Washington State School Seismic Safety Assessments Project

SEISMIC UPGRADES CONCEPT DESIGN REPORT

Adams Elementary School – Main Building

Spokane Public Schools

June 2019

PREPARED FOR

Washington Department of Natural Resources
Superintendent of Public Instruction, Washington

PREPARED BY

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EXECUTIVE SUMMARY

This report documents the findings of a preliminary seismic evaluation of the Adams Elementary School Main Building in Spokane, Washington. The school is a K-5 elementary school serving approximately 360 students. The school consists of an 18,200-square-foot main structure with a 7,200-square-foot gymnasium addition and 8,000 square feet spread across three portable classroom buildings. The main structure is a two-story building over a daylight basement, with classrooms, maintenance, and mechanical rooms in the basement; classrooms, a library, and administrative offices on the first floor; and classrooms and storage rooms on the second floor. The original building was constructed in 1910, with additions in both 1917 and 1950. The original structure and the first addition are of unreinforced masonry (URM) bearing wall construction with wood floor and roof structures. The 1950 classroom addition is URM bearing walls with evidence of an open-web steel joist and concrete floor system. The foundations are shallow continuous wall footings and shallow spread footings for the main structure.

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 seismic deficiencies that include no seismic joint at adjacent buildings and no defined transfer of in-plane forces to shear walls. Adequate wall anchorage was not observable but is assumed to be noncompliant. Other deficient items include hazardous materials, lack of flexible couplings in piping, overhead glazing, and a tall URM chimney. Some items that were not observed, but are likely to be compliant, include well-defined load paths, adequate shear stress capacity in walls, and connectivity between girder-type members and their supports.

Conceptual seismic upgrade recommendations for structural and nonstructural systems are provided to improve the performance of the building to meet the designated performance criteria of ASCE 41-17. Sketches for the concept-level seismic upgrades are provided in Appendix B. The structural upgrades include providing seismic ties between adjacent buildings, improving connections for the transfer load to shear walls, and improved wall anchorage. The recommendations for nonstructural upgrades include installation of lateral bracing on overhead piping, installation of flexible couplings on piping, replacing windows with laminated glass, and cutting down the height of the existing chimney. These recommendations, structural and nonstructural, are based on limited field observations and minimal access to existing drawings. Complete as-built drawings and verification of unknown deficiencies are recommended prior to pursuing seismic upgrades to the building.

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Acronyms

ADA	Americans with Disabilities Act
ASCE	American Society of Civil Engineers
BPOE	Basic Performance Objective for Existing Buildings
BSE	Basic Safety Earthquake
BU	Built-Up
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
IBC	International Building Code
ICOS	Information and Condition of Schools
IEBC	International Existing Building Code
IO	Immediate Occupancy
LS	Life Safety
MCE	Maximum Considered Earthquake
MEP	Mechanical/Electrical/Plumbing
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
OSPI	Office of the 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

Reference List

Codes and References

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ASCE 7-10, 2010, *Minimum Design Loads for Buildings and Other Structures*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

ASCE 31-03, 2003, *Seismic Evaluation of Existing Buildings*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

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ASCE 41-17, 2018, *Seismic Evaluation and Retrofit of Existing Buildings*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

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FEMA E-74, *Reducing the Risks of Nonstructural Earthquake Damage.* Prepared by https://www.fema.gov/fema-e-74-reducing-risks-nonstructural-earthquake-damage

FEMA Earthquake School Hazard Hunt Game and Poster. Prepared by https://www.fema.gov/media-library/assets/documents/90409

Promoting Seismic Safety: Guidance for Advocates. Prepared by https://www.fema.gov/media-library/assets/documents/3229

Drawings

March 1917, existing drawings entitled "Additions and Alterations on Adams School., 37th Ave., and Regal St. School Dist. No. 81 Spokane Washington"

1.0 Introduction

1.1 Background

The Washington Geological Survey (WGS), a division of the Department of Natural Resources (DNR), is conducting a seismic assessment of 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. The two main components of this 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.

Fifteen school buildings were selected in consultation with WGS and the School Seismic Safety Steering Committee (SSSSC) 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 fifteen 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 as listed in the following sections.

1.2.1 Information Review

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

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

1.2.2 Field Investigations

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

2. Limitations Due to Access and Worker Safety: Field observations at each site were typically performed by an individual engineer. 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, lathe 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 checklist items that were not documented due to access limitations are noted.

1.2.3 Seismic Evaluations

1. Preliminary Seismic Evaluations: Preliminary 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. Concept-Level Designs: 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. Cost Estimating: Through the concept-level seismic upgrades design process, ProDims 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. Project Reports: A preliminary seismic evaluation report on the overall Tier 1 seismic assessment of the schools will be provided to DNR/WGS and OSPI. The Tier 1 seismic evaluation of each building was documented by a standard report format that provides a summary of the structural systems of the building, Tier 1 checklist, building sketches/plans (if available), and site photographs. The reports will summarize the seismic evaluation, with concept-level seismic upgrade sketches and opinions of probable construction costs for seismic upgrades for each school building.

2. Building Photography: Photos and videos were taken of each building during on-site walkthroughs to document the existing building configurations, conditions, and structural systems.

3. Record Drawings: Record drawings and other information that was collected during the evaluation process are available for DNR/WGS, OSPI, and the school districts.

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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

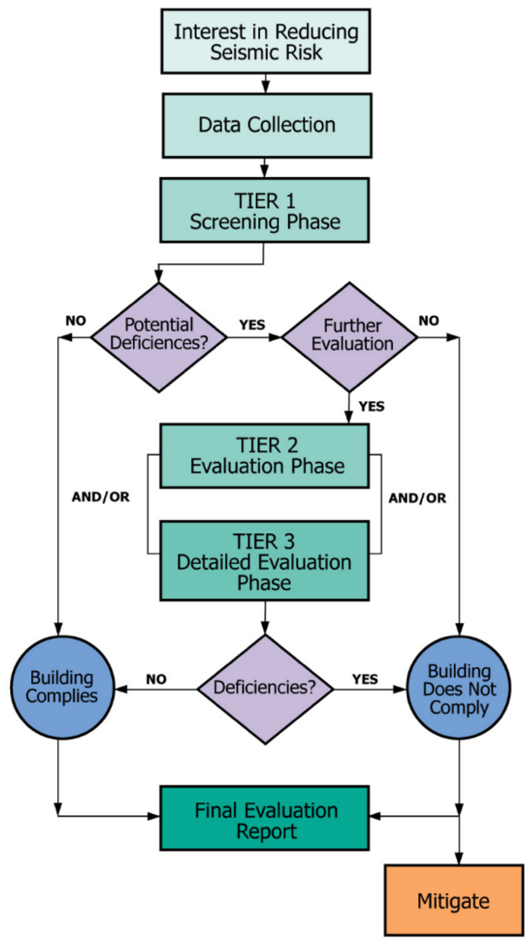

Figure 2-1. Flow Chart and Description of ASCE 41 Seismic Evaluation Procedure.

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: in this building's case, the shear walls and wall anchorage. 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 Adams Elementary School Seismicity

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

The Level of Seismicity is categorized as Very Low, Low, Moderate, or High based on the probabilistic ground accelerations. Ground accelerations and mass generate inertial (seismic) forces within a building (Force = mass x acceleration). Ground acceleration therefore is the parameter that classifies the level of seismicity. From geographic region to region, as the ground accelerations increase, so does the level of seismicity (from low to high). Where this building is located, the design short-period spectral acceleration, S_{DS}, is 0.266 g, and the design 1-second period spectral acceleration, S_{D1} is 0.129 g. Based on ASCE 41 Table 2-4, the Level of Seismicity for this building is classified as **Low**.

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

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

Table 2.2.1-1. Spectral Acceleration Parameters (Not Site-Modified).

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	0.090 g	0.2 Seconds	0.221 g	0.2 Seconds	0.221 g	0.2 Seconds	0.332 g
1.0 Seconds	0.034 g	1.0 Seconds	0.077 g	1.0 Seconds	0.080 g	1.0 Seconds	0.115 g

2.2.2 Adams Elementary School Structural Performance Objective

The school building is an Educational Group E Occupancy (Risk Category III) structure and has not been identified as a critical structure requiring immediate use following an earthquake. However, Risk Category III buildings are structures that represent a substantial hazard to human life in the event of failure. According to ASCE 41, the BPOE for Risk Category III structures is the Damage Control structural performance level at the BSE-1E seismic hazard level and the Life 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-2E** 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). In-situ testing of building materials and removal of architectural finishes are outside of the scope of this study. Material properties and existing construction information were assumed since existing structural drawings were not available. If the concept design is developed further, additional materials tests and site investigations will be required to substantiate assumptions about the existing framing systems.

ASCE 41 Classified Building Type

Use of ASCE 41 for seismic evaluations requires buildings to be classified from a group of common building types historically defined in previous seismic evaluation standards (ATC-14, FEMA 310, and ASCE 31-03). The school is classified in ASCE 41 Table 3-1 as Unreinforced Masonry Bearing Walls with Flexible Diaphragm, URM, and Unreinforced Masonry Bearing walls with Rigid Diaphragms, URMa. Unreinforced Masonry Bearing Walls (URM) include those that have perimeter bearing walls of unreinforced clay brick, stone, or concrete masonry. Interior bearing walls, where present, also consist of unreinforced brick, stone, or masonry. Floor and roof framing consists of straight or diagonal lumber sheathing supported by wood joists, which, in turn, are supported on posts and timbers. The diaphragms are flexible relative to the walls. Where they exist, ties between the walls and diaphragms consist of anchor or bend steel plates embedded in the mortar joints and attached to framing. Unreinforced Masonry Bearing Walls (URMa) are similar to URM buildings, except that the diaphragms are stiff relative to the unreinforced masonry walls and interior framing. The diaphragms consist of metal deck and concrete fill supported on steel framing.

2.3 Report Limitations

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

3.0 Building Description & Seismic Evaluation Findings

3.1 Building Overview

3.1.1 Building Description

Original Year Built: 1910
Building Code: Unknown

Year Addition Built: 1917, 1950

Number of Stories: 2
Attic Below Roof: Yes
Floor Area: 27,300 SF

FEMA Building Type: URM
ASCE 41 Level of Seismicity: Low
Site Class: C

The building is a three-story structure consisting primarily of URM bearing and shear walls with wood-framed floors and roof. The building was completed in three "phases," with the original, easternmost portion of the building constructed in 1910, followed by additions to the west in 1917 and around 1950. All three additions are three stories and appear similar in construction type, although there is some evidence of steel and concrete floor framing being used in the 1950 addition.

The structural system consists of nonductile URM bearing walls. The roof on the original construction and the 1917 addition consists of 2x8 wood joist rafters spanning between 2x4 pony walls, which bear on 2x4 blocking between the 2x12 ceiling joists. The floor system of those areas consists of 2½x16 joists at 12 inches on center, spanning from exterior walls to interior corridor bearing walls at the first and second floor. The roof on the 1950 classroom addition is assumed to be a similar wood structure. The floor system of the 1950 addition is assumed to consist of a concrete deck supported by open-web steel joists, spanning between interior and exterior walls at the first and second floor. Only a small portion of the floor system was visible for the latter addition and no drawings were available.

The foundation system for the building is composed of shallow continuous wall footings under concrete stem walls at the interior and exterior bearing lines.

3.1.2 Building Use

The building functions as an elementary school, with approximately 336 students and 35 staff. The basement consists of a mechanical room and several classrooms. The main floor contains the office, library, and a few classrooms. The upper floor is mostly classroom space, with some small storage areas.

3.1.3 Structural System

Table 3.1.3-1. Structural System Descriptions.

Structural System	Description
Structural Roof	Based on the drawings provided for the 1917 addition, the roof in that area is composed of wood sheathing supported by 2x8 rafters spanning over 2x4 cripple walls that bear on 2x12 wood joists at the ceiling level. The roof system in the 1910 portion of the building is assumed to be of similar construction. The roof system in the 1950 addition is unknown.
Structural Floor(s)	In the 1917 addition, the floor is composed of wood sheathing supported by wood joists. The floor system in the 1910 portion of the building is assumed to be of similar construction, while the floor system in the 1950 addition is generally unknown. There was an exposed area of floor in the southwest corner of the 1950 addition that was composed of a concrete slab supported by open-web steel joists, but the extent of that floor assembly could not be confirmed.
Foundations	In the 1917 addition, the foundation system consisted of concrete basement walls supported by continuous concrete footings. The foundations in the 1910 and 1950 portions of the building could not be observed, but are assumed to be of similar construction type.
Gravity System	The roof and floor systems are supported by interior and exterior URM walls.
Lateral System	The lateral system generally consists of wood diaphragms and URM bearing/shear walls. In a portion of the 1950 addition, an area of the floor was observed to be concrete, but the majority of the structure was hidden by finishes.

3.1.4 Structural System Visual Condition

Table 3.1.4-1. Structural System Condition Descriptions.

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

Table 3.1.4-1. Structural System Condition Descriptions.

Structural System	Description
Gravity System	Generally good, although there were a few isolated areas of the URM walls where the mortar was deteriorating. There is also a substantial amount of ivy growing on the east wall of the building. The condition of the wall could not be assessed, but ivy has been known to cause damage to URM walls by infiltrating and widening cracks.
Lateral System	Generally good, although there were a few isolated areas of the URM walls where the mortar was deteriorating. There is also a substantial amount of ivy growing on the east wall of the building. The condition of the wall could not be assessed, but ivy has been known to cause damage to URM walls by infiltrating and widening cracks.

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
Adjacent Buildings	There was no joint observed between this building and the adjacent gymnasium/cafeteria building.
Transfer to Shear Walls	This condition could not be observed due to access limitations, but it is assumed to be noncompliant based on the drawings that are available. In the drawings, there is no clear connection between the diaphragms and walls for the transfer of in-plane forces.

3.2.2 Structural Checklist Items Marked as "U"nknown

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

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

Deficiency	Description
Load Path	The existing drawings we received show only a portion of the building. There appears to be wood-framed diaphragms and URM shear walls on all sides that provide a complete load path, but the connections between them are not clearly defined in the drawings and were unable to be observed.
Liquefaction	The liquefaction potential of site soils is unknown at this time given available information. "Bedrock" liquefaction potential is identified per ICOS based on state geologic mapping. Requires further investigation by a licensed geotechnical engineer to determine liquefaction potential.
Slope Failure	Requires further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Requires further investigation by a licensed geotechnical engineer to determine whether site is near locations of expected surface fault ruptures.
Shear Stress Check	Due to a lack of complete as-built drawings, the extents of the URM shear walls is not fully clear. Based on a check of the portion of the building where drawings were available, it appears there is adequate wall to limit the shear stress to 30 pounds per square inch, but a more detailed investigation of the whole building would need to be performed to confirm this.
Wall Anchorage	Drawings were only available for a portion of the building. For that portion, there are anchors shown that anchor the walls perpendicular to the joists to the diaphragms, but none were shown at the walls parallel to the joists. The as-built conditions could not be observed in the field due to access limitations; the anchor sizes and their adequacy to resist the prescribed forces could not be evaluated.
Wood Ledgers	Ledgers were not shown in the drawings provided, but this condition could not be observed in the field due to access limitations.
Girder-Column Connection	The drawings were not clear on the connection between girders and columns, and this condition could not be observed in the field.

3.2.3 Nonstructural Seismic Deficiencies

The nonstructural seismic deficiencies identified during the Tier 1 evaluation are summarized below. Commentary for each deficiency is provided based on this 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 3.2.3-1. Identified Nonstructural Seismic Deficiencies based on Tier 1 Checklists.

Deficiency	Description
HM-3 Hazardous Material	The natural gas piping observed in the mechanical room is suspended by metal straps or hanger rods, but lateral bracing was not observed.
HM-5 Flexible Couplings	Flexible couplings were not observed on the gas piping.
CG-8 Overhead Glazing	There are window panes greater than 16 square feet that do not appear to be laminated.
MC-1 URM Chimneys	The height-to-width ratio of the chimney extension above the roof could not be measured due to limitations in access, but it appeared to exceed the limit noted.

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
P-1 Unreinforced Masonry	The tops of the interior walls could not be observed. Based on the building type, it is assumed that all of the URM walls are bearing and/or tied into the floor and roof framing.
P-2 Heavy Partitions Supported by Ceilings	The tops of the interior walls could not be observed. Based on the building type, it is assumed that all of the URM walls are bearing and/or tied into the floor androof framing.
C-1 Suspended Lath & Plaster	The ceiling details could not be observed, but the ceiling appeared to be direct-applied.
C-2 Suspended Gypsum Board	The ceiling details could not be observed, but the ceiling appeared to be direct-applied.

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

Deficiency	Description
PCOA-1 URM Parapets or Cornices	Some building drawings were available, but this configuration could not be observed and our understanding is that the parapets were modified at some point in time.
MC-2 Anchorage	This condition could not be observed.
S-1 Stairs Enclosures	Building drawings were unavailable and this condition could not be observed.
S-2 Stair Details	Building drawings were unavailable and this condition could not be observed.

4.0 Conclusion and Recommendations

4.1 Seismic-Structural Upgrade Recommendations

Based on the lack of existing building drawings and the limitations of the on-site observations, the Adams Elementary School structure has a lot of unknowns.

4.1.1 Seismic Connections

The joint between the main building and the gymnasium addition has no clear gap to allow for independent movement of the two structures during a seismic event. It is recommended that additional ties be added between the two structures to more rigidly connect the two. Horizontal ties and straps should be added to the existing gymnasium roof. The ties should through-bolt to the existing URM wall and connect to a channel spanning horizontally between vertical strongbacks. The strongbacks should be tied into the ceiling and floor framing.

4.1.2 Diaphragm Connections

The diaphragm-to-shear-wall connection is assumed to be inadequate based on limited information in the 1917 drawings. Where floor joists are parallel to shear walls, the joist immediately adjacent to the wall should be anchored to the shear wall with post-installed anchors. Where floor joists are perpendicular to the shear walls, blocking should be installed at the face of the wall between the joists; post-installed anchors should be used to anchor the blocking to the wall. The diaphragm connection applies at both floor and roof levels. Where the floor is concrete over metal deck, the diaphragm connection is assumed to be compliant.

4.1.3 Wall Anchorage

The out-of-plan anchorage of the walls at the diaphragms is assumed to be inadequate based on the age and nature of the building. Where floor joists are perpendicular to shear walls, tension ties should be added to joists, as required, to properly brace the walls. Where the floor joists are parallel to shear walls, blocking between joists should be installed at a specified spacing in as many bays as required to develop the anchorage load into the diaphragm. A strap should be installed over the existing sheathing, aligned with the blocking, and a tension tie should be installed to the blocking panel of the nearest the wall. The anchorage applies at both floor and roof levels. Where the floor is concrete over metal deck, the wall anchorage is assumed to be compliant.

4.2 Nonstructural Upgrade Recommendations

4.2.1 Hazardous Materials

The extent of hazardous material in the building is unknown. The following recommendations should be implemented to prevent the release of hazardous materials:

- Breakable containers that hold hazardous material, including gas cylinders, should be restrained by latched doors, shelf lips, wires, or other methods.
- Piping or ductwork conveying hazardous materials should be braced or otherwise protected from damage resulting in hazardous material release.
- Piping containing hazardous material, including natural gas, should have shutoff valves or other devices to limit spills or leaks.
- Hazardous material ductwork and piping, including natural gas piping, should have flexible couplings.

4.2.2 Architectural Considerations

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

For existing building remodel projects, the International Existing Building Code (IEBC) is 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 current accessibility standards per the American 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, fire alarm system, etc. 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.

Seismic Connections between Main Building and Addition

The joint between the main building and the gymnasium addition has no clear gap to allow for independent movement of the two structures during a seismic event. It is recommended that additional ties be added between the two structures to more rigidly connect the two. Horizontal ties and straps should be added to the existing gymnasium roof.

The ties should through-bolt the existing URM wall and connect to a channel spanning horizontally between vertical strongbacks. The strongbacks should be tied into the ceiling and floor framing.

The impact on traffic flow and ADA requirements must be carefully evaluated where these frames are to be installed on the building interior.

The impact on existing finishes will need to be addressed on a case-by-case basis, depending on location of the proposed work.

Where installed on the exterior, the visual impact of the frames could be significant; ways to minimize impact on the building's character will need to be studied.

The impact of through-wall fasteners on existing wall finishes needs to be considered, as does the impact on wall insulation and vapor barriers.

Interior Shear Walls

Existing interior masonry shear walls are to be strengthened with bi-directional FRP. Interior CMU walls separating the gym from the storage rooms are to be braced with HSS vertical strongback. These will also be installed in the lobby areas; impact on traffic flow and ADA requirements must be carefully evaluated.

Existing shear wall thickness may differ from proposed CMU shear wall thickness, depending on finishes proposed.

Storage and offices spaces may be impacted by any additional wall width. Doors to office and storage areas may need to be removed/replaced.

Openings for items such as electrical outlets and switches in the CMU shear walls to get bi-directional FRP will need to be coordinated with existing conditions. Floor and ceiling finishes could be impacted.

Roof Diaphragm Connections

The diaphragm-to-shear wall connection is assumed to be inadequate based on limited information in the 1917 drawings.

- Where floor joists are parallel to shear walls, the joist immediately adjacent to the wall should be anchored to the shear wall with post-installed anchors.
- Where floor joists are perpendicular to the shear walls, blocking should be installed at the face of the wall between the joists; post-installed anchors should be used to anchor the blocking to the wall.

The diaphragm connection applies at both floor and roof levels.

Roof diaphragm upgrades may require the removal of finishes above and below the roof deck for access to install new work. If existing insulation is above the roof deck, it will need to be replaced with additional insulation to meet current energy code requirements (R-38). Existing ceilings will need to be removed and replaced to allow access to the underside of the deck, in order to install blocking and upgrade the perimeter roof and wall connections.

Ceilings

The ceilings in the building are a combination of integrated acoustical ceiling tiles supported by steel channel systems, direct-applied lath and plaster, and direct-applied or suspended gypsum board. The recommended seismic mitigation measures include providing ceiling attachments that resist seismic forces to suspended gypsum board and suspended lath and plaster ceilings for every 12 square feet of area. Suspended acoustical ceilings have suffered significant damage in past earthquakes, causing a falling hazard to the occupants during an earthquake.

Light fixtures within the integrated suspended ceilings are required to be independently supported to the structure above with a minimum of two wires at opposite corners. Repair plaster ceilings; finish to match adjacent. Replace damaged ceiling tiles with new tiles to match. Another option would be to replace the plaster and acoustic tiles with Tectum acoustic panels suspended below the roof structure.

Existing suspended T-bar ceilings would need to be removed and reinstalled with new seismically-braced T-bar in order to gain access to the underside of the roof and floor diaphragms for blocking installation.

The existing ceiling-mounted light fixtures in the gym and elsewhere appear to be substandard and could become dangerous in an earthquake. Lighting should be updated to current lightweight LED fixtures with seismic bracing.

Chimney

The building includes a URM chimney. While the dimensions could not be verified during the field investigation, the height-to-width ratio appears to be noncompliant. The chimney should be cut down as required to be compliant. If additional height is required for proper ventilation, an additional metal chimney should be fitted.

Overhead Glazing

For interior and exterior glazing panes more than 16 square feet in area, provide laminated annealed or laminated heat-strengthened glass that is detailed to remain in the frame when cracked. Non-laminated glazing that shatters during an earthquake can pose a severe life safety threat to occupants. Shattered exterior windows also compromise the exterior weather barrier, which can become disruptive to the operation of the building after an earthquake. The building has large areas of glass block infill above the windows on one end of the building. The glass block can become dislodged during a seismic event, posing a severe falling hazard during the event and compromising the exterior weather barrier after the event.

Stairwell Glazing

The stair well at the gymnasium in the west façade of the building has 6-1/2-foot-wide by 24-foot-tall glass block panels. Glass block walls can pose a severe falling hazard during an earthquake. The recommended seismic mitigation for the glass block panels are:

- Install horizontal out-of-plane steel framing across the exterior and interior faces of the glass block at the top and bottom to provide lateral restraint.

Care must be taken to ensure that the character of the existing building is not altered by proposed structural modifications.

Contents and Furnishings

The building contains various tall and narrow furniture, such as shelving and storage units, that are freestanding away from any backing walls. This furniture is highly susceptible to toppling if not anchored properly and can become a life safety hazard or adversely affect post-earthquake operations. The recommended seismic mitigation for tall and narrow furniture is:

- Anchor storage cabinets or shelving units that are more than 6 feet high and with a height-to-depth or height-to-width ratio greater than 3-to-1 to the structure or to each other to prevent toppling during an earthquake.
- Provide bracing or restraint for equipment, stored items, or other contents weighing more than 20 pounds and with a center of mass that is more than 4 feet above the adjacent floor level.

4.2.3 Mechanical/Electrical/Plumbing (MEP) Systems

The main seismic concerns for mechanical equipment, ducting, and piping are sliding, swinging, and overturning. Inadequate lateral restraint or anchorage can shift equipment off its supports or topple equipment to the ground or onto other equipment. Inadequate bracing of piping and ducting, or the inability for piping to tolerate differential movement from the equipment it is attached to, can damage or dislodge connections. Such damage in fluid piping can potentially lead to major leaks or loss and disruption by damaging contents. The recommended seismic mitigation for MEP systems is as follows:

- Provide seismic bracing for equipment that weighs more than 20 pounds, has a center of mass more than 4 feet above the adjacent floor level, and is not in-line equipment.

4.3 Opinion of Conceptual Construction Costs

A preliminary opinion of probable construction costs to perform the concept-level seismic upgrade recommendations provided in this report is included in Appendix C. The input for these preliminary probable costs are 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 that this 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. Consequently, the costs presented in this concept-level design report are very preliminary in nature and are only intended to be utilized in their aggregate form with the entire statewide school seismic safety assessments study.

For this preliminary opinion of probable construction costs, an estimate of the current year (2019) construction costs of the probable scope of work was developed. These costs were developed based on the Tier 1 checklist, concept-level seismic upgrade design sketches, and project narratives. Then a -20 percent (low) to +50 percent (high) range variance was used to develop the construction cost estimate range for the concept-level scope of work. The -20 percent to +50 percent range variance guidance is from Table 1 of the AACE International Recommended Practice 56R-08, *Cost Estimate Classification System for Class 5 Estimates*. The variable cost range of a Class 5 estimate is due to the limited design completeness and is defined as 0 percent to 2 percent Project Definition Deliverables.

The estimated structural and nonstructural construction cost to mitigate the deficiencies identified in the Tier 1 checklists of the Adams Elementary School Main Building ranges between approximately $1.1M and $2.1M (-20 percent/+50 percent). The estimated construction cost to seismically upgrade this building is approximately $1.4M. On a per-square-foot basis, the seismic upgrade construction cost is estimated to be approximately $52 per square foot in 2019 dollars, with a variance range between $42 per square foot and $78 per square foot.

This preliminary opinion of construction cost includes labor, materials, equipment, and general contractor general conditions (mobilization), 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 project costs not included in the construction cost estimate are building permits, design fees, change order contingencies, escalation at a recommended 4.1 percent* per year to the midpoint of construction (currently unknown), materials testing/inspection, project planning and design schedule delay contingencies, and owner's overall project contingency. Additional owner's project costs would likely include owner's general overhead costs, including project management, financing/bond costs, administration/contract/accounting costs, review of plans, value engineering studies, equipment, fixtures, furnishings and technology, and relocation of the school staff and students during construction. These additional costs are not included in this preliminary concept-level design construction cost estimate.

Costs of all types excluded from the construction costs are site work, construction of replacement facilities, and mitigation of seismic risks for existing facilities and building code changes that occur over time after this report. <u>Future planning budgets should not be set on the basis of the preliminary construction costs estimate based on the concept-level design ideas presented in this report</u>. For budget planning purposes, it is highly recommended that a seismic upgrade budget be determined after the owner defines the scope of work and obtains the services of an A/E design team to study the proposed seismic mitigation strategies and to refine the concept-level seismic upgrades design approach contained in this report.

*-4.1%/year escalation rate for planning purposes should be compounded annually to the midpoint of construction and is sourced from *Engineering News Record (ENR),* November, 2017, the most recent rate representative of the escalation of construction costs throughout the state of Washington.

Table 4.3.1. 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)
Adams Elementary School Main Building	URM	Low / C	**Structural**					
			Life Safety	27,300 SF	$24 ($655K)	-	$45 ($1.23M)	$30 ($820K)
			Nonstructural					
			Life Safety	27,300 SF	$18 ($486K)	-	$33 ($911K)	$22 ($608K)
			Total					
				27,300 SF	$42 ($1.14M)	-	$78 ($2.14M)	$52 ($1.43M)

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

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Appendix A: Field Investigation Report and Tier 1 Checklists

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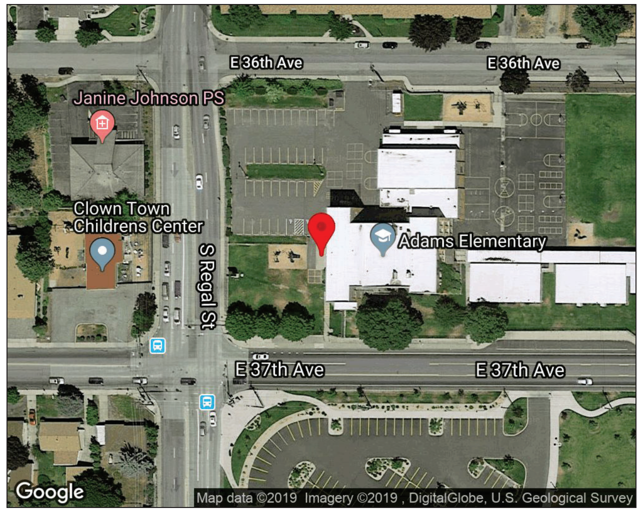
1. Spokane, Adams Elementary School, Main Building

1.1 Building Description

Building Name:	Main Building
Facility Name:	Adams Elementary School
District Name:	Spokane
ICOS Latitude:	47.62126
ICOS Longitude:	-117.368
ICOS County/District ID:	32081
ICOS Building ID:	19951
ASCE 41 Bldg Type:	URM
Enrollment:	334
Gross Sq. Ft. :	27300
Year Built:	1910
Number of Stories:	3
S_{XS} BSE-2E:	0.265
S_{X1} BSE-2E:	0.136
ASCE 41 Level of Seismicity:	Low
Site Class:	C
V_{S30}(m/s):	553
Liquefaction Potential:	Bedrock
Tsunami Risk:	None
Structural Drawings Available:	Partial
Evaluating Firm:	DCI Engineers - Spokane



The building is a three-story structure consisting primarily of Unreinforced Masonry (URM) bearing and shear walls with wood-framed floors and roof. The building was completed in three "phases" with the original, easternmost portion of the building being constructed in 1910, followed by an additions to the west in 1917 and around 1950. All three additions are three stories and appear similar in construction type, although there is some evidence of steel/concrete floor framing being used in the 1950 addition.

1.1.1 Building Use

An elementary school building with approximately 336 students and 35 staff. The basement consists of a mechanical room and several classrooms. The main floor contains the office, library and a few classrooms. The upper floor is mostly classroom space with some small storage areas.

1.1.2 Structural System

Table 1.1-1. Structural System Description of Adams Elementary School

Structural System	Description
Structural Roof	Based on the drawings provided for the 1917 addition, the roof in that area is comprised of a wood sheathing supported by 2x8 rafters spanning over 2x4 cripple walls that bear on 2x12 wood joists at the ceiling level. The roof system in the 1910 portion of the building is assumed to be of similar construction. The roof system in the 1950 addition is unknown.
Structural Floor(s)	In the 1917 addition, the floor is comprised of wood sheathing supported by wood joists. The floor system in the 1910 portion of the building is assumed to be of similar construction while the floor system in the 1950 addition is generally unknown. There was an exposed area of floor in the southwest corner of the the 1950 addition that was comprised of a concrete slab supported by open web steel joists, but the extents of that floor assembly could not be confirmed.
Foundations	In the 1917 addition the foundation system consisted of concrete basement walls supported by continuous concrete footings. The foundations in the 1910 and 1950 portions of the building could not be observed, but are assumed to be of similar construction type.
Gravity System	The roof and floor systems are supported by interior and exterior URM walls.
Lateral System	The lateral system generally consists of wood diaphragms and URM bearing/shear walls. In a portion of the 1950 addition a portion of the floor was observed to be concrete, but the majority of the structure was hidden by finishes.

1.1.3 Structural System Visual Condition

Table 1.1-2. Structural System Condition Description of Adams Elementary School

Structural System	Description
Structural Roof	Good. No visible signs of corrosion, damage or deterioration
Structural Floor(s)	Good. No visible signs of corrosion, damage or deterioration
Foundations	Good. No visible signs of corrosion, damage or deterioration
Gravity System	Generally good although there were a few isolated areas of the URM walls where the mortar was deteriorating. There is also a substantial amount of ivy growing on the east wall of the building. The condition of the wall could not be assessed, but ivy has been known to cause damage to URM walls by infiltrating and widening cracks.
Lateral System	Generally good although there were a few isolated areas of the URM walls where the mortar was deteriorating. There is also a substantial amount of ivy growing on the east wall of the building. The condition of the wall could not be assessed, but ivy has been known to cause damage to URM walls by infiltrating and widening cracks.

1.2 Seismic Evaluation Findings

1.2.1 Structural Seismic Deficiencies

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

Table 1-3. Identified Structural Seismic Deficiencies for Spokane Adams Elementary School Main Building

Deficiency	Description
Adjacent Buildings	There was no joint observed between this building and the adjacent gymnasium/cafeteria building.
Transfer to Shear Walls	This condition could not be observed due to access limitations, but it is assumed to be \Noncompliant\ based on the drawings that are available. In those drawings there is no clear connection between the diaphragms and walls for the transfer of in-plane forces.

1.2.2 Structural Checklist Items Marked as 'U'nknown

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

Table 1-4. Identified Structural Checklist Items Marked as Unknown for Spokane Adams Elementary School Main Building

Unknown Item	Description
Load Path	The existing drawings we received are show only a portion of the building. There does appear to be wood framed diaphragms and URM shearwalls on all sides that provide a complete load path, but the connections between them are not clearly defined in the drawings and were unable to be observed.
Shear Stress Check	Due to a lack of complete \as-built\ drawings the extents of the URM shear walls isn't fully clear. Based on a check of the portion of the building where drawings were available it appears that there is adequate wall to limit the shear stress to 30psi, but a more detailed investigation of the whole building would need to be performed to confirm this.
Wall Anchorage	Drawings were only available for a portion of the building. For that portion, there are anchors shown that anchor the walls perpendicular to the joists to the diaphragms, but none were shown at the walls parallel to the joists. The as-built conditions could not be observed in the field due to access limitations, thus the anchor sizes and their adequacy to resist the prescribed forces could not be evaluated.
Wood Ledgers	Ledgers were not shown in the drawings provided, but this condition could not be observed in the field due to access limitations.
Girder-Column Connection	The drawings were not clear on the connection between girders and columns and this condition could not be observed in the field.

1.3.1 Nonstructural Seismic Deficiencies

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

Table 1-5. Identified Nonstructural Seismic Deficiencies for Spokane Adams Elementary School Main Building

Deficiency	Description
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	The natural gas piping observed in the mechanical room is suspended by metal straps or hanger rods, but lateral bracing was not observed.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Flexible couplings were not observed on the gas piping.
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	There are window panes greater than 16 ft2 that do not appear to be laminated.
MC-1 URM Chimneys. HR-LMH; LS-LMH; PR-LMH.	The height to width ratio of the chimney extension above the roof could not be measured due to limitations in access, but it appeared to exceed the limit noted.

1.3.2 Nonstructural Checklist Items Marked as 'U'nknown

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

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

Table 1-6. Identified Nonstructural Checklist Items Marked as Unknown for Spokane Adams Elementary School Main Building

Unknown Item	Description
P-1 Unreinforced Masonry. HR-LMH; LS-LMH; PR-LMH.	The tops of the interior walls could not be observed although, based on the building type it is assumed that all of the URM walls are bearing and/or tied into the floor/roof framing.
P-2 Heavy Partitions Supported by Ceilings. HR-LMH; LS-LMH; PR-LMH.	The tops of the interior walls could not be observed although, based on the building type it is assumed that all of the URM walls are bearing and/or tied into the floor/roof framing.
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	The ceiling details could not be observed, but the ceiling appeared to be direct applied.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	The ceiling details could not be observed, but the ceiling appeared to be direct applied.
PCOA-1 URM Parapets or Cornices. HR-LMH; LS-LMH; PR-LMH.	Some building drawings were available, but this configuration could not be observed and our understanding is that the parapets were modified at some point in time.
MC-2 Anchorage. HR-LMH; LS-LMH; PR-LMH.	This condition could not be observed.
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	Building drawings were unavailable and this condition could not be observed.
S-2 Stair Details. HR-not required; LS-LMH; PR-LMH.	Building drawings were unavailable and this condition could not be observed; likely not capable of accommodating drift.

Photos:

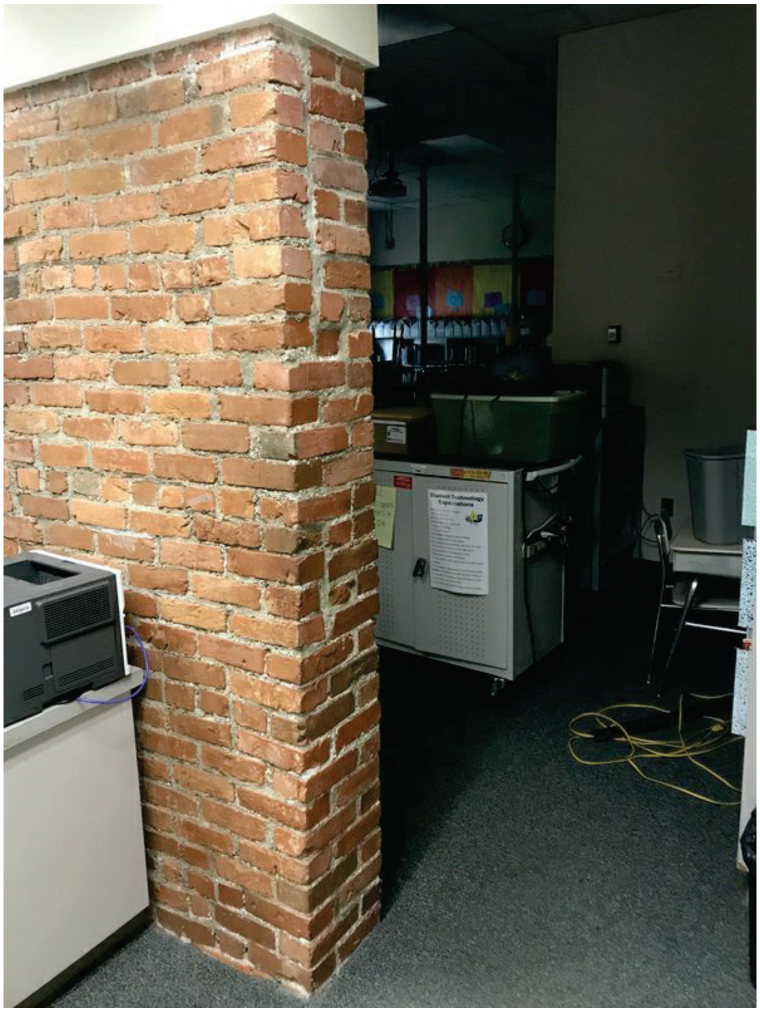


Figure 1-1. Interior exposed URM wall.

Figure 1-2. Mech Room - gas piping is painted yellow

Figure 1-3. Mech Room - gas piping is painted yellow

Figure 1-4. Deteriorated mortar in masonry column at east entry

Figure 1-5. Deteriorated mortar in masonry column at east entry

Figure 1-6. Ivy growth on east wall of building

Figure 1-7. Gas meter at northwest corner of building

Figure 1-8. View from northwest corner of building, URM chimney can be seen

Figure 1-9. West elevation/entry showing infill glass block above windows

Figure 1-10. Original photo from SE corner of building showing original taller parapet configuration.

Spokane, Adams Elementary School, Main Building

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	The existing drawings we received are show only a portion of the building. There does appear to be wood framed diaphragms and URM shearwalls on all sides that provide a complete load path, but the connections between them are not clearly defined in the drawings and were unable to be observed.
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 was no joint observed between this building and the adjacent gymnasium/cafeteria building.
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		No mezzanines were present.

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				

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				
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				
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				
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				
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				

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		Not applicable due to Low seismicity. The liquefaction potential of site soils is unknown at this time given available information. Bedrock 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		Not applicable due to Low seismicity. If it were to evaluated in the future it would require further investigation by a licensed geotechnical engineer to determine susceptibility to slope failure.
Surface Fault Rupture	Surface fault rupture and surface displacement at the building site are not anticipated. (Tier 2: Sec. 5.4.3.1; Commentary: Sec. A.6.1.3)			X		Not applicable due to Low seismicity. If it were to be evaulated in the future it would 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		Not applicable due to Low seismicity.
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		Not applicable due to Low seismicity.

17-36 Collapse Prevention Structural Checklist for Building Types URM and URMa

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				
Shear Stress Check	The shear stress in the unreinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 30 lb/in.2 (0.21 MPa) for clay units and 70 lb/in.2 (0.48 MPa) for concrete units. (Tier 2: Sec. 5.5.3.1.1; Commentary: Sec. A.3.2.5.1)				X	Due to a lack of complete as-built drawings the extents of the URM shear walls isn't fully clear. Based on a check of the portion of the building where drawings were available it appears that there is adequate wall to limit the shear stress to 30psi, but a more detailed investigation of the whole building would need to be performed to confirm this.

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Wall Anchorage	Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Tier 2: Sec. 5.7.1.1; Commentary: Sec. A.5.1.1)				X	Drawings were only available for a portion of the building. For that portion, there are anchors shown that anchor the walls perpendicular to the joists to the diaphragms, but none were shown at the walls parallel to the joists. The as-built conditions could not be observed in the field due to access limitations, thus the anchor sizes and their adequacy to resist the prescribed forces could not be evaluated.

Wood Ledgers	The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 5.7.1.3; Commentary: Sec. A.5.1.2)				X	Ledgers were not shown in the drawings provided, but this condition could not be observed in the field due to access limitations.
Transfer to Shear Walls	Diaphragms are connected for transfer of seismic forces to the shear walls. (Tier 2: Sec. 5.7.2; Commentary: Sec. A.5.2.1)		X			This condition could not be observed due to access limitations, but it is assumed to be Noncompliant based on the drawings that are available. In those drawings there is no clear connection between the diaphragms and walls for the transfer of in-plane forces.
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	The drawings were not clear on the connection between girders and columns and this condition could not be observed in the field.

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

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Proportions	The height-to-thickness ratio of the shear walls at each story is less than the following: Top story of multi-story building – 9; First story of multi-story building – 15; All other conditions – 13. (Tier 2: Sec. 5.5.3.1.2; Commentary: Sec. A.3.2.5.2)			X		Not applicable due to Low seismicity.
Masonry Layup	Filled collar joints of multi-wythe masonry walls have negligible voids. (Tier 2: Sec. 5.5.3.4.1; Commentary: Sec. A.3.2.5.3)			X		Not applicable due to Low seismicity.

Diaphragms (Stiff or Flexible)

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Openings at Shear Walls	Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.4)			X		Not applicable due to Low seismicity.
Openings at Exterior Masonry Shear Walls	Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 8 ft (2.4 m) long. (Tier 2: Sec. 5.6.1.3; Commentary: Sec. A.4.1.6)			X		Not applicable due to Low seismicity.

Flexible Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Cross Ties	There are continuous cross ties between diaphragm chords. (Tier 2: Sec. 5.6.1.2; Commentary: Sec. A.4.1.2)			X		Not applicable due to Low seismicity.

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		Not applicable due to Low seismicity.
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		Not applicable due to Low seismicity.
Diagonally Sheathed and Unblocked Diaphragms	All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4 to-1. (Tier 2: Sec. 5.6.2; Commentary: Sec. A.4.2.3)			X		Not applicable due to Low seismicity.
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		Not applicable due to Low seismicity.

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Stiffness of Wall Anchors	Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors. (Tier 2: Sec. 5.7.1.2; Commentary: Sec. A.5.1.4)			X		Not applicable due to Low seismicity.
Beam, Girder, and Truss Supports	Beams, girders, and trusses supported by unreinforced masonry walls or pilasters have independent secondary columns for support of vertical loads. (Tier 2: Sec. 5.7.4.4; Commentary: Sec. A.5.4.5)			X		Not appicable due to Low seismicity.

Spokane, Adams Elementary School, Main Building

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 stairs are enclosed, but pressurization and smoke duct controls were not observed to be present.
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		Equipment of this type was not 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		No hazardous material was observed in breakable containers.
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			The natural gas piping observed in the mechanical room is suspended by metal straps or hanger rods, but lateral bracing was not observed.

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				A shutoff valve for the natural gas piping was observed in the mechanical room.
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			Flexible couplings were not observed on the gas piping.
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		Piping of this type was not observed.

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	The tops of the interior walls could not be observed although, based on the building type it is assumed that all of the URM walls are bearing and/or tied into the floor/roof framing.
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	The tops of the interior walls could not be observed although, based on the building type it is assumed that all of the URM walls are bearing and/or tied into the floor/roof framing.
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 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)				X	The ceiling details could not be observed, but the ceiling appeared to be direct applied.
C-2 Suspended Gypsum Board. HR-not required; LS-MH; PR-LMH.	Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)				X	The ceiling details could not be observed, but the ceiling appeared to be direct applied.
C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.2)			X		
C-4 Edge Clearance. HR-not required; LS-not required; PR-MH.	The free edges of integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in. (13 mm); in High Seismicity, 3/4 in. (19 mm). (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.4)			X		
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 ft2 (13.4 m2) are supported by closure angles or channels not less than 2 in. (51 mm) wide. (Tier 2: Sec. 13.6.4 ; Commentary: Sec. A.7.2.6)			X		
C-7 Seismic Joints. HR-not required; LS-not required; PR-H.	Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2,500 ft2 (232.3 m2) and has a ratio of long-to-short dimension no more than 4-to-1. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.7)			X		

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		Light fixtures that weigh more per square foot than the ceiling they penetrate were not observed.
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/ft2 (0.48 kN/m2) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m) (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.1)			X		Heavy cladding components were not observed on the building.
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 steel or concrete moment-frames.

CG-3 Multi-Story Panels. HR-MH; LS-MH; PR-MH.	For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.4)			X		The building does not have any multi-story panels.
CG-4 Threaded Rods. HR-not required; LS-MH; PR-MH.	Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.9)			X		The building does not have any panel connections.
CG-5 Panel Connections. HR-MH; LS-MH; PR-MH.	Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.5)			X		The building does not have cladding panels.
CG-6 Bearing Connections. HR-MH; LS-MH; PR-MH.	Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.6)			X		The building does not have cladding panels.
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 concrete cladding panels.
CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft2 (1.5 m2) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Tier 2: Sec. 13.6.1.5; Commentary: Sec. A.7.4.8)		X			There are window panes greater than 16 ft2 that do not appear to be laminated.

Masonry Veneer

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
M-1 Ties. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft2 (0.25 m2), and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in. (914 mm); for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (610 mm). (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.1)			X		Masonry veneer is not present at this building.
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		Masonry veneer is not present at this building.
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		Masonry veneer is not present at this building.
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		Masonry veneer is not present at this building.
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		Masonry veneer is not present at this building.
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		Masonry veneer is not present at this building.
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-tothickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.1)				X	Some building drawings were available, but this configuration could not be observed and our understanding is that the parapets were modified at some point in time.

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		No canopies were observed.
PCOA-3 Concrete Parapets. HR-H; LS-MH; PR-LMH.	Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Tier 2: Sec. 13.6.5; Commentary: Sec. A.7.8.3)			X		Based on the building type, it is unlikely that there are concrete parapets on this building.
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		These types of elements were not observed on this building.

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			The height to width ratio of the chimney extension above the roof could not be measured due to limitations in access, but it appeared to exceed the limit noted.
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	This condition could not be observed.

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	Building drawings were unavailable and this condition could not be observed.

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	Building drawings were unavailable and this condition could not be observed; likely not capable of accommodating drift.

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		No industrial storage racks of this type were observed.
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		NA due to LS-not required for moderate and low seismic zones.
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		NA due to LS-not required for moderate and low seismic zones.
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		NA due to LS-not required for moderate and low seismic zones.

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		NA due to LS-not required for moderate and low seismic zones.
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		NA due to LS-not required for moderate and low seismic zones.
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 ft2 (0.56 m2) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft (9.2 m). The maximum spacing of longitudinal bracing does not exceed 60 ft (18.3 m). (Tier 2: Sec. 13.7.6; Commentary: Sec. A.7.14.2)			X		
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		NA due to LS-not required for moderate and low seismic zones.
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		NA due to LS-not required for moderate and low seismic zones.
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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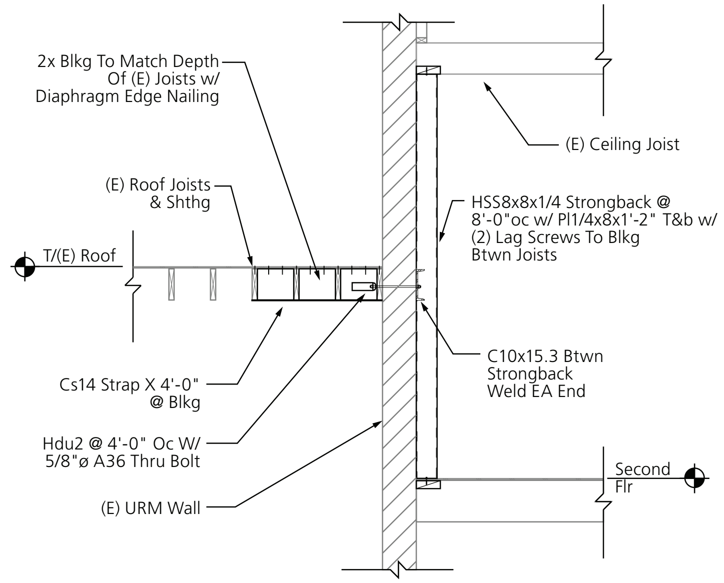
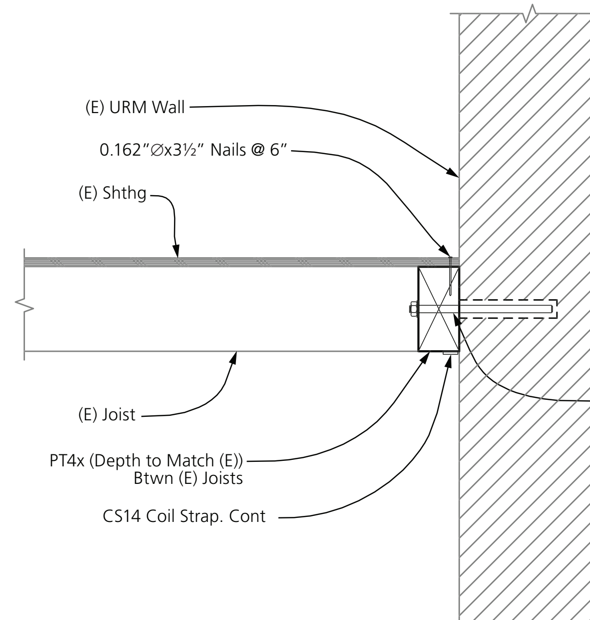


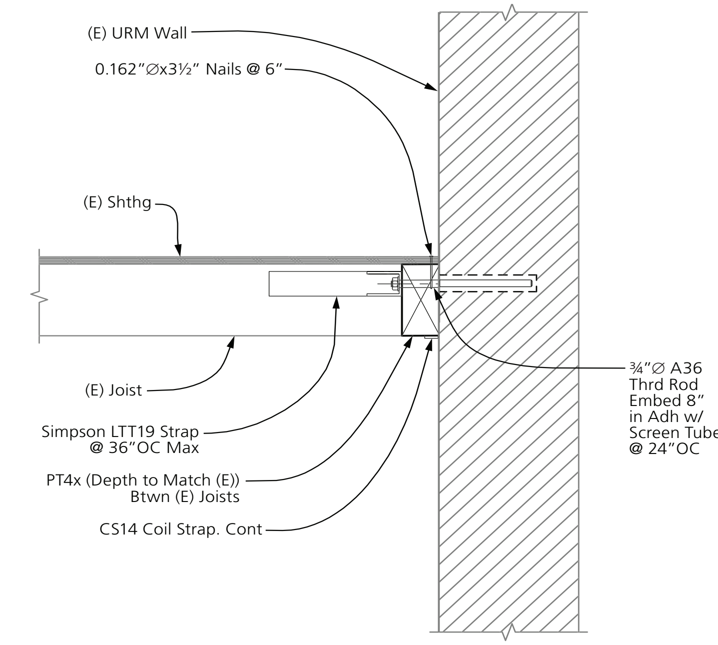
GYMNASIUM WALL AT MAIN BUILDING SECTION

Notes:

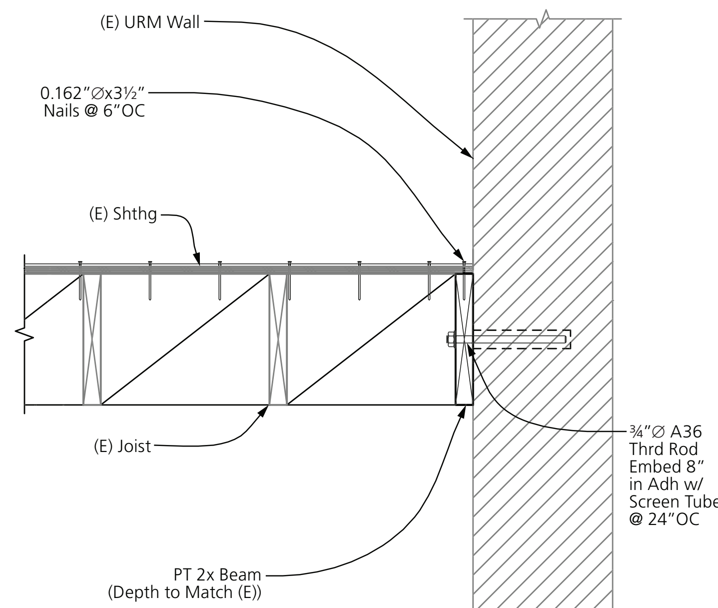
Roof Framing Assumed Parallel To Wall. At Roof Framing Perpendicular To Framing, Attach HDU To Joist & Install Diaphragm Edge Nailing To Joist, Typ.



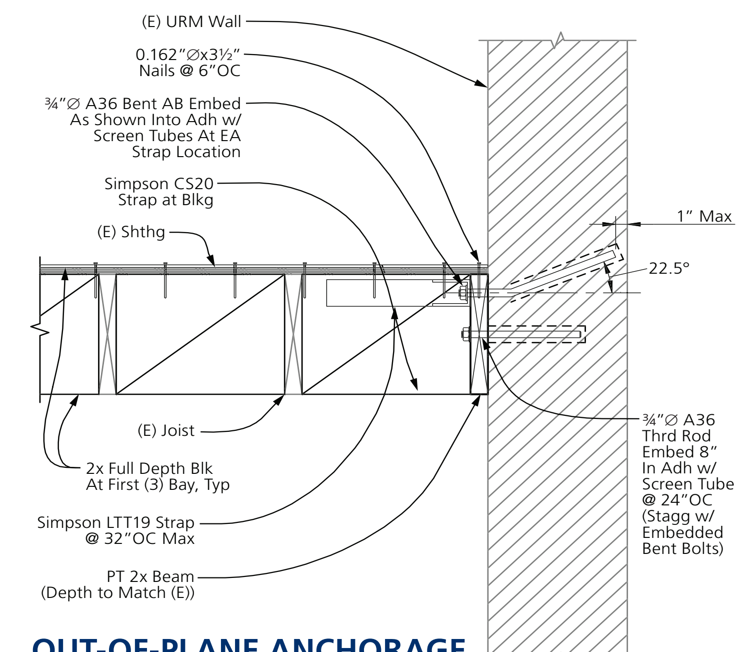
IN-PLANE ANCHORAGE
Perpendicular to Floor Joists



OUT-OF-PLANE ANCHORAGE
Perpendicular to Floor Joists



IN-PLANE ANCHORAGE
Parallel to Floor Joists



OUT-OF-PLANE ANCHORAGE
Parallel to Floor Joists

Notes:

1. Materials, Sizes, & Spacing Shown On Details Are For Example Only. Structural Analysis Of Existing Building & Applicable Loads Is Required For Construction.
2. Drill All Holes In URM With A Drill Set To Rotation Only, Typical Throughout.

Notes:

1. Materials, Sizes, & Spacing Shown On Details Are For Example Only. Structural Analysis Of Existing Building & Applicable Loads Is Required For Construction.
2. Drill All Holes In URM With A Drill Set To Rotation Only, Typical Throughout.

Figure 1 - Conceptual Sections

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Appendix C: Opinion of Probable Construction Costs

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PRODIMS
PROJECT MANAGEMENT SERVICES

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

Name:	**Wa State School Seismic Safety Assessment**
Second Name:	**Adams Elementary School**
Location:	**State of Washington**
Design Phase:	**ROM Cost Estimates**
Date of Estimate:	**April 26, 2019**
Date of Revision:	
Month of Cost Basis:	**1Q, 2019**

Adams Elementary School

Master Estimate Summary

Project Name		Total Estimated Construction Cost
Adams Elementary School	Structural Costs	$819,045
Adams Elementary School	Non-Structural Costs	$607,659
TOTAL ESTIMATED CONSTRUCTION COST		**$1,426,704**

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 month of Cost Basis noted Above

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 are not included in the estimates. Soft costs can include design fees, sales tax, permits, owner's contingency and FF+E.
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.

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

Name: **Wa State School Seismic Safety Assessment**
Second Name: **Adams Elementary School**
Location: **Spokane, WA**
Design Phase: **ROM Cost Estimates**
Date of Estimate: **April 26, 2019**
Date of Revision:
Month of Cost Basis: **4Q, 2018, 1Q, 2019**

Areas	sqft
1st Floor	18,200
2nd Floor	9,100
Total Areas	**27,300**

Adams Elementary School

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below $ 625,225

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	$ 62,523	$ 687,748
General Conditions	10.0%	$ 62,523	$ 750,270
Home Office Overhead	5.0%	$ 31,261	$ 781,531
Profit	6.0%	$ 37,514	$ 819,045
Escalation Not Included-Costs in 1Q, 2019 Dollars	0.0%	$ -	$ 819,045
Washington State Sales Tax	0.0%	$ -	$ 819,045

Total Markups Applied to the Direct Cost 31.00%
Markups are multiplied from each subtotal- They are not multiplied from the direct cost

		$/sqft
TOTAL ESTIMATED CONSTRUCTION COST-- →	**$ 819,045**	**$ 30.00**
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE -- →	**$ 655,236**	**$ 24.00**
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE -- →	**$ 1,228,567**	**$ 45.00**

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											
Superstructure											
Upper Floor Systems											
	Diaphragm and Wall Anchorage Connection-Mix of In-Line and Out-Of-Plane Connections at Parallel and Perpendicular Wall/Joist Conditions - Wood and Metal Hardware with Anchor Bolts drilled into Masonry Walls - Quantity is Parametric Based on Perimeter	447	lnft	$ 56.80	$ 25,389.60	$ 23.20	$ 10,370.40	$ 4.80	$ 2,145.60	$ 84.80	$ 37,905.60
	Add Plywood Sheating at 2nd Floor	9,100	sqft	$ 2.31	$ 20,998.25	$ 1.24	$ 11,306.75	$ 0.21	$ 1,938.30	$ 3.76	$ 34,243.30
	Gym to Main Building Connection - Wood Blocking, Hardware and Structural Steel-C Channel/HSS Tube Steel	50	lnft	$ 184.96	$ 9,248.00	$ 104.04	$ 5,202.00	$ 17.34	$ 867.00	$ 306.34	$ 15,317.00
Roof Systems											
	Diaphragm and Wall Anchorage Connection-Mix of In-plane and Out-Of-Plane Connections at Parallel and Perpendicular Wall/Joist Conditions - Wood and Metal Hardware with Anchor Bolts drilled into Masonry Walls - Quantity is Parametric Based on Perimeter	836	lnft	$ 56.80	$ 47,484.80	$ 23.20	$ 19,395.20	$ 4.80	$ 4,012.80	$ 84.80	$ 70,892.80
	Add Plywood Sheating at Roof System	18,200	sqft	$ 2.31	$ 41,996.50	$ 1.24	$ 22,613.50	$ 0.21	$ 3,876.60	$ 3.76	$ 68,486.60
Roofing System											
	Remove Existing Roofing System	18,200	sqft	$ 2.02	$ 36,691.20	$ 0.08	$ 1,528.80	$ 0.13	$ 2,293.20	$ 2.23	$ 40,513.20
	Install New Roofing System - Including Roof Membrane, New Insulation, Coverboard and Flashing and Trim for a Complete System	18,200	sqft	$ 10.02	$ 182,309.40	$ 8.53	$ 155,300.60	$ 1.11	$ 20,256.60	$ 19.66	$ 357,866.60
Subtotal of the Direct Cost of Construction				**Adams Elementary School**							**$ 625,225**

PRODIMS

520 Kirkland Way, Suite 301
Kirkland, WA 98033
Phone: 425-828-0500 Fax: 425-828-0700
www.prodims.com

Non-Structural Costs

Name: Wa State School Seismic Safety Assessment
Second Name: Adams Elementary School
Location: Spokane, WA
Design Phase: ROM Cost Estimates
Date of Estimate: April 26, 2019
Date of Revision:
Month of Cost Basis: 4Q, 2018, 1Q, 2019

Areas	sqft
1st Floor	18,200
2nd Floor	9,100
Total Areas	27,300

Adams Elementary School

Construction Cost Estimate

Subtotal Direct Cost From the Estimate Detail Below $ 463,862

	Percentage of Previous Subtotal	Amount	Running Subtotal
Scope Contingency	10.0%	$ 46,386	$ 510,248
General Conditions	10.0%	$ 46,386	$ 556,634
Home Office Overhead	5.0%	$ 23,193	$ 579,827
Profit	6.0%	$ 27,832	$ 607,659
Escalation Not Included-Costs in 1Q, 2019 Dollars	0.0%	$ -	$ 607,659
Washington State Sales Tax	0.0%	$ -	$ 607,659

Total Markups Applied to the Direct Cost 31.00%
Markups are multiplied from each subtotal- They are not multiplied from the direct cost

		$/sqft
TOTAL ESTIMATED CONSTRUCTION COST--→	**$ 607,659**	**$ 22.26**
-20% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --→	**$ 486,127**	**$ 17.81**
+50% TOTAL ESTIMATED CONSTRUCTION COST VARIANCE --→	**$ 911,488**	**$ 33.39**

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*										
	Interiors and M/E/P/FP systems										
	Interior Wall/Door/Casework/Specialties Systems										
	New Flooring Finishes for Installation of Seismic Work at Second Floor	9,100	sqft	$ 2.59	$ 23,591.75	$ 1.66	$ 15,083.25	$ 0.26	$ 2,320.50	$ 4.51	$ 40,995.50
	Reinforce Light Fixtures with Additional Attachments	27,300	sqft	$ 1.28	$ 34,971.30	$ 0.82	$ 22,358.70	$ 0.13	$ 3,439.80	$ 2.23	$ 60,769.80
	Modify URM Chimney	1	sqft	$ 9,860.00	$ 9,860.00	$ 4,640.00	$ 4,640.00	$ 870.00	$ 870.00	$ 15,370.00	$ 15,370.00
	New Ceilings and Finishes for Installation of Seismic Work	27,300	sqft	$ 3.36	$ 91,591.50	$ 2.15	$ 58,558.50	$ 0.33	$ 9,009.00	$ 5.83	$ 159,159.00
	Mechanical/Electrical/Fire Protection Systems	27,300	sqft	$ 3.56	$ 97,322.78	$ 2.92	$ 79,627.73	$ 0.39	$ 10,617.03	$ 6.87	$ 187,567.53

*Allows 30 percent of existing nonstructural systems M/E/P/FP require upgrades/replacement.

Subtotal of the Direct Cost of Construction	**Adams Elementary School**	**$**	**463,862**

Appendix D: Earthquake Performance Assessment Tool (EPAT) Worksheet

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Washington Schools Earthquake Performance Assessment Tool (EPAT)
MAIN PAGE

Full District Name	Spokane		
Point of Contact	Phil Wright		
Telephone	503-269-5452		
E-Mail	philw@spokaneschools.org		
File Name	Spokane, Adams Elementary School, Main Building EPAT.xlsm	**File Date:**	10/19/2018

District	Spokane
Facility Name	Adams Elementary School
Building Part Name	Main Building

Earthquake Ground Motion (% g)		**Earthquake Hazards**	
20% in 50 year PGA	3.7%	**Site Class**	C
10% in 50 year PGA	6.1%	**Ground Shaking Hazard**	Low
2% in 50 year PGA	16.6%	**Liquefaction Potential**	Very Low
Percentile S_s *Among all WA Campuses*	3%	**Combined Earthquake Hazard Level**	Low

Total Building Part Area (Square Feet)	**Building Evaluated By**	**Input Data by Person(s)**
34,628	DNR, Reid Middleton	Kendra Tappe, Reid Middleton

The Earthquake Ground Motion and Earthquake Hazard Hazards data shown above are primarily for use and interpretation by engineers.

Refer to the EPAT User Guide for technical explanations of the Earthquake Ground Motion and the Earthquake Hazards information.

Washington Schools Earthquake Performance Assessment Tool (EPAT)
BUILDING DATA PAGE

Facility Name	Adams Elementary School
Building Name	Main Building
Building Use	Educational, Assembly

Data Entry Item	User Entered Values	Default Values	Used for BCA
Seismic Data			
Decimal Latitude	47.621	47.619711	47.621
Decimal Longitude	-117.368	-117.36836	-117.368
Site Class (Soil/Rock Type)	C	C	C
Liquefaction Potential	Very Low	Very Low	Very Low
Geographic Region for Seismic Zones	Eastern	Eastern	Eastern
Building Structural Data			
HAZUS Building Type***	URM	Unreinforced Masonry Bearing Walls	URM
Number of Stories (Excluding Basement)***	3		3
Year Built***	1910		1910
Code for Building Design (if known)	Unknown	**Use the Drop-Down menus to Select Data Entries for the Bright Green Shaded data cells.**	Unknown
Design Code Year (if known)	Unknown		Unknown
Severe Vertical Irregularity***	No		No
Moderate Vertical Irregularity***	No		No
Plan (Horizontal) Irregularity***	No		No

***** Mandatory Data Entry**

Washington Schools Earthquake Performance Assessment Tool (EPAT)
RESULTS SUMMARY

District Name	Spokane	**Existing Building Life Safety Risk & Priority for Retrofit or Replacement**
School Name	Adams Elementary School	
Building Name	Main Building	Low

Building Data

HAZUS Building Type	URM	Unreinforced Masonry Bearing Walls
Year Built	1910	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	Eastern	
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	Low	Frequency and severity of earthquakes at this site
Percentile S_s Among WA K-12 Campuses	3%	Earthquake ground shaking hazard is higher than 3% 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	Low	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	13%	9.8%	Low	Green/Yellow
Life Safety Retrofit Building	5.8%	3.0%	Very Low	Green/Yellow
Current Code Building	4.0%	1.7%	Very Low	Green

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

Source for the Data Entered into the Tool

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

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Appendix E: Adams Elementary School Record Drawings

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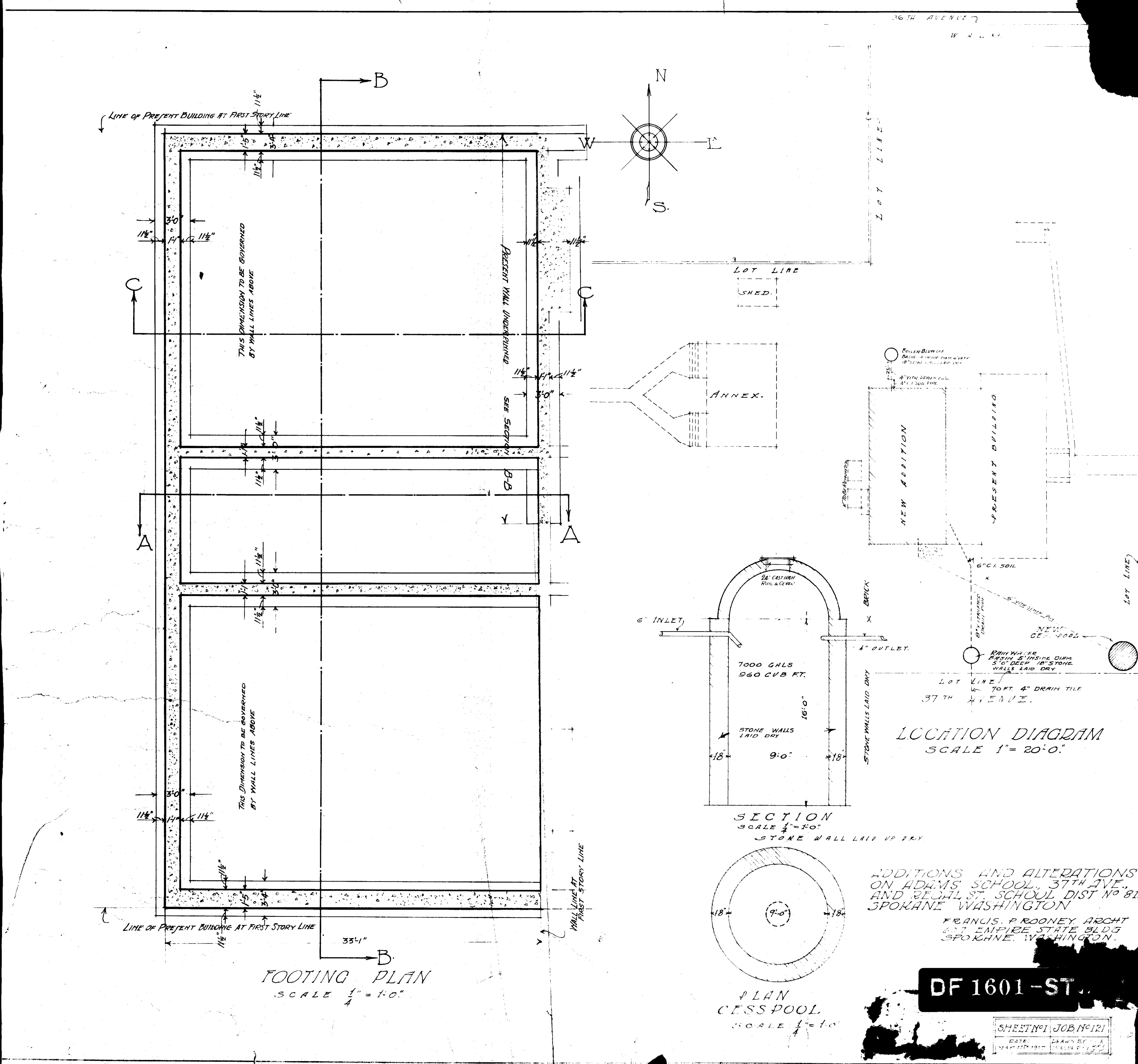
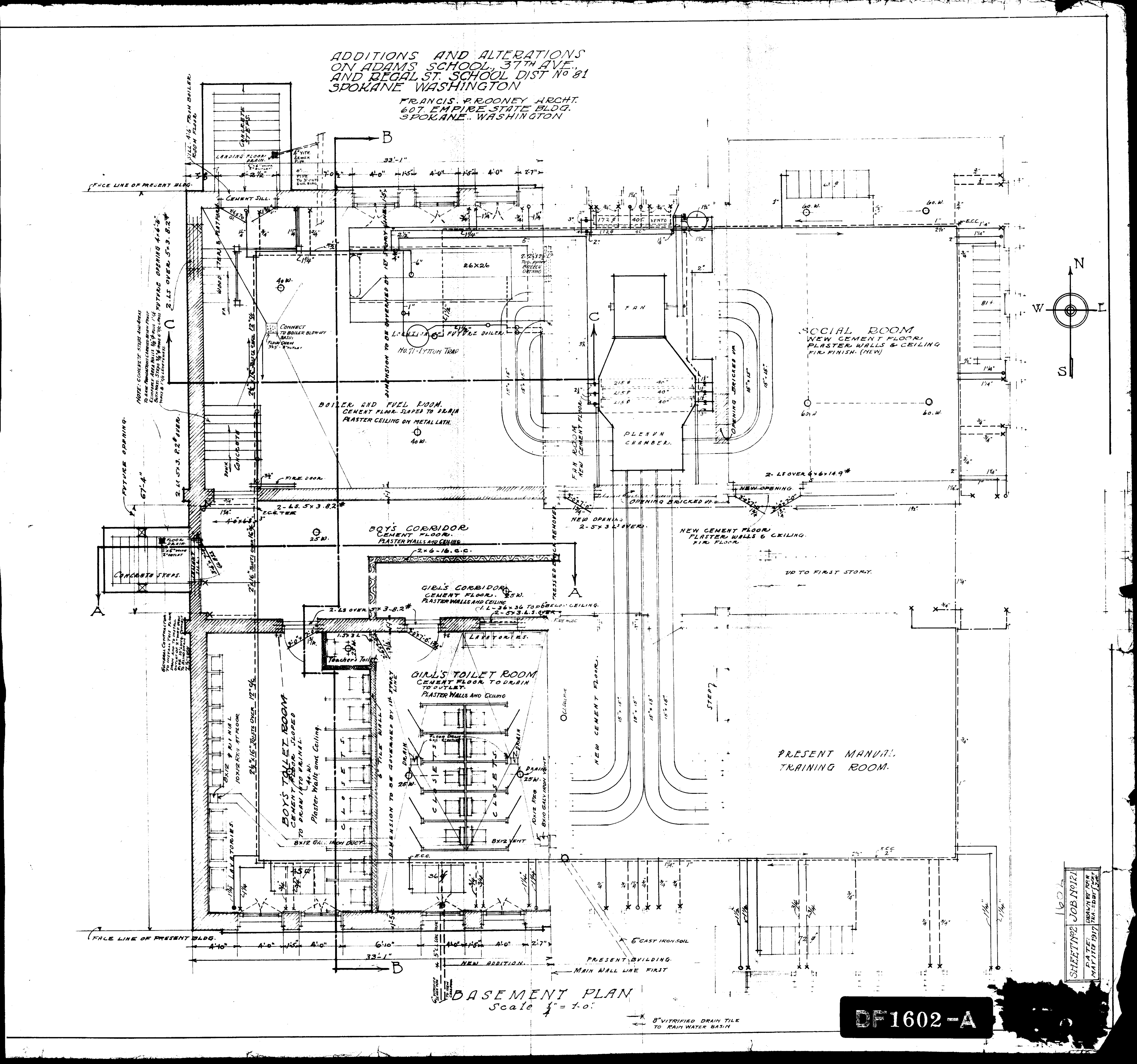
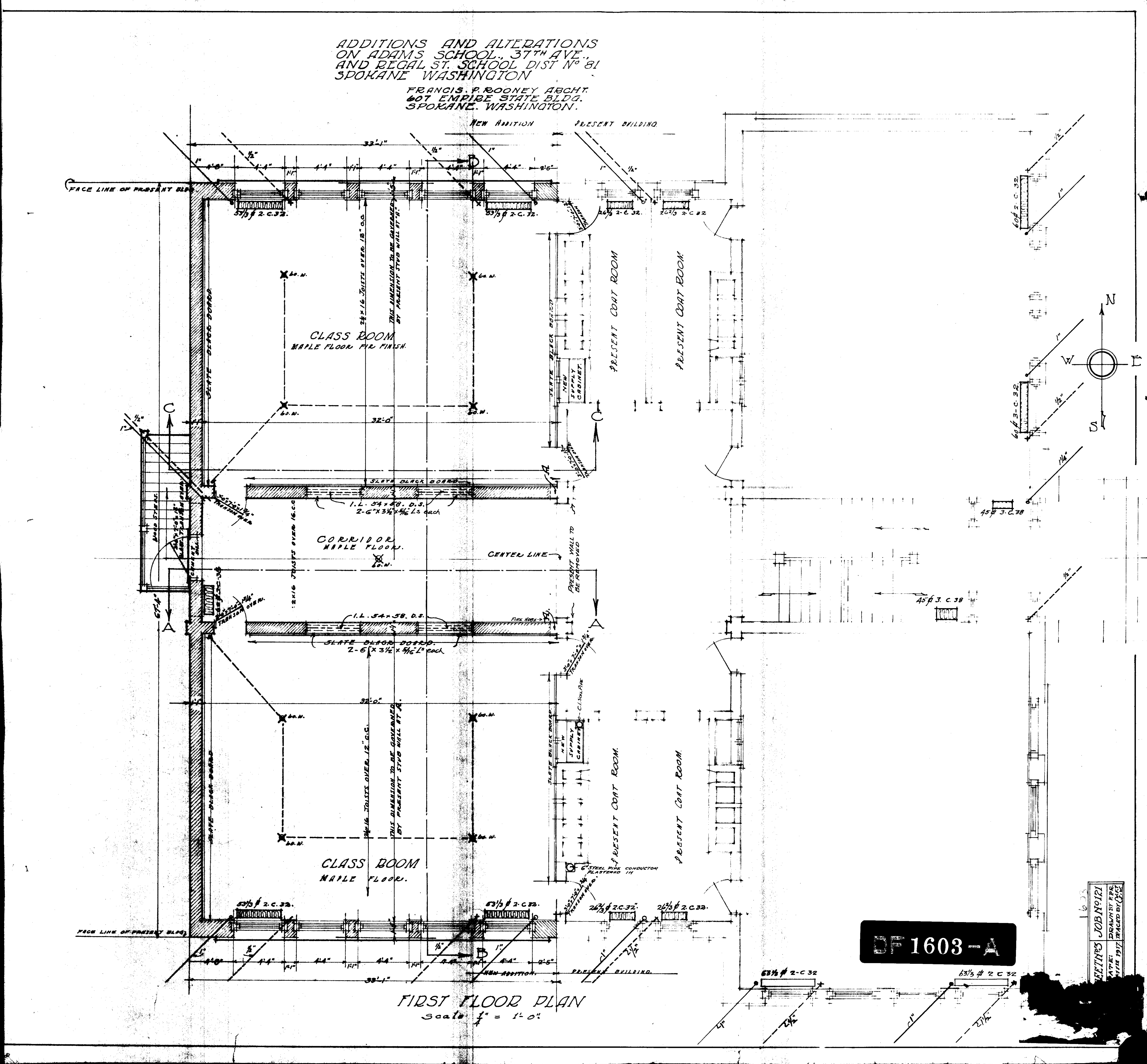
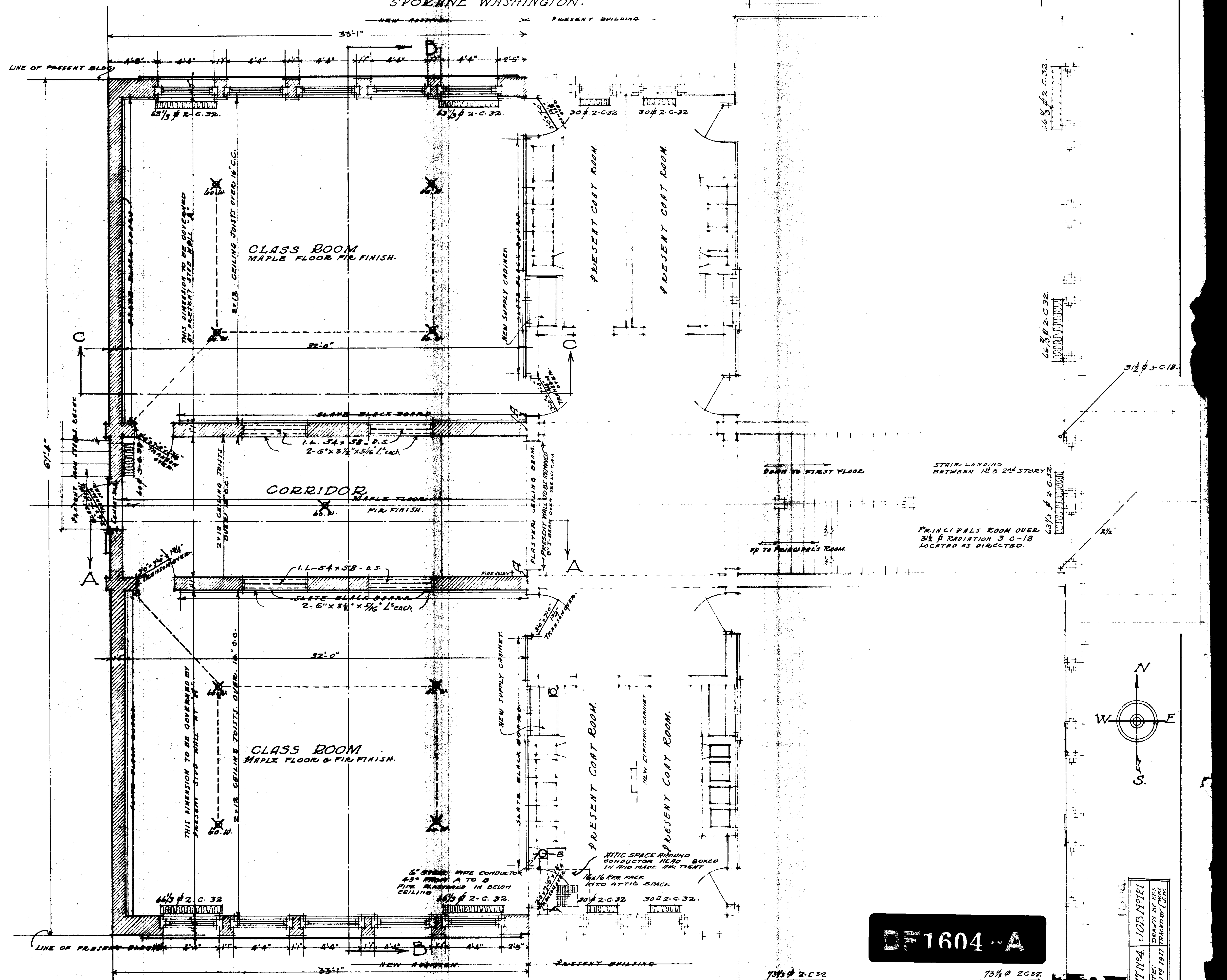

LINE OF PRESENT BUILDING AT FIRST STORY LINE
THIS DIMENSION TO BE GOVERNED BY WALL LINES ABOVE
PRESENT WALL UNDERPINNED
SEE SECTION B-B
WALL LINE AT FIRST STORY LINE
33'-1"
FOOTING PLAN
SCALE 1/4" = 1'-0"
N
S
W
E
36TH AVENUE
LOT LINE
SHED
ANNEX.
NEW ADDITION
PRESENT BUILDING
6" C.I. SOIL
NEW CESSPOOL
37TH AVENUE
LOCATION DIAGRAM
SCALE 1" = 20'-0"
24" CAST IRON RING & COVER
6" INLET
4" OUTLET
BRICK
7000 GALS
960 CUB FT.
16'-0"
STONE WALLS LAID DRY
9'-0"
18"
SECTION
SCALE 1/4" = 1'-0"
STONE WALL LAID UP DRY
PLAN
CESSPOOL
SCALE 1/4" = 1'-0"
ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL, 37TH AVE.,
AND REGAL ST. SCHOOL DIST No 81.
SPOKANE WASHINGTON
FRANCIS. P. ROONEY. ARCHT
EMPIRE STATE BLDG
SPOKANE. WASHINGTON.
DF 1601-ST
SHEET No 1
JOB No 121


ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL, 37TH AVE.
AND REGAL ST. SCHOOL DIST No 81
SPOKANE WASHINGTON
FRANCIS P. ROONEY ARCHT.
607. EMPIRE STATE BLDG.
SPOKANE, WASHINGTON
FACE LINE OF PRESENT BLDG.
CONCRETE STEPS
CEMENT SILL.
BOILER AND FUEL ROOM.
CEMENT FLOOR SLOPED TO DRAIN
PLASTER CEILING ON METAL LATH.
FUTURE BOILER
No. 71 LYTTON TRAP
FAN
PLENUM CHAMBER.
FAN ROOM NEW CEMENT FLOOR
SOCIAL ROOM
NEW CEMENT FLOOR
PLASTER WALLS & CEILING
FIR FINISH. (NEW)
FIRE DOOR.
NEW OPENING
OPENING BRICKED UP
BOYS CORRIDOR
CEMENT FLOOR.
PLASTER WALLS AND CEILING
NEW CEMENT FLOOR
PLASTER WALLS & CEILING
FIR FLOOR
UP TO FIRST STORY.
GIRL'S CORRIDOR
CEMENT FLOOR.
PLASTER WALLS AND CEILING
LAVATORIES.
Teacher's Toilet
GIRL'S TOILET ROOM
CEMENT FLOOR TO DRAIN TO OUTLET.
PLASTER WALLS AND CEILING
BOY'S TOILET ROOM
CEMENT FLOOR SLOPED TO DRAIN INTO URINAL.
Plaster Walls and Ceiling.
LAVATORIES.
CLOSETS
NEW CEMENT FLOOR
PRESENT MANUAL TRAINING ROOM.
STEP
FACE LINE OF PRESENT BLDG.
6" CAST IRON SOIL
PRESENT BUILDING.
MAIN WALL LINE FIRST
NEW ADDITION.
BASEMENT PLAN
Scale 1/4" = 1'-0"
8" VITRIFIED DRAIN TILE TO RAIN WATER BASIN
SHEET No 2 JOB No 121
DATE MAY 11TH 1917
DF 1602-A


ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL., 37TH AVE.,
AND REGAL ST. SCHOOL DIST Nº 81
SPOKANE WASHINGTON
FRANCIS. P. ROONEY ARCHT.
607 EMPIRE STATE BLDG.
SPOKANE. WASHINGTON.
NEW ADDITION
PRESENT BUILDING
FACE LINE OF PRESENT BLDG.
CLASS ROOM
MAPLE FLOOR FIR FINISH.
SLATE BLACK BOARD
PRESENT COAT ROOM
PRESENT COAT ROOM
NEW SUPPLY CABINET.
CORRIDOR
MAPLE FLOOR.
CENTER LINE
PRESENT WALL TO BE REMOVED
CLASS ROOM
MAPLE FLOOR.
NEW SUPPLY CABINET
PRESENT COAT ROOM.
PRESENT COAT ROOM.
6" STEEL PIPE CONDUCTOR PLASTERED IN
N
W
E
S
FIRST FLOOR PLAN
Scale 1/4" = 1'-0"
DF 1603-A
JOB Nº 121

ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL, 37TH AVE.
AND REGAL ST SCHOOL DIST No 81.
SPOKANE WASHINGTON

FRANCIS J. ROONEY ARCHT.
607 EMPIRE STATE BLDG.
SPOKANE WASHINGTON.



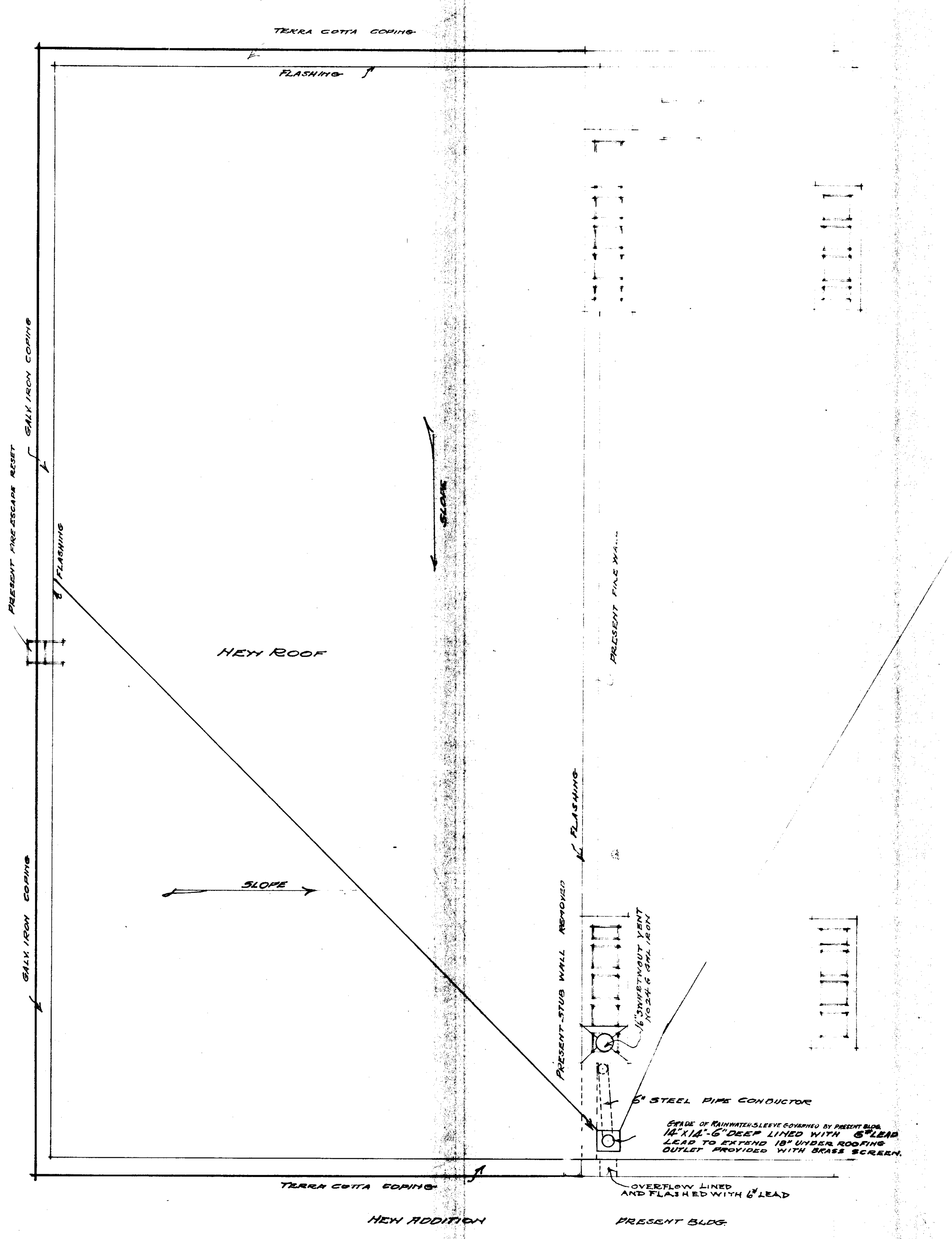
SECOND FLOOR PLAN

SCALE 1/4" = 1'-0"

DF1604-A

ADDITIONS AND ALTERATIONS ON ADAMS SCHOOL., 37TH AVE. AND REGAL ST. SCHOOL DIST No 81 SPOKANE WASHINGTON

FRANCIS P. ROONEY ARCHT.
607 EMPIRE STATE BLDG.
SPOKANE WASHINGTON.



ROOF PLAN
Scale 1/4" = 1'-0"

SHEET No 5	JOB No 121
DATE: MAY 11TH 1917	DRAWN BY F.P.R. TRACED BY W.F.T. / J.W.

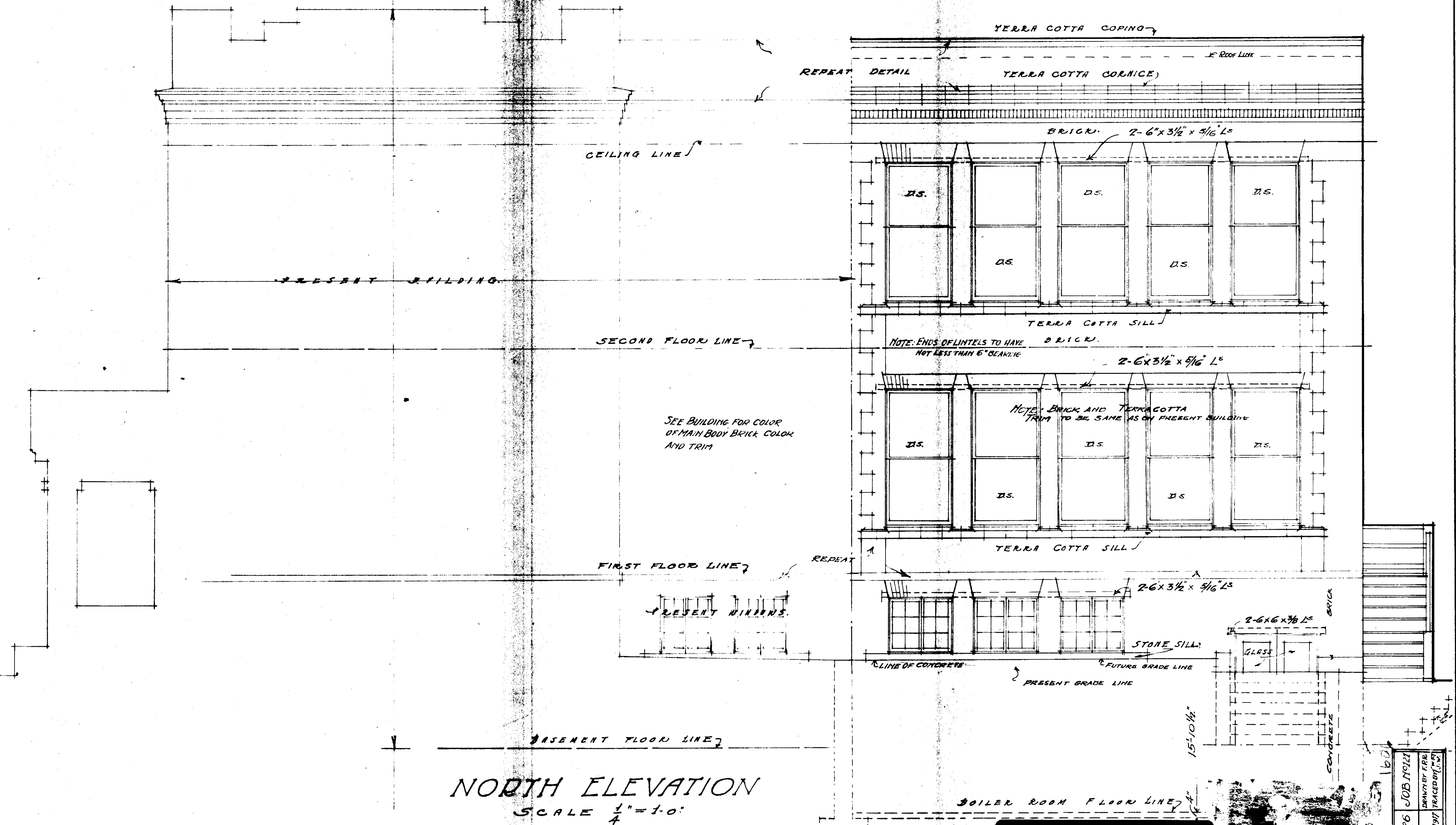
1605

DF 1605-A

12

ADDITIONS AND ALTERATIONS ON ADAMS SCHOOL, 37TH AVE., AND REGAL ST. SCHOOL DIST No 81 SPOKANE WASHINGTON

FRANCIS. F. ROONEY. ARCHT.
607. EMPIRE STATE BLDG.
SPOKANE. WASHINGTON.



NORTH ELEVATION

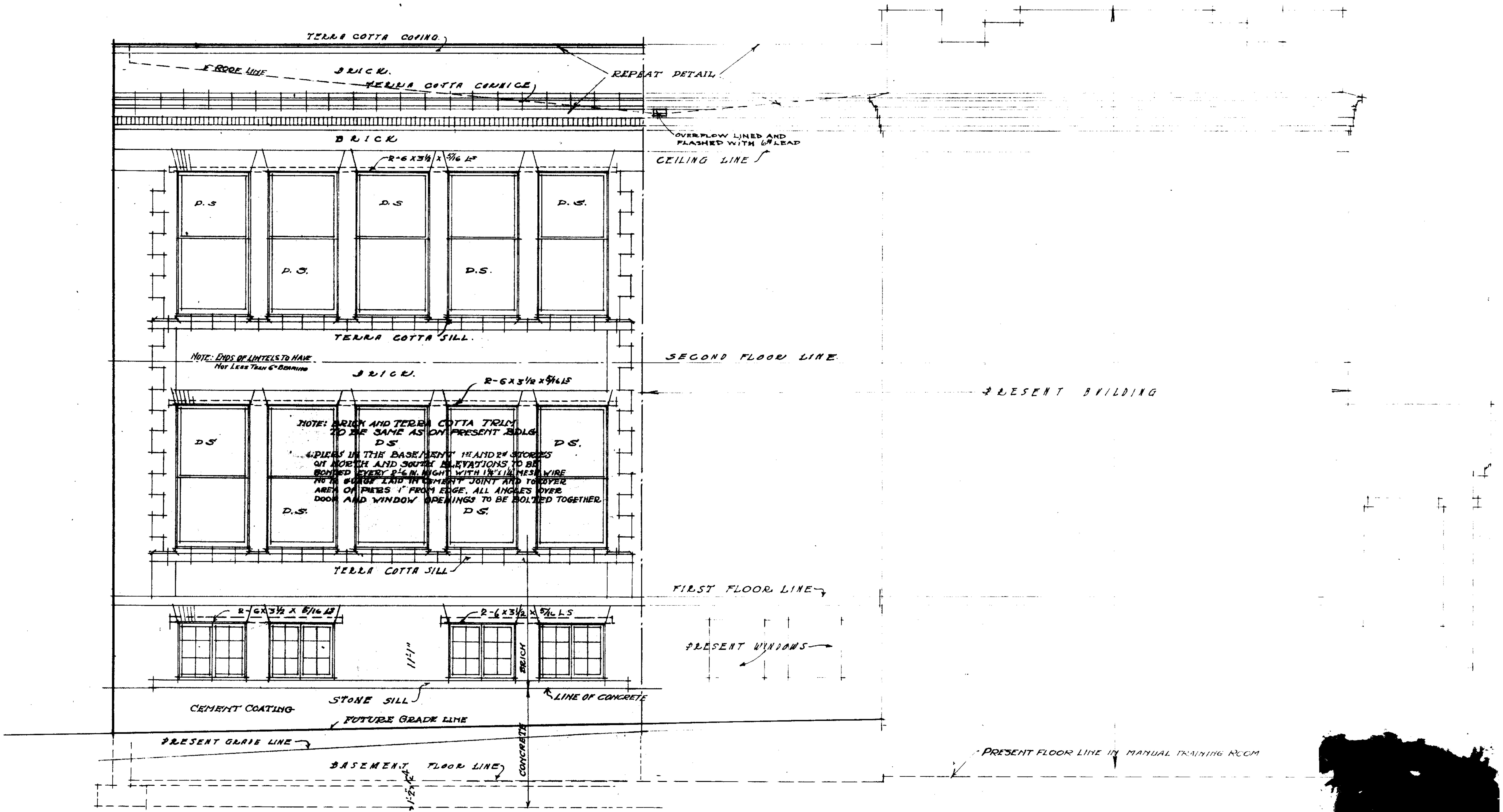
SCALE 1/4" = 1'-0"

SHEET No 6	JOB No 121
DATE: MAY 11th 1917	DRAWN BY F.R.R. TRACED BY J.W.

DF 1606-A

ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL., 37TH AVE.,
AND REGAL ST. SCHOOL DIST NO 81
SPOKANE WASHINGTON

FRANCIS. J. ROONEY ARCHT.
607 EMPIRE STATE BLDG.
SPOKANE., WASHINGTON.



SOUTH ELEVATION
Scale ¼" = 1'-0"

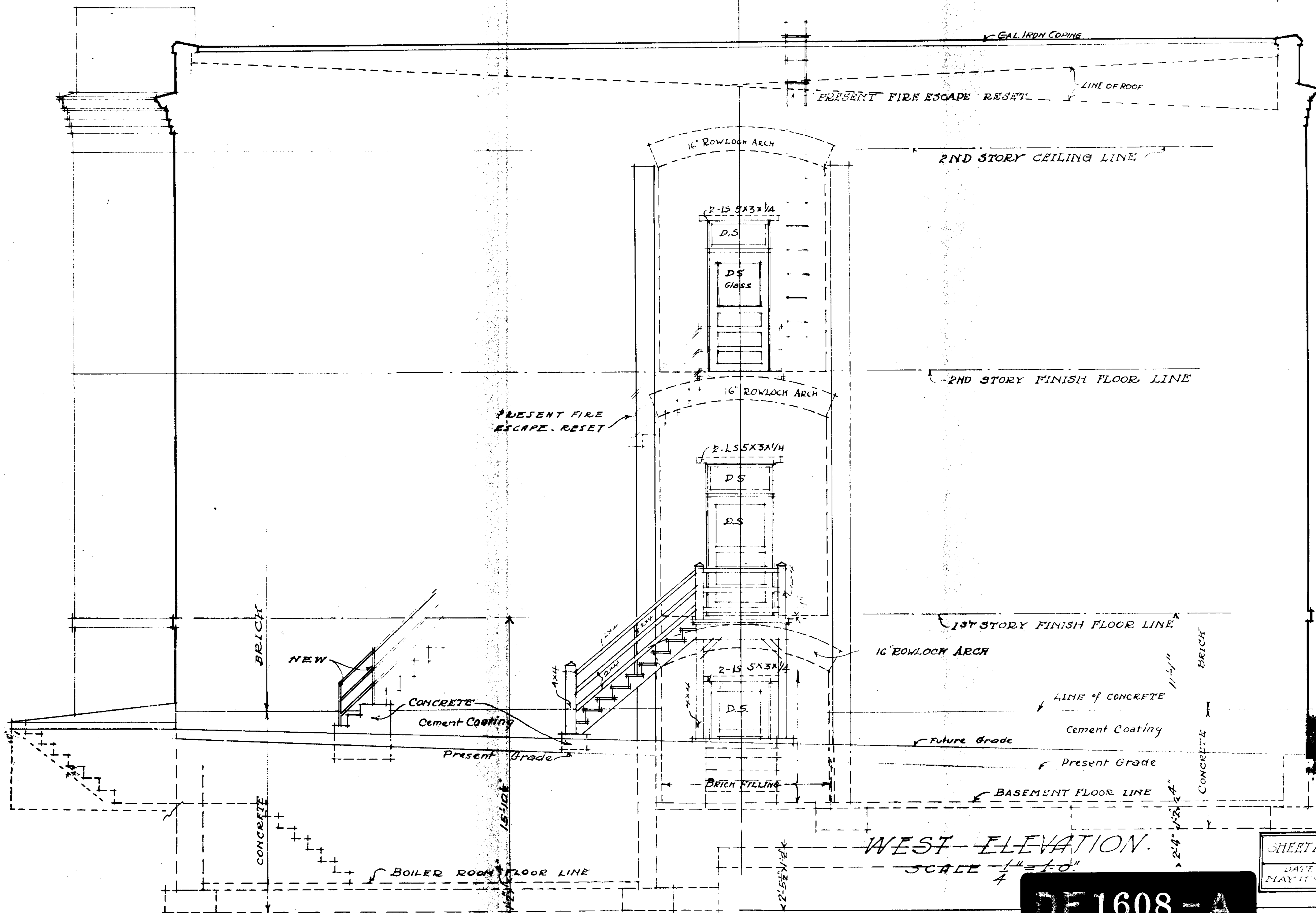
DF 1607-A

1607

SHEET NO 7	JOB NO 121
DATE: MAY 11TH 1917	DRAWN BY F.P.R. TRACED BY W.F.T. J.W.

ADDITIONS AND ALTERATIONS ON ADAMS SCHOOL., 37TH AVE., AND REGAL ST. SCHOOL DIST NO 81 SPOKANE WASHINGTON

FRANCIS. J. ROONEY. ARCHT.
607 EMPIRE STATE BLDG.
SPOKANE., WASHINGTON



WEST ELEVATION.
SCALE 1/4" = 1'-0"

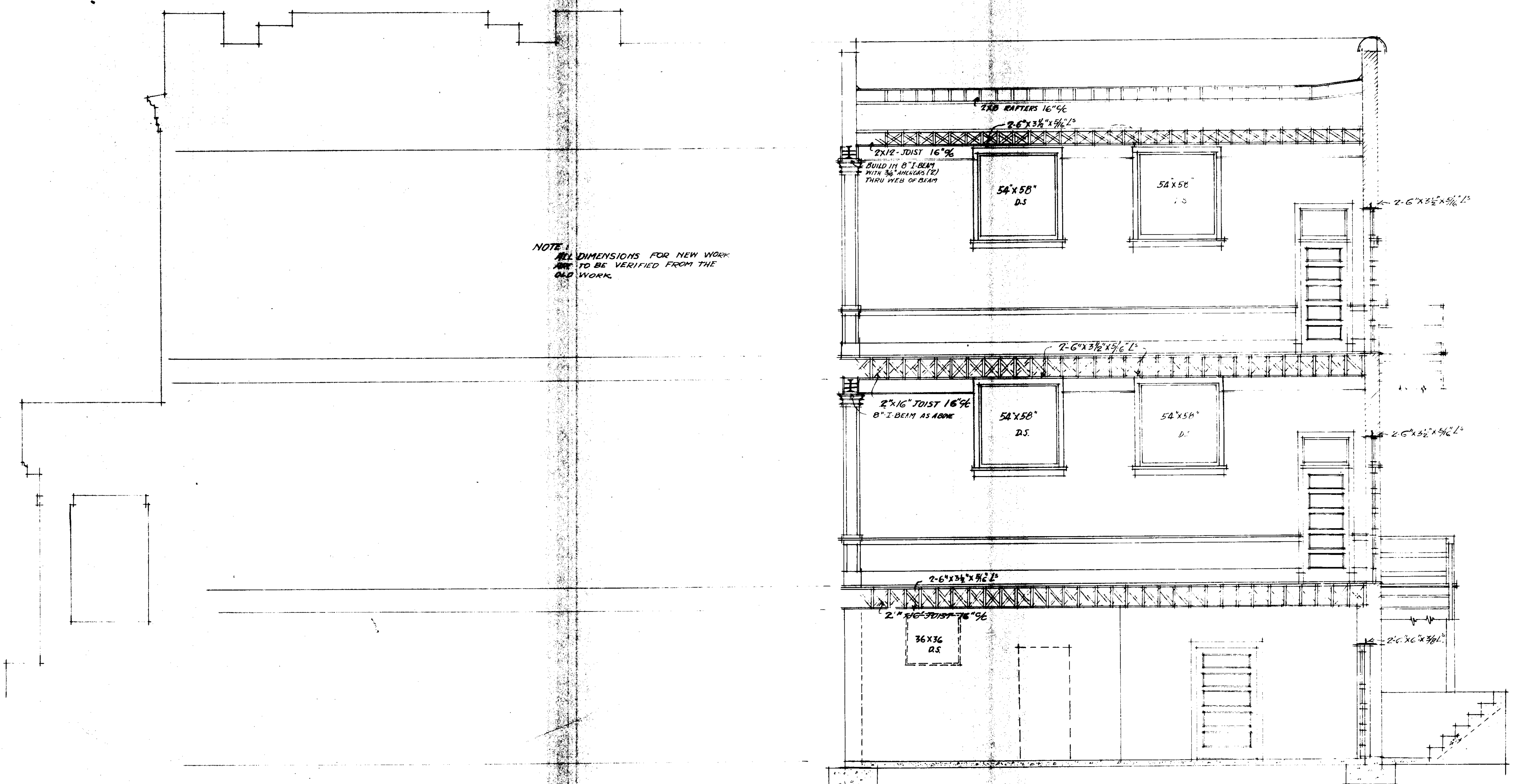
SHEET NO 8	JOB NO 121
DATE MAY 11TH 1917.	DRAWN BY F.J.R. TRACED BY W.E.T. J.W.

1623

DF 1608 - A

ADDITIONS AND ALTERATIONS ON ADAMS SCHOOL., 37TH AVE. AND REGAL ST. SCHOOL DIST No 81 SPOKANE WASHINGTON.

FRANCIS J. ROONEY ARCHT
607 EMPIRE STATE BLDG.
SPOKANE. WASHINGTON.



CROSS SECTION "A-A".

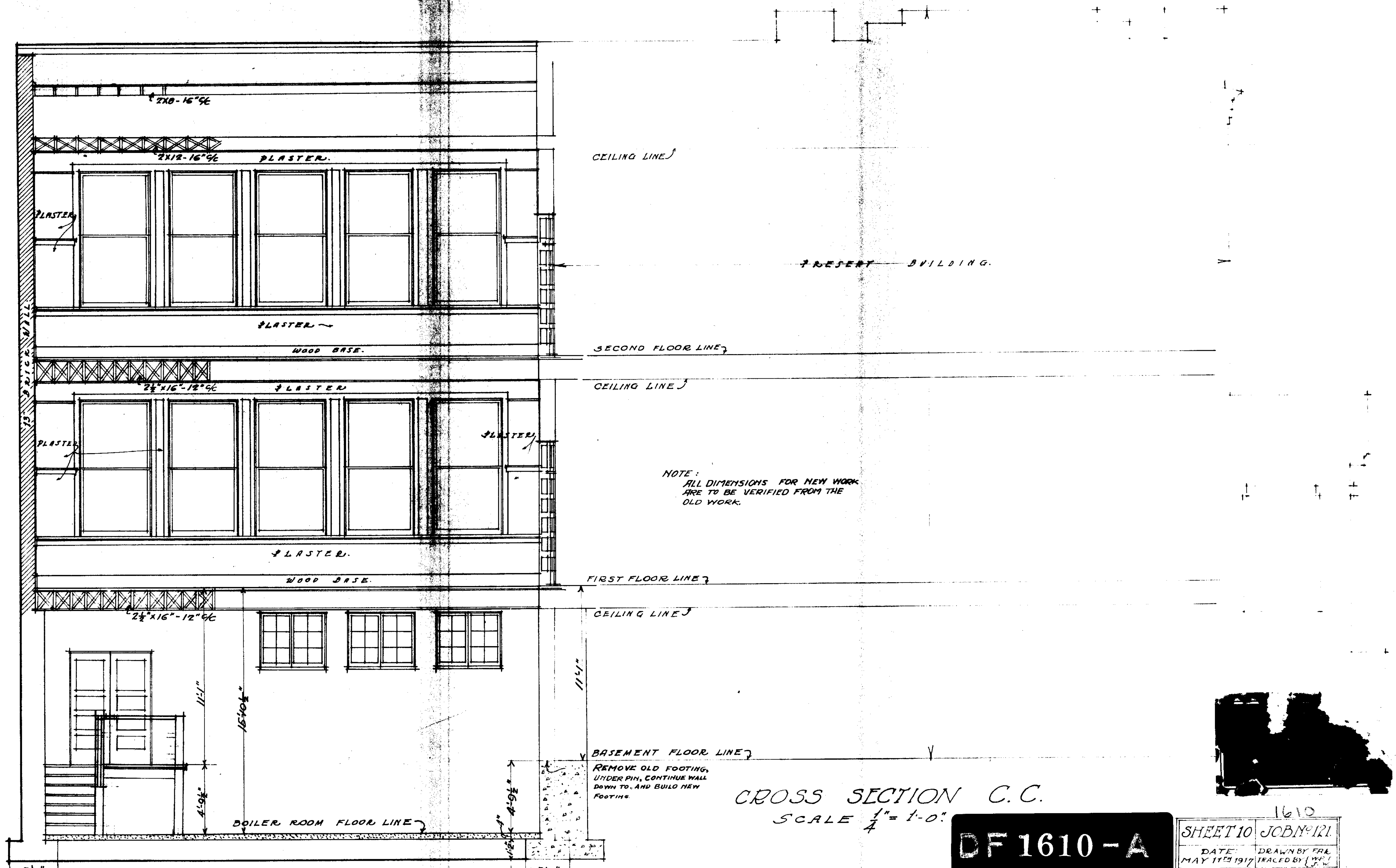
SCALE ¼" = 1'-0".

DF 1609-A

SHEET No 9	JOB No 121
DATE: MAY 11th 1917	DRAWN BY F.R.R. TRACED BY W.A.T. J.W.

ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL, 37TH AVE.
AND REGAL ST. SCHOOL DIST No 81.
SPOKANE WASHINGTON

FRANCIS J. ROONEY ARCHT.
607 EMPIRE STATE BLDG.
SPOKANE. WASHINGTON.



NOTE:
ALL DIMENSIONS FOR NEW WORK ARE TO BE VERIFIED FROM THE OLD WORK.

CROSS SECTION C.C.
SCALE ¼" = 1'-0"

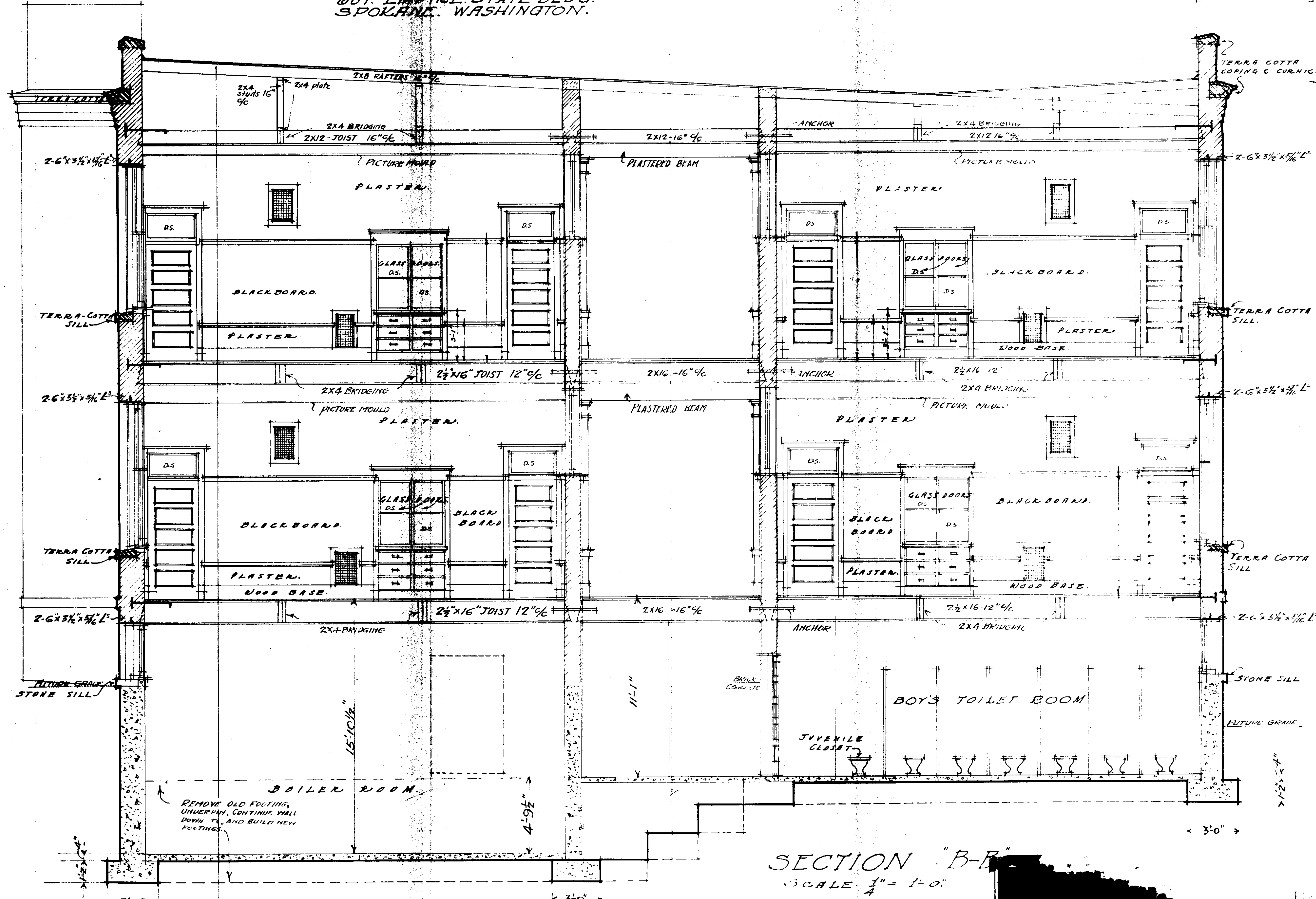
1610

DF 1610-A

SHEET 10	JOB No 121.
DATE: MAY 11th 1917	DRAWN BY FRL TRACED BY

ADDITIONS AND ALTERATIONS
ON ADAMS SCHOOL, 37TH AVE.
AND REGAL ST. SCHOOL DIST. № 81
SPOKANE WASHINGTON

FRANCIS J. ROONEY ARCHT.
607. EMPIRE STATE BLDG.
SPOKANE. WASHINGTON.



SECTION "B-B"
SCALE 1/4" = 1'-0"

DF1611-A

SHEET № 11	JOB № 121
DATE MAR. 11 1917	DRAWN BY F.J.R. TRACED BY W.F.T. J.W.

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Appendix F: FEMA E-74 Nonstructural Seismic Bracing Excerpts

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Life Safety Systems

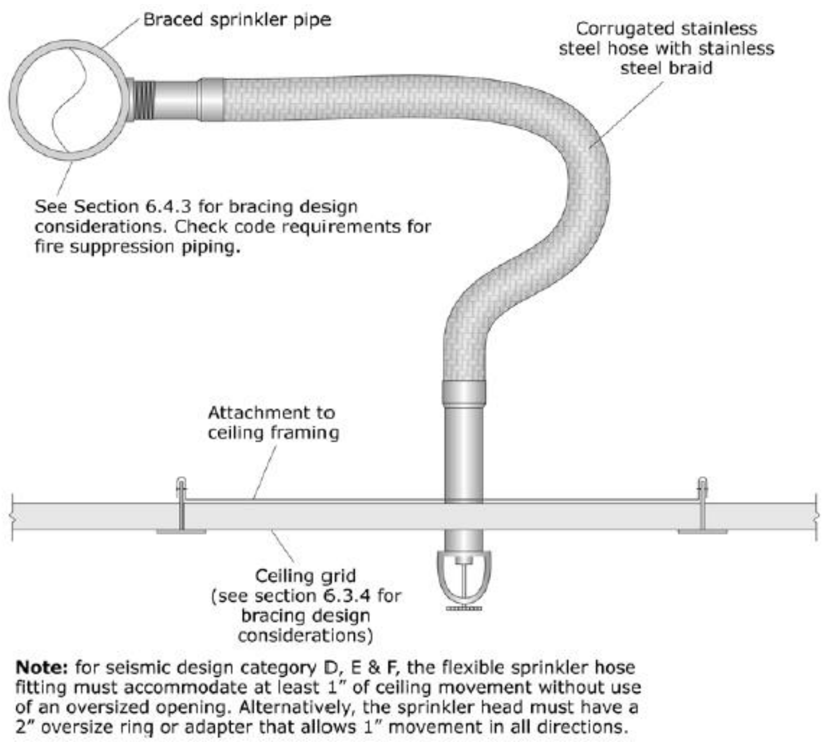


Figure G-1. Flexible Sprinkler Drop.

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

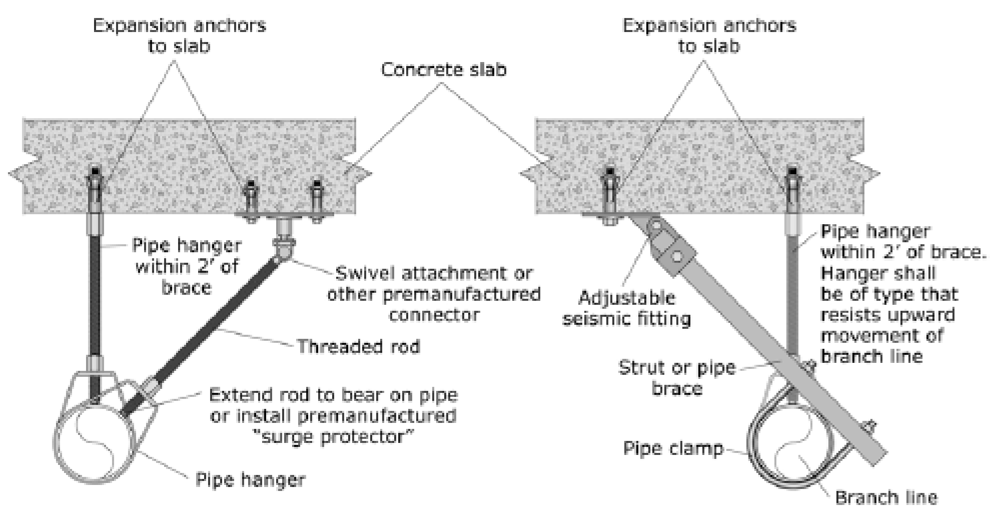


Figure G-2. End of Line Restraint.

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

Partitions

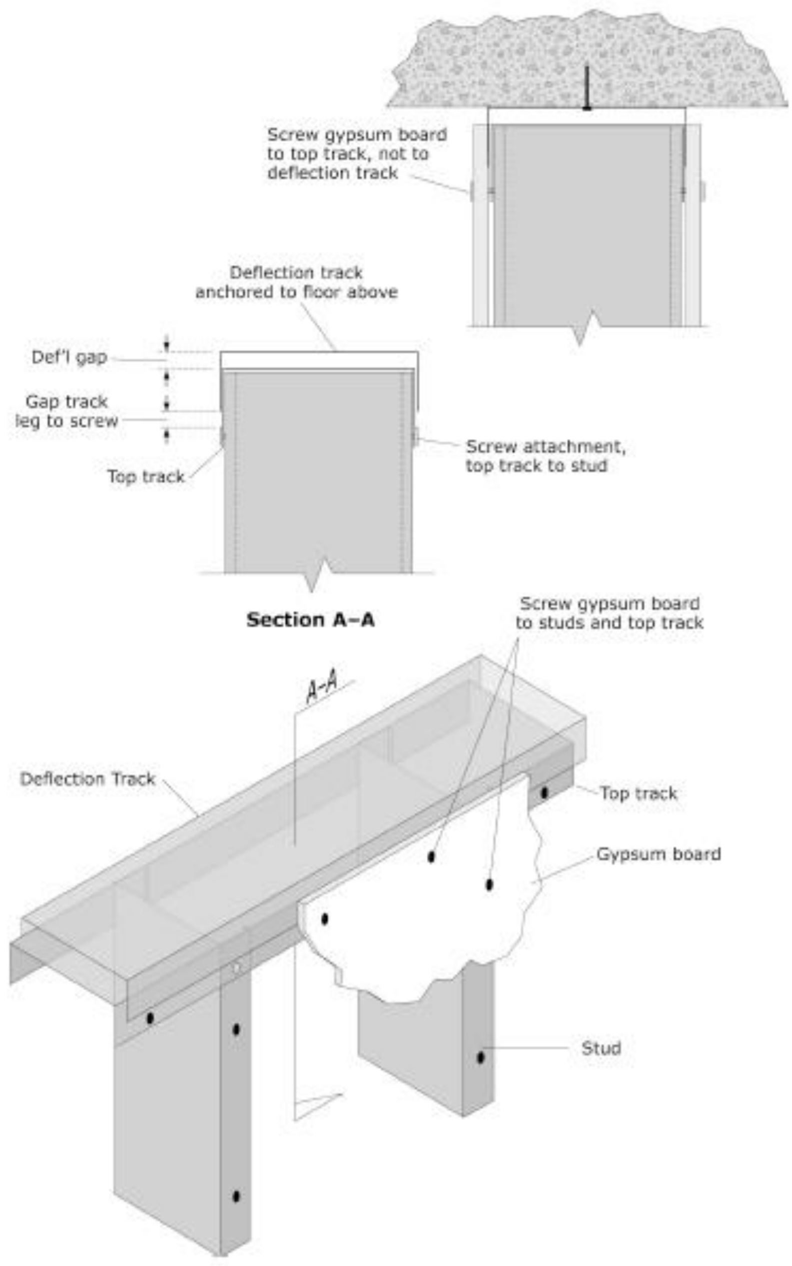


Figure G-3. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.

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

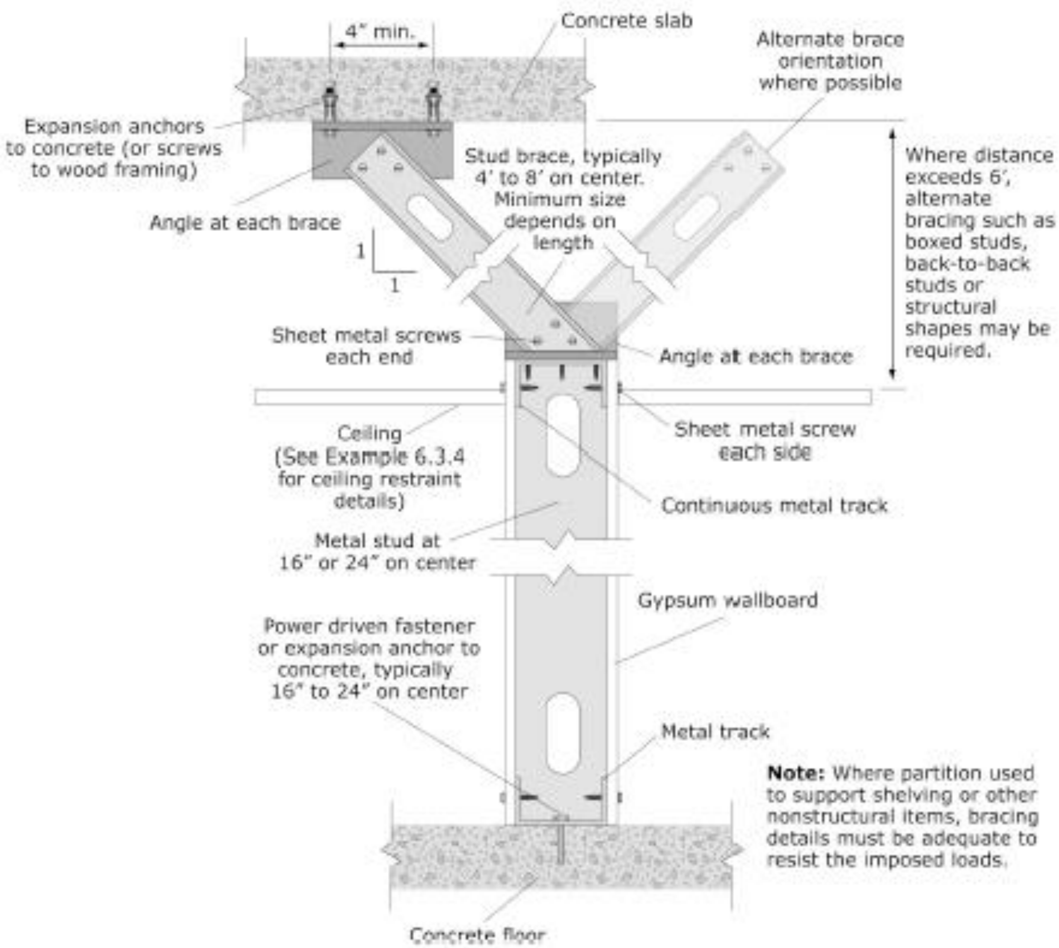


Figure G-4. Mitigation Schemes for Bracing the Tops of Metal Stud Partitions Walls.

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

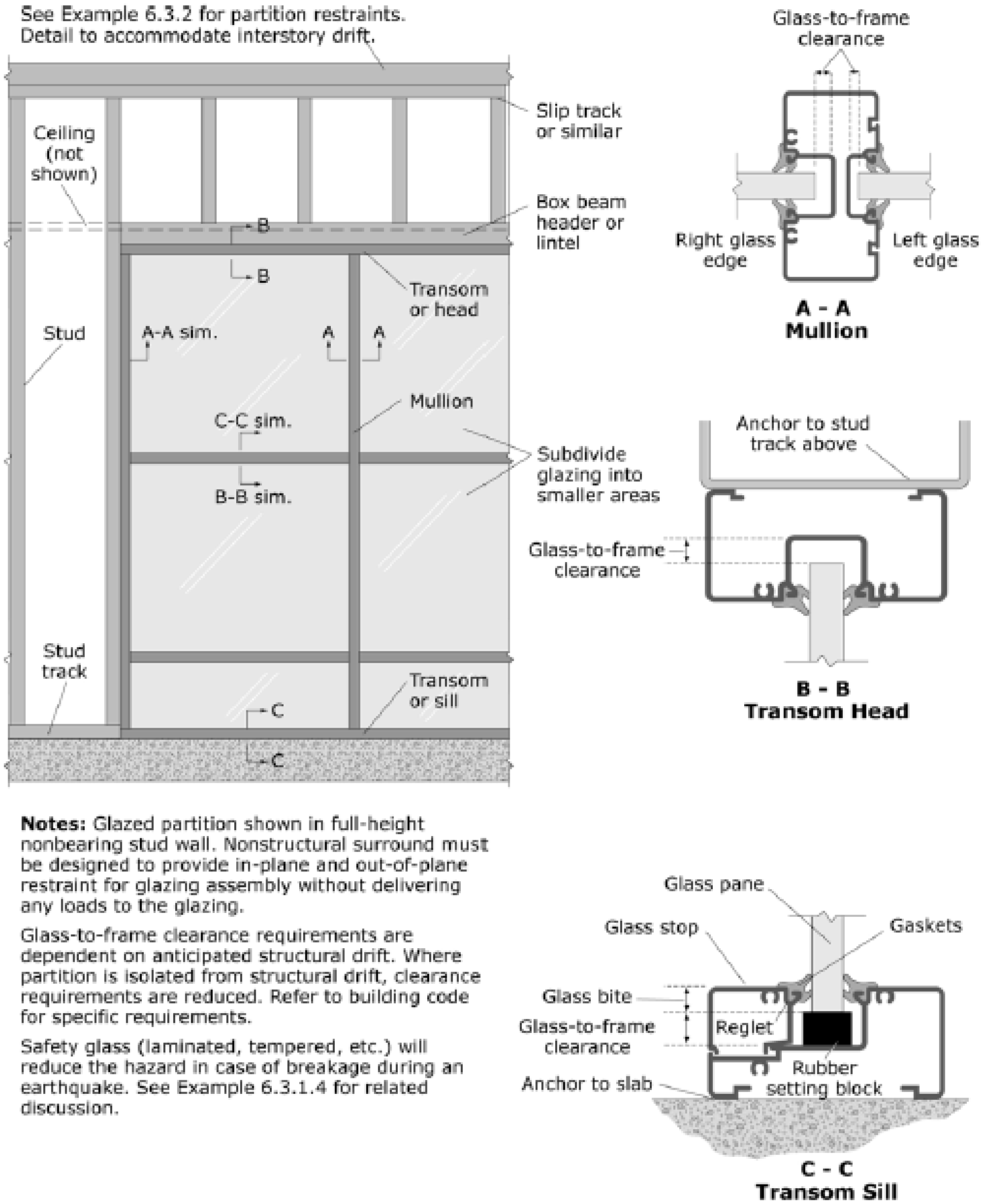


Figure G-5. Full-height Glazed Partition.

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

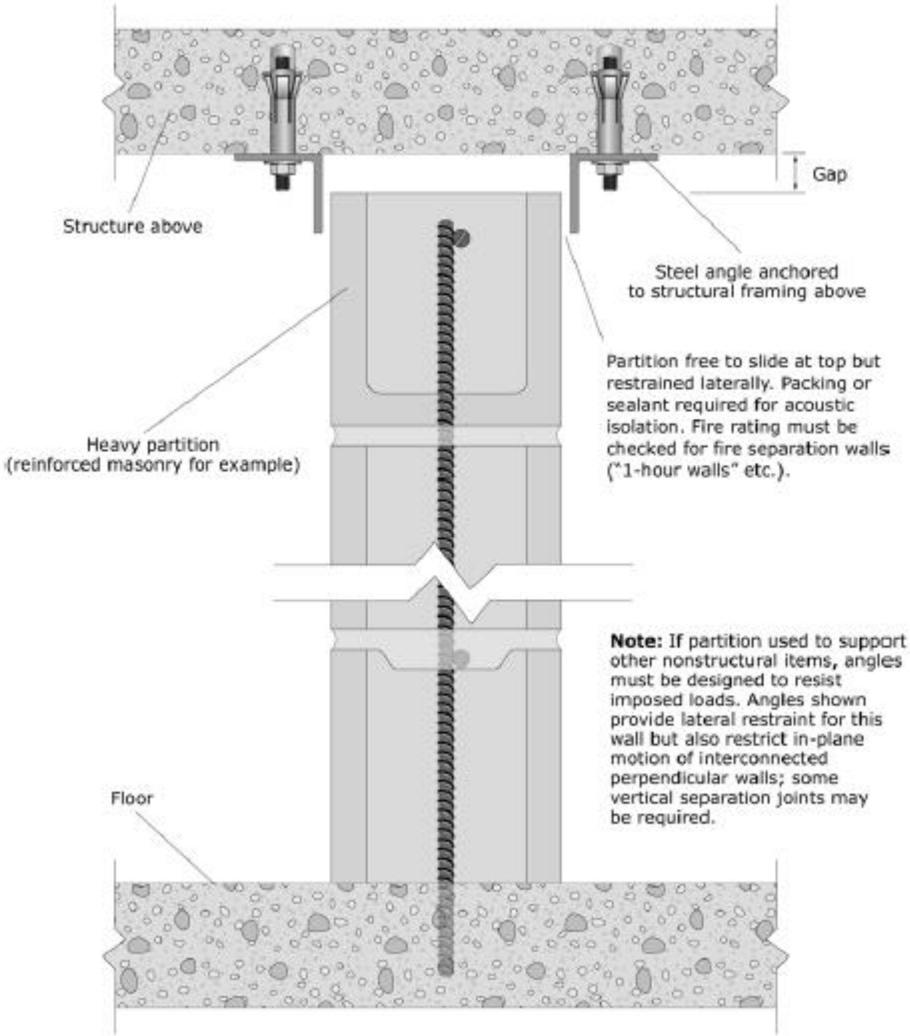


Figure G-6. Full-height Heavy Partition.

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

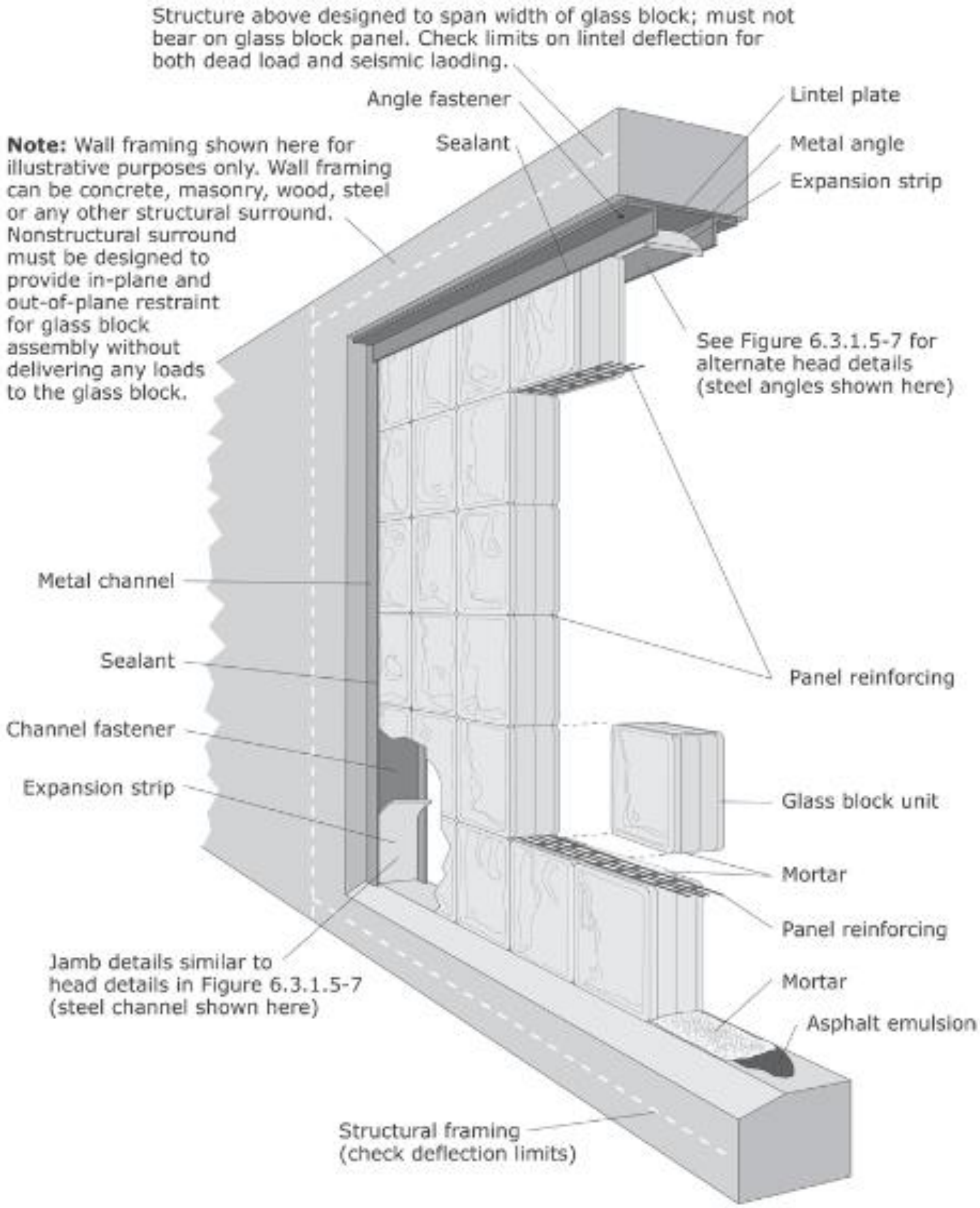


Figure G-7. Typical Glass Block Panel Details.

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

Ceilings

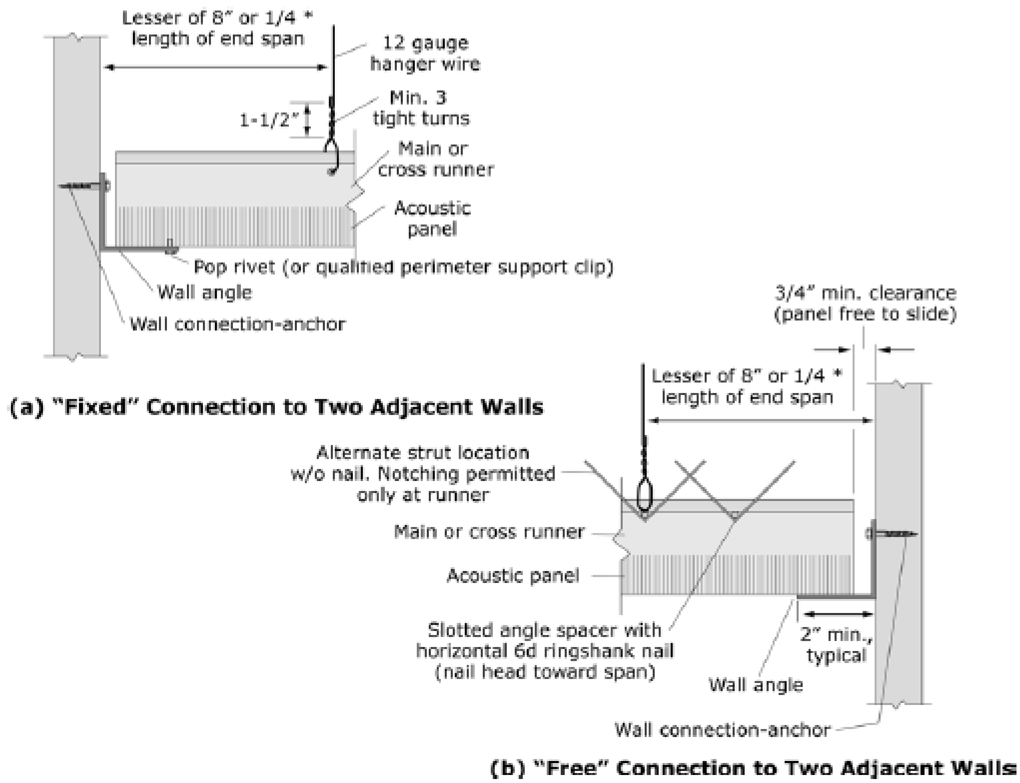
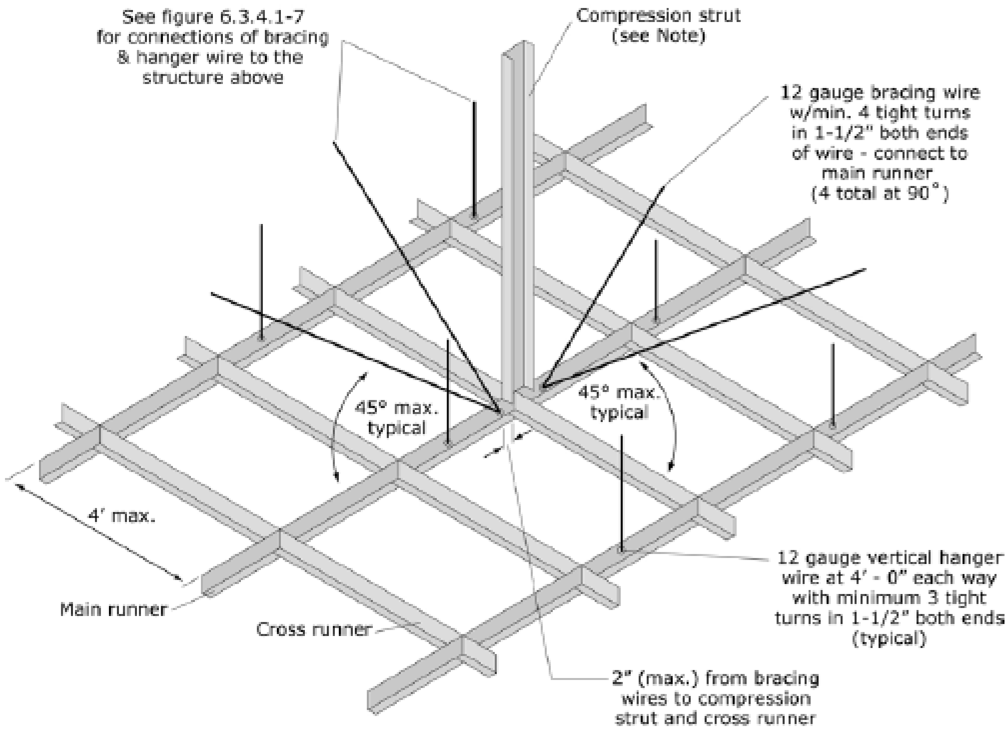


Figure G-8. Suspension System for Acoustic Lay-in Panel Ceilings – Edge Conditions.

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



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

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

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

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

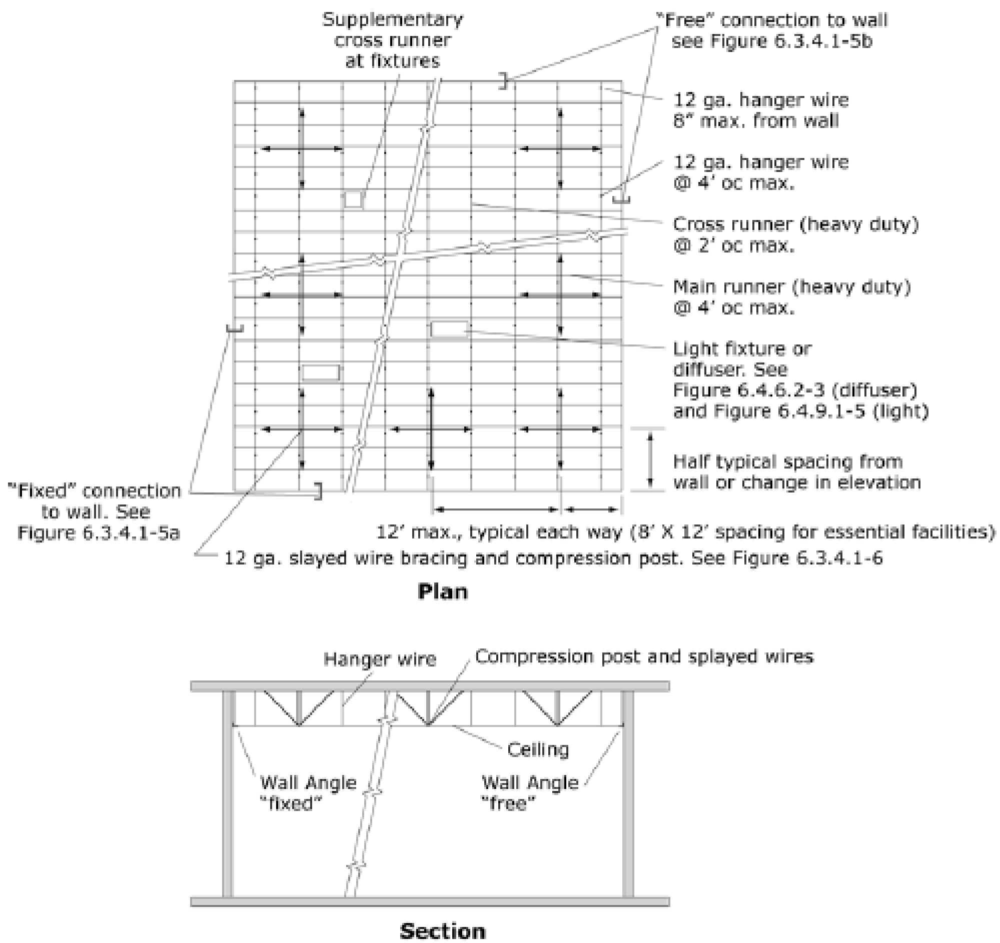


Figure G-10. Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Layout.

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

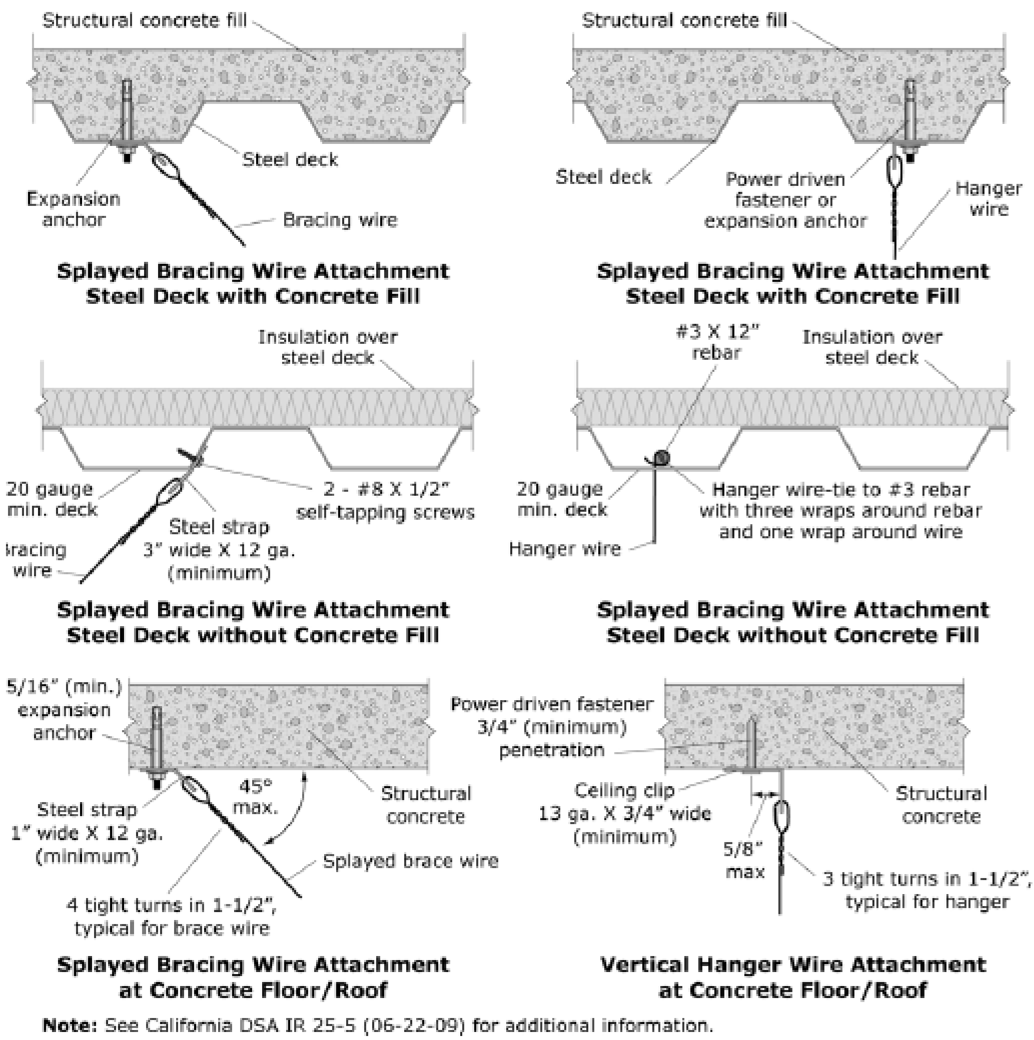
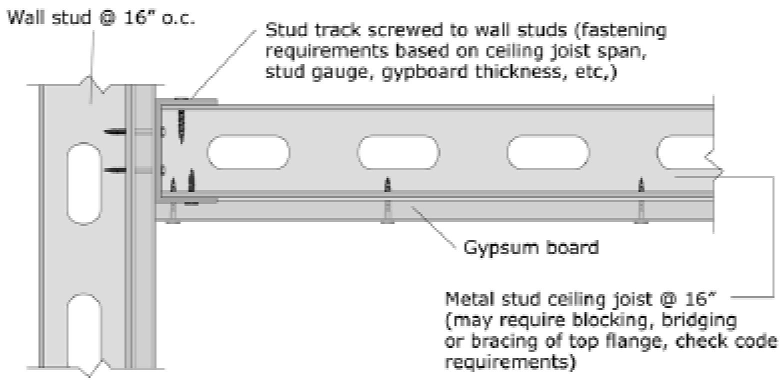
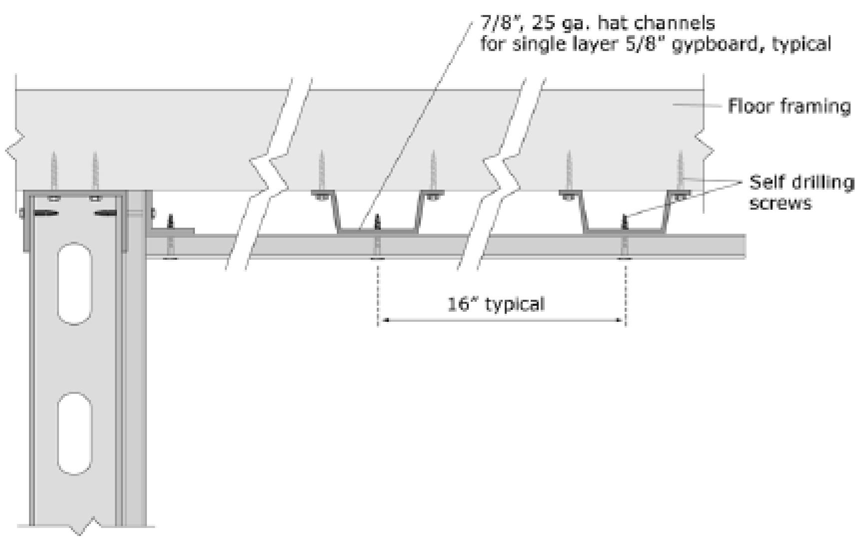


Figure G-11. Suspension System for Acoustic Lay-in Panel Ceilings – Overhead Attachment Details.

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



a) Gypsum board attached directly to ceiling joists



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

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

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

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

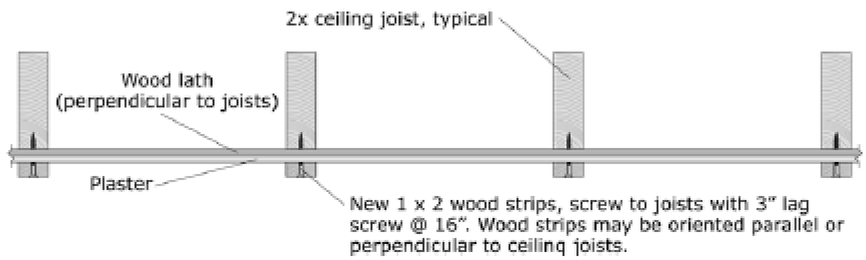


Figure G-13. Retrofit Detail for Existing Lath and Plaster.

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

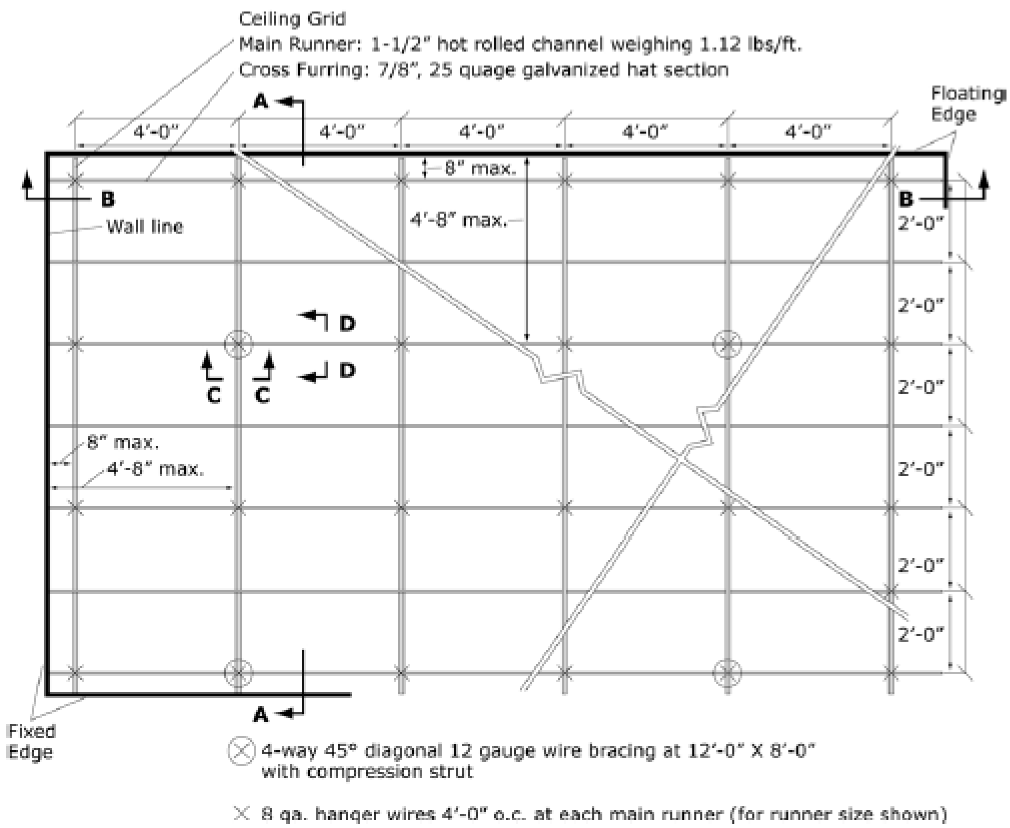


Figure G-14. Diagrammatic View of Suspended Heavy Ceiling Grid and Lateral Bracing.

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

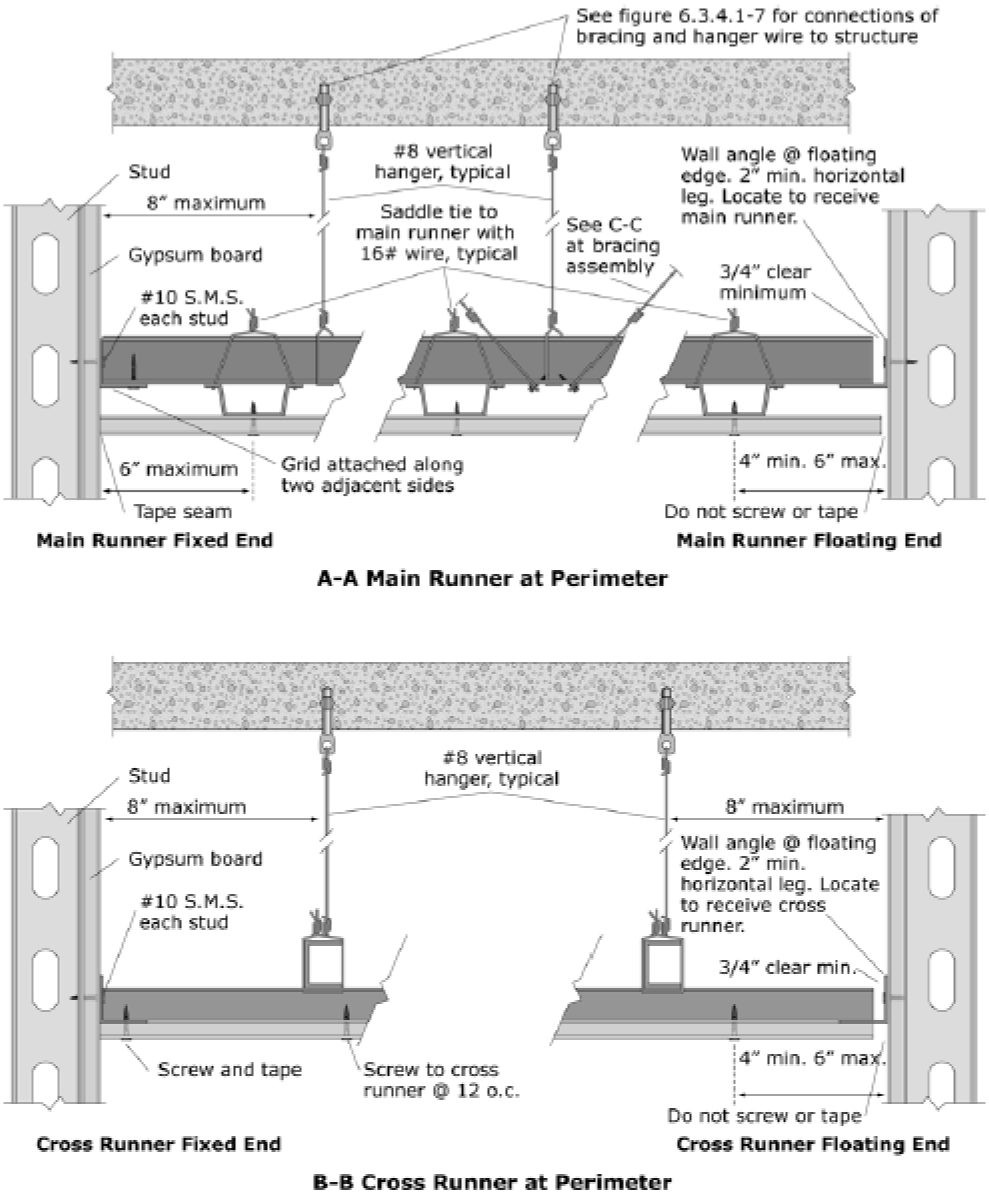


Figure G-15. Perimeter Details for Suspended Gypsum Board Ceiling.

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

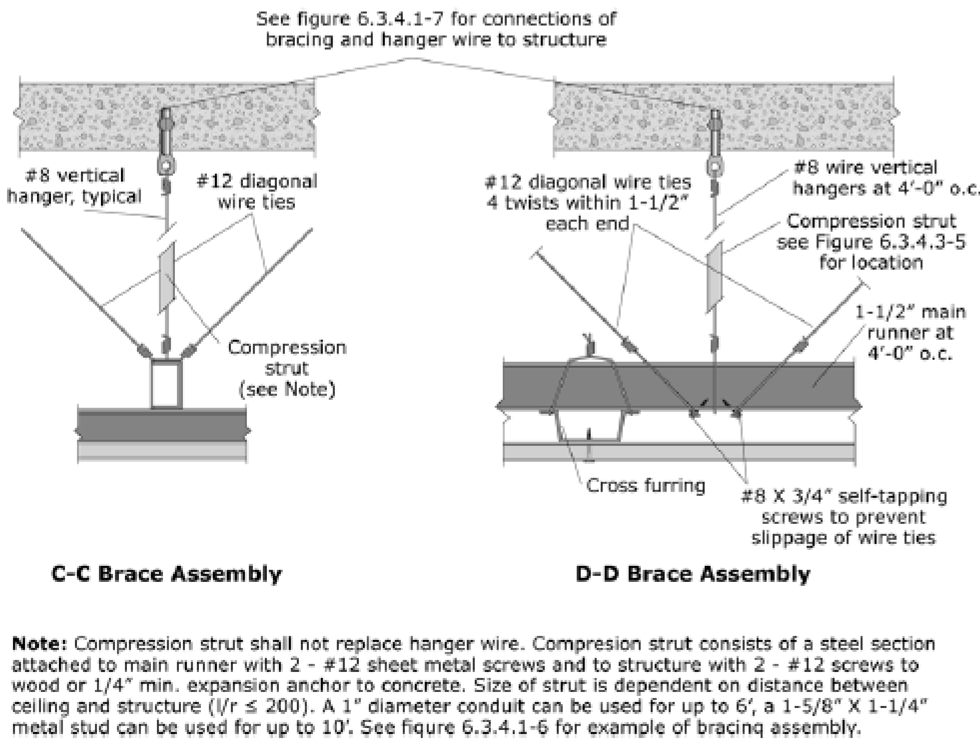


Figure G-16. Details for Lateral Bracing Assembly for Suspended Gypsum Board Ceiling.

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

Light Fixtures

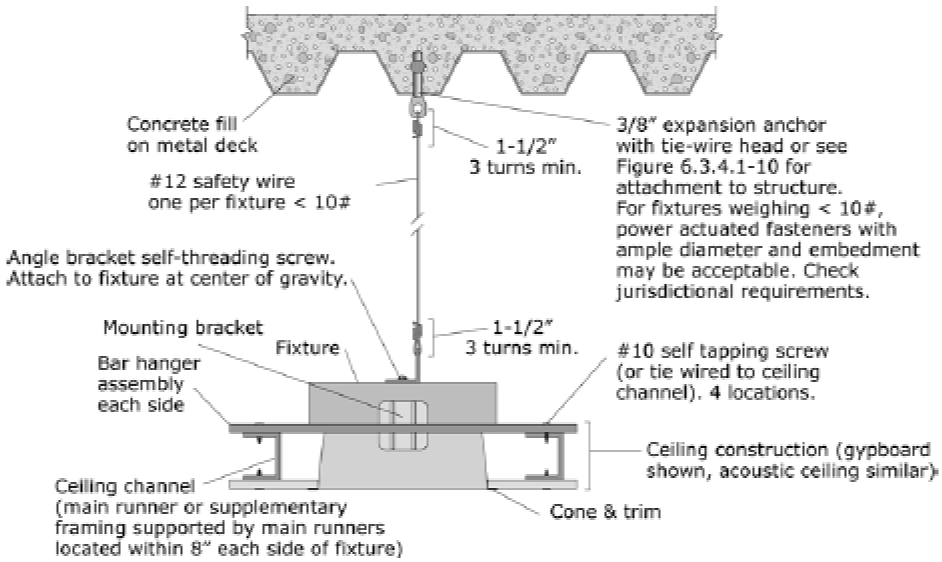


Figure G-17. Recessed Light Fixture in suspended Ceiling (Fixture Weight < 10 pounds).

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

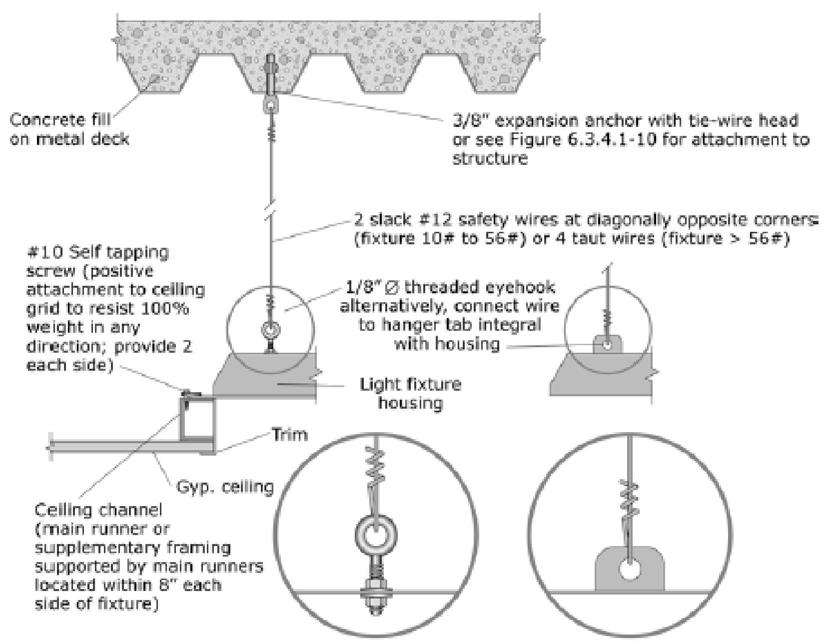


Figure G-18. Recessed Light Fixture in suspended Ceiling (Fixture Weight 10 to 56 pounds).

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

Contents and Furnishings

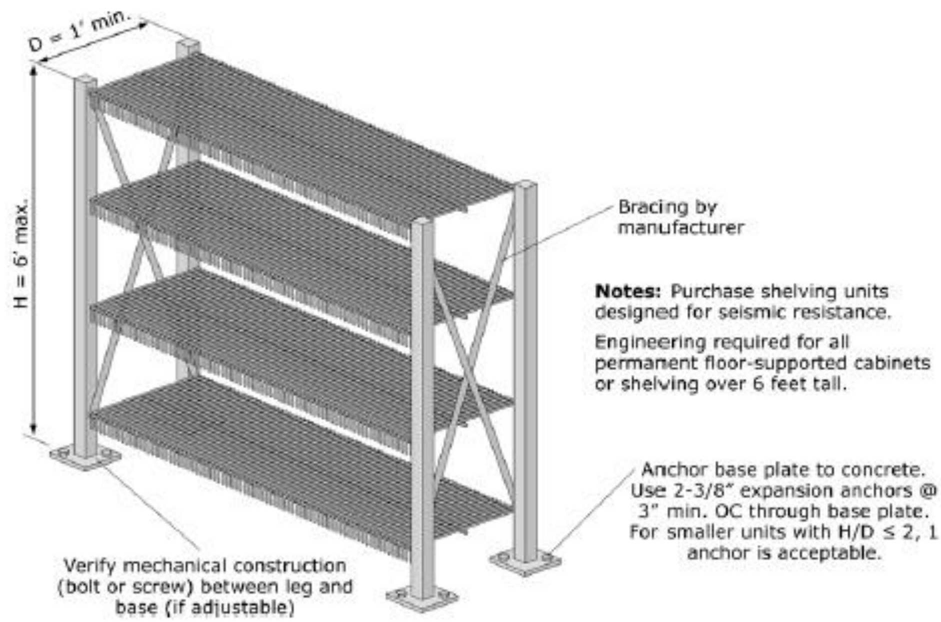


Figure G-19. Light Storage Racks.

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

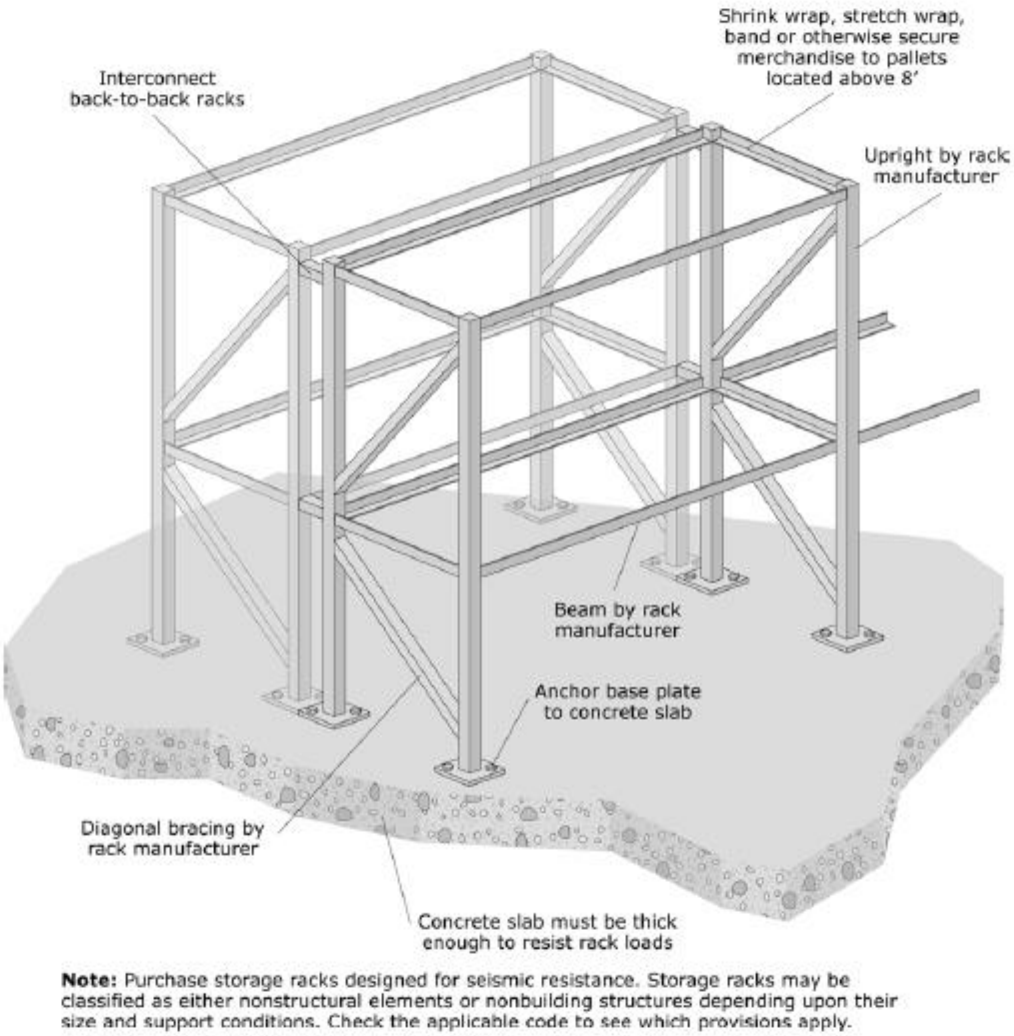


Figure G-20. Industrial Storage Racks.

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

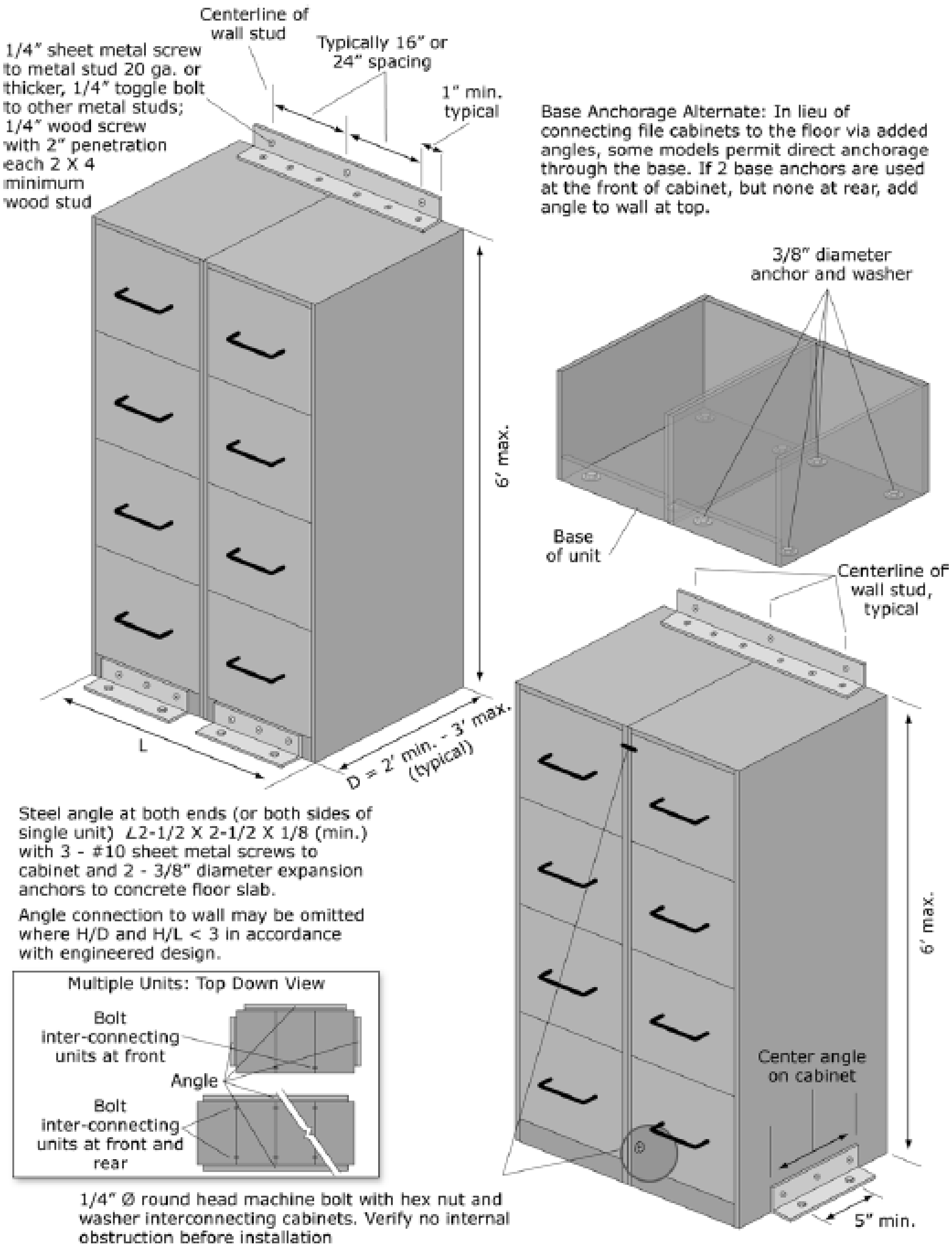


Figure G-21. Wall-mounted File Cabinets.

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

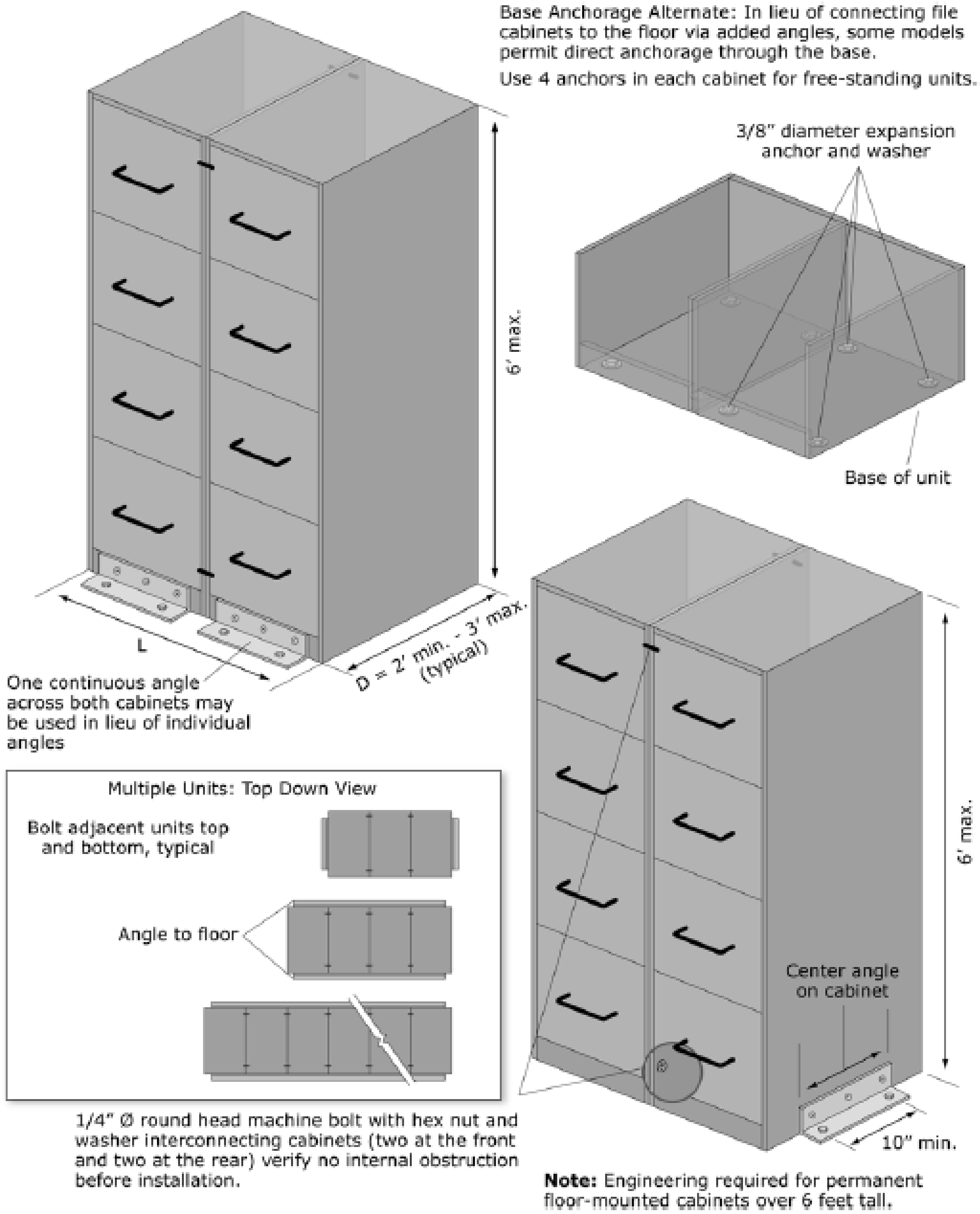


Figure G-22. Base Anchored File Cabinets.

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

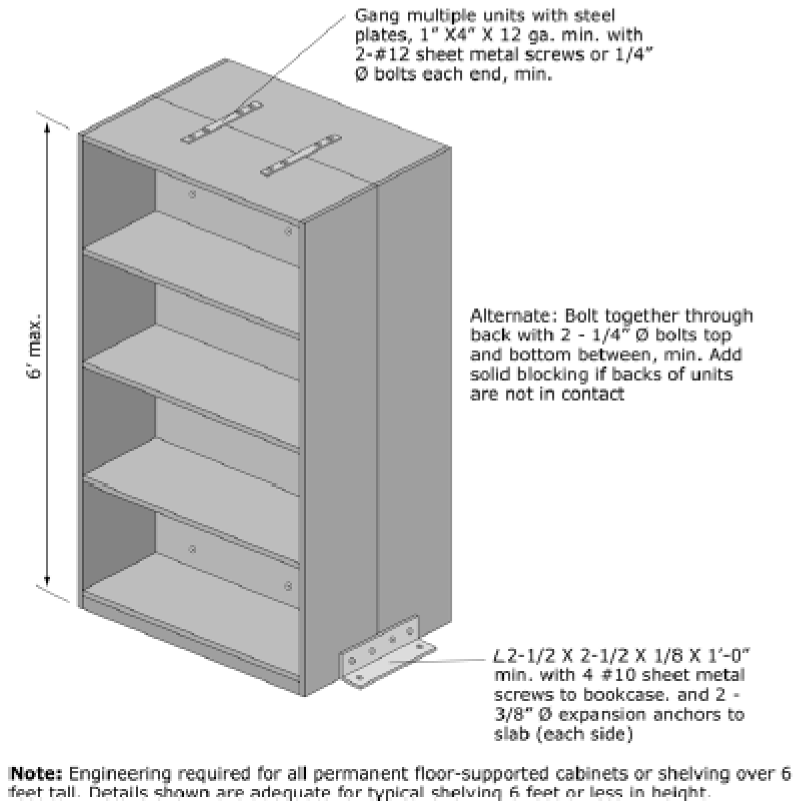


Figure G-23. Anchorage of Freestanding Book Cases Arranged Back to Back.

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

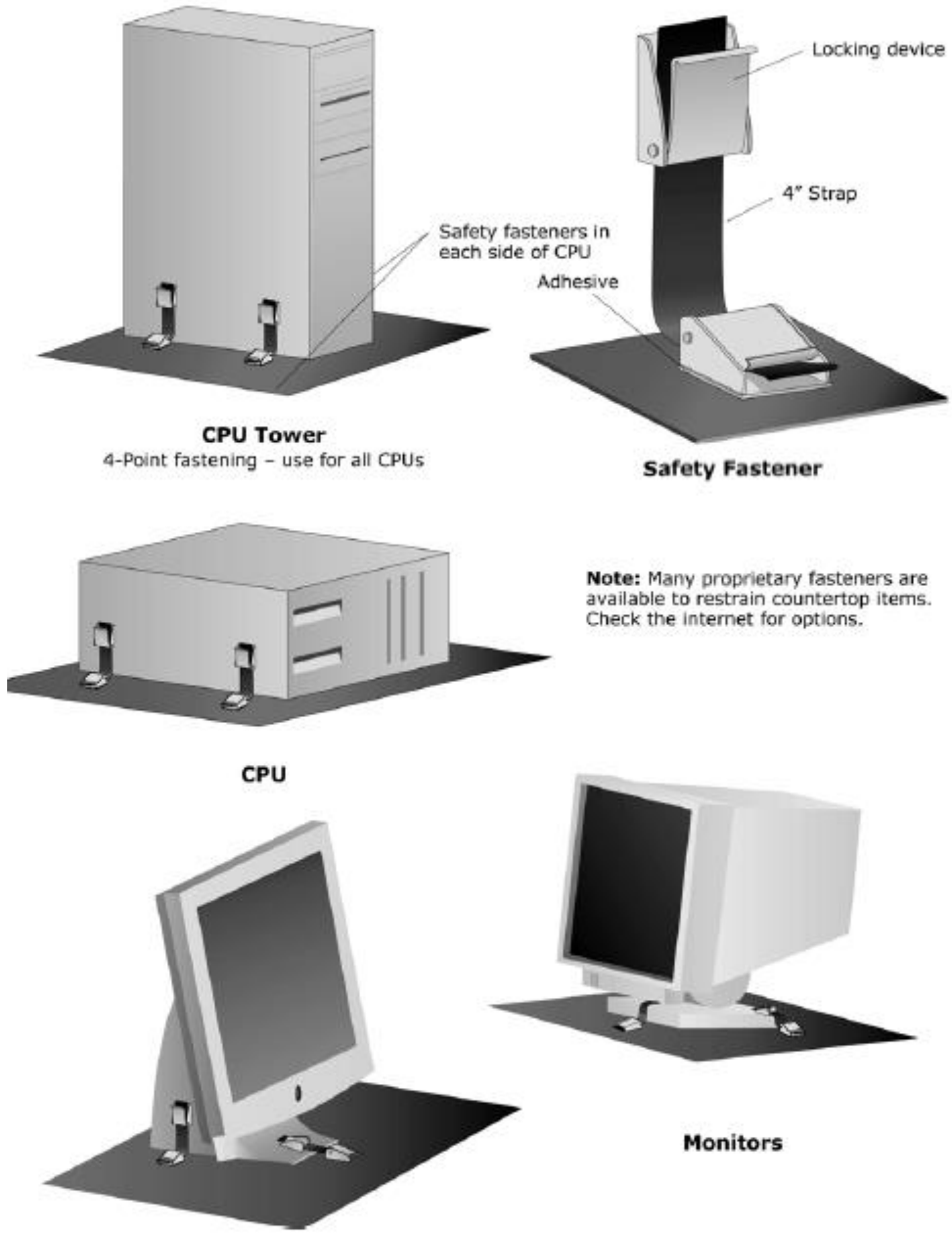


Figure G-24. Desktop Computers and Accessories.

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

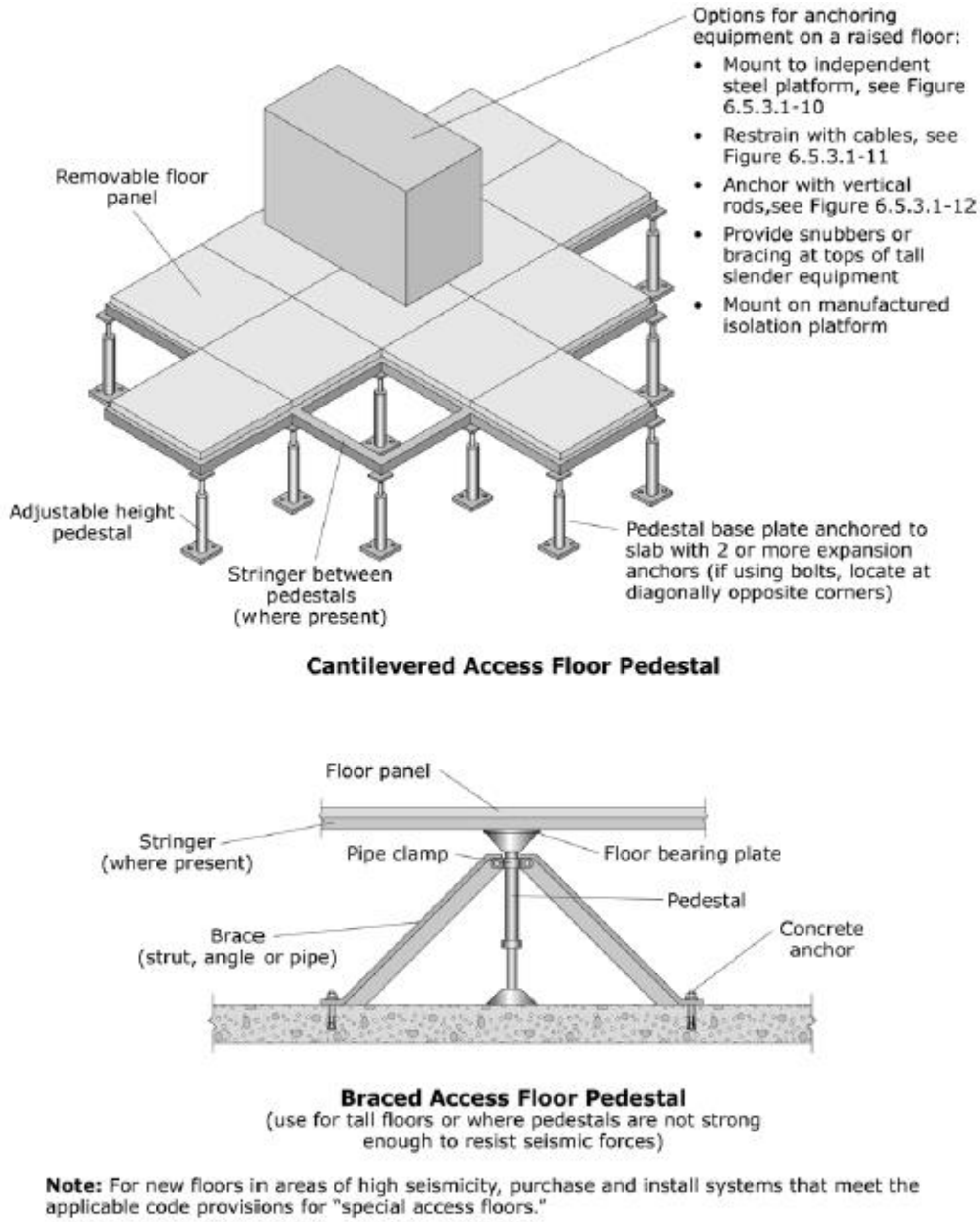


Figure G-25. Equipment Mounted on Access Floor.

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

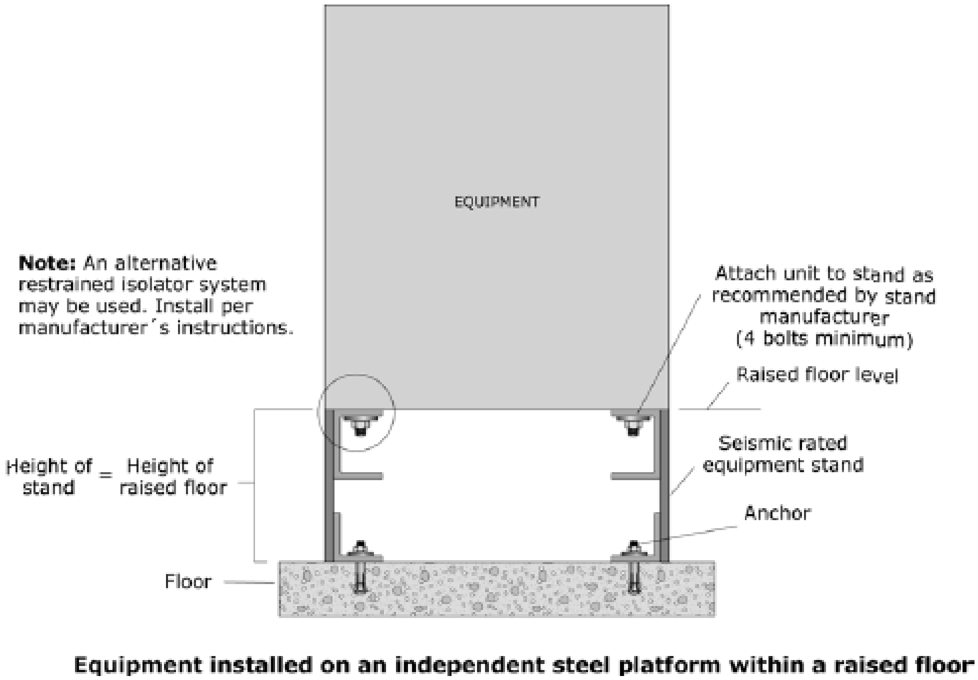


Figure G-26. Equipment Mounted on Access Floor – Independent Base.

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

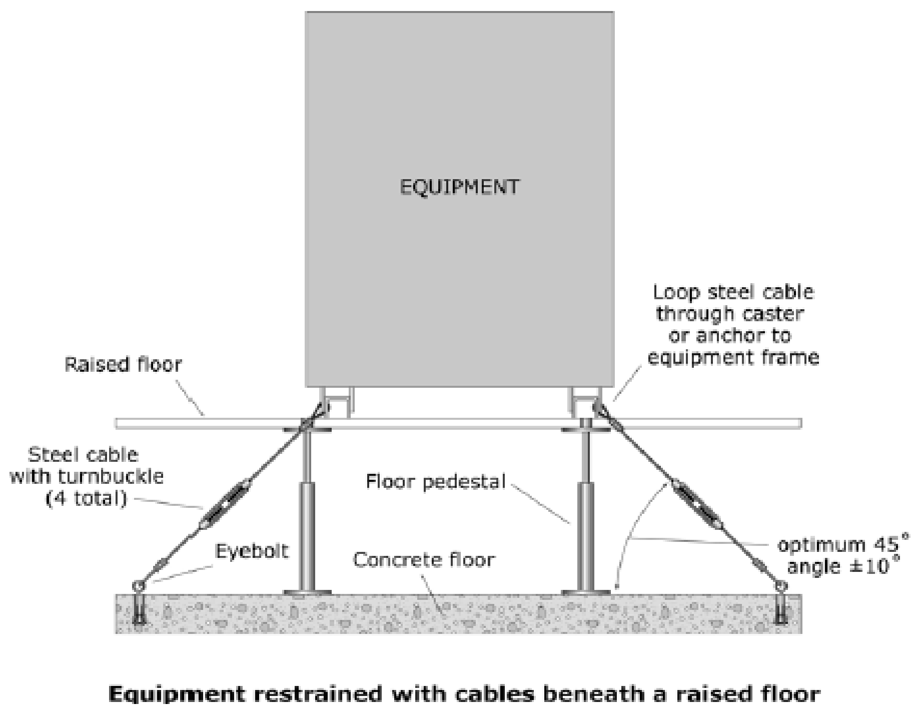
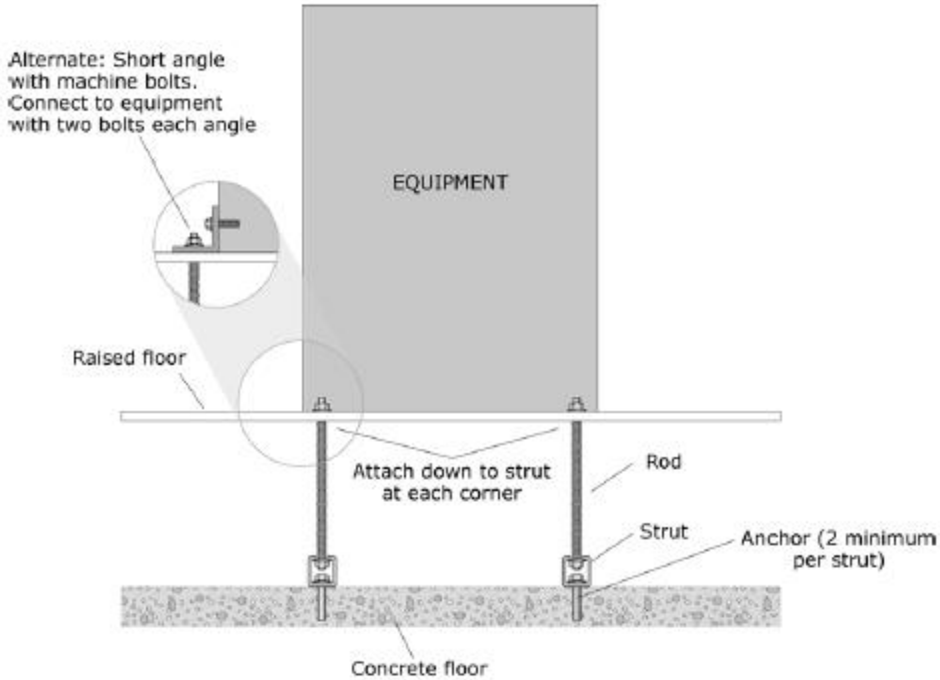


Figure G-27. Equipment Mounted on Access Floor – Cable Braced.

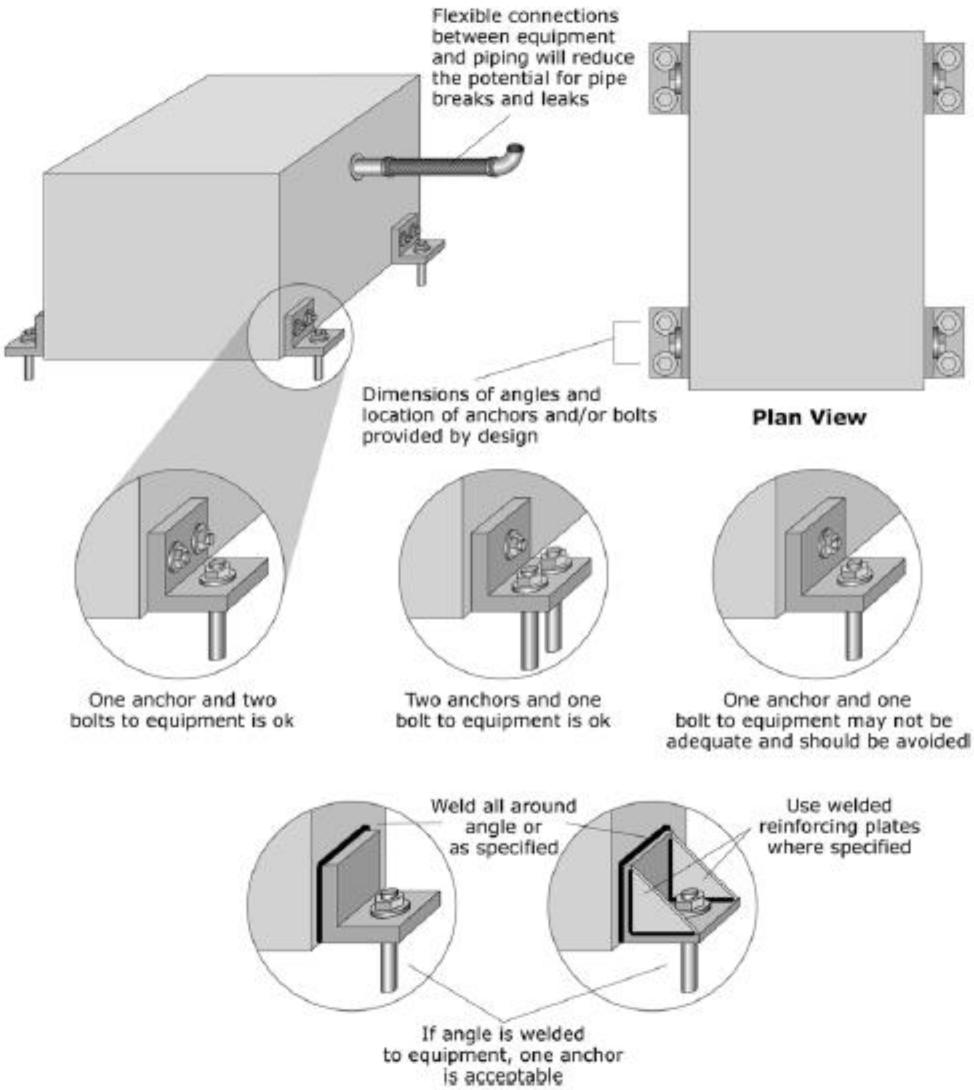
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



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)

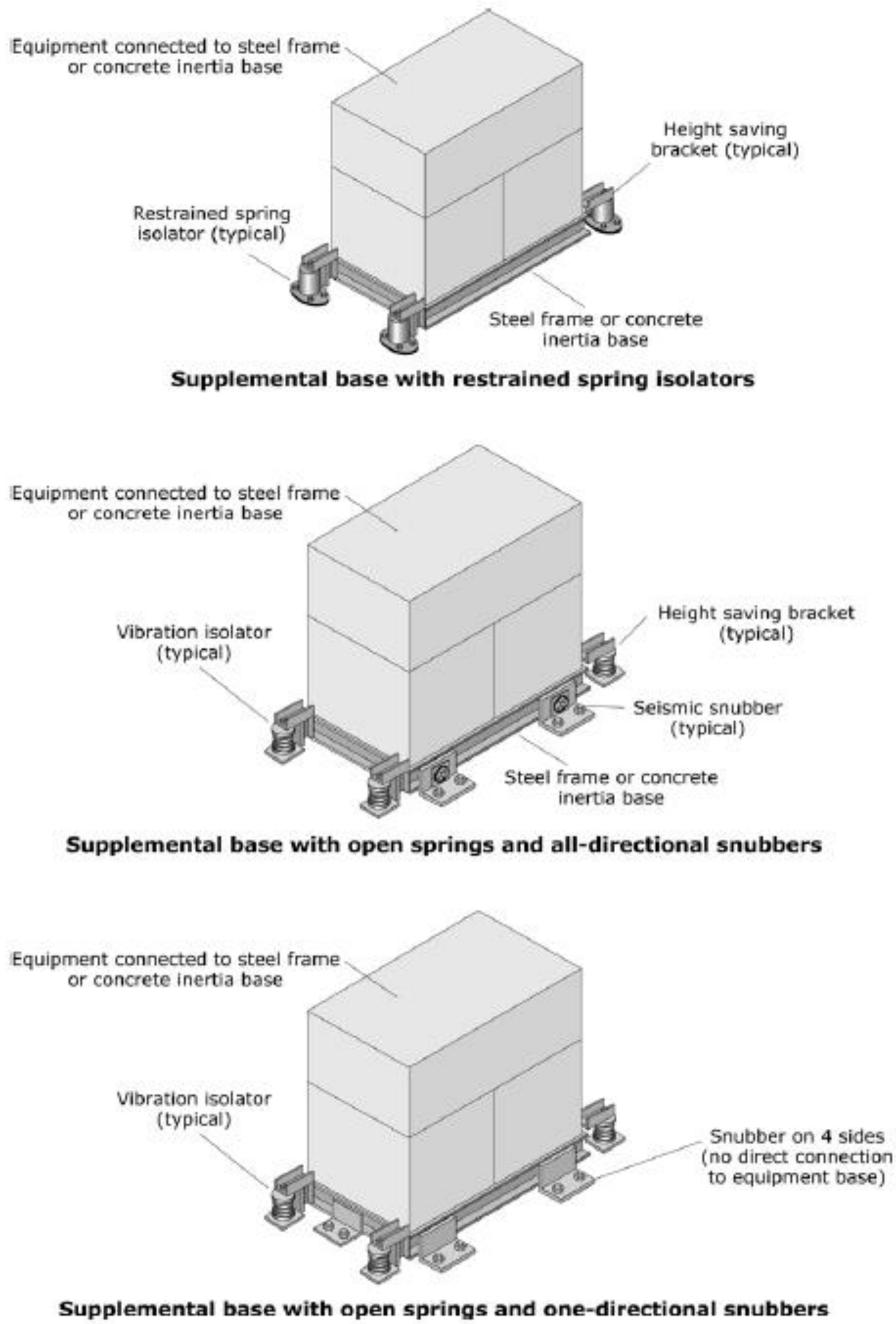


Figure G-30. HVAC Equipment with Vibration Isolation.

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

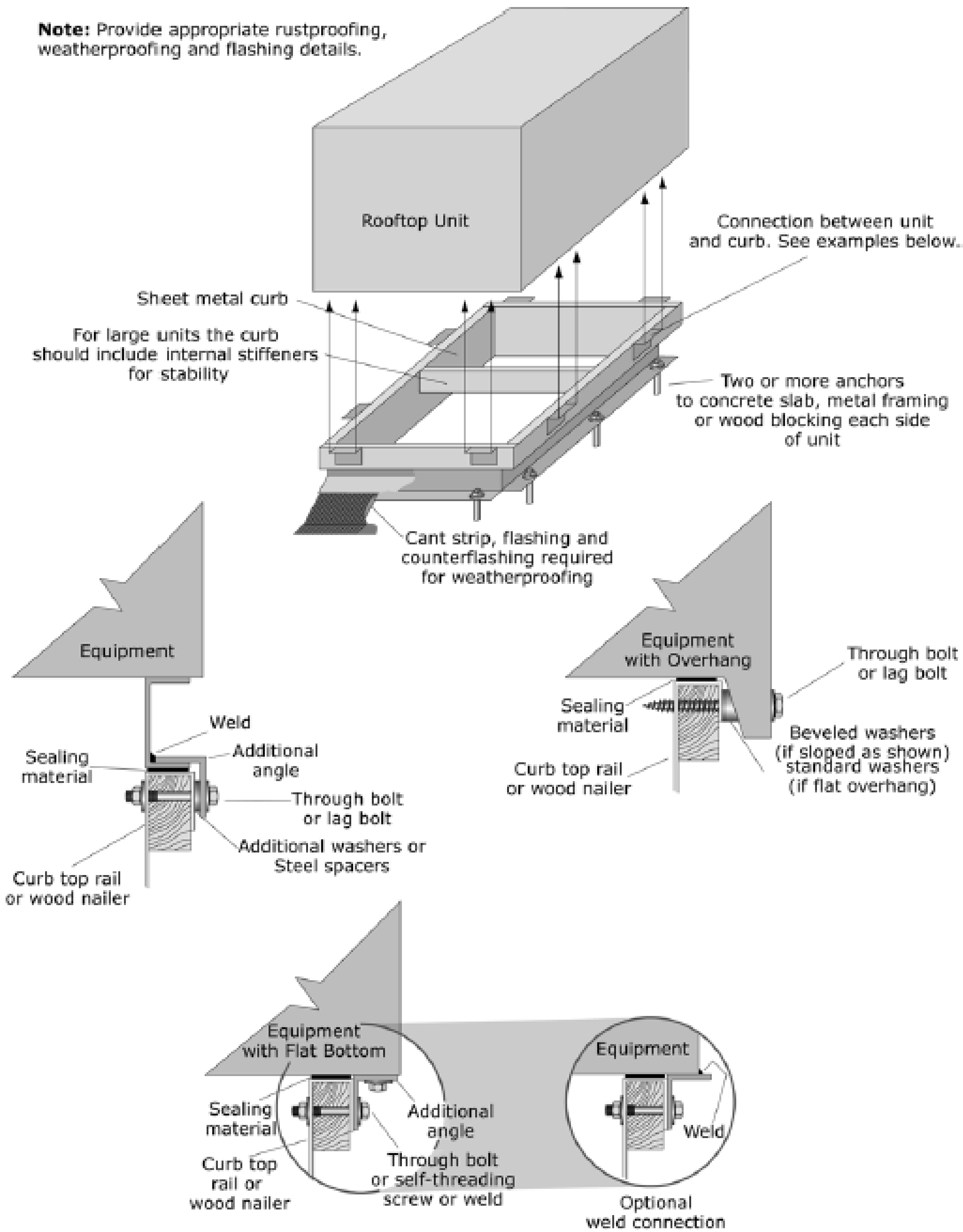


Figure G-31. Rooftop HVAC Equipment.

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

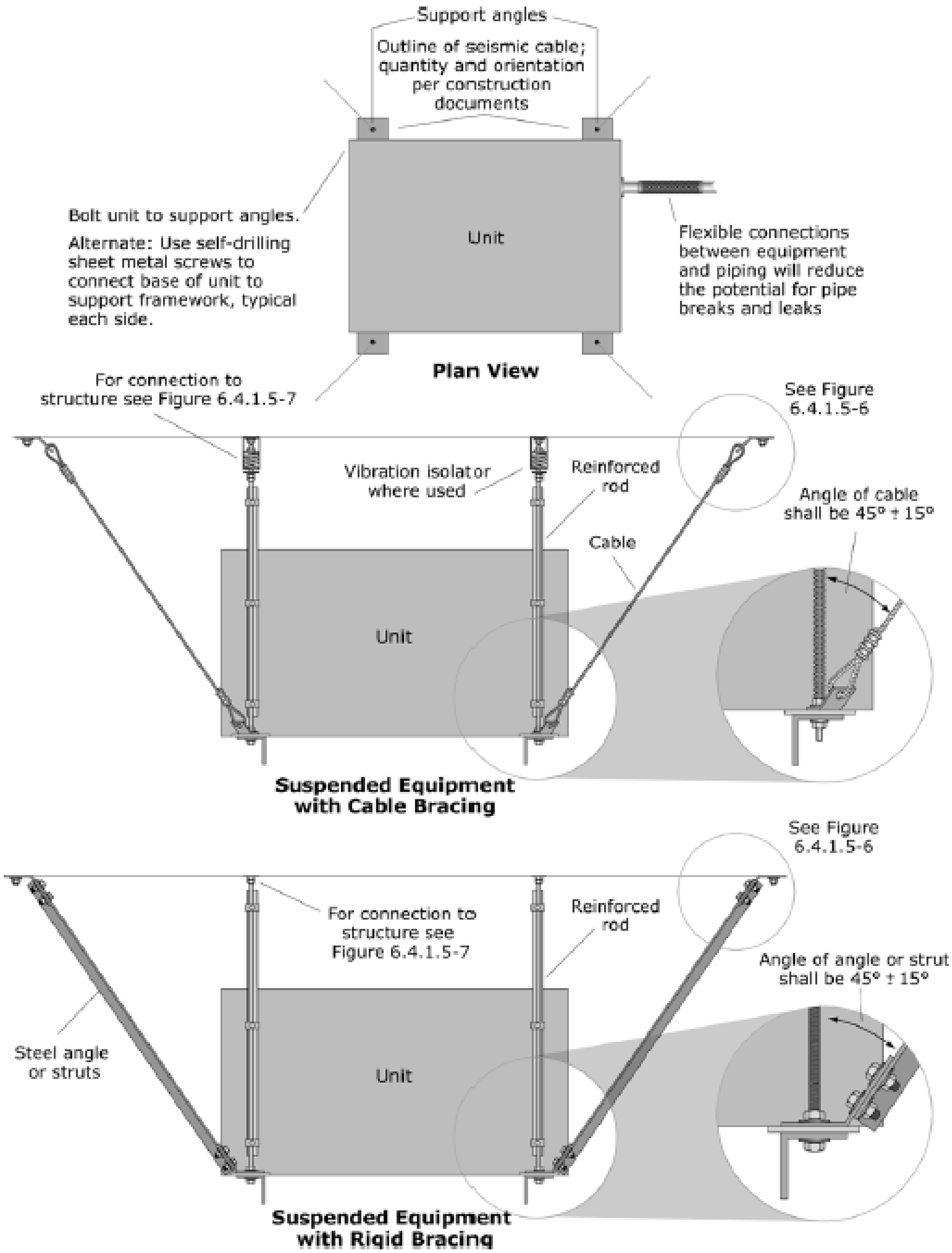


Figure G-32. Suspended Equipment.

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

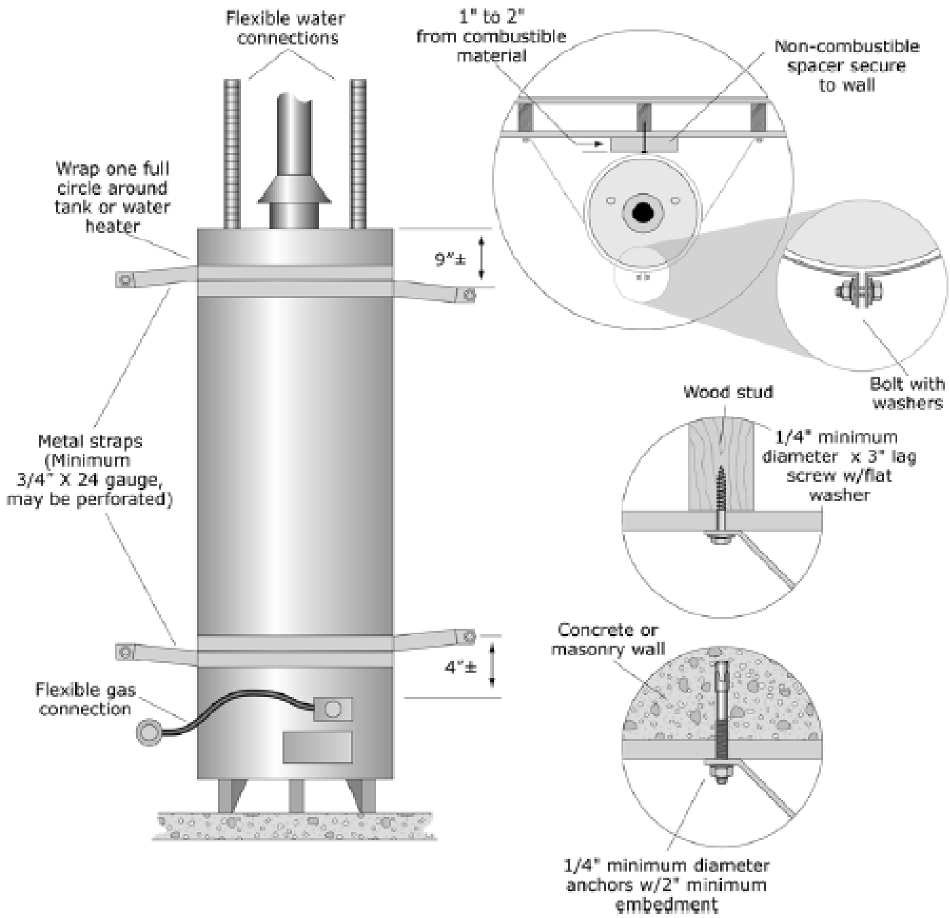


Figure G-33. Water Heater Strapping to Backing Wall.

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

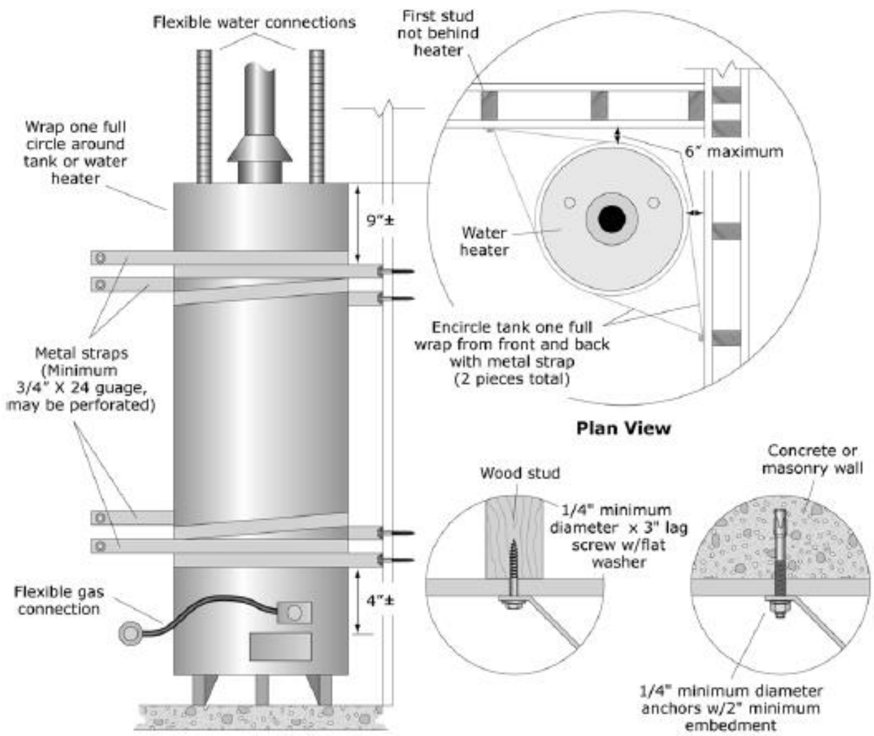


Figure G-34. Water Heater – Strapping at Corner Installation.

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

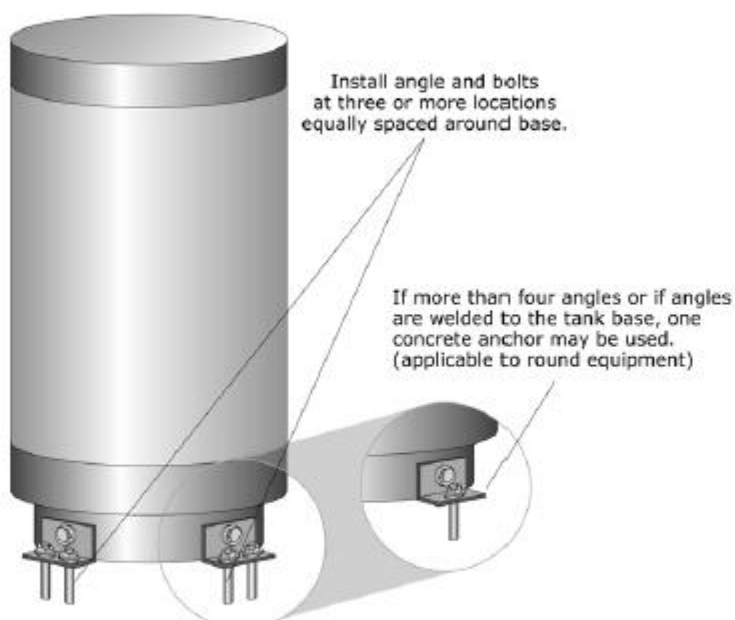


Figure G-35. Water Heater – Base Mounted.

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

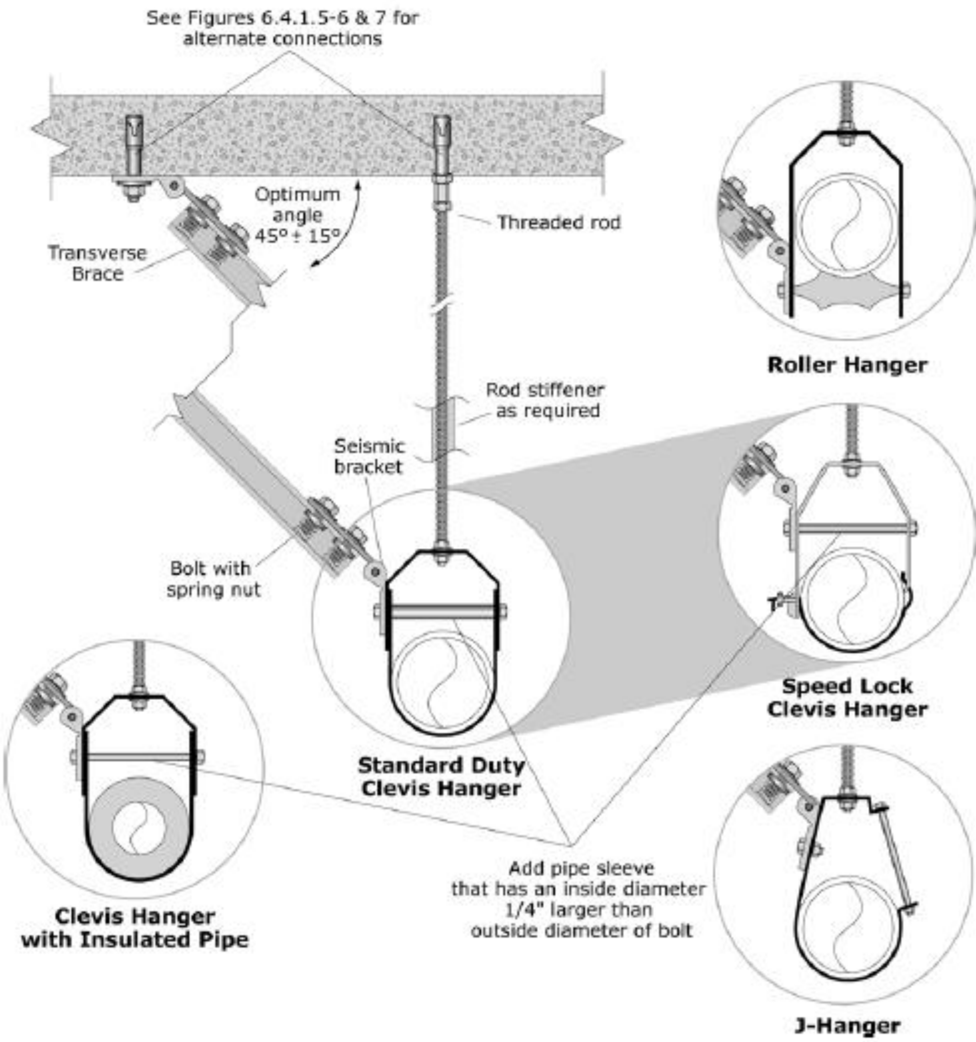


Figure G-36. Rigid Bracing – Single Pipe Transverse.

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

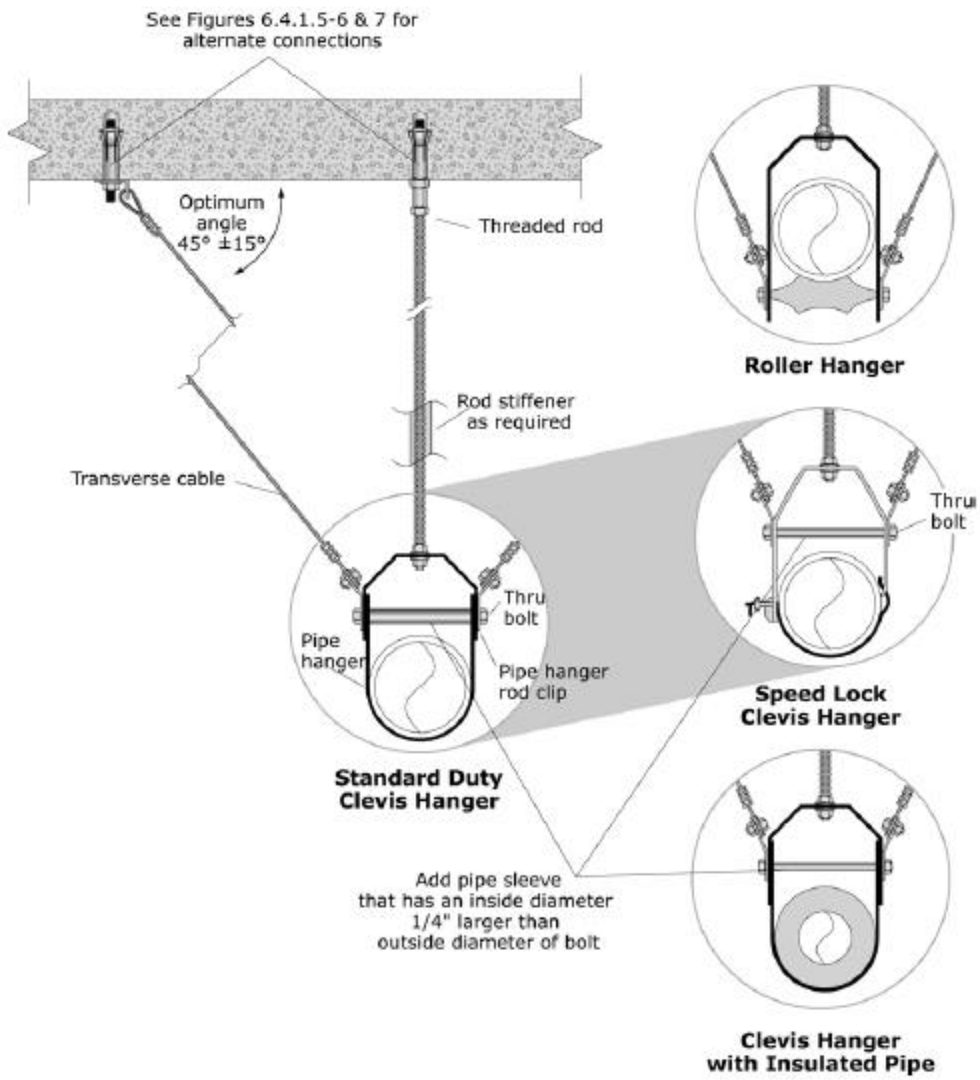


Figure G-37. Cable Bracing – Single Pipe Transverse.

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

Electrical and Communications

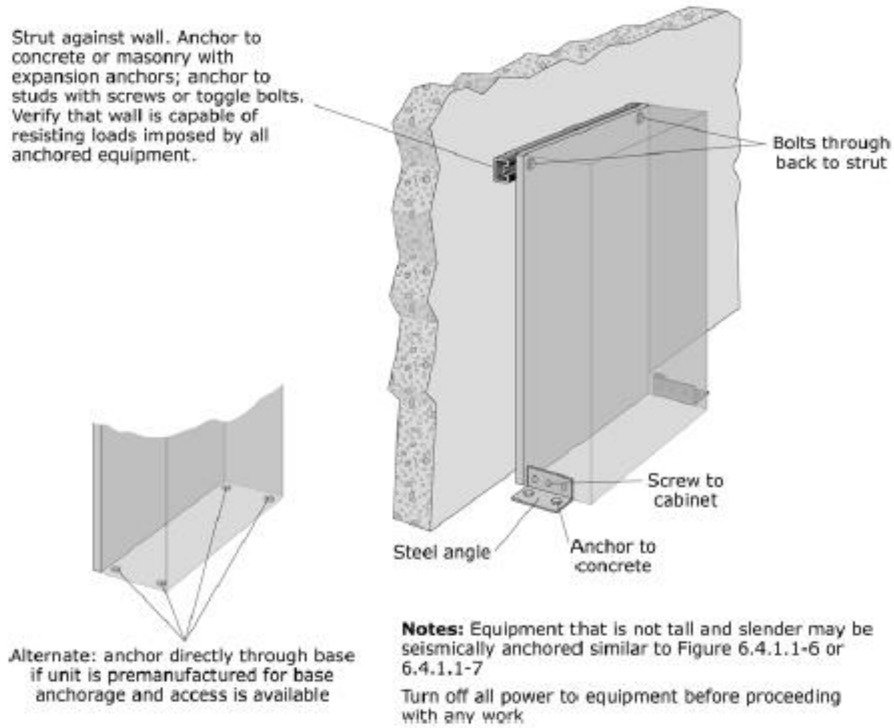


Figure G-38. Electrical Control Panels, Motor Controls Centers, or Switchgear.

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

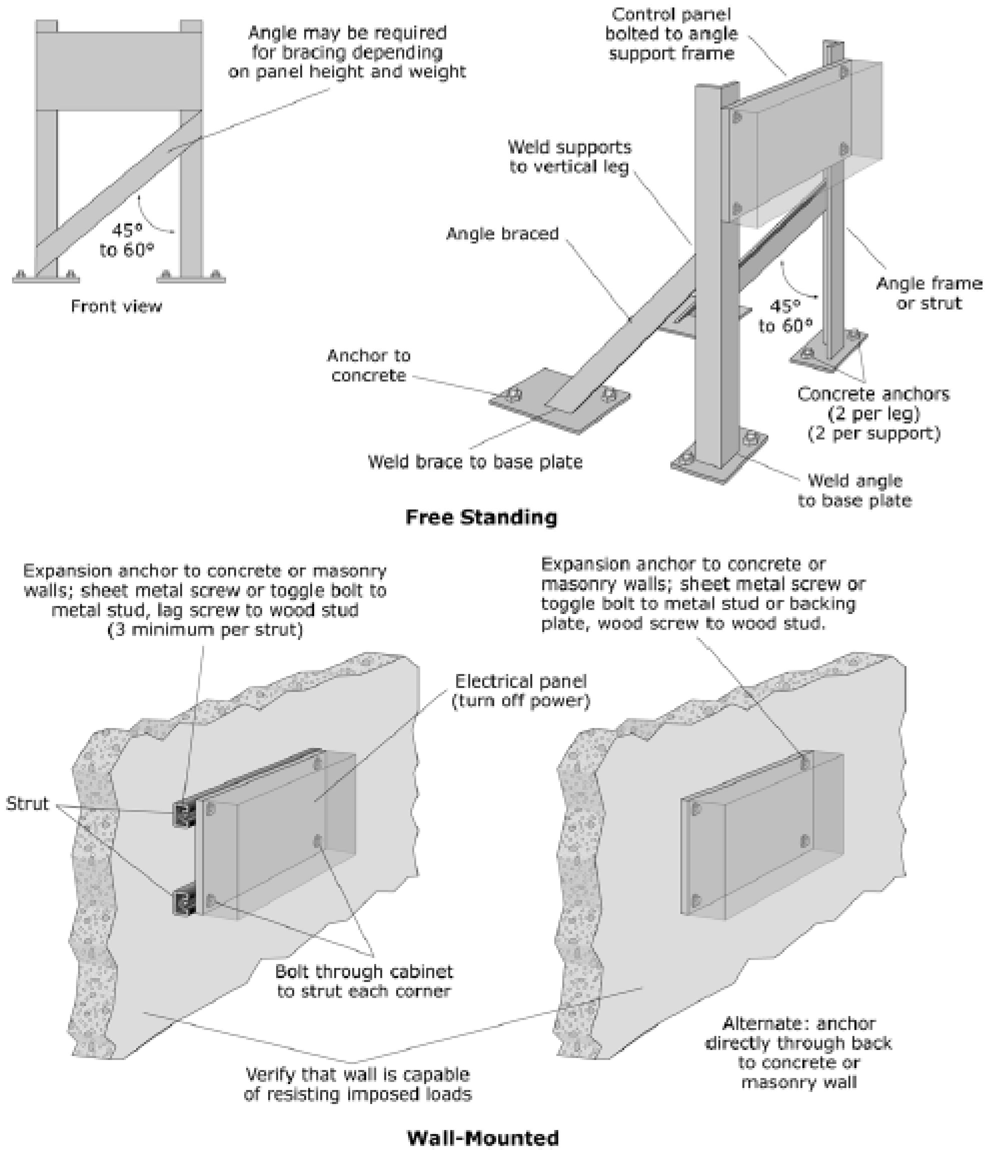


Figure G-39. Freestanding and Wall-mounted Electrical Control Panels, Motor Controls Centers, or Switchgear.

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

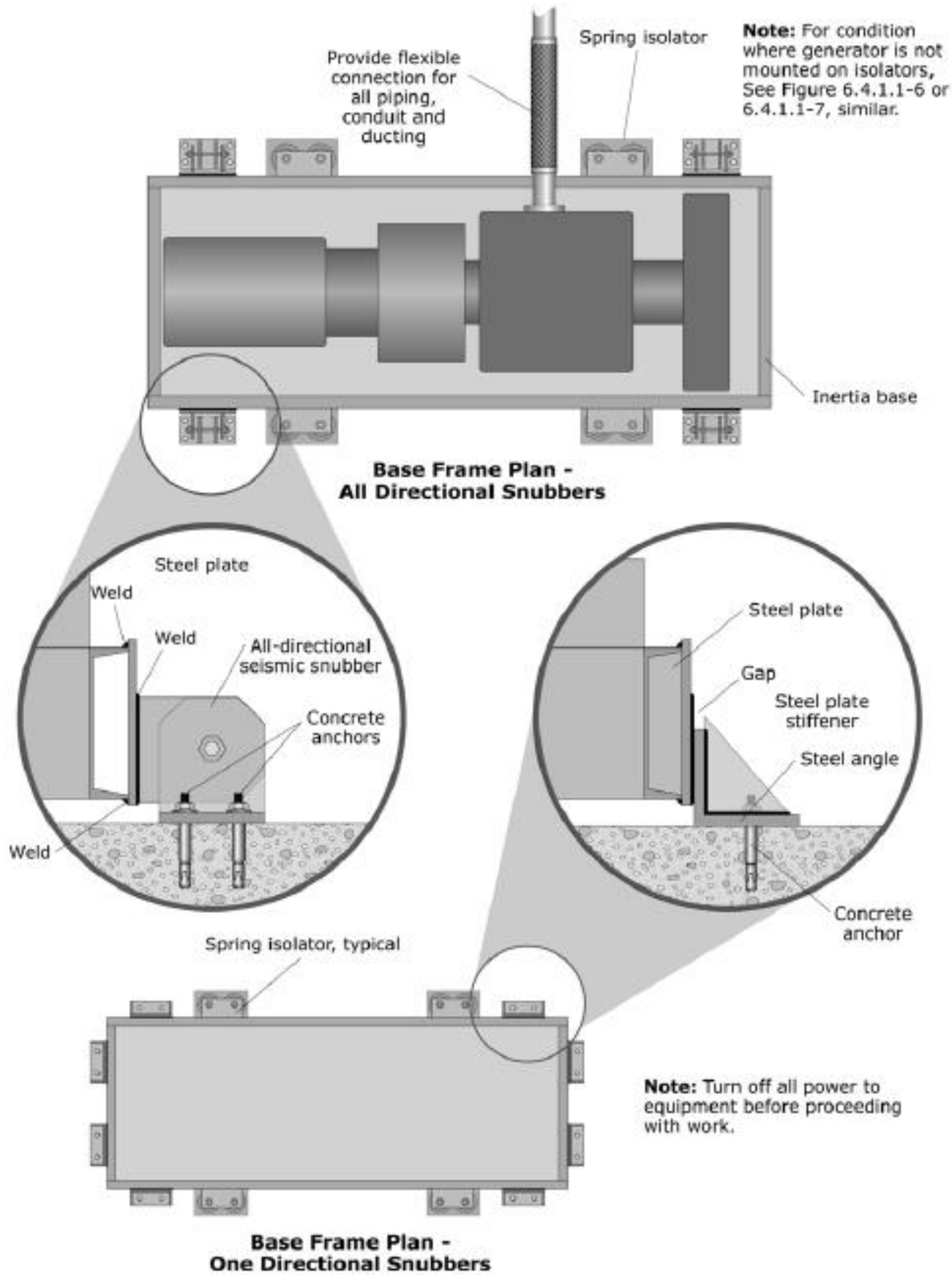


Figure G-40. Emergency Generator.
(FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

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