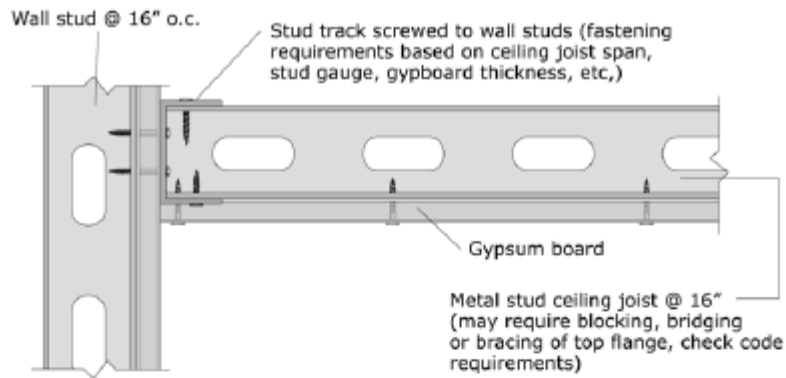
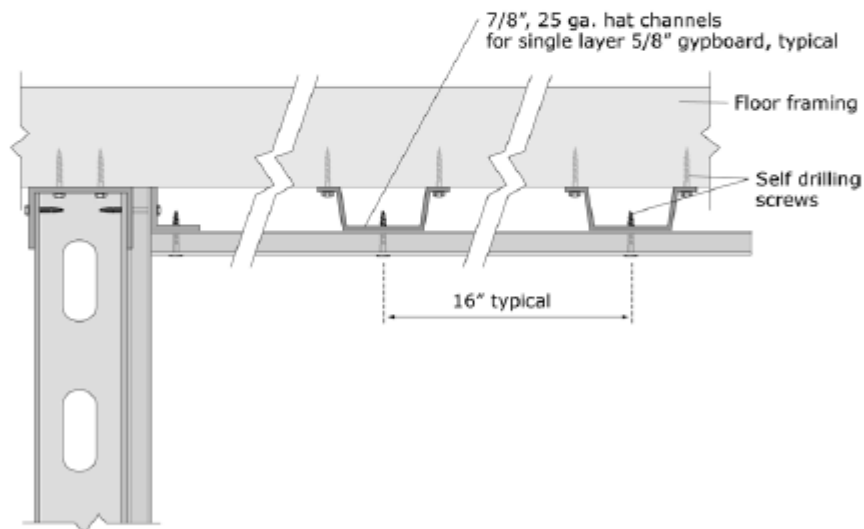


Figure G-11. Suspension System for Acoustic Lay-in Panel Ceilings – Overhead Attachment Details.

(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)

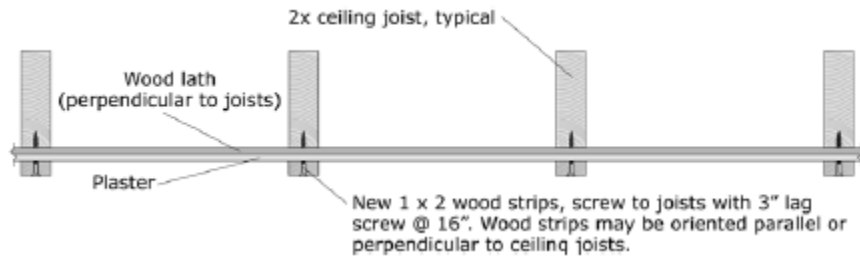


Figure G-13. Retrofit Detail for Existing Lath and Plaster.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

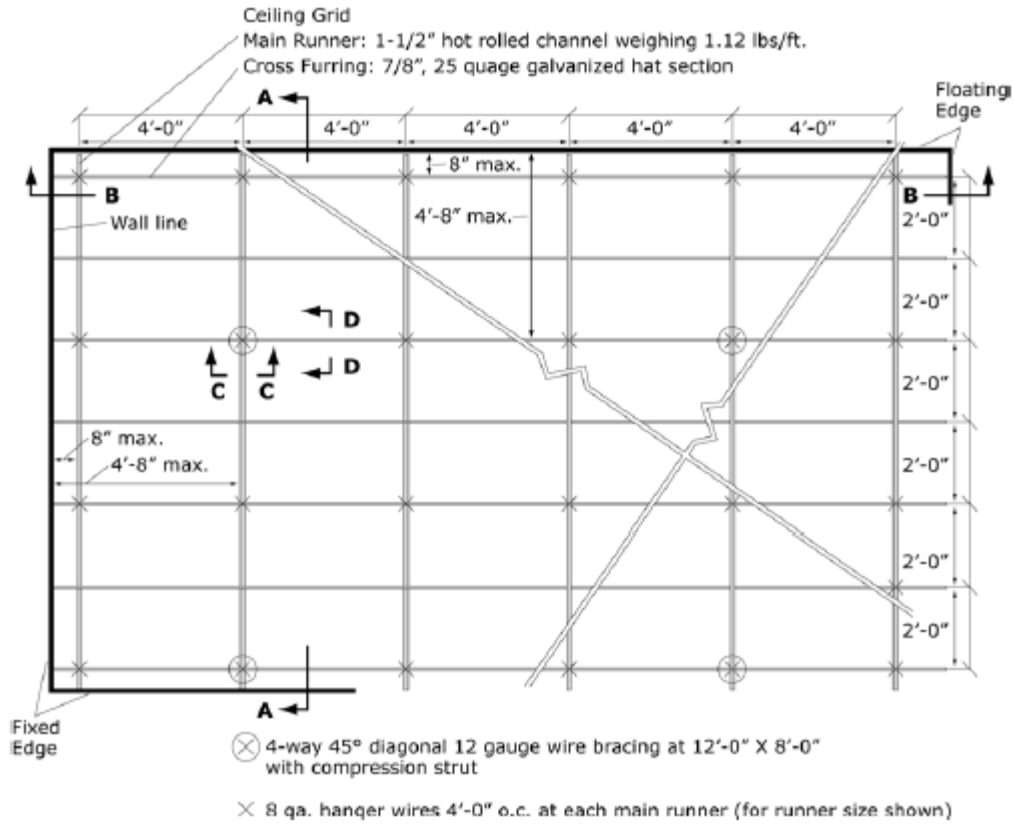
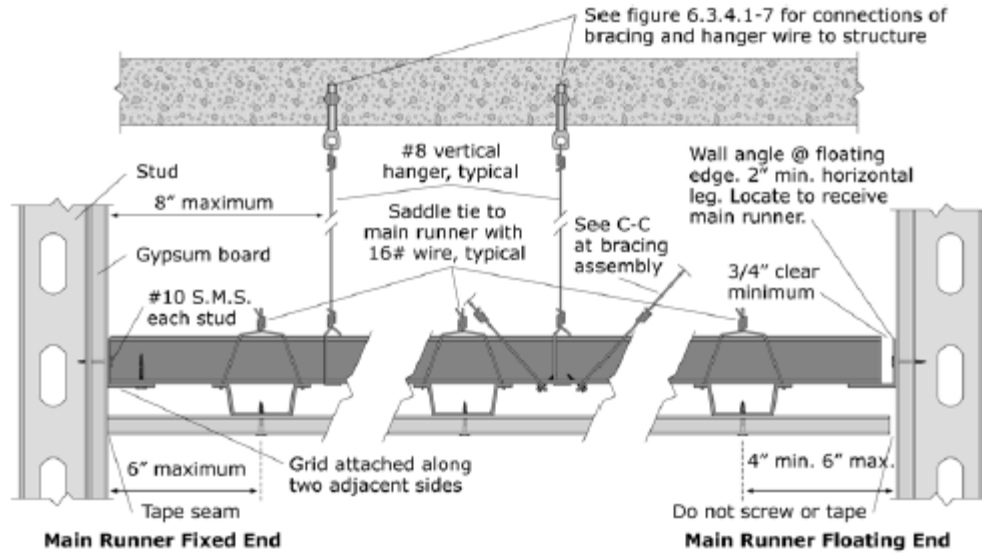
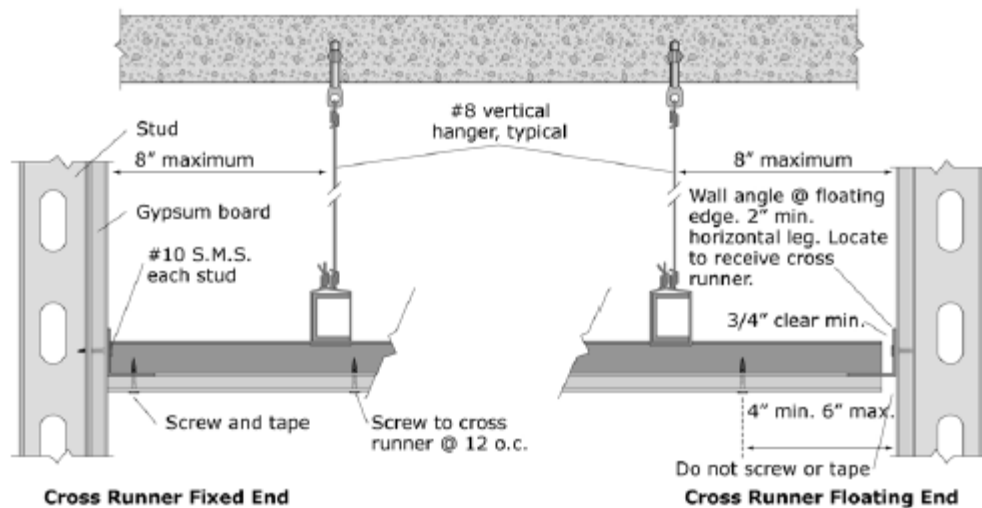


Figure G-14. Diagrammatic View of Suspended Heavy Ceiling Grid and Lateral Bracing.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

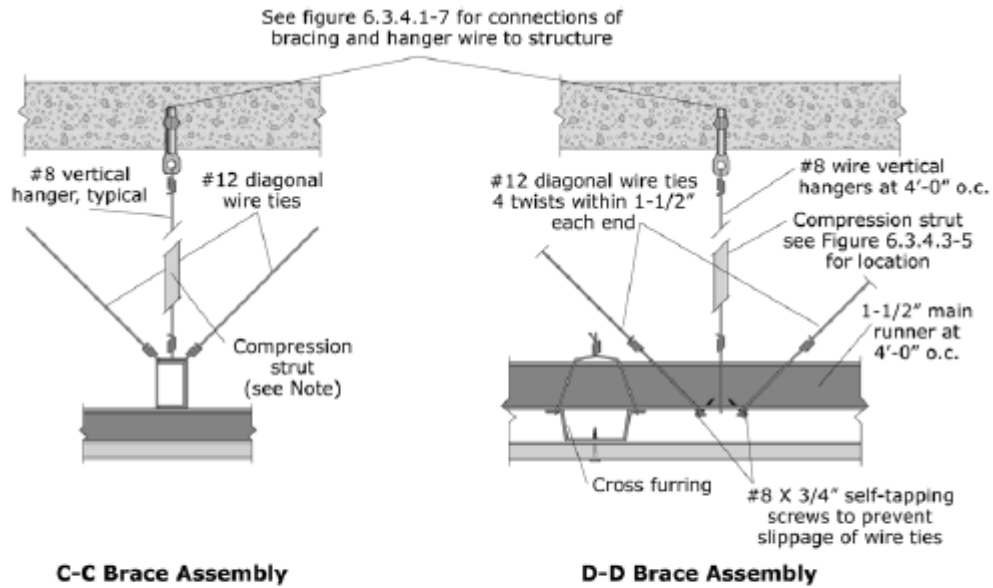


A-A Main Runner at Perimeter



B-B Cross Runner at Perimeter

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. 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 concrete. Size of strut is dependent on distance between ceiling and structure ($l/r \leq 200$). 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

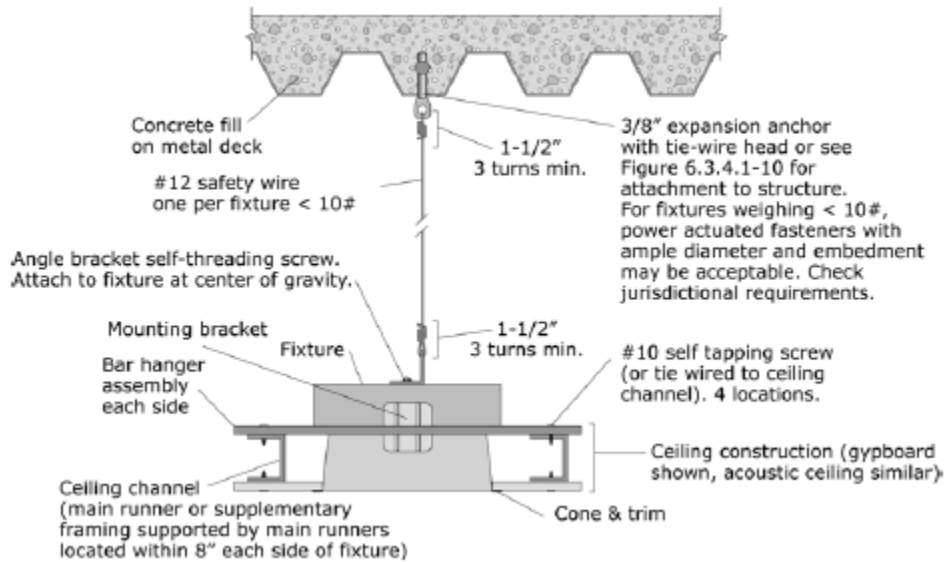


Figure G-17. Recessed Light Fixture in suspended Ceiling (Fixture Weight < 10 pounds).
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

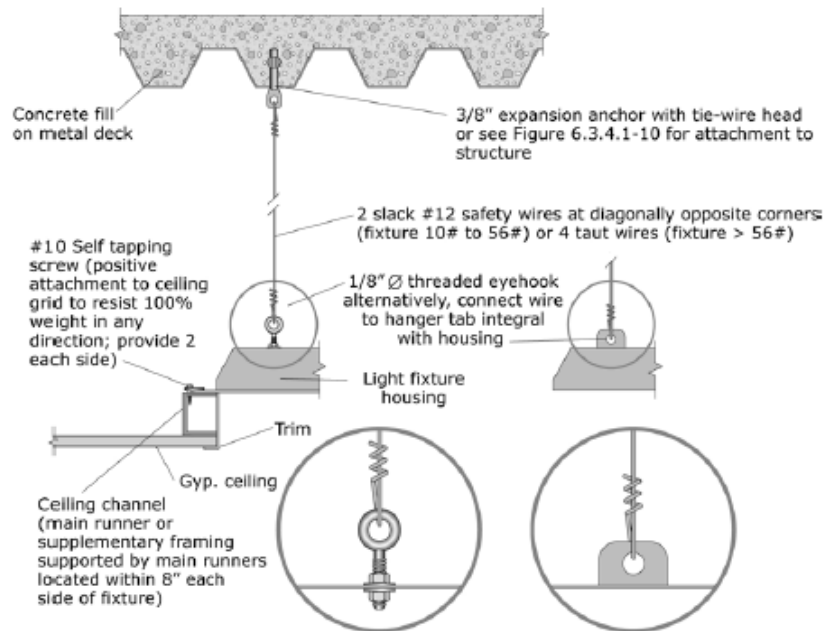


Figure G-18. Recessed Light Fixture in suspended Ceiling (Fixture Weight 10 to 56 pounds).
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Contents and Furnishings

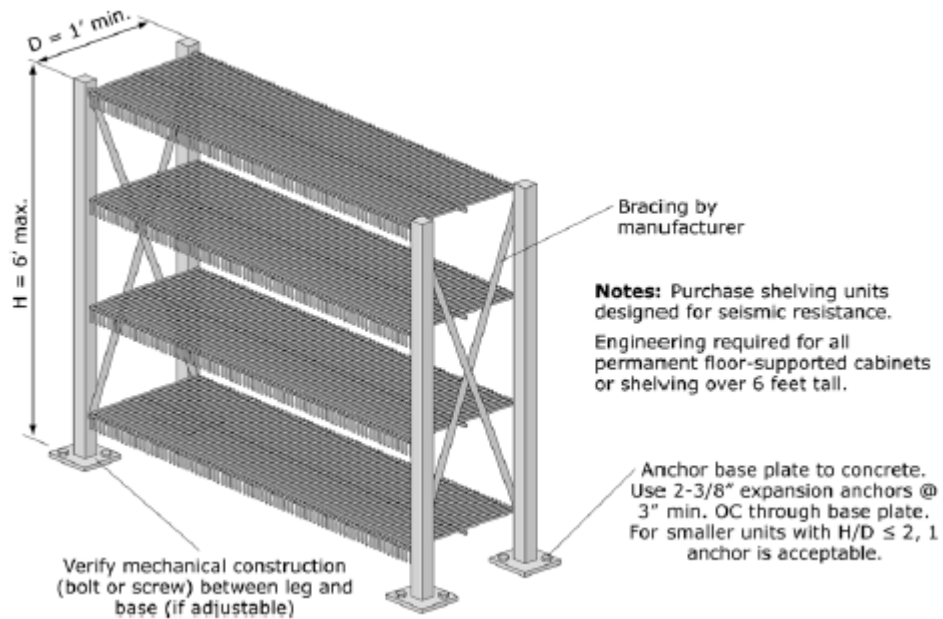


Figure G-19. Light Storage Racks.
(FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage*)

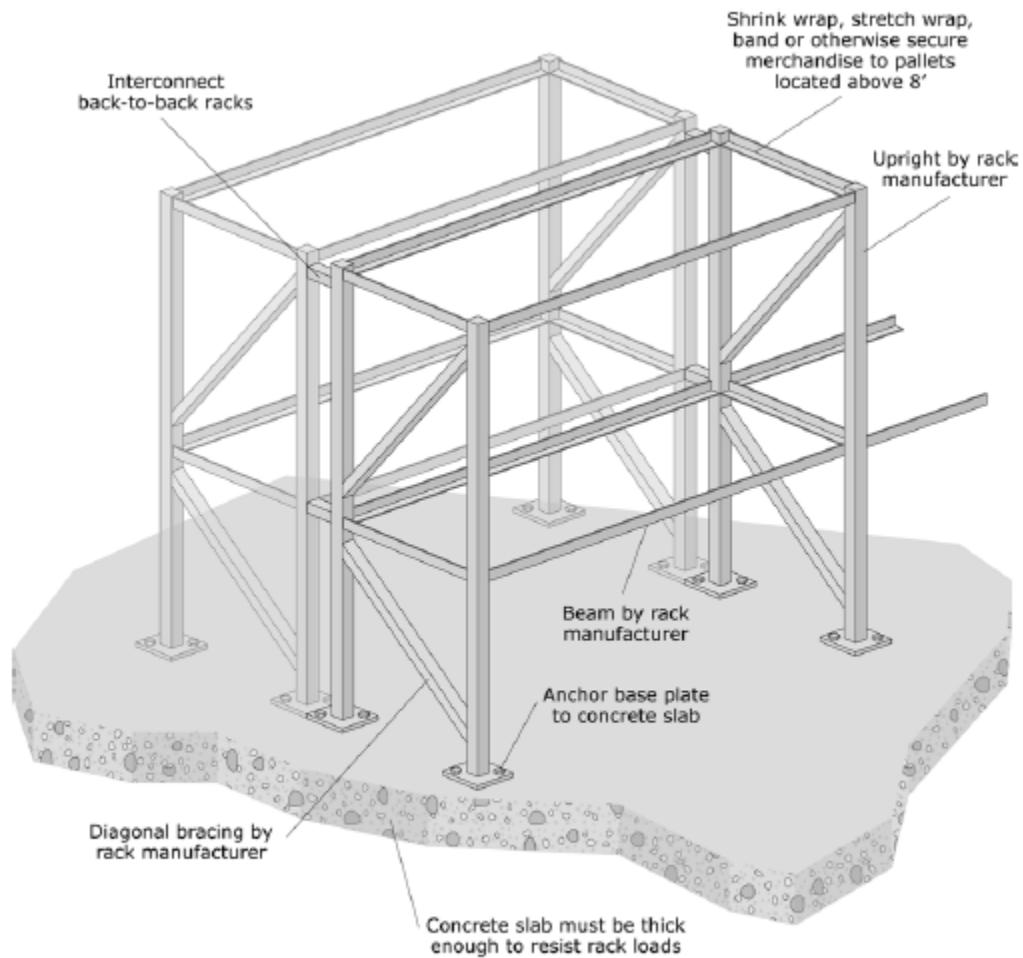


Figure G-20. Industrial Storage Racks.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

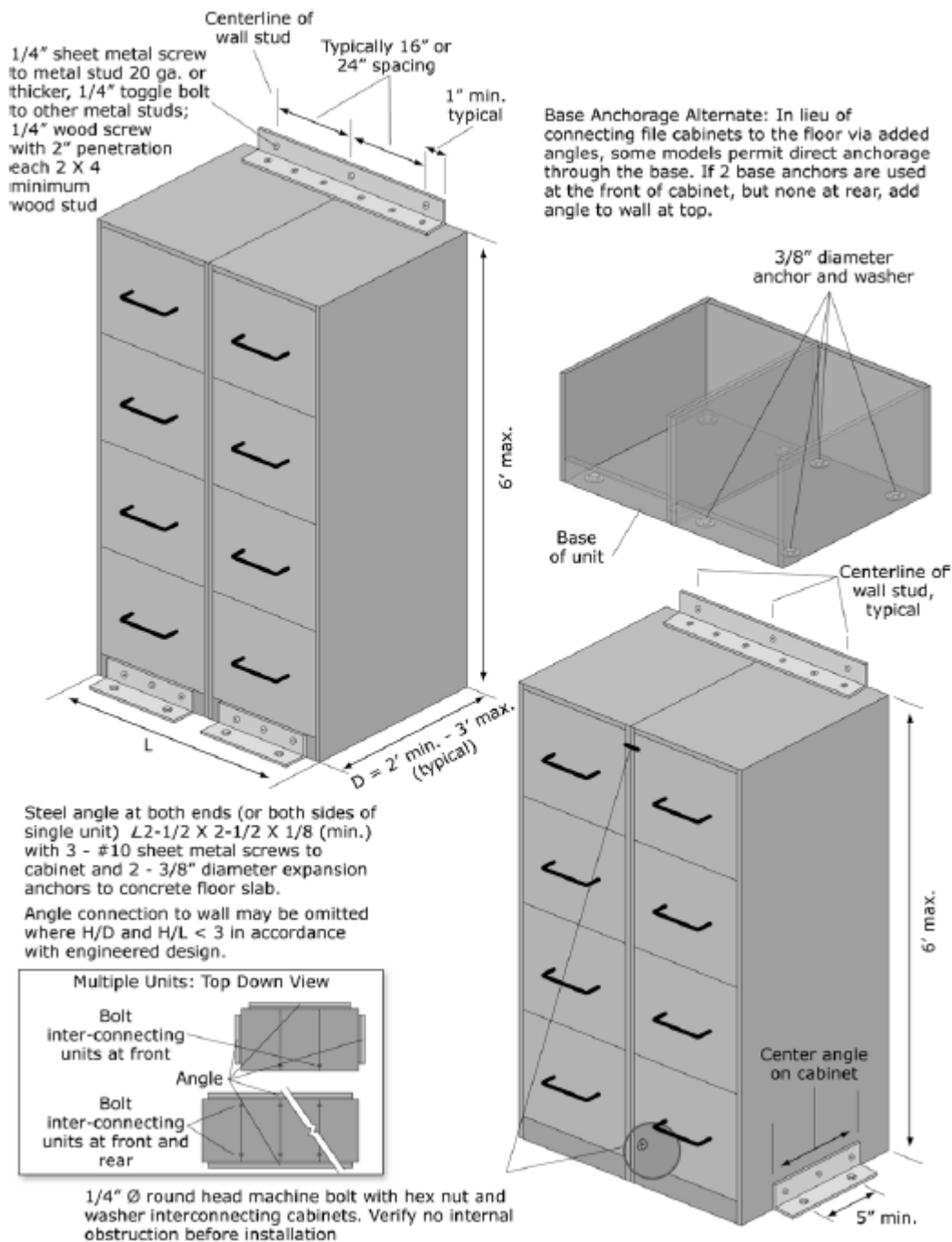


Figure G-21. Wall-mounted File Cabinets.

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

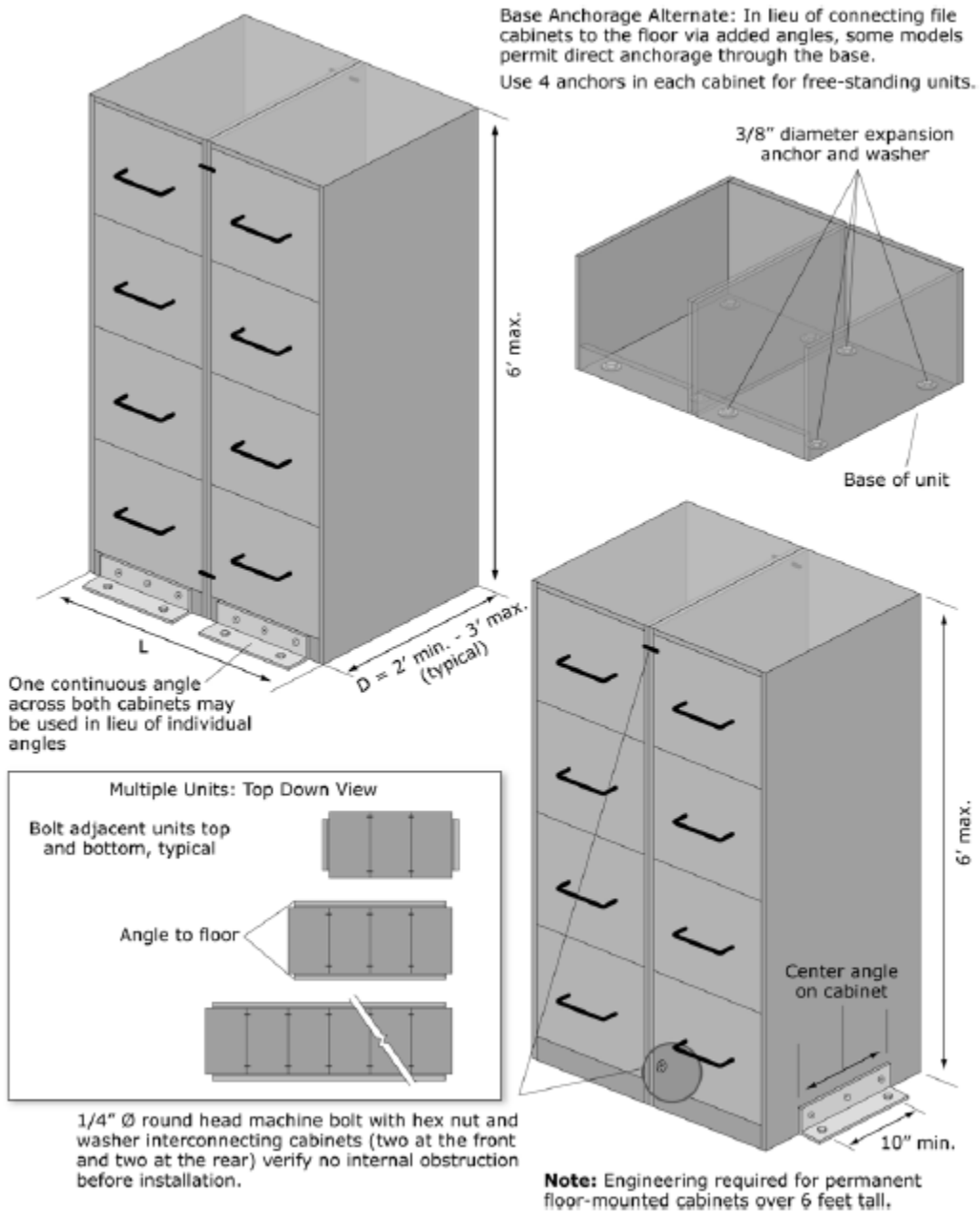
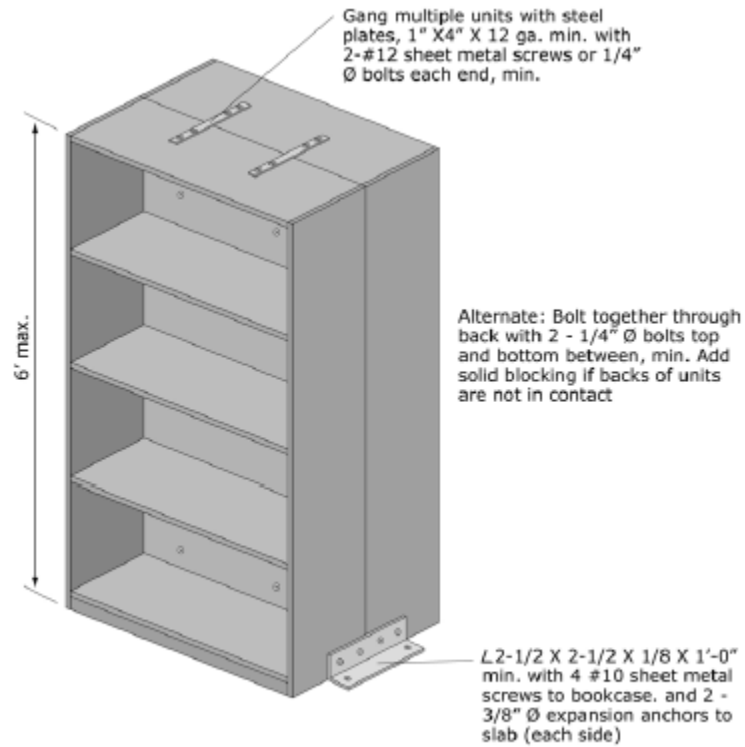


Figure G-22. Base Anchored File Cabinets.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Note: Engineering required for all permanent floor-supported cabinets or shelving over 6 feet tall. Details shown are adequate for typical shelving 6 feet or less in height.

Figure G-23. Anchorage of Freestanding Book Cases Arranged Back to Back.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

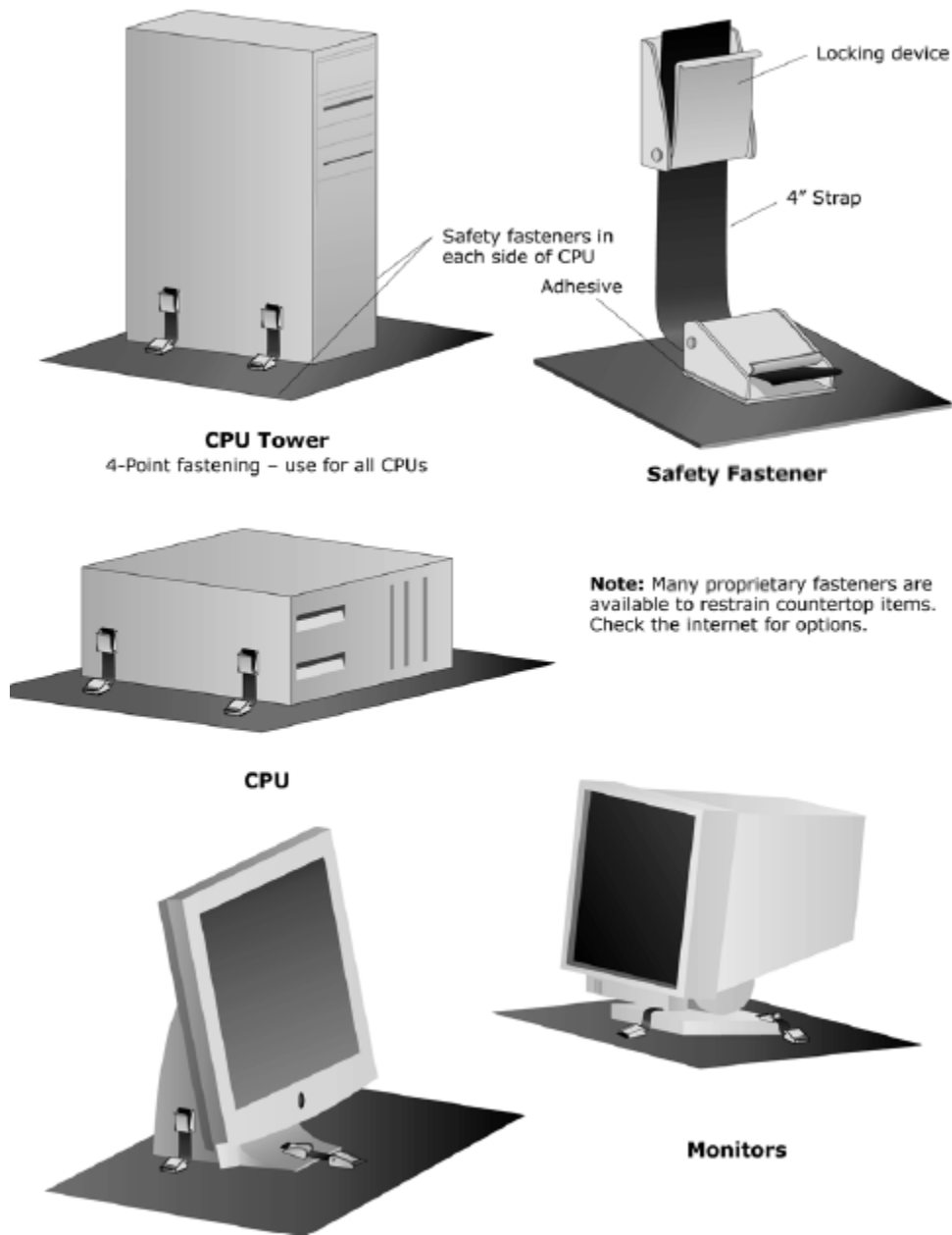
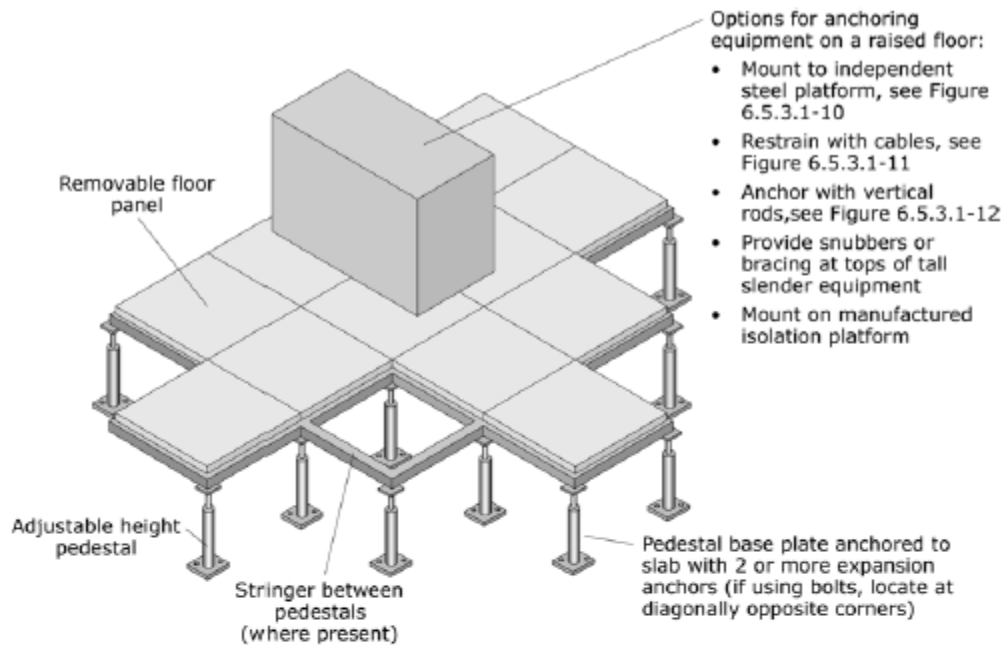
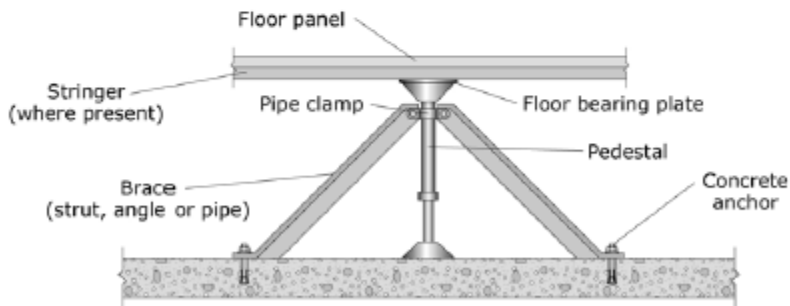


Figure G-24. Desktop Computers and Accessories.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



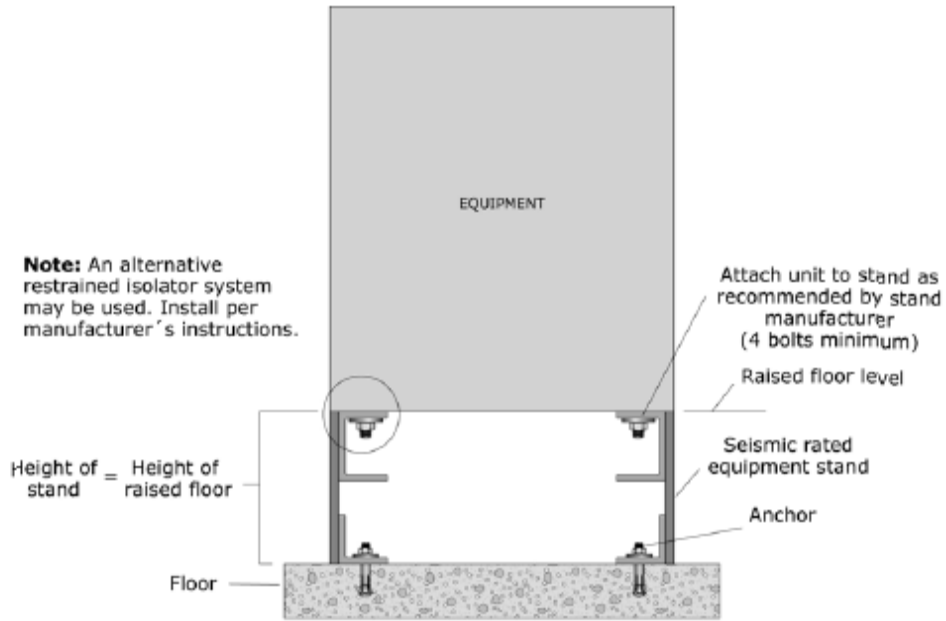
Cantilevered Access Floor Pedestal



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

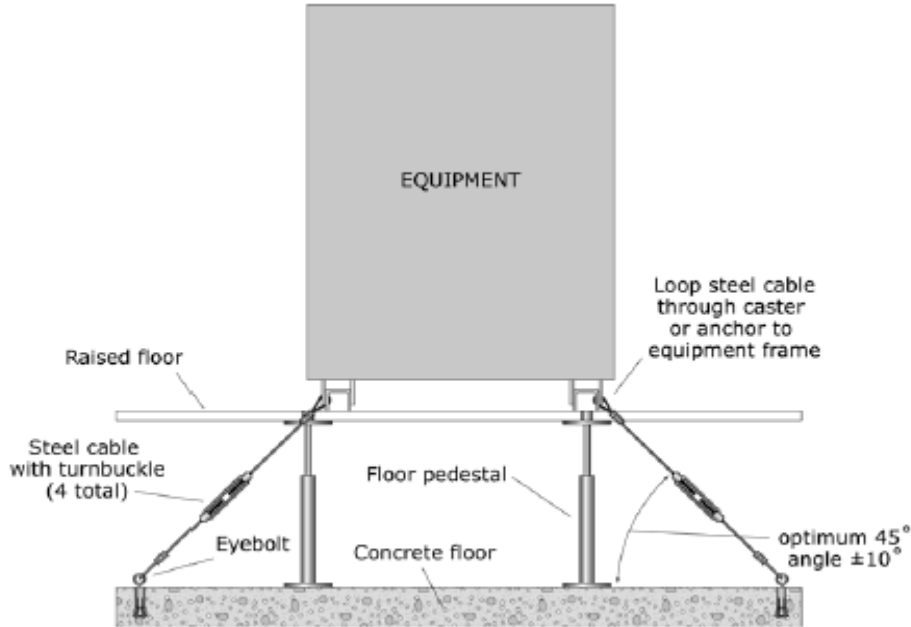
Note: For new floors in areas of high seismicity, purchase and install systems that meet the applicable code provisions for "special access floors."

Figure G-25. Equipment Mounted on Access Floor.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



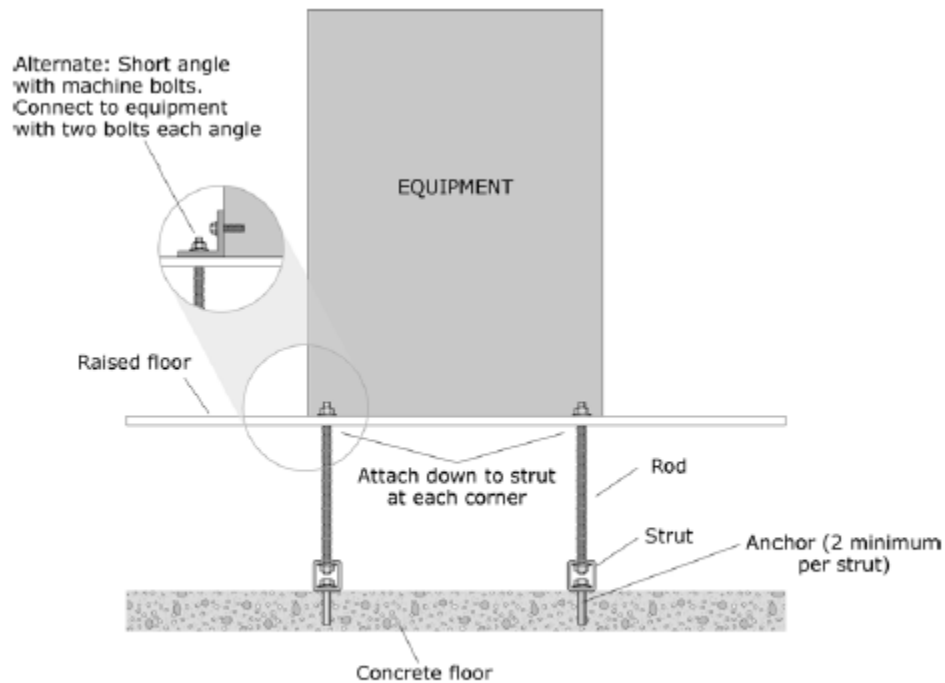
Equipment installed on an independent steel platform within a raised floor

Figure G-26. Equipment Mounted on Access Floor – Independent Base.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Equipment restrained with cables beneath a raised floor

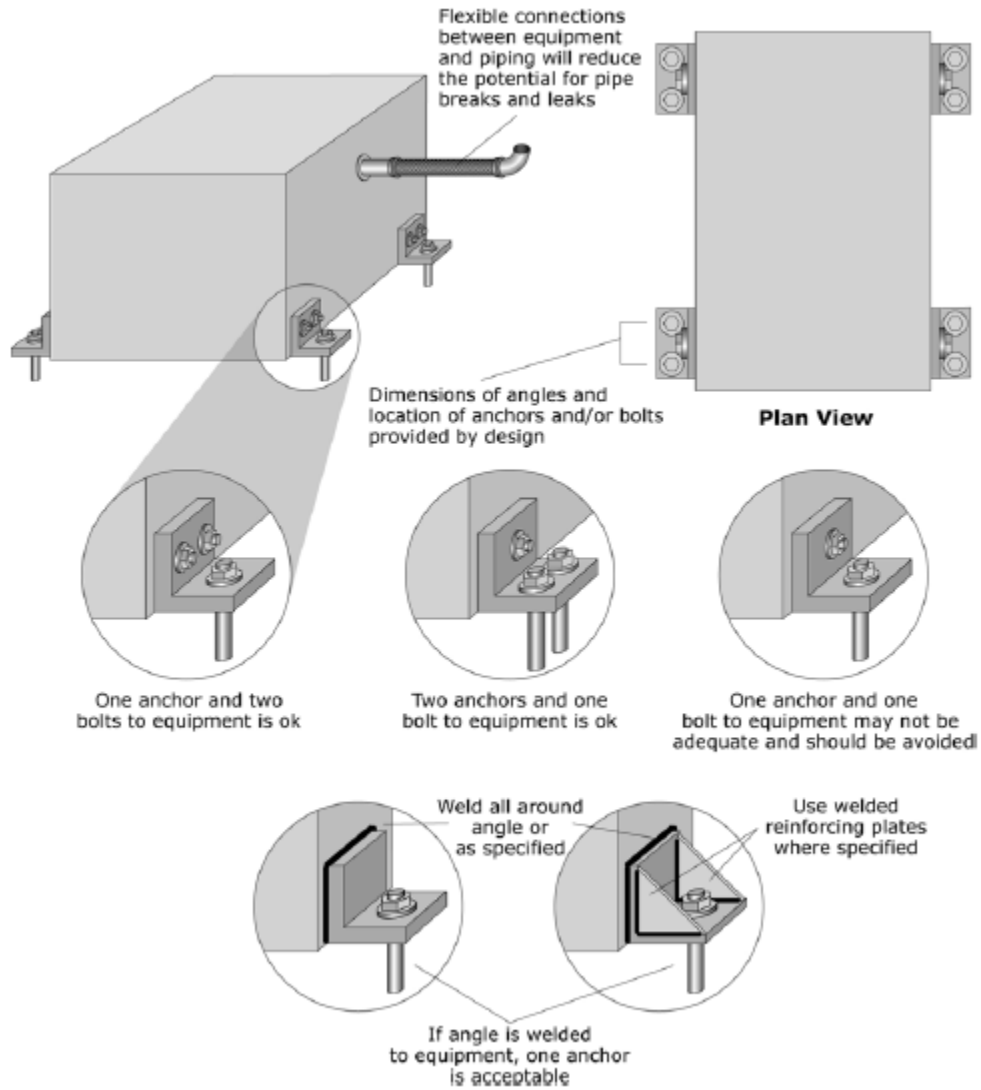
Figure G-27. Equipment Mounted on Access Floor – Cable Braced.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Equipment anchored with vertical rods beneath a raised floor

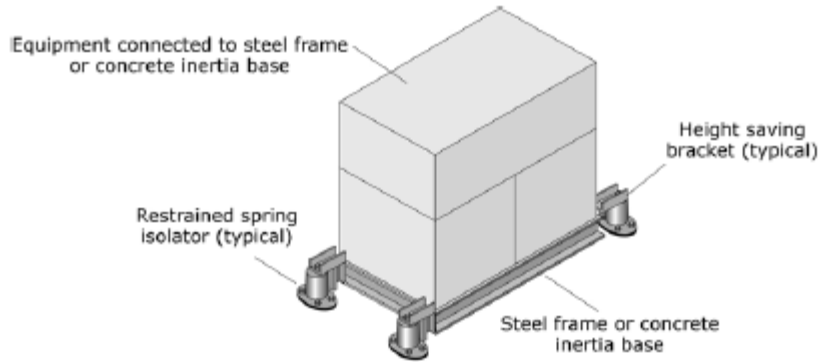
Figure G-28. Equipment Mounted on Access Floor – Tie-down Rods.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Mechanical and Electrical Equipment

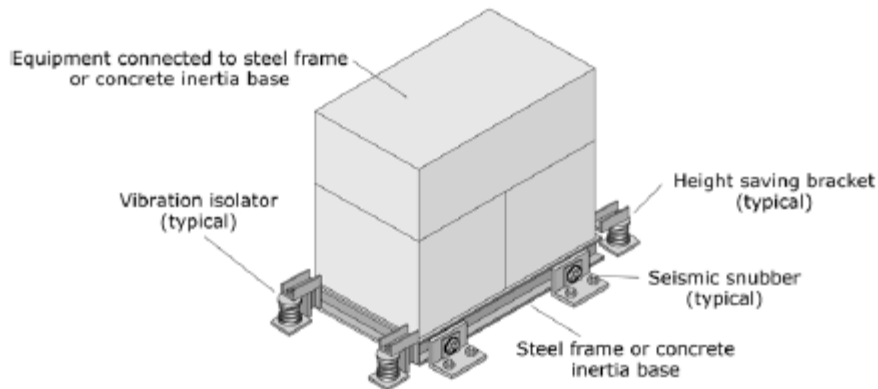


Note: Rigidly mounted equipment shall have flexible connections for the fuel lines and piping.

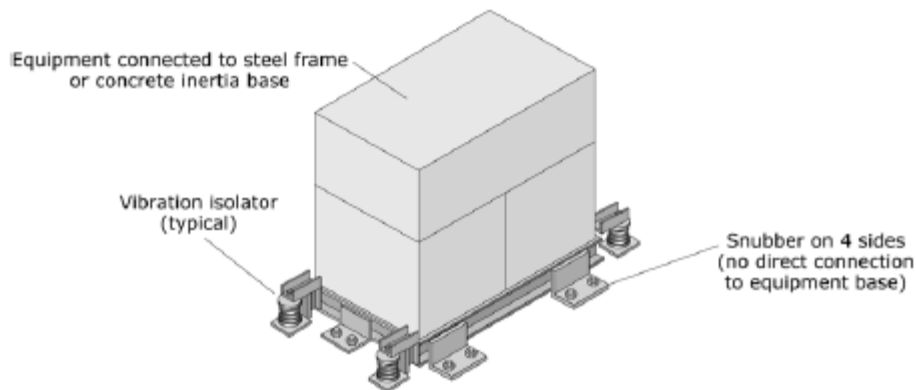
Figure G-29. Rigidly Floor-mounted Equipment with Added Angles.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



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)

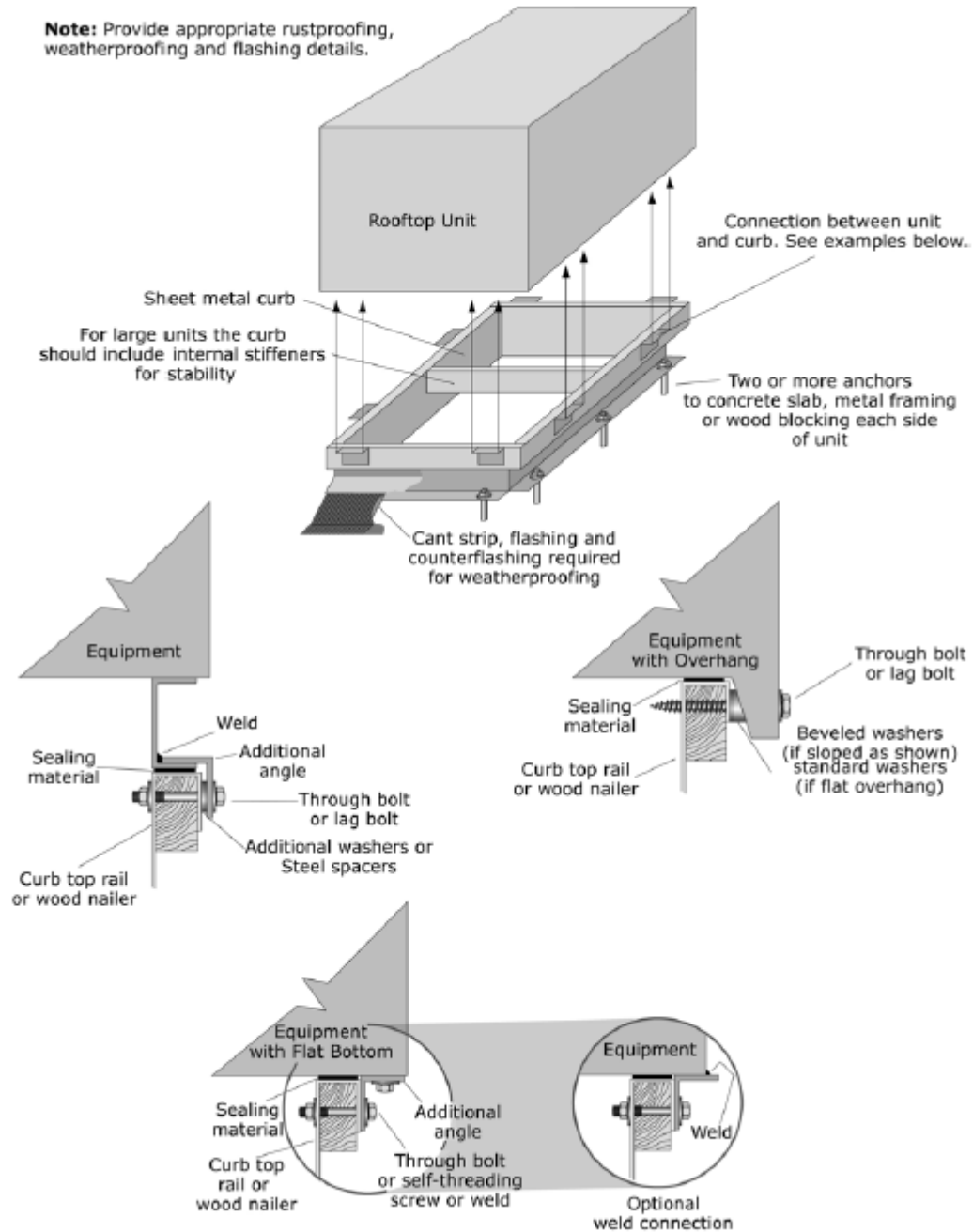


Figure G-31. Rooftop HVAC Equipment.

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

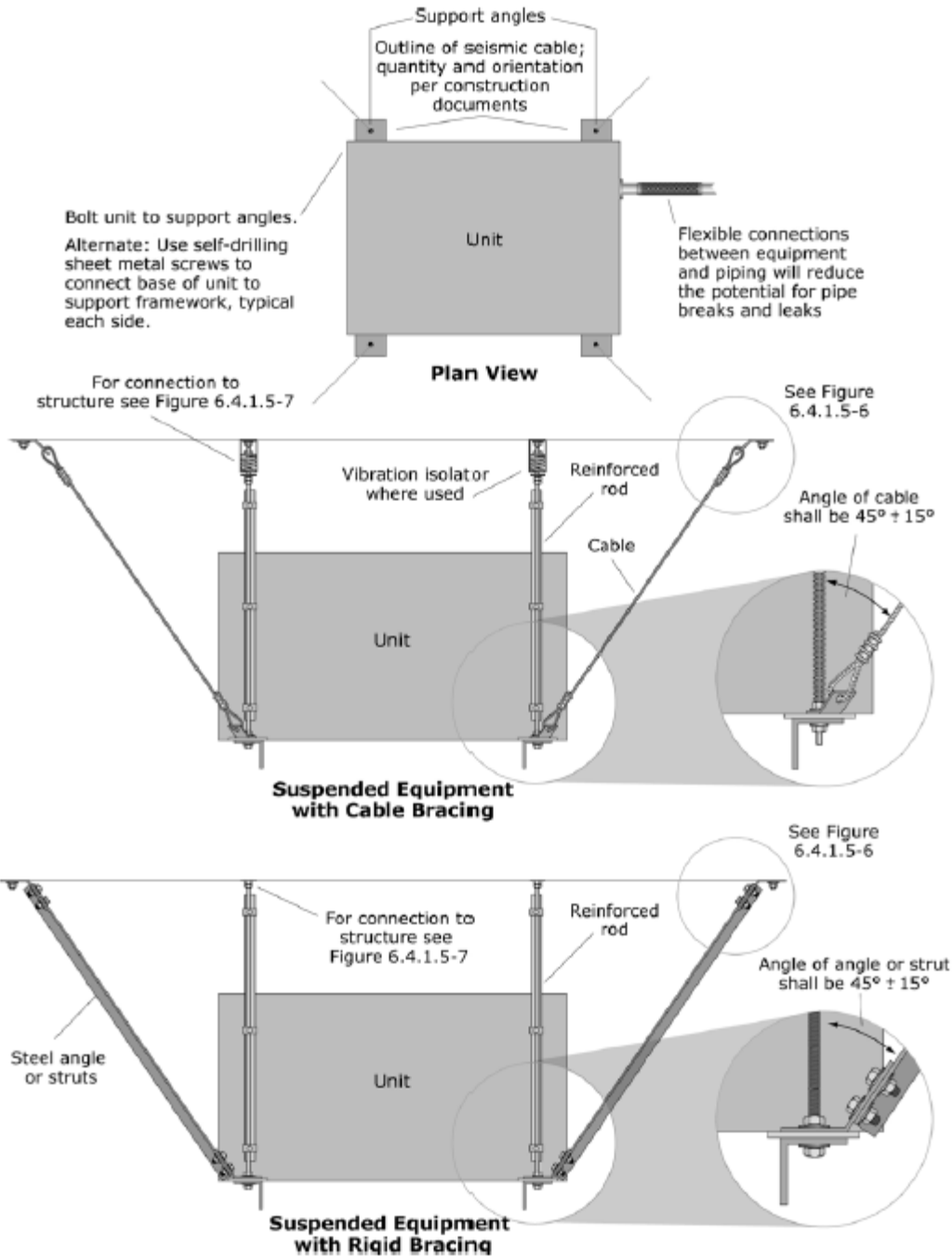


Figure G-32. Suspended Equipment.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

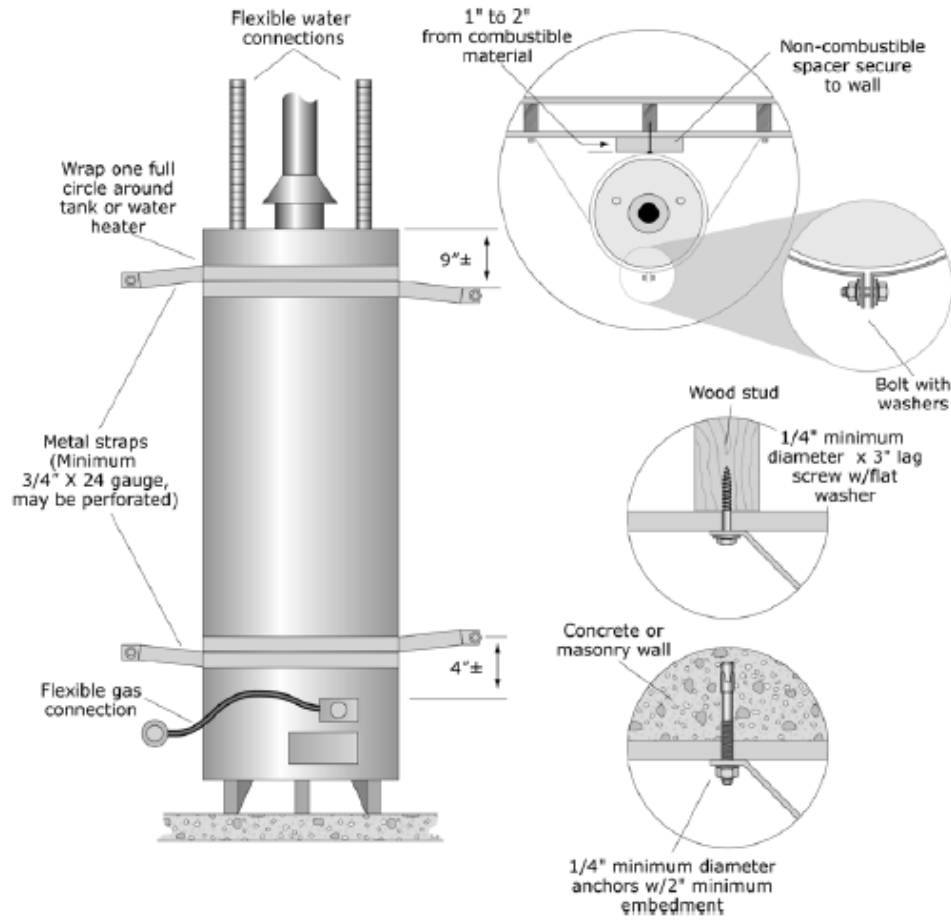


Figure G-33. Water Heater Strapping to Backing Wall.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

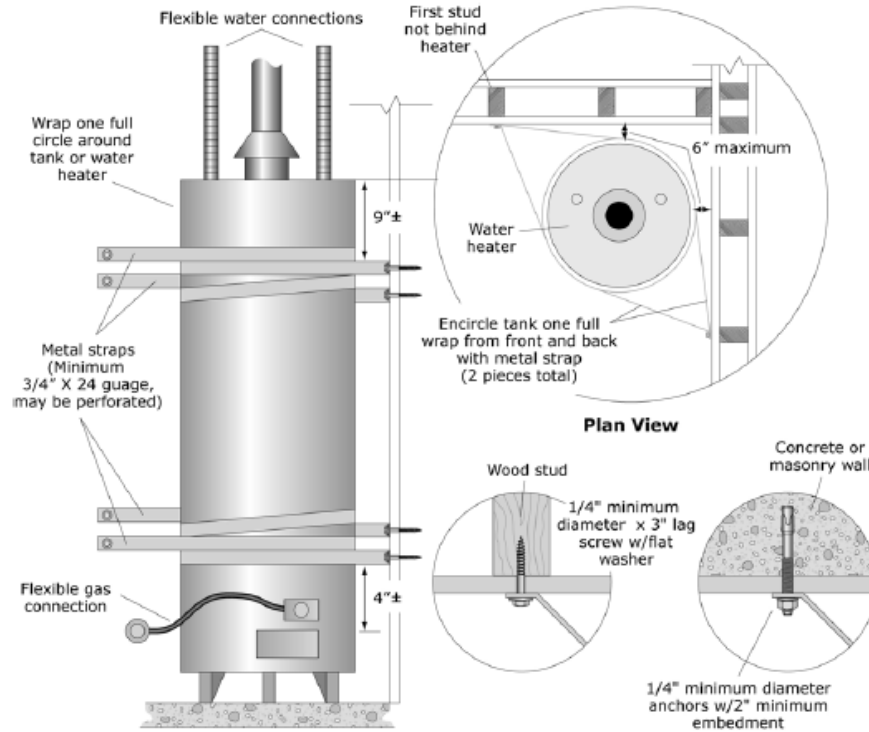


Figure G-34. Water Heater – Strapping at Corner Installation.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

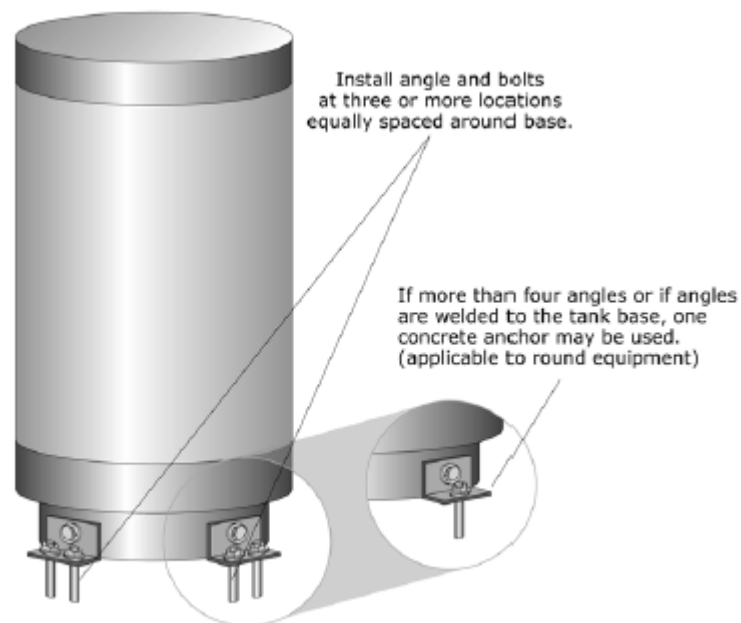


Figure G-35. Water Heater – Base Mounted.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

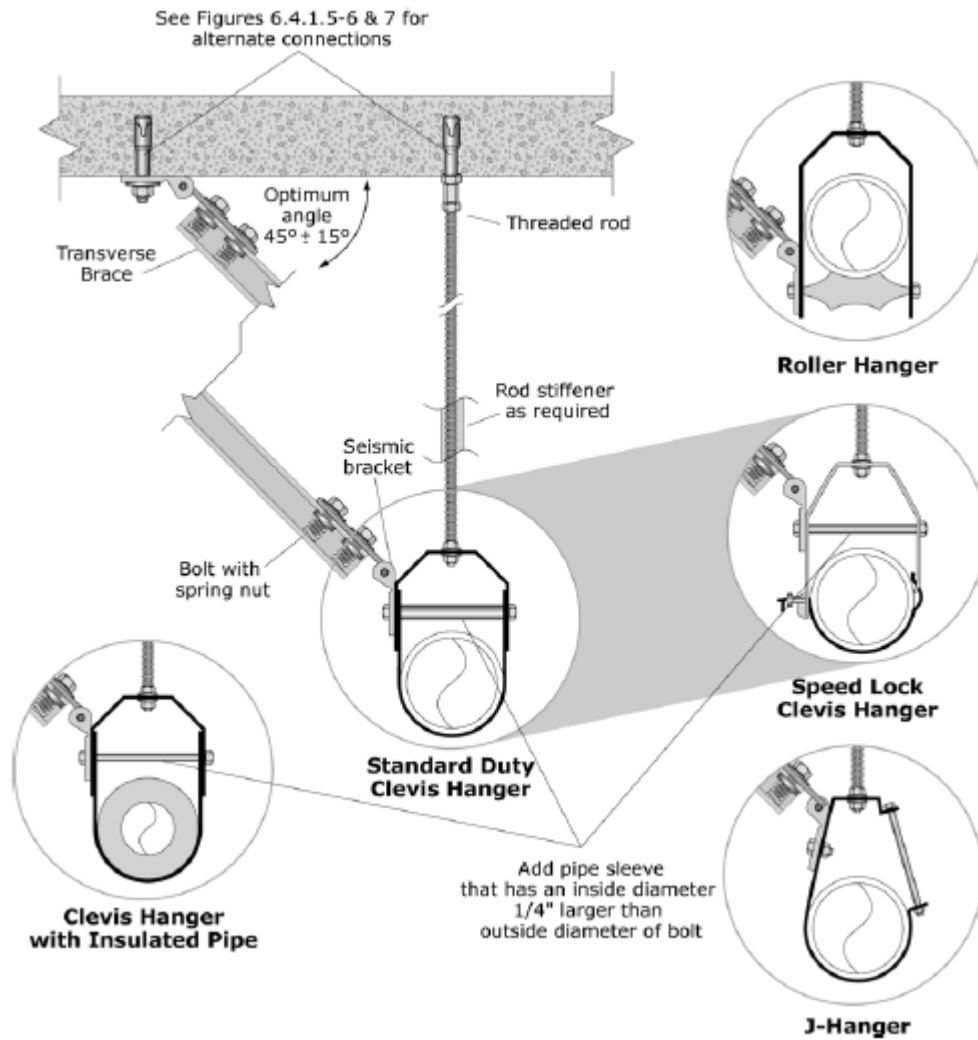


Figure G-36. Rigid Bracing – Single Pipe Transverse.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

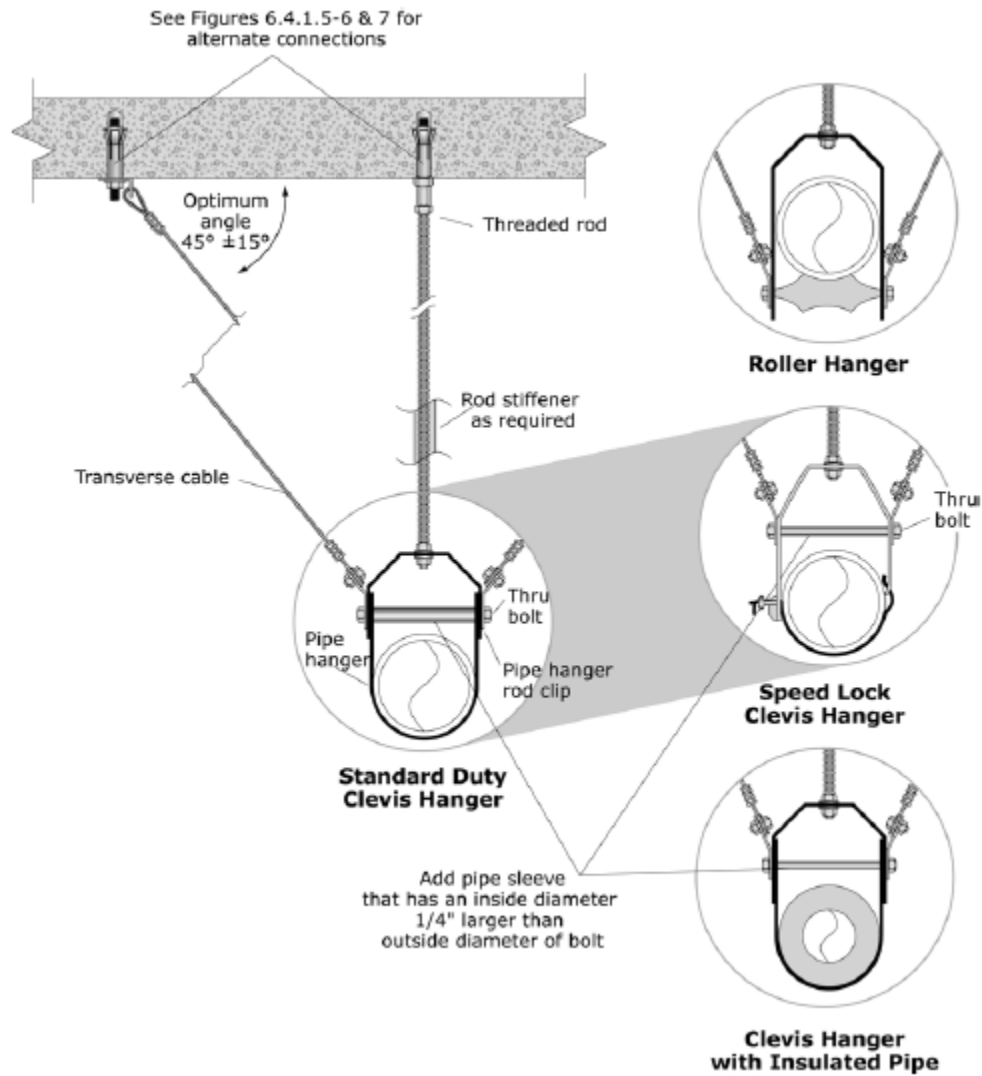


Figure G-37. Cable Bracing – Single Pipe Transverse.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

Electrical and Communications

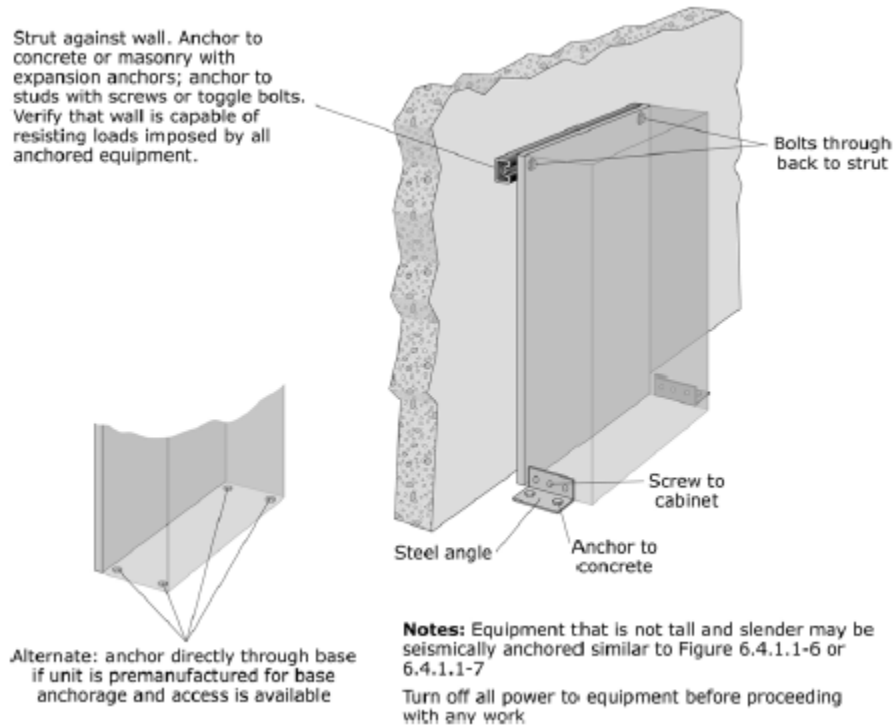


Figure G-38. Electrical Control Panels, Motor Controls Centers, or Switchgear.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

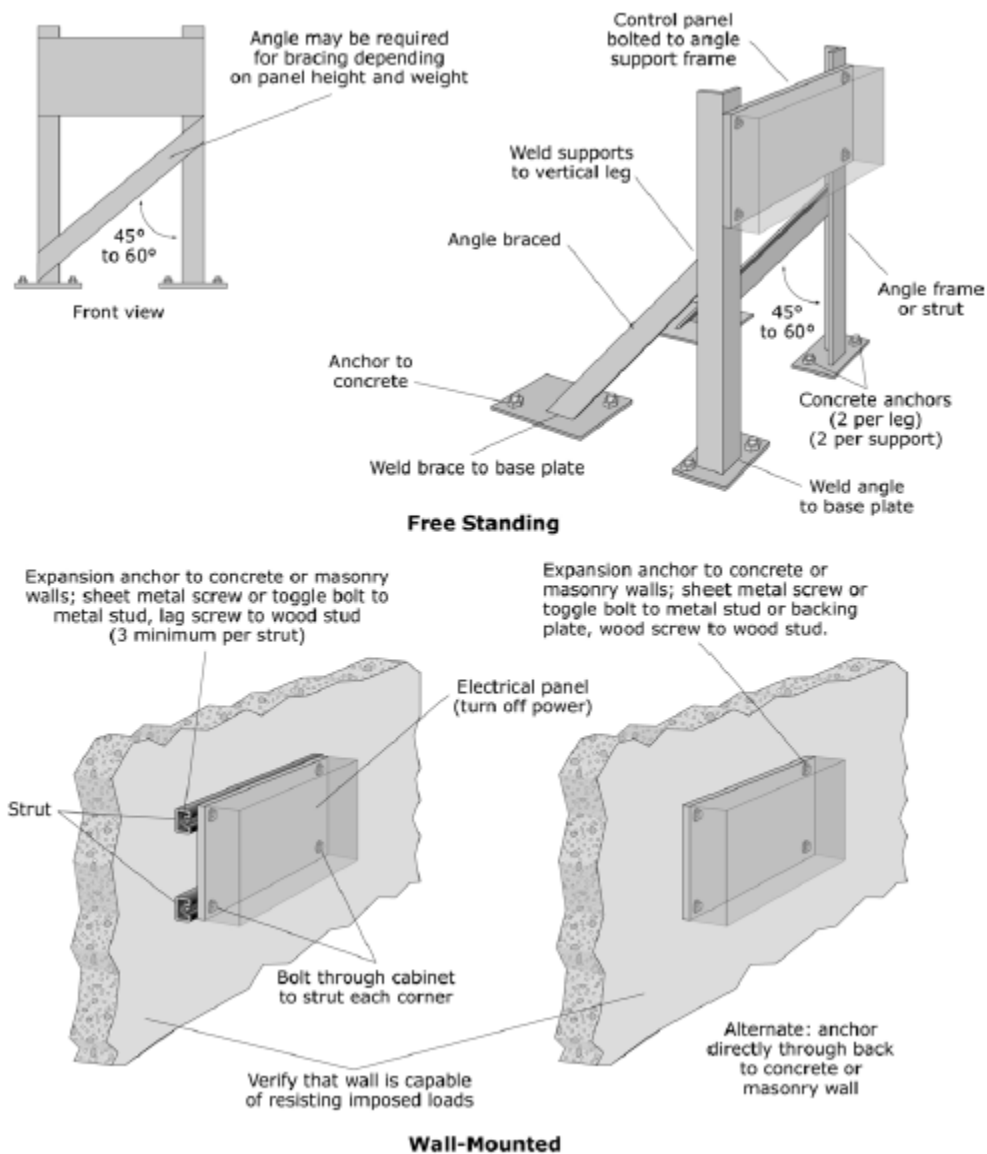


Figure G-39. Freestanding and Wall-mounted Electrical Control Panels, Motor Controls Centers, or Switchgear.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

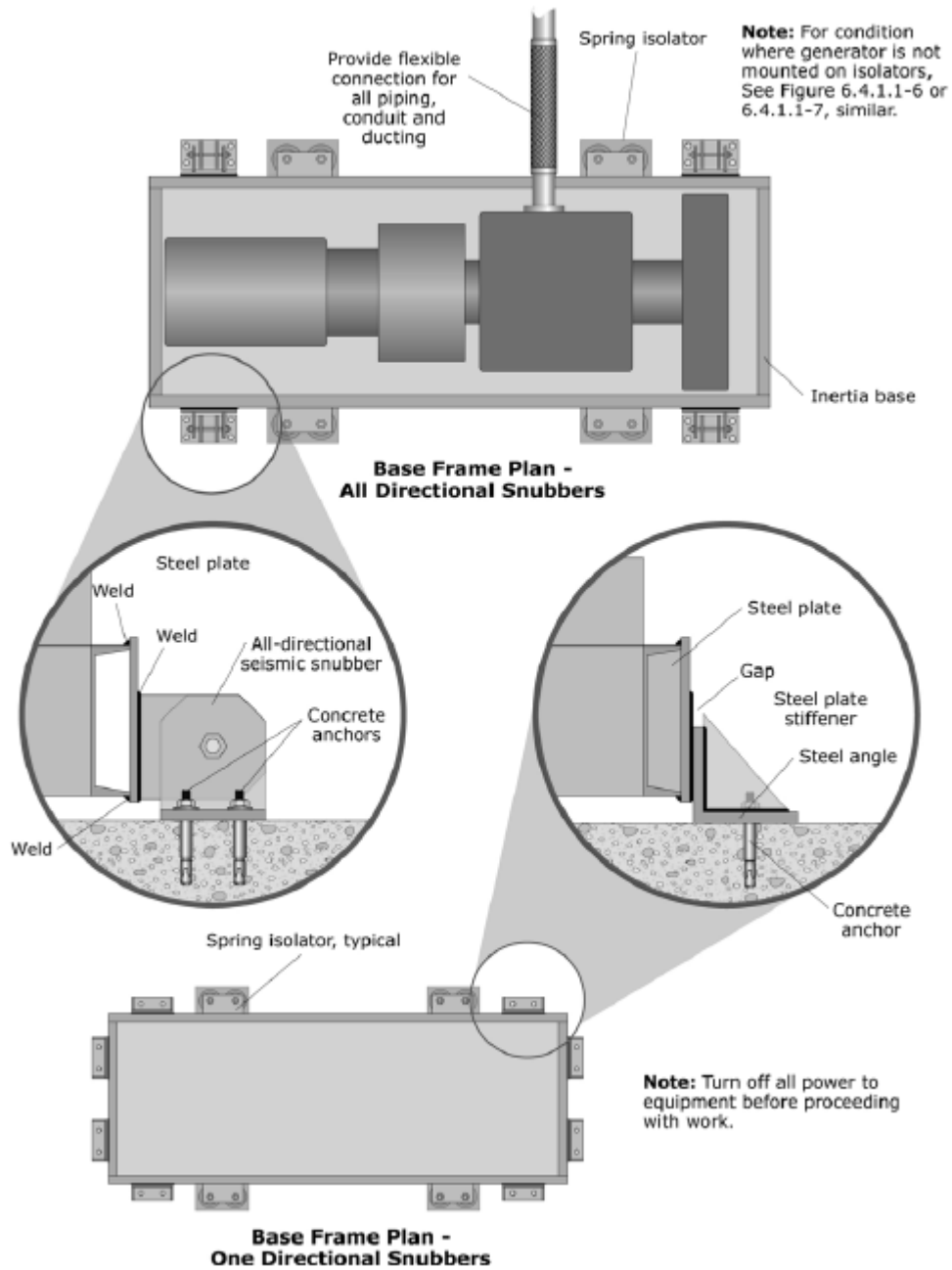


Figure G-40. Emergency Generator.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)