WASHINGTON STATE DEPT OF NATURAL RESOURCES

WASHINGTON GEOLOGICAL SURVEY
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September 28, 2018

The Honorable Jay Inslee
Governor of the State of Washington
PO Box 40002, Olympia, WA 98504

The Honorable Christine Rolfes and the Senate Ways and Means Committee
P.O. Box 40466, Olympia, WA 98504

The Honorable Steve Tharinger and the House Capital Budget Committee
P.O. Box 40600, Olympia, WA 98504

Subject: Capital Budget 2017-2019 Biennium Sec. 3132 Public School Seismic Safety Assessment Progress Report

Dear Governor Inslee and members of the Senate Ways and Means and the House Capital Budget Committees,

We are writing to provide a preliminary report on the progress of the statewide school seismic safety needs assessment, as appropriated in the 2017–2019 capital budget (Sec. 3062), led by the Washington State Department of Natural Resources' (DNR). This appropriation directs DNR to work with the Office of Superintendent of Public Instruction (OSPI), the Office of Emergency Management (EMD), and the State Board of Education to assess the current level of seismic safety of Washington State's public K-12 schools.

The capital budget appropriation is for $1,200,000; the legislative directive (Appendix A) states that these funds shall be used to assess urban and rural schools, of varying capacity, in high seismic risk areas, and to assess fire stations within one mile of schools. The directive states that there shall be an on-site geologic assessment to determine the seismic site class of soils, a structural and nonstructural seismic evaluation of school buildings, and a determination of costs to seismically upgrade school buildings to life-safety standards and to seismically upgrade fire stations to immediate occupancy standards. These assessments will be submitted to OSPI to use in their Inventory and Condition of Schools (ICOS) database. Additionally, DNR and OSPI must provide technical assistance to schools to incorporate seismic building survey information into their school safety plans.

The directive put forth in the capital budget appropriation is an appropriate first-step in improving the seismic safety of Washington state schools. Seismic safety is a necessary goal for Washington State schools, however, it will take much more funding to accomplish this goal than was allocated this biennium. DNR and OSPI are requesting additional funding in the upcoming biennium to continue this effort. To best determine how to accomplish as much as possible with limited time and funding allotted this biennium DNR, OSPI, EMD, and the State Board of Education, along with help from the United States Geological Survey (USGS), and the University of Washington Civil Engineering Department, developed a committee—the School Seismic Safety Steering Committee (SSSSC)—and hired an engineering firm with experience in the design of K-12 schools and state-wide resources, to help with this project and to decide which schools to assess. Reid Middleton, Inc. was selected as the

best qualified engineering firm and are now under contract with DNR to conduct the structural engineering assessments and seismic upgrade design concepts and cost estimates.

Based on earlier studies (Washington State School Seismic Safety Pilot Project, 2011) and (WA EMD Aberdeen and Walla Wall Schools Districts Seismic Evaluation Report, 2012), the SSSSC determined that the allocated funding allows for assessment of approximately 220 individual school buildings (not campuses), five fire stations within 1 mile of schools, and seismic upgrade design concepts and cost estimates for 15 school buildings. The project objective is to evaluate a representative sample of school buildings across the state so that the results from the geologic and seismic evaluations and costs to upgrade can be extrapolated to similar school buildings throughout Washington state to determine what it may cost to complete these seismic assessments statewide. Additionally, we hope to determine what it will take to get all Washington state public school buildings seismically upgraded to meet current seismic safety standards.

This preliminary report goes over the progress made to date, next steps for completing this project by the end of the biennium, and upcoming legislative asks to continue this effort to make Washington state schools safer during earthquakes.

> *"Across Washington State, about 386,000 students—or one in every three enrolled—live in earthquake prone areas and attend schools built before seismic construction standards were adopted statewide. In addition, about 31,000 students in Washington attend schools that are in tsunami inundation zones" (Doughton and Gilbert, 2016).*

Project Activities

Funding allowed for a preliminary seismic screening evaluation at 220 schools buildings across the state and to perform concept-level seismic upgrade designs (with estimated construction costs) for 15 sample school buildings and five fire stations within one mile of a school (Fig. 1). Geologic site assessments were performed at each of the selected school campuses. A complete list of schools assessed in this project can be found in Appendix B.

Due to funding limitations, the 220 school buildings being seismically evaluated in this study comprise a very small sample size of the state's 4,444 individual school buildings (only ~0.3% of school buildings will receive the concept-level seismic upgrades design and cost estimates and ~5% will receive a the preliminary seismic screening evaluation). Consequently, it should be recognized that the extrapolations and resulting conclusions and cost estimates will have a level of accuracy limited by the project's level of detail and relatively small sample size.

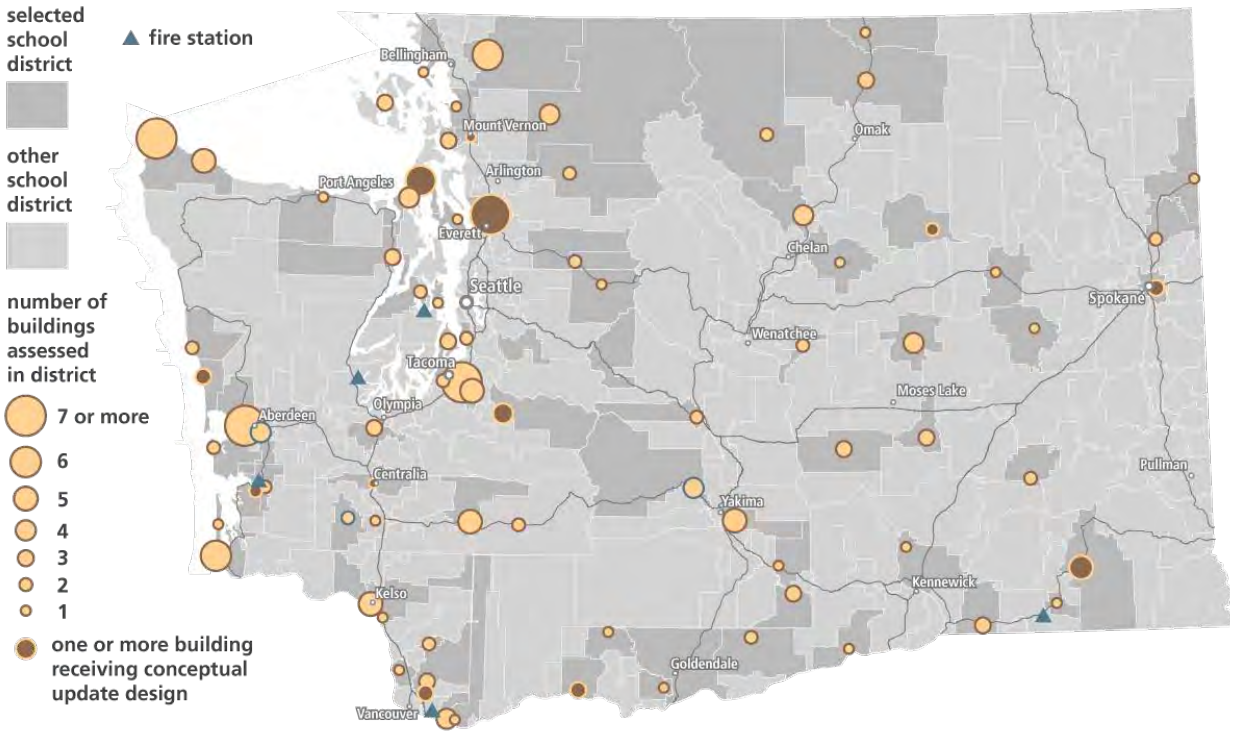


Figure 1. Map showing the location of the 220 school buildings selected for this project, highlighting the 15 schools receiving conceptual update, designs and five fire stations assessed for this project.

A preliminary seismic screening evaluation is defined as:

a) An on-site assessment, under the supervision of a licensed geologist, of the seismic site class of the soils per National Earthquake Reduction Program (NEHRP) provisions at the facilities to determine the level of earthquake shaking expected at the site;
b) An on-site seismic investigation of the school buildings to screen the building for potential seismic hazards. Field investigations were performed by licensed Structural Engineers using standardized building code seismic screening and calculation methods and structural plans (where available). The structural engineers evaluated building type, age, configuration, condition, and related structural and nonstructural features to determine seismic hazards and expected level of seismic performance;
c) Creation of a seismic screening report for each building to document the findings from each school building. These reports will be distributed to each school district to facilitate further seismic improvement work;
d) Input of this seismic screening information into the OPSI ICOS database;
e) Development of a statewide seismic screening database to analyze the results from this screening study to evaluate current Washington state schools seismic safety.

A concept-level seismic upgrade design includes the preliminary seismic screening evaluation plus the following:

f) Additional seismic screening and structural calculations to determine a cost-effective approach to seismically upgrade the school building;

g) Design of concept-level seismic upgrades and a review of architectural impacts of the proposed seismic upgrades to life-safety performance levels for school buildings and immediate occupancy performance levels for assembly occupancy school buildings (gymnasiums) and fire stations;
h) Preparation of preliminary concept-level design seismic upgrade cost estimates to better understand the costs to upgrade these seismically deficient buildings;
i) Preparation of a concept-level seismic upgrades design report for each facility to be utilized to document the results and communicate the upgrade designs to each school district and fire district;
j) Input of this concept-level seismic upgrades design approaches and costs to both the OPSI ICOS database and the statewide seismic screening database for data analyses and extrapolation evaluate current Washington state schools seismic safety.

The engineering concept-level seismic upgrade designs provide: (1) more detailed information about the structural and nonstructural seismic deficiencies a building possesses, (2) design solutions for how to mitigate these seismic deficiencies, and (3) estimated construction costs to improve the seismic performance of the buildings to meet current building code levels. This information will then be extrapolated to the statewide school buildings database to better understand the scope of seismic risk for Washington state schools and related costs to improve school seismic safety.

At each school campus a team of DNR geology personnel conducted a seismic survey using the Multi-channel Analysis of Surface Waves (MASW) and Microtremor Array Measurements (MAM) methods. These methods were employed to determine the National Earthquake Hazard Reduction program (NEHRP) categorized site class at each school. Site class (Table 1) is a simplified method for characterizing the ground-motion amplifying effects of soft soils during an earthquake by evaluating the relation of average shear-wave velocity in the upper 30 m of the soil–rock column to the amplification of shaking at ground surface (Vs30 measurement). Shear waves are the earthquake waves that create the strongest horizontal shaking and are the most damaging to buildings and structures. Site class provides some measure of the potential for strong shaking in a particular area during an earthquake.

Table 1: NEHRP site class categories. Softer soils typically increase shaking amplification.

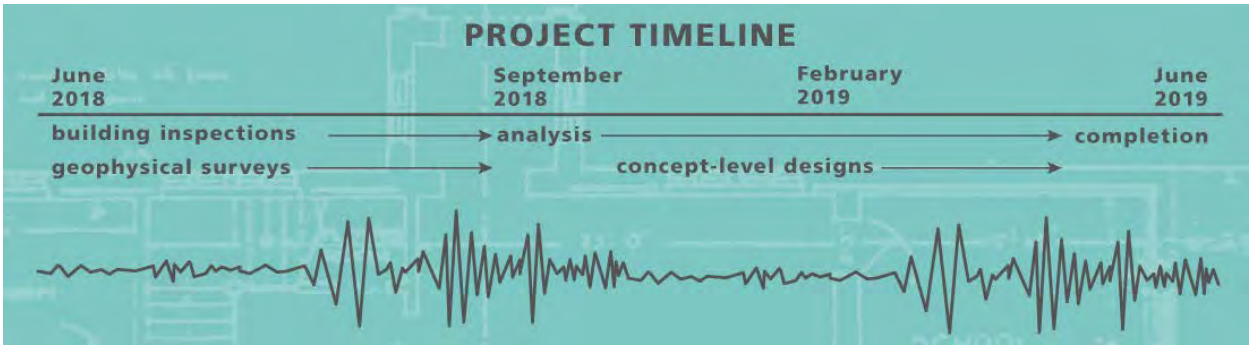
NEHRP Site Class	Description	Vs30 measurement (m/s)
A	Hard rock	>1,500
B	Rock	760–1,500
C	Soft rock/ very dense soil	360–760
D	Stiff soil	180–360
E	Soft soil	<180
F	Soils requiring site-specific study	--

As the project progresses, the data from the seismic screening inventory of the 220 buildings and the concept-level seismic upgrade designs and costs for the 15 school buildings and 5 fire stations will be analyzed in a relational database to extrapolate findings from this project to the state's remaining school buildings that have not been evaluated at this time. This will provide a better

understanding of the seismic vulnerabilities of the entire inventory of our state's school buildings, and will allow for costs to seismically upgrade the entire inventory of school buildings to be estimated.

Project Timeline

The graphic below illustrates the major project milestones.



Accomplishments to Date

This project is on schedule and on budget. Here is a simplified list of progress made to date:

- assembled a steering committee to select the best qualified engineering firm for this project and help guide school site selection;
- hired a structural engineering firm to conduct structural and nonstructural seismic screening evaluations;
- hired geologists to conduct site class investigations (soil properties that correspond to expected ground shaking during an earthquake);
- selected schools for this statewide seismic assessment that provides a broad geographic representation of urban and rural schools;
- performed outreach with each school district in coordination with OSPI to inform them about the statewide seismic evaluation project and to request access to their campuses;
- conducted 95% of the geologic assessment and seismic screening evaluation field of the 220 school buildings work during the 2018 summer months while the students and staff were away from the schools;
- input school seismic screening data into the OPSI Earthquake Performance Assessment Tool (EPAT) database;
- started compiling and processing data for the on-site geologic assessment of site class and the engineering surveys;
- completed a draft concept-level upgrades design and report for Lincoln Elementary School in Mount Vernon to illustrate what a finished concept-level seismic upgrades design report for each school building will include (Appendix C)

School Selection

For this project, school buildings were selected based on the seismic hazard, year built, building construction type, geographic location, and student capacity (details below). A complete list of selected school buildings can be found in Appendix B and are shown on Figure 1.

a. Seismic Hazard: Schools in high, medium, and low seismic hazard areas (based on contours of peak ground acceleration (PGA) from the 2014 USGS National Seismic Hazard map long-term model, PGA 2% in 50 years), were selected with a greater emphasis on higher hazard areas and mapped tsunami inundation zones (Fig. 2). We prioritized campuses that were proximal to active faults.
b. Building Type: We selected schools representing all building types (wood frame, concrete, steel, masonry, unreinforced masonry, etc.). Building type was from the ICOS database and later refined by Reid Middleton. Only educational facilities and permanent structures were assessed in this study; portables and auxiliary buildings (greenhouses, bus depots, etc.) were excluded.
c. Year Built*:* Building age is one of the most significant factors to quickly determine the seismic vulnerability of a structure. As we learn more about different faults, the understanding of the seismic hazard for the state continues to evolve. Earthquakes and the damage that they cause also provide relevant lessons for building officials and design professionals resulting in more stringent seismic codes over time. For this study we selected a relatively uniform sample of different school buildings built in different decades to try to better understand the effects of more detailed seismic hazard information and more stringent seismic codes on school buildings.

   88% of permanent public K-12 WA school buildings were constructed prior to 2005, which means they do not incorporate expected shaking from a Cascadia subduction zone or Seattle Fault earthquake into their building design. School buildings built in accordance with the current building code (2015 International Building Code (IBC) adopted in WA July 1, 2016) are designed to provide life-safety performance for occupants in the building. This means that the buildings are designed to protect the occupants while maintaining safe egress (exits), but these buildings are not necessarily going to be useable after the earthquake (immediate occupancy). Furthermore, most buildings designed using the 1997 Uniform Building Code (or later building code versions) are considered "benchmark" buildings in accordance with ASCE 41. Benchmark buildings are defined by ASCE 41 as buildings that were constructed to a building code with "modern" seismic provisions. Therefore, buildings constructed before 1998 were the general focus of this study as these buildings are more likely at a higher less seismic risk than buildings constructed after 1998.
d. Geography: School buildings were selected from a wide geographic region across the state to provide representation of schools in rural and urban districts (Fig. 1). School districts in large metropolitan areas such as Seattle and Bellevue were not part of this initial study to ensure that a statewide sample provided a broad representation of state school districts and because the Seattle school district has done a fantastic job seismically upgrading many of their schools already.
e. Capacity and Enrollment: We are looking at buildings of varying capacity and schools with all levels of enrollment with an emphasis on school buildings with larger enrollments.
f. Grade: Only public K-12 school buildings that are education facilities are included in this initial study.

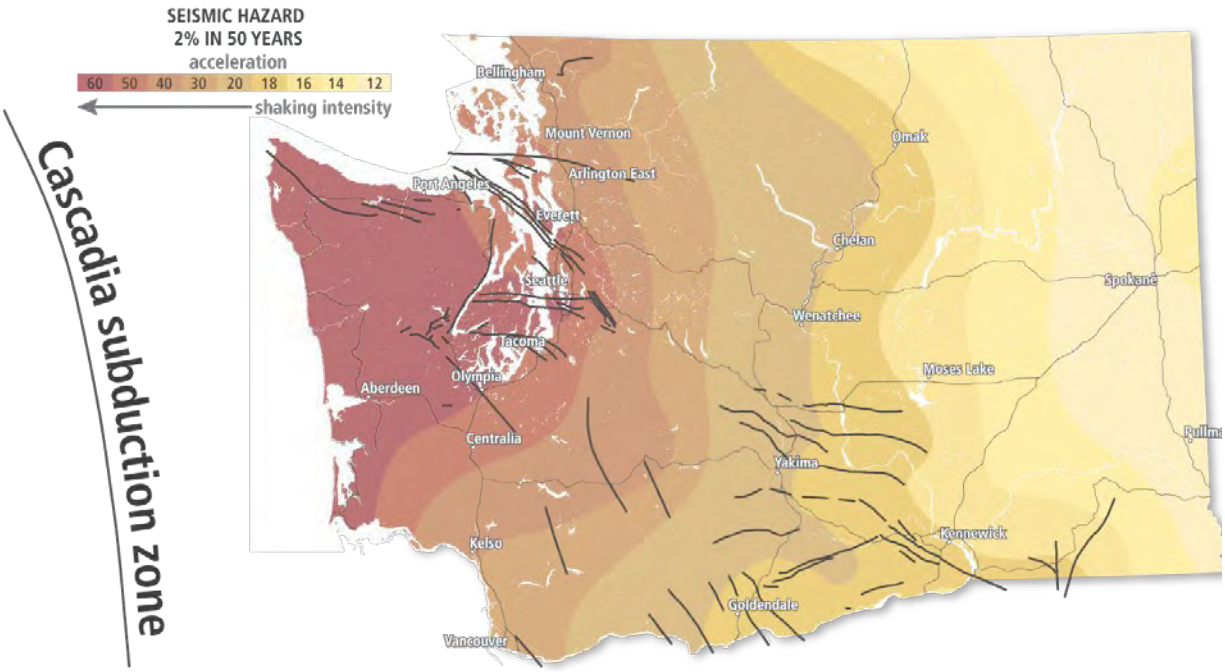


Figure 2. Map of the seismic hazard, expressed as contours of peak ground acceleration as a fraction of standard gravity, in Washington state. These values are from the USGS two-percent probability of exceedance in 50 years map of peak ground acceleration which is a proxy for seismic hazard (Peterson and others, 2015). Warmer colors indicate higher hazard areas. Major active faults are shown as black lines.

Selection of 15 Schools for More Comprehensive Analysis

We selected a small representative sample of 15 school buildings to receive a more comprehensive seismic evaluation, concept-level seismic upgrade design, and cost estimate (Table 2). We focused on schools that are in high seismic risk areas, and a couple that are in moderate to lower risk areas so that we can determine the difference in cost to seismically upgrade school buildings across the state. Additionally, we focused on main school buildings and gymnasiums because large public facilities, such as gyms, are typically utilized as community emergency shelters. We also selected school buildings of varying age, type, and construction materials.

Table 2: Schools receiving the more comprehensive seismic evaluation and concept-level seismic upgrades designs and cost estimates.

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Battle Ground	Prairie High School	1,577	600 Building	1979	life safety
Boisfort	Boisfort Elementary	99	Gymnasium Building	1963	immediate occupancy
Carbonado	Carbonado Historical School 19	179	B—Community Gym	1936	immediate occupancy
Centralia	Edison Elementary School	345	Main Building	1918	life safety

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Cosmopolis	Cosmopolis Elementary School	164	Main Building	1960	life safety
Coupeville	Coupeville High School	321	Gymnasium	1981	life safety
Dayton	Dayton High School	139	Gymnasium	1966	immediate occupancy
Grand Coulee Dam	Lake Roosevelt K-12	750	CTE Building	1955	life safety
Marysville	Totem Middle School	556	Main Building	1966	life safety
Mount Vernon	Lincoln Elementary School	373	Main Building	1938	life safety
Naches Valley	Naches Valley High School	453	Main Building	1979	life safety
North Beach	Pacific Beach Elementary School	150	Gym/Lunchroom	1956	immediate occupancy
South Bend	South Bend Jr/Sr High School	225	Koplitz Field House	1950	immediate occupancy
Spokane	Adams Elementary School	334	Main Building	1910	life safety
White Salmon Valley	Columbia High School	387	C Court—Gym	1970	life safety

Selection of Five Fire Stations

One of the directives in the budget allotment was to assess fire stations within a one-mile radius of schools. Due to limited funding we were only able to assess five fire stations to receive a field investigation and a seismic screening evaluation to determine the level of effort and costs for similar evaluations statewide in order to inform policy and future funding requirements (Table 3).

Table 3: Fire stations within one-mile radius of school building that are receiving the more comprehensive seismic evaluation and concept-level seismic upgrade designs and cost estimates.

Fire Station Name	Address	Town
Fire Station	212 Commercial St.	Raymond
Fire Station No. 9	17408 SE 15th St.	Vancouver
Fire Station	911 Park Ave.	Bremerton
County Fire District No. 4	2251 S Howard St.	Walla Walla
Fire Station	122 W Franklin St.	Shelton

Next Steps

We have made excellent progress on this project and are on track for timely completion. The next steps are:

a. *Process geological data to determine site class at each school site.*
b. *Deliver site class to engineers and enter into ICOS.* Once subsurface conditions for the campus are evaluated and the measured Vs30 is deemed both accurate and representative of the school grounds, the site class is assigned to each school and entered into the ICOS database with ICOS facility number. A report discussing the results of the on-site geological assessment for each campus surveyed and site class evaluated will be produced and submitted for the appendix of the final report. In some cases, multiple schools occupy a single campus, and will be assigned the same site class from the on-site geologic assessment of their shared campus.
c. *Complete ASCE 41-17 checklists for all buildings.* This work will be concluded by the end of November 2018.
d. *Complete more comprehensive concept-level seismic upgrades design and cost estimates for 15 school buildings and 5 fire stations.* This work is ongoing and will be concluded by the end of December 2018.

    Refer to Appendix C for an example concept-level seismic upgrade case study for Lincoln Elementary School in Mount Vernon, Washington. This example shows what will be included in a concept-level seismic upgrade design and cost estimate that our project is creating and furnishing to OSPI and the school districts.

e. *Enter engineering data into ICOS/EPAT*. We are starting to test the importing of the data gathered from the field investigation work into the ICOS database. This work is ongoing and will be completed by the end of the project.
f. *Draft summary seismic reports and distribute them to school districts and OSPI.* Summary preliminary seismic screening reports are being generated for each school building and will be included in the comprehensive project reports.
g. *Extrapolate study results across the entire state to give some idea of how much this may cost to assess each school building and what it may cost to retrofit those in need.*
h. *Write final report containing all data for each building.* After all geologic and engineering data are collected, processed, documented, entered into ICOS, and submitted to each district and school, a final report will be written by DNR and Reid Middleton, Inc. This report will summarize the methods, the results, and the implications, and it will be delivered to the governor, the appropriate committees of legislature, school districts, and OSPI.

Upcoming Legislative Asks

1. DNR is asking for $5,000,000 in the upcoming 2019–2021 Capital Budget to continue school seismic safety assessments as directed in the 2017-2019 capital budget. We propose to use this funding to conduct comprehensive seismic assessments on approximately 400 school buildings in high-risk areas across Washington State. DNR will work with OSPI to prioritize buildings that apply for study and survey grants and are flagged as high risk. A comprehensive assessment provides geologic and engineering assessments, seismic upgrade design concept, and an estimated cost to upgrade the building which will allow school districts to make informed decisions on how to provide seismically safe learning environments for their children and staff.

2. The Office of Superintendent of Public Instruction (OSPI) is requesting funding in the 2019–2021 Capital Budget to increase the amount provided to school districts for study and survey grants. This increase in funding will provide OSPI additional information regarding the risk of a natural hazards to each school building being assessed in the study and survey requirement process. Data collected for each building will be entered into OSPI's Information and Condition of Schools (ICOS) Pre-Disaster Mitigation Module to determine individual building risk of natural hazards such as: earthquakes, tsunamis, volcanic activities, floods, wildfires, and landslides.

   This proposal would enhance existing study and survey grant funding to allow each school district who receives a study and survey grant to conduct a Rapid Visual Screening (RVS) for each permanent school building used for instruction in a school district. A RVS is a procedure developed by the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA). The RVS helps to quickly identify, inventory, and score buildings according to their risk of collapse by a major earthquake, and the information collected from each RVS will be entered into ICOS to help determine a building's seismic risk.

   The estimated cost per building to complete a RVS is $500. Based on the number of historical study and survey grants, the collective estimated cost to provide this additional funding for study & survey grants is $1.5 million for the 2019–2021 biennium.

Together, these two capital budget requests from OSPI and DNR will provide school districts and the legislature with valuable information about the condition of permanent school buildings and will also provide recommendations for seismic upgrades that could help to safeguard children and faculty.

Thank you for your continuing support and for funding a project that increases the safety of Washington's Schools.

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Appendices:

A. *2017-2019 Capital budget directive (Sec. 3062)*
B. *Complete list of schools assessed*
C. *Case study: Lincoln Elementary School*
    1. *Geologic report*
    2. *Engineering report*

7 **Sec. 3062.** 2018 c 2 s 3132 (uncodified) is amended to read as
8 follows:
9 **FOR THE DEPARTMENT OF NATURAL RESOURCES**
10 Public School Seismic Safety Assessment (91000091)

11 The appropriation in this section is subject to the following
12 conditions and limitations:
13 (1) The department, in consultation with the office of emergency
14 management, the office of the superintendent of public instruction,
15 and the state board of education, shall develop a prioritized seismic
16 risk assessment that includes seismic safety surveys of public
17 facilities that are subject to high seismic risk as a consequence of
18 high earthquake hazard and soils that amplify that hazard. The
19 seismic safety surveys must be conducted for the following types of
20 public facilities in the following order:
21 (a) A minimum of twenty-five public school facilities that have a
22 capacity of two hundred fifty or more persons and are routinely used
23 for ((~~student activities by~~)) the instruction of students in
24 kindergarten through twelfth grade ((~~public schools~~)). The survey
25 must be a representative sample of urban and rural school districts
26 located in different geographical areas of the state; ((~~and~~))
27 (b) Public school facilities with capacity of fewer than two
28 hundred fifty persons; and
29 (c) Fire stations located within a one-mile radius of a facility
30 described in ((~~subsection (1)~~))(a) of this subsection.
31 (2) The department must coordinate survey efforts made under
32 subsection (1)(a) and (b) of this section whenever possible.
33 (3) The initial phase of the prioritized seismic needs assessment
34 of the facilities specified in subsection((~~s~~)) (1)(a) and (b) shall
35 include, but is not limited to, the following:
36 (a) An on-site assessment, under the supervision of licensed
37 geologists, of the seismic site class of the soils at the facilities;

(b) An on-site inspection of the facility buildings, including structural systems using structural plans where available, condition, maintenance, and nonstructural seismic hazards following standardized methods by licensed structural engineers;

(c) An estimate of costs to retrofit facilities specified in subsection (1)(a) of this section to life safety standards as defined by the American society of civil engineers; and

(d) An estimate of costs to retrofit facilities specified in subsection (1)(b) of this section to immediate occupancy standards as defined by the American society of civil engineers.

((~~(3)~~)) (4) The department ((~~shall develop geographic information system databases of survey data and~~)) must collect and submit survey data to the superintendent of public instruction in a format compatible with the inventory and condition of schools database. The department must enter into an agreement with the superintendent of public instruction to make any necessary modifications to the inventory and condition of schools database to receive and report the survey data.

(5) The department must share that data with the governor((~~, the superintendent of public instruction,~~)) and the appropriate legislative committees.

((~~(4)~~)) (6) The department and the office of the superintendent of public instruction must provide technical assistance to the school facilities sampled to incorporate survey information into their school safety plans.

(7) A preliminary report on the progress of the statewide seismic needs assessment specified in this section shall be submitted to the ((~~office of financial management and the~~)) appropriate committees of the legislature by October 1, 2018. The final report and statewide seismic needs assessment shall be submitted to the office of financial management and the appropriate committees of the legislature by June 30, 2019.

Appropriation:

State Building Construction Account—State. $1,200,000

Prior Biennia (Expenditures). $0

Future Biennia (Projected Costs). $0

TOTAL. $1,200,000

Appendix B: Complete List of Schools Assessed

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Battle Ground	Maple Grove K-8	484	Gym	1990	
			Main Building	1990	
	Praire High School	1,577	400 Building	1995	
			500 Building	1979	
			600 Building	1979	life safety
	River Homelink	966	Main Building	1980	
Bickleton	Bickleton Elementary and High School	87	Bldg B—Vocational/Transportation	1961	
			Main Building	2010	
Boistfort	Boistfort Elementary	99	Gymnasium Building	1963	immediate occupancy
			Main Building	1936	
Burlington-Edison	Edison Elementary School	449	Original Building	1995	
Camas	Lacamas Heights Elementary School	353	100 Pod	1962	
			Multipurpose	1962	
	Liberty Middle School	763	Main Building	1958	
			Music Building	1970	
	Skyridge Middle School	936	Main Building	1995	
Cape Flattery	Clallam Bay High and Elementary School	115	Big Gym	1962	
			Elementary Building	1962	
			Elementary Gym	1980	
			High School Building	1972	
			Shop and Art Building	1980	
	Neah Bay Elementary School	166	Elementary School	1961	
	Neah Bay Junior/ Senior High School	185	High School Classroom Building	1976	
			High School Gym	1972	
			High School Shop Building	1972	
Carbonado	Carbonado Historical School 19	179	1st and 2nd Grade and Special Education Building	1968	
			A—Main Building	1929	
			B—Community Gym	1936	immediate occupancy
			Computer Lab and Library	1989	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Centerville	Centerville Elementary School	82	Main Building	1919	
Central Kitsap	Ridgetop Junior High School	438	Main Building	1986	
	Silver Ridge Elementary School	412	Main Building	1990	
Centralia	Edison Elementary School	345	Main Building	1918	life safety
Concrete	Concrete High School	271	Main Building	1951	
			Tech Building	1952	
	Concrete K-6 School	254	Gym	1981	
			Main Building	1981	
Cosmopolis	Cosmopolis Elementary School	164	Auditorium Building	1960	
			Gymnasium Building	1969	
			Main Building	1960	life safety
			Multipurpose Building	1960	
Coupeville	Coupeville Elementary School	413	Cedar Pod	1979	
			Main	1974	
			Multipurpose	1979	
	Coupeville High School	321	Annex	1978	
			Gymnasium	1981	life safety
	Coupeville Middle School	222	Middle and High School Building	1992	
Creston	Creston Junior Senior High School	57	Creston K-12 School Building	1953	
Darrington	Darrington Elementary School	311	Main Elementary School	1990	
	Darrington Senior High School	134	High School	1935	
			Woodshop	1960	
Dayton	Dayton High School	139	Ag Shop	1954	
			Gymnasium	1966	immediate occupancy
			High School Building	1923	
			Wood Shop	1966	
	Dayton K-8 School	245	Elementary and Middle School Building	1966	
Dixie	Dixie Elementary School	30	Main Building	1921	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
East Valley (Yakima)	East Valley Central Middle School	686	6th Grade Building	1980	
			7th–8th Grade Building	2010	
			Computer Lab Building	1996	
			Gymnasium Building	1950	
	East Valley Elementary School	550	Main Building	1996	
Evaline	Evaline Elementary School	50	Main Building	1926	
Ferndale	Beach Elementary	30	Main Building	1919	
Fife	Fife High School	837	Building IV 400 Library	1950	
			Building IX 900 Science	1970	
			Building V 500 Main	1950	
			Building VI 600 Gyms	1956	
			Building VII 700 Cafeteria	1963	
			Building VIII 800 Shop	1963	
Glenwood	Glenwood School	30	Main Building	1981	
Grand Coulee Dam	Lake Roosevelt K-12	750	CTE Building	1955	life safety
		750	Wood Shop	1974	
Green Mountain	Green Mountain School	158	Gymnasium	1950	
			Main Building	1932	
Harrington	Harrington Elementary & High School	87	Main Building	1936	
Highline	Woodside Site	27	Annex	1960	
			Main Building	1958	
Hoquiam	Hoquiam High School	491	A—Administration	1966	
			B—Science	1966	
			E—Library	1966	
			H—Gymnasium	1966	
	Lincoln Elementary School	317	Administrative and Library Building	1968	
			East Wing	1968	
			Multipurpose Building	1968	
			West Wing	1968	
Index	Index Elementary School	44	Enclosed Covered Play	1997	
			Main Building	1954	
Kelso	Carrolls Elementary School	148	Main Building	1948	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
La Conner	La Conner High School	219	High School Auditorium	1921	
			High School Main Building	1974	
	La Conner Middle School (form. Elem.)	133	Old Auditorium/Cafeteria Building	1921	
Longview	R. A. Long High School	928	Gym	1927	
			Main Building	1927	
			RA Long Annex	1963	
			Science Wing	1935	
			Shop Building	1942	
Mabton	Mabton Jr/Sr High School	387	Greenhouse	1900	
			Main Building	1950	
			Shop/Ag Building	1900	
Mansfield	Mansfield Elem and High School	106	Main Building	1983	
Marysville	Liberty Elementary School	520	Main Building	1951	
	Marysville Middle School	800	Building B	1960	
			Building C—Shop Classrooms	1960	
			Main Building	1960	
	Totem Middle School	556	Cafeteria Gym Building	1958	
			Main Building	1966	life safety
			School House Cafe	1955	
			Science Building	1962	
Methow Valley	Liberty Bell Junior Senior High School	259	Main Building	1994	
	Methow Valley Elementary School	341	Main Building	1963	
Morton	Morton Elementary School	176	Gymnasium	1985	
			Main Building	1930	
	Morton Junior Senior High School	152	Gymnasium	1957	
			Main Building	1957	
			Shop	1957	
Mount Baker	Mount Baker Junior High School	256	200 Building—JHS	1992	
			Pro-Rate Portion of Commons—Building 100	1990	
		579	300 North	1980	
			300 South	1980	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Mount Baker	Mount Baker Junior High School		700 Building	1992	
			800 Building (Former Deming Elem.)	1970	
			Field House	1968	
Mount Vernon	Lincoln Elementary School	373	Main Building	1938	life safety
Naches Valley	Naches Valley High School	453	Gym Building		
			Main Building	1979	life safety
			Vocational Building	1979	
	Naches Valley Intermediate School	184	Main Building	1952	
	Naches Valley Middle School	407	Main Building	1994	
Newport	Newport High School	354	Main Building	1983	
North Beach	Pacific Beach Elementary School	150	Gym/Lunchroom	1956	immediate occupancy
			Main Building	1956	
			Quad Building	1970	
Ocean Beach	Ilwaco (Hilltop) Middle School	316	Auditorium	1936	
			Main Building	1932	
	Ilwaco High School	286	Ilwaco High School	1971	
			Stadium Complex	1976	
	Long Beach Elementary School	243	Main Building	1964	
	Ocean Park Elementary School	166	Main Building	2005	
Ocosta	Ocosta Elementary School	320	Primary Addition	1986	
	Ocosta Junior Senior High School	285	Junior Senior High	1986	
Oroville	Oroville Elementary School	323	Main Building	1954	
Palisades	Palisades Elementary School	32	Grange Hall	1930	
			Main Building	1923	
Pasco	Edwin Markham Elementary School	371	Main Building	1962	
Pateros	Pateros K-12 School	138	Main Building	1948	
			Metal Shop	1962	
			Music Building	1958	
			Wood Shop	1995	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Paterson	Paterson Elementary School	145	Main Building	1968	
Port Angeles	Roosevelt Elementary School	502	Main Building	1978	
Port Townsend	Port Townsend High School	366	Gym	1941	
			Main Building	1934	
			Math Science Annex	1928	
			Stuart Building	1952	
Puyallup	Maplewood Elementary School	434	Main Building	1934	
	Puyallup High School	1,752	Gymnasium and Swimming Pool Building	1958	
			Library Science Building	1962	
			Main Building	1927	
	Spinning Elementary School	318	East and West Classroom Wings		
			Main Building	1890	
Quilcene	Quilcene High And Elementary School	206	Elementary	1952	
			High School	1935	
			Middle School	1964	
Raymond	Raymond Elementary School	325	Raymond elementary	1955	
	Raymond Junior Senior High School	251	Main Building	1925	
Ridgefield	Union Ridge Elementary School	777	Main Building	1952	
Riverside	Chattaroy Elementary School	289	35 Wing Building	1934	
			Main Building	1987	
Royal	Red Rock Elementary School	596	Main Building	1992	
	Royal High School	492	A—Gymnasium	1965	
			B—Main Building	1965	
	Royal Middle School	248	Main Building	1991	
Shaw Island	Shaw Island School	16	Admin/RR Building	1952	
			Intermediate Classroom Building	1992	
			Primary Classroom Building	1902	
Skykomish	Skykomish School	16	Main Building	1938	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
South Bend	South Bend Jr/Sr High School	225	Koplitz Field House	1950	immediate occupancy
			Vocational Building	1954	
South Whidbey	South Whidbey Elementary School	510	Main Building	1988	
Spokane	Adams Elementary School	334	Gym and Cafeteria	1950	
			Main Building	1910	life safety
	Audubon Elementary School	427	Main Building	1980	
	Libby Center	278	Main Building	1928	
Sunnyside	Outlook Elementary School	646	Outlook Elementary Main Building	1932	
Tacoma	Fern Hill Elementary School	324	Main Building	1911	
	Oakland High School	203	Main Building	1911	
Taholah	Taholah School	187	Covered Court	1991	
			Main Building	1973	
Thorp	Thorp Elementary and Junior Senior High School	124	Brick Building	1930	
			Thorp Elem/Jr/Sr High School	1991	
Tonasket	Tonasket Elementary School	593	Greenhouse	1995	
			Tonasket Elementary	1995	
	Tonasket Middle-High School	569	High School/Middle School	1995	
Touchet	Touchet Elementary and High School	226	CTE Building	1960	
			Elementary - Main Building	1960	
			Secondary Facility	1975	
Tumwater	Black Lake Elementary School	504	Building A	1982	
			Building B	1982	
			Building C	1984	
Vashon Island	Vashon Island High School	596	Building D—Gymnasium	1961	
			Building F—Votech	1934	
			Building K—Annex	1957	
Warden	Warden K-12	326	Cafeteria	1900	
			Gymnasium	1900	
			Middle School/High School	1998	
Washougal	Hathaway Elementary School	422	Main Building	1935	

District Name	Facility Name	Enrollment	Building Name	Year Built	Concept Upgrade Performance Objective
Washtucna	Washtucna Elementary High School	46	Ag Shop/ Music Room	1956	
			Main Building	1956	
White Pass	White Pass Elementary School	231	Main Building	1964	
	White Pass Junior Senior High School	227	Main Building	2010	
White Salmon Valley	Columbia High School	387	C Court—Gym	1970	life safety
			Libray	1970	
			Metal /Wood Shop	1970	
	Hulan L. Whitson Elementary School	427	Main Building	1956	
	Wayne M. Henkle Middle School	195	Middle School	1960	
Wilson Creek	Wilson Creek K-12	92	Business Building/Home Ec.	1984	
			Gym/Commons	1997	
			Main—Gym & Classrooms	1932	
			Vo-Ag / Science Bldg	1989	

Appendix C: Draft Case Study—Lincoln Elementary School, Geologic and Engineering Assessments

SITE CLASS ASSESSMENT OF LINCOLN ELEMENTARY SCHOOL, MOUNT VERNON SCHOOL DISTRICT, SKAGIT COUNTY, WASHINGTON—2018 SCHOOL SEISMIC SAFETY PROJECT

by Corina Forson, Loyd T. West,
Travis Neilson, Megan Yakavonis,
and Dominic Martinez

Prepared for:
The Office of the Superintendent of Public Instruction

WASHINGTON
GEOLOGICAL SURVEY
School Seismic Safety Project
October 2018

DRAFT

WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

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Table 1. Site class per NEHRP 2

Site Class Assessment of Lincoln Elementary School, Mount Vernon School District, Skagit County, WA—2018 School Seismic Safety Project

by Corina Forson[1], Loyd T. West[1], and Travis Neilson[1], Megan Yakavonis[1], and Dominic Martinez[1]

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EXECUTIVE SUMMARY

This document describes the steps taken and results from the site class assessment for Lincoln Elementary School, located at 1005 South 11th St, Mount Vernon, WA for the purpose of determining the geologic site classification per NEHRP guidelines. As a result of these efforts, the average shear-wave velocity down to 30 m depth (Vs30) is estimated to be 462 m/sec. After an assessment of local geology and subsurface conditions, a site class of C is deemed appropriate for Lincoln Elementary School. The measured value is higher than the site class of D from the reconnaissance site class mapping of Palmer and others (2007). This site class assessment is not intended to supersede a geotechnical investigation by a licensed professional.

CAMPUS SITE DESCRIPTION

Lincoln Elementary School (ICOS facility number 12495) of the Mount Vernon school district, is located at 1005 South 11th St, Mount Vernon, WA on approximately 2.64 acres of developed land (parcel number P53615). The school campus is located within an urban area of Skagit County (sec 20, T34N R04 E) and bounded to the north by East Broad St, to the east by South 11th St, to the south by East Skagit St, and to the west by South 9th St. Buildings on campus consist of a three-story school building located on the eastern quarter portion, a playground on the southern-central portion, and several smaller portables on the north-central portion, with a grass field on the western third. Elevation ranges from approximately 52 m above sea level on the east side of campus to 43 m above sea level on the west side, reflecting a relatively flat but sloping topography from the east to west. The northwest portion of the site is elevated approximately 2 m above East Broad St and South 9th St, and the soils are held back by retaining walls.

GEOLOGIC OVERVIEW

The mapped geology at the school site are weakly consolidated to unconsolidated Pleistocene glacial deposits and Quaternary fluvial and lacustrine deposits which overlie Paleozoic to Mesozoic metasedimentary basement rocks (Fig. 1). Mapped surficial geologic units for the campus consist mostly of Pleistocene glacial and nonglacial deposits (unit Qe), with a relatively small portion of the campus mapped as Pleistocene continental glacial drift (unit Qvt) in the northwestern corner (Fig. 1; Dethier and

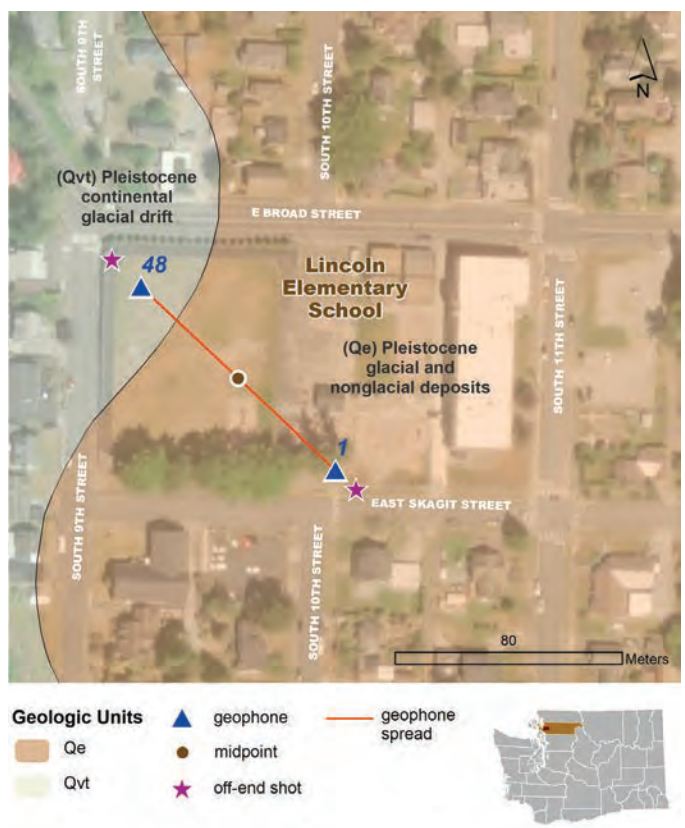

Figure 1. Aerial photo of the geophone spread with respect to Lincoln Elementary School facilities and geologic units. Pleistocene continental glacial drift (unit Qvt) and Pleistocene glacial and nonglacial deposits (unit Qe).

others, 981). A log from a water well[1] located approximately 0.6 km to the northeast of the campus, depicts predominantly silty sand and sand down to a depth of 10 ft (3 m) below existing grade (BEG), predominantly clay between 10 and 167 ft (3 and 51 m) BEG, and clay and gravel from 167 to 237 ft (51–72 m) BEG. Depth to bedrock at the campus is ~300 ft (~91 m)(Eungard, 2014). Depth of artificial fill is unknown. Previous reconnaissance-scale site class mapping (Palmer and others, 2007) for this area depicts site-class zones of C–D and D, with the C–D zone occupying the western two thirds of the campus and the D zone occupying the eastern third (Fig. 2). However, the entire footprint of the school building is located within the mapped site class D zone.

METHODS

A team of WGS personnel conducted a seismic survey using the Multi-channel Analysis of Surface Waves (MASW) method (Park and others, 1999; Xia and others, 1999; Miller and others, 2001) and Microtremor Array Measurements (MAM) method (Hayashi and others, 1999). MASW is a method first implemented in Park and others (1999) and uses an active source to generate surface waves whose frequency vs. velocity relationship is used to solve for velocity with depth. MAM is a passive, or ambient noise, method that leverages spatial autocorrelation (SPAC), as described in Aki (1957), to generate a frequency vs. velocity relationship which is again used to solve for velocity with depth. These methods were employed to determine the site

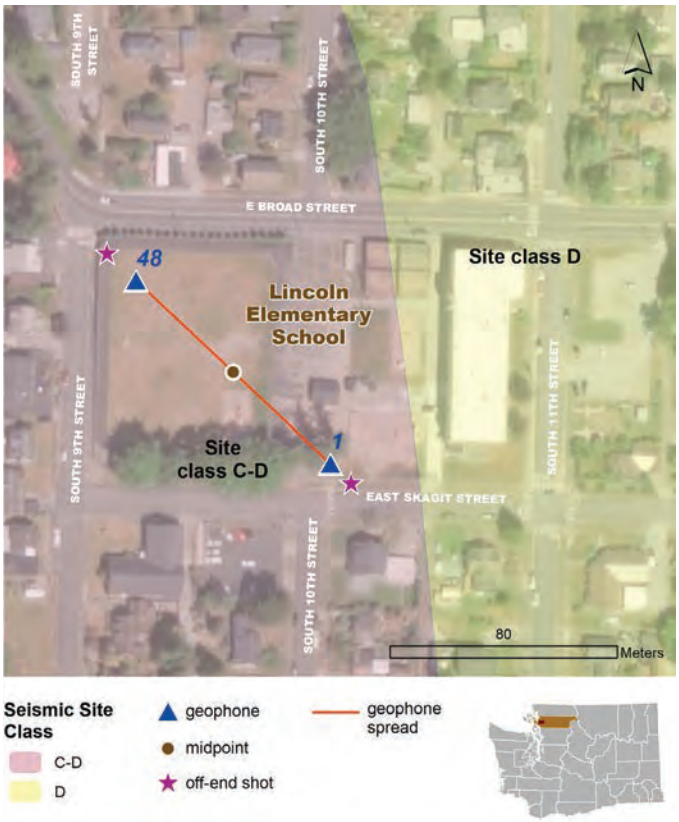

Figure 2. Aerial photo of Lincoln Elementary School campus showing geophone spread and site class mapping from Palmer and others (2007).

Figure 3. Photo of geophone spread deployment at Lincoln Elementary School, viewed to the southeast from Geophone 26 to Geophone 1.

Table 1. Site class per NEHRP. Softer soils typically amplify ground motions (ASCE, 2017)..

NEHRP Site Class	Description	Vs30 measurement (m/sec)
A	Hard rock	>1,500
B	Rock	760–1,500
C	Soft rock/very dense soil	360–760
D	Stiff soil	180–360
E	Soft soil	<180
F	Soils requiring site-specific study	--

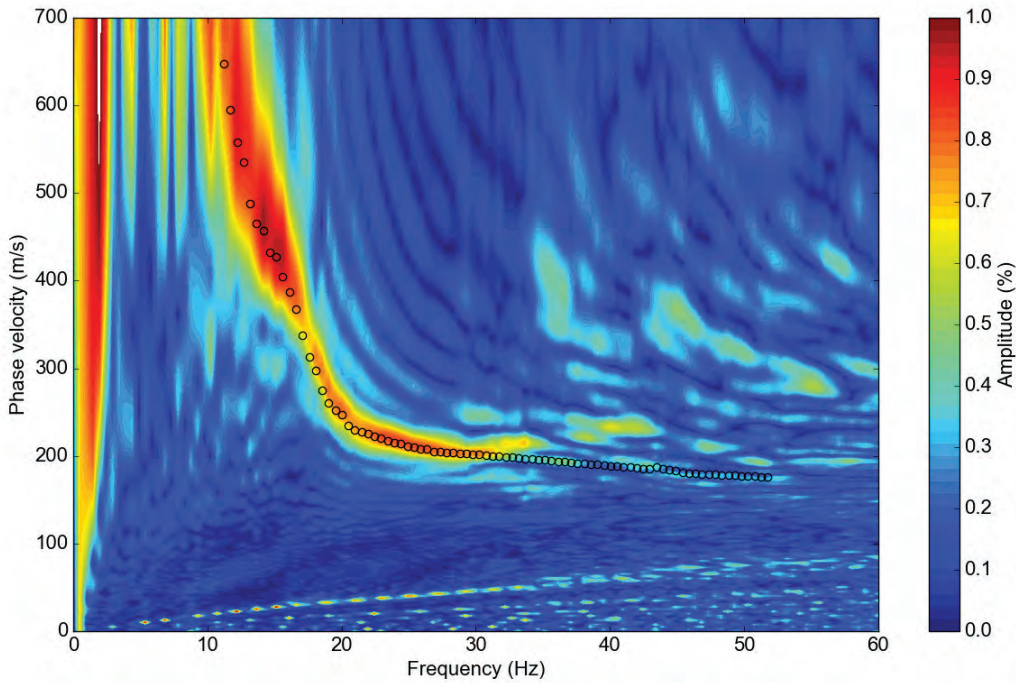

Figure 4. Phase-velocity/frequency spectral plot of shot gather (1004), located at 1 m off-end of Geophone 1 at Lincoln Elementary School. The phase velocity/frequency picks (black circles) define the trend of the dispersion curve of the fundamental mode of surface waves identified at the maximum amplitude (warm colors).

class at the school. Site class (Table 1) is a simplified method for characterizing the ground-motion amplifying effects of soft soils during an earthquake by evaluating the relation of average shear-wave velocity in the upper 30 m of the soil–rock column to the amplification of shaking at ground surface (Vs30 measurement). Shear waves are the earthquake waves that create the strongest horizontal shaking and are the most damaging to buildings and structures. Site class provides some measure of the potential for strong shaking in a particular area during an earthquake.

The site class assessment included the deployment of a single linear geophone spread in a general northwest direction across the grass field and playground on the western half of the campus (orange line in Figs. 1 and 2). The geophone spread consisted of 48 4.5-Hz single-channel vertical geophones deployed with a 2-m spacing for a total spread length of 94 m. Figure 3 shows

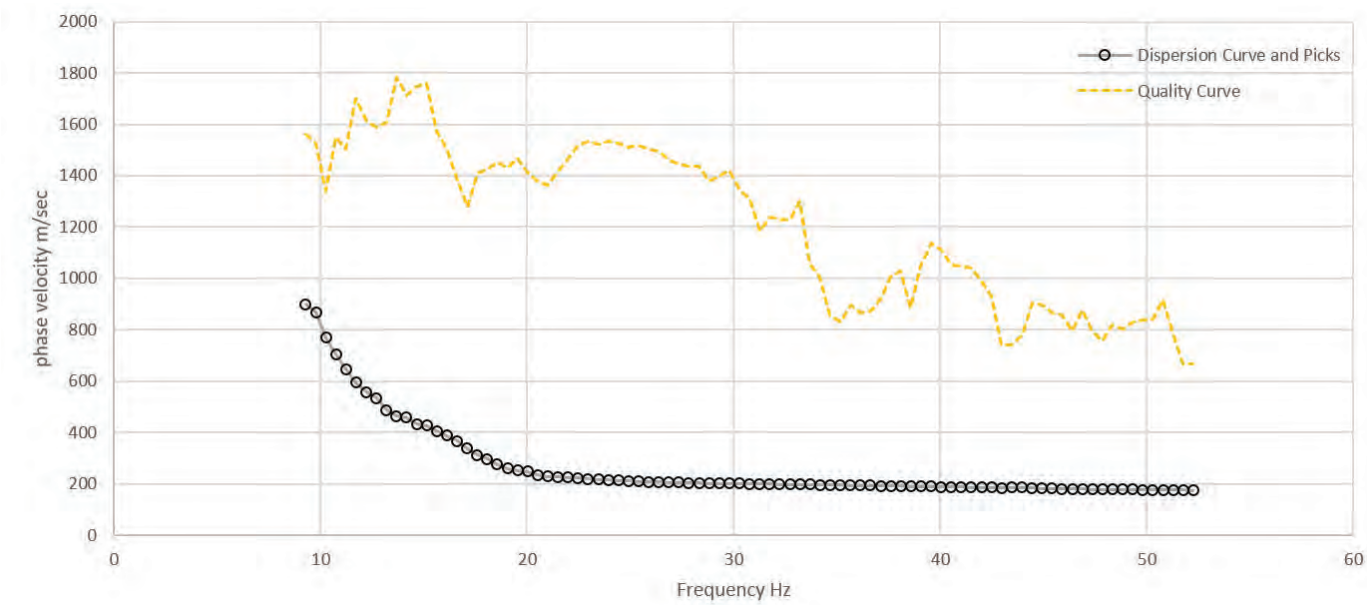

Figure 5. Calculated dispersion curve (gray line) with phase-velocity/frequency picks (black circles). The quality curve (dashed orange line) is a relative indicator of the quality of the picks that define the dispersion curve. Higher quality picks are associated with the quality curve at higher phase velocities and lower quality picks with the quality curve at lower phase velocities.

[1] Well Tag ID: AFG 217; (48.418965, -122.321639), Washington Department of Ecology at https://fortress.wa.gov/ecy/wellconstruction/map/wclswebMap/WellLogSearchResult.aspx?imageName=00247160.TIF&region=NWRO&folder=00278&xcoord=1197905&ycoord=1130660&search_scope=&result_num=10&welllogid=247160

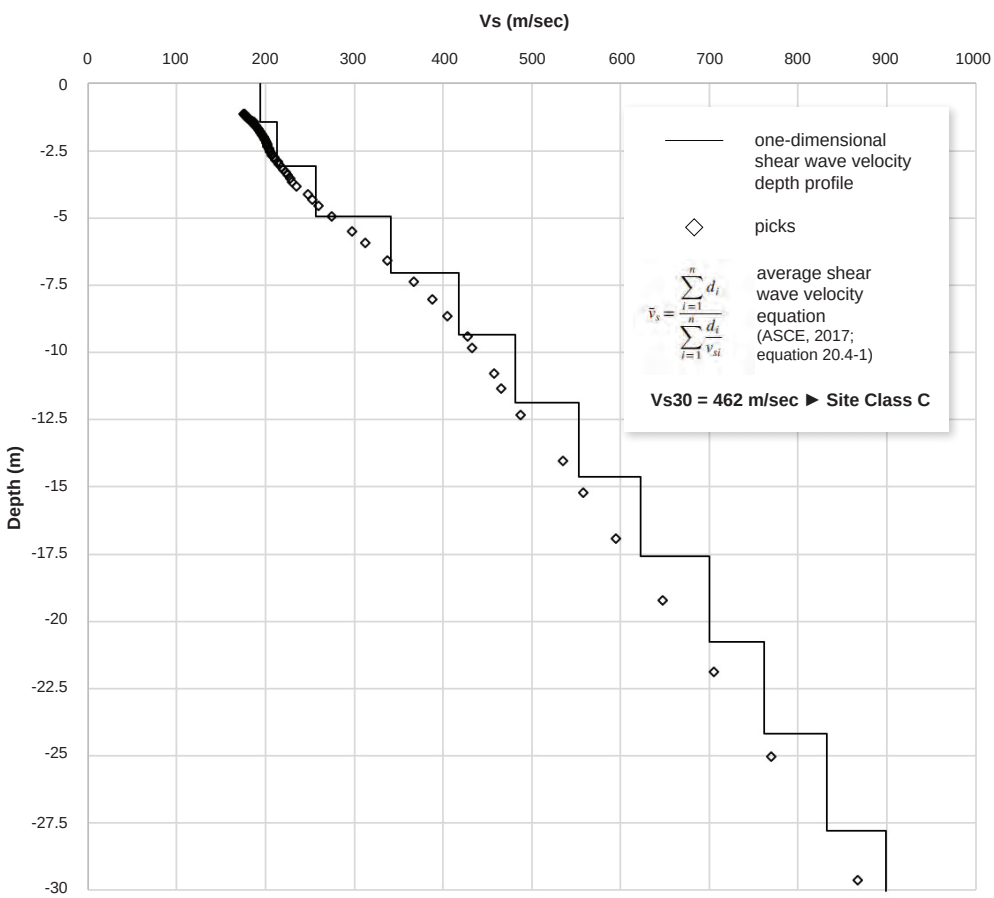

Figure 6. The modeled one-dimensional shear wave velocity versus depth profile (black line) and the picks (black circles) from the phase-velocity/frequency plot (Fig. 4) for Lincoln Elementary School. The average shear wave velocity to a depth of 30 m is determined by dividing the entire profile thickness by the summation of the velocities and thickness of the distinct layers of the profile (ASCE, 2017). D_i = The thickness of any layer between 0 and 100 ft (30m); V_S = The shear wave velocity in m/sec.

the placement of geophones, connections with seismic spread cables, and the two 24-channel seismographs. MASW was collected using an active source consisting of a 7.23-kg sledge hammer struck against a steel plate. Multiple strikes were stacked into single seismic shot-gathers at varying locations outside and inside the spread. The farthest shots located outside of the spread were at 10 m and 14 m off-end from Geophones 1 and 48, respectively (Figs. 1 and 2). MAM was collected using the same geophone spread.

The seismic data were compared with available nearby ground truth data, such as well logs and geotechnical boreholes, and local geology to check for consistency. Because the site

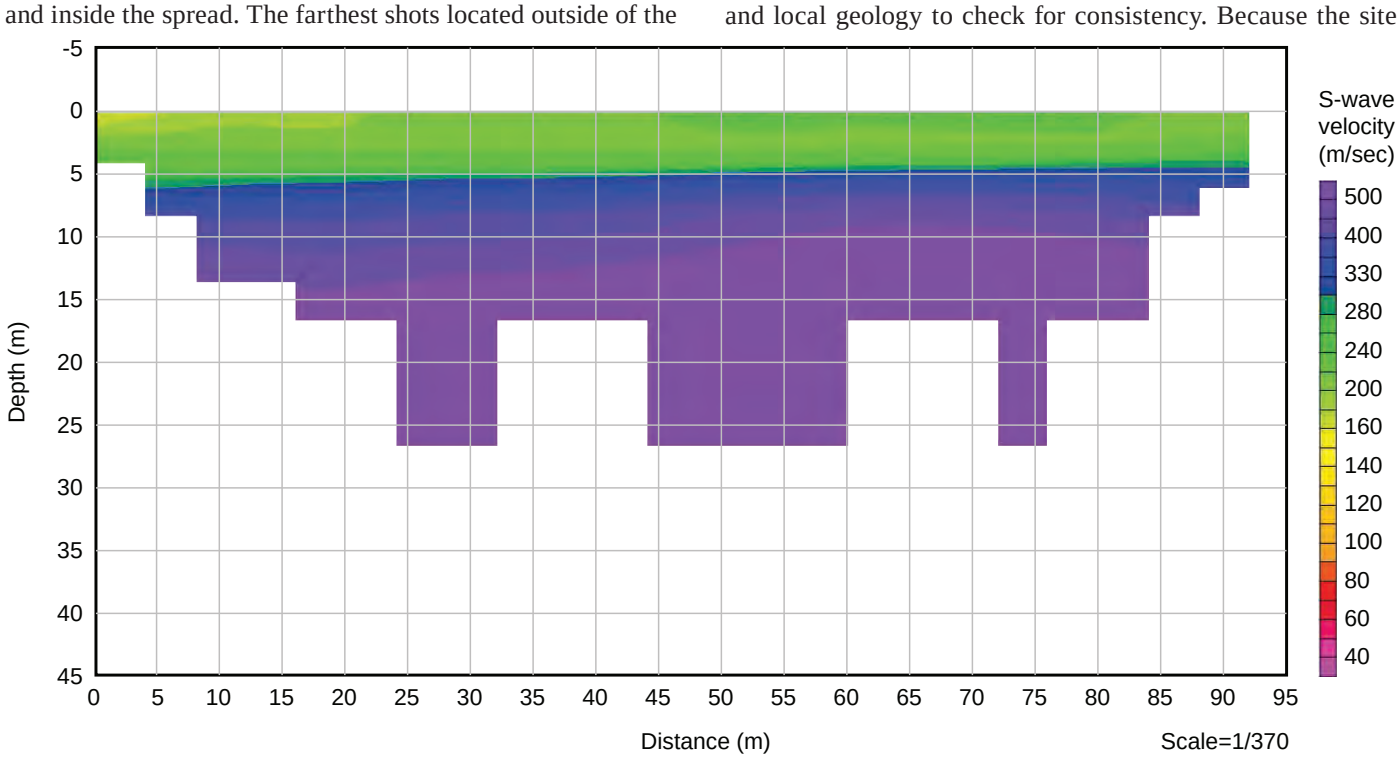

Figure 7. Two-dimensional shear wave velocity model (MASW).

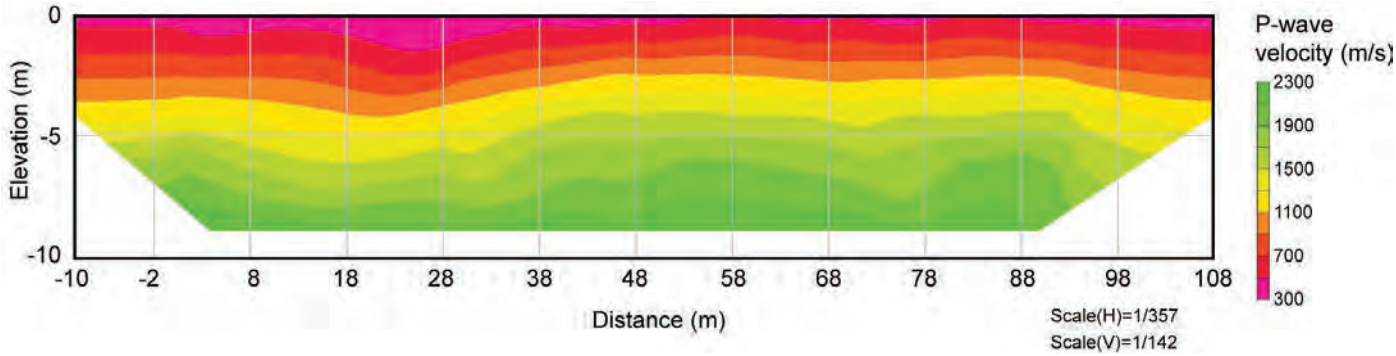

Figure 8. Two-dimensional P-wave velocity tomographic inversion model.

contains a geologic boundary and a mapped site class boundary, we performed a more comprehensive seismic analysis using 2D MASW (Fig. 7) and 2D seismic refraction (Fig. 8) using the same data. These analyses confirmed that there were no lateral heterogeneities at the campus, and that the measured Vs30 value may be applied to the entire campus.

RESULTS

Field seismic data from the Lincoln Elementary School campus was processed and analyzed using the MASW and MAM methods to calculate the one-dimensional shear wave velocity structure and Vs30. However, because the MASW sampled to below 30 m depth, only the MASW was used for the calculation of Vs30, and the MAM analysis was used only as a check for consistency and the results not shown. The data were processed, and the calculated dispersion curve (see Fig. 5) from the phase-velocity/frequency picks (Fig. 4) display good coherency between 16 Hz to 36 Hz and the fundamental mode of Rayleigh waves can be discerned from 9 to 36 Hz. Figure 6 depicts the one-dimensional shear wave velocity model from the dispersion curve analysis. Subsequent inversions resulted in an unrealistic velocity structure with higher than acceptable root mean square values (>5%). Thus, the analysis used the initial model as the final model, and the calculated Vs30 at the spread (Figs. 1 and 2) is 462 m/sec, correlating with a site class C per NEHRP guidelines.

As shown in Figures 1 and 2, the site crosses both a geologic boundary and a previously mapped site classification boundary; therefore, a 2D MASW and 2D refraction analysis were performed. The subsurface can contain significant lateral

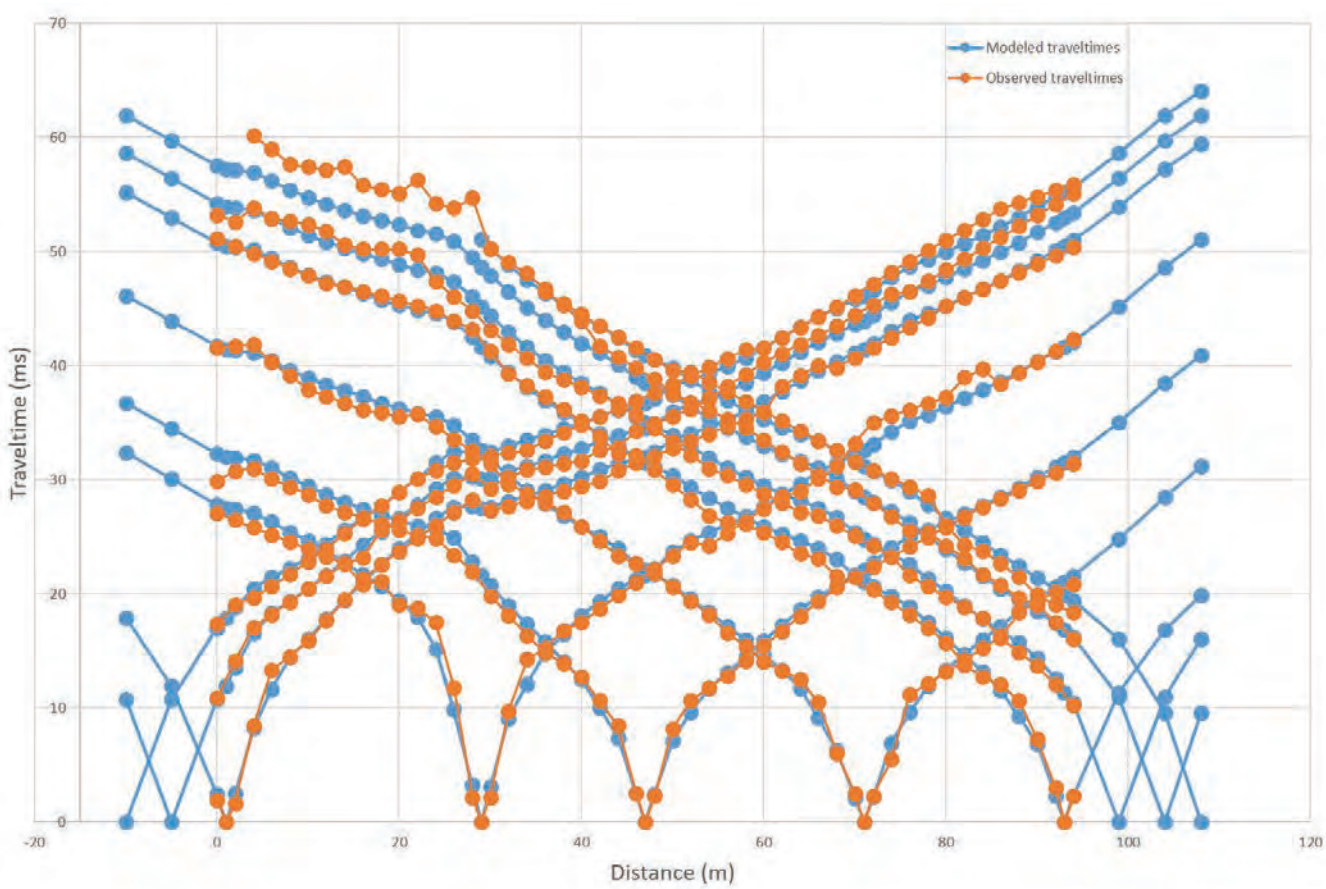

Figure 9. Time-distance plot depicting the observed versus calculated traveltimes at all shot points (10 shots total; 5 interior and 6 exterior) for the 2D refraction model. The geophone 1 of the spread is located at 0 m and geophone 48 located at 94 m.

variations in velocity structure over relatively short distances that can increase or decrease Vs30 across a site. The 2D MASW velocity model (Fig. 7) depicts a laterally continuous velocity structure that increases with depth and is free of anomalous or discontinuous velocities that would indicate a lateral change in geology. Most of the shot-gathers showed first arrivals from the refraction analysis that were generally clear and discernable. The first arrivals were inverted using a tomographic inversion (Fig. 8) and show a mostly laterally homogeneous velocity structure through the depths of confidence. The p-wave velocity near the surface is as low as 300 m/sec and is as high as 2,000 m/sec at 13 m, there is a smooth velocity gradient in between these values. The refraction data indicates that the subsurface down to 13 m is laterally homogeneous and lacks a strong velocity contrast. This would suggest that the subsurface is composed of simple stratigraphy, most likely unconsolidated sediments (unit Qe), that are increasingly compacted with depth.

CONCLUSION

The intent of the geologic site class assessment is to measure the Vs30 at a specific site (lincoln elementary) to determine a more accurate site classification, while qualitatively taking into account overall consistency of available and applicable geologic data from the surrounding area. Although the site crosses a mapped geologic boundary and a predicted site class boundary, the 2D MASW and 2D refraction do not indicate significant heterogeneous velocity structure at the location of the linear geophone spread. Furthermore, bedrock velocities are not observed in the seismic analysis, and bedrock is not encountered in the nearby well that was drilled to a maximum depth of 72 m BEG. Although available borehole data is too distant from the site to be applied directly, logged soils are consistent with measured velocities. Therefore, due to the proximity of the Lincoln Elementary School building to the location of the spread (Figs. 2 and 3) and the lack evidence for heterogeneous velocity structure at the site, we assign site class C to Lincoln Elementary School.

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Washington State School Seismic Safety Assessments Project

SEISMIC UPGRADES CONCEPT DESIGN REPORT

Lincoln Elementary School

Mount Vernon School District

Draft Report – September 2018

PREPARED FOR

PREPARED BY

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Lincoln Elementary School
Mount Vernon School District

September 2018

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Washington Superintendent of Public Instruction

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Acronyms

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
FEMA	Federal Emergency Management Agency
IBC	International Building Code
IO	Immediate Occupancy
LFRS	Lateral Force-Resisting System
LS	Life Safety
PBEE	Performance-Based Earthquake Engineering
UBC	Uniform Building Code
WF	Wide Flange

Reference List

Codes and References

2015 IBC, *2015 International Building Code*, prepared by the International Code Council, Washington, D.C.

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.

ASCE 41-06, 2007, *Seismic Rehabilitation of Existing Buildings*, prepared by the Structural Engineering Institute of the American Society of Civil Engineers, Reston, Virginia.

ASCE 41-13, 2014, *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, 1994, *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide*, prepared by Wiss, Janney, Elstner Associates, Inc., under contract from the Federal Emergency Management Agency (FEMA), Washington, D.C.

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FEMA 547, 2006, *Techniques for the Seismic Rehabilitation of Existing Buildings*, prepared by Rutherford & Chekene Consulting Engineers under contract with the National Institute of Standards and Technology (NIST), funded by the Federal Emergency Management Agency (FEMA).

Drawings

Arch N. Torbitt Architects, November 1937, existing drawings titled “Lincoln Elementary School,” Eleventh and Skagit Streets, Mount Vernon, Washington.

Larry Erickson and Associates, June 1982, existing drawings titled “Modernization of Lincoln Elementary School,” Mount Vernon School District No. 320, Mount Vernon, 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 220 school buildings and 5 fire stations across Washington State to better understand the current level of seismic risk of our state's public-school buildings. The two main components of this project are 1) the geologic site characterizations, and 2) the seismic assessments of school buildings to be conducted by Reid Middleton, Inc. As part of the seismic assessments, the structural engineering team is also conducting seismic evaluations and concept-level seismic upgrade designs for 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 designs 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 to represent a variety of regions, building uses, eras of construction, 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.

1.2 Scope of Services

The project is being performed in several distinct and overlapping phases of work. This 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 will research available school building records and relevant site data and building drawings in advance of the field investigations. This research included searching of school building records and contacting the school 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. It is expected that some school districts may have these documents readily available, while other school districts may not have these documents on record.

2. Site Geologic Data: Reid Middleton is utilizing the site geological data provided by the WGS and will include site shear wave velocities. This data 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: Reid Middleton and their project team performed site visits at each of the identified school buildings to observe the building's age, condition, configuration, and structural system for the purposes of the ASCE 41 Tier 1 seismic evaluations. This task included confirmation of general information included 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 have been prepared and were 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 not readily observable and safely accessible. Observations requiring access to confined spaces, potential hazardous material exposure, an unsecured ladder, work around energized equipment or mechanical hazards, areas requiring OSHA fall-protection, steep or unstable slopes, deteriorated structural assemblies, or other conditions deemed to be potentially unsafe by the engineer, were not performed. Removal of finishes (e.g. gypsum board, lathe and plaster, brick veneer, roofing materials, etc.) 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. ASCE checklist items that are not documented due to access limitations are noted.

1.2.3 Seismic Evaluations

1. Preliminary Seismic Evaluations: Reid Middleton and their project team performed a preliminary ASCE 41-17 Tier 1 seismic structural and nonstructural evaluations of the school building evaluated in accordance with *Seismic Evaluations of Existing Buildings ASCE 41* (ASCE 41) Tier 1 Evaluation Procedures.

2. Concept-Level Designs: Reid Middleton performed further seismic evaluation work on the selected school buildings to provide concept-level seismic retrofits and/or upgrade designs, based on the results of Tier 1 seismic evaluations. The concept-level seismic upgrades design work includes a narrative descriptions of proposed seismic retrofits and/or upgrade schemes, concept sketches depicting the extent and type of recommended structural upgrades, and opinions of probable costs.

3. Cost Estimating: Through the concept-level seismic upgrades design process, Reid Middleton will determine cost estimates for the preferred concept-level seismic upgrade designs for the select school buildings. These concept-level seismic upgrades designs and associated cost estimates are intended to be representative samples of the state's public schools to be able to extrapolate the cost to upgrade these selected schools to estimate the overall capital needs of seismically upgrading Washington State schools.

1.2.4 Reporting and Documentation

1. Project Reports: Reid Middleton is providing a preliminary seismic report on the overall Tier 1 seismic assessment of schools assessed to WGS and OSPI. Each building's Tier 1 seismic evaluation is documented by a standard report format that provides a summary of the building's structural system, the Tier 1 checklist, building sketches/plans (if available), and site photos. For the select school building concept-level seismic upgrade designs, Reid Middleton is providing a summary report of each seismic evaluation with concept-level seismic upgrade sketches and construction cost estimates. The project reports and concept-level seismic upgrade design documents will be compiled into a single, final report with an introduction summarizing the overall findings and recommendations along with individual sections documenting the individual buildings findings and recommendations.

2. Building Photography: Reid Middleton and the project team have taken photos and videos of each building during on-site walk-throughs to document the existing building configurations, conditions, and structural systems.

3. Record Drawings: Drawings or other information that Reid Middleton collects during the evaluation process is being made available for DNR/WGS, OSPI, and the school districts. OSPI and/or the Reid Middleton project team have requested original drawings and previous building evaluations from each school district for use in this project.

2.0 Seismic Evaluation Procedures and Criteria

2.1 Performance Based Earthquake Engineering

Performance Based Earthquake Engineering (PBEE) can be defined as the engineering of a structure to resist different levels of earthquake demands in order to meet the needs and performance objectives of building owners and other stakeholders. ASCE 41*Seismic Evaluation and Retrofit of Existing Buildings* is a standard that employs a PBEE philosophy in its evaluation and retrofit methodologies. ASCE 41 allows building owners, design professionals, and the local building authorities to customize performance objective goals with code-defined seismic hazard levels for individual buildings.

2.2 ASCE 41 Seismic Evaluation and Retrofit Overview

The current standard for seismic evaluation and retrofit (upgrades) of existing buildings is the *Seismic Evaluation and Retrofit of Existing Buildings Standard (ASCE 41)*. 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. See Figure 2.1 for a flow chart describing 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

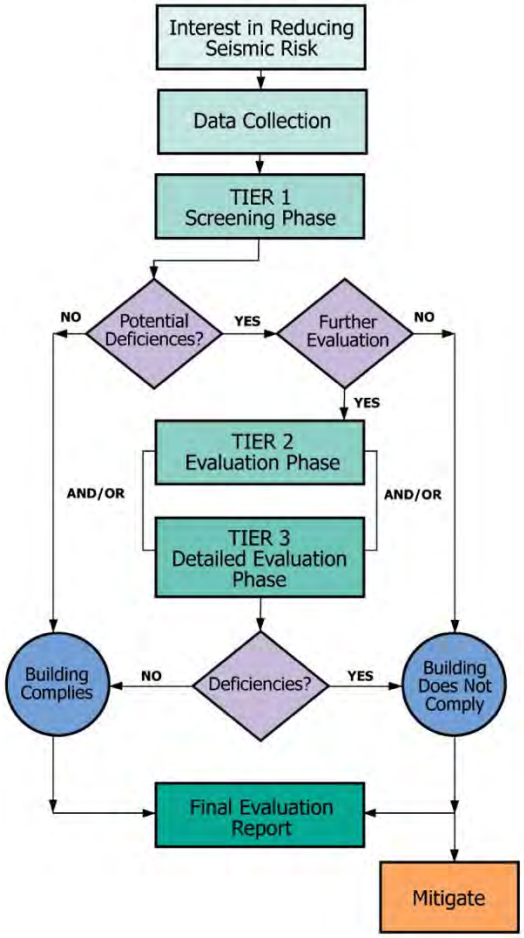


Figure 2.1. Flow Chart and Description of ASCE 41 Seismic Evaluation Procedure.

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. They 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. It 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 includes a Tier 1 screening and a Tier 2 evaluation of potential deficiencies.

2.3 Seismic Evaluation and Retrofit Criteria

ASCE 41 employs a Performance-Based Earthquake Engineering 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. See Appendix F Performance-Based Earthquake Engineering (PBEE) for discussion of the seismic hazard levels and levels of performance.

2.3.1 Lincoln 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 the 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 upon the probabilistic ground accelerations discussed in Appendix F. 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 0.77g. Based on ASCE 41 Table 2-4, the Level of Seismicity for this building is classified as **High**.

The ASCE 41 Basic Performance Objective for Existing Buildings (BPOE) makes use of the BSE-1E (Basic Safety Earthquake – 1E) seismic hazard level and the BSE-2E (Basic Safety Earthquake – 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 2475-year return period. See Appendix F for further discussion regarding the probabilistic seismic hazard levels.

Table 2.3.1 provides the spectral accelerations for the 225-year, 975-year, and 2,475-year return interval events specific to Lincoln Elementary School that are considered in this study.

Table 2.3.1. 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	0.38 g	0.2 Seconds	0.72 g	0.2 Seconds	0.76 g	0.2 Seconds	1.09 g
1.0 Seconds	0.14 g	1.0 Seconds	0.28 g	1.0 Seconds	0.30 g	1.0 Seconds	0.43 g

2.3.2 Lincoln Elementary School Structural Performance Objective

The existing 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. Per ASCE 41, the Basic Performance Objective for Existing Buildings (BPOE) for Risk Category III structures is the Damage Control structural performance level at the BSE-1E seismic hazard level and the Limited Safety structural performance level at the BSE-2E seismic hazard level. The ASCE 41 Tier 1 evaluations were conducted in accordance with ASCE 41 requirements and ASCE 41 seismic performance levels. Concept-level upgrades were developed for the **Life Safety** structural performance level at the **BSE-1N** seismic hazard level in accordance with DNR direction, the project scope of work and the project legislative language.

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

Knowledge Factor

A knowledge factor, *k*, is an ASCE 41 prescribed factor that is used to account for uncertainty in the as-built data considering the selected Performance Objective and data collection processes (availability of existing drawings, visual observation, and level of materials testing). A knowledge factor of $\boldsymbol{k = 0.9}$ per ASCE 41 Table 6-1 is used based on the Life Safety performance level. No in-situ testing of building materials was performed, and material properties and existing construction information were provided in the existing record drawings.

ASCE 41 Classified Building Type

Use of ASCE 41 for seismic evaluations requires buildings to be classified from a group of a common building types historically defined in previous seismic evaluations standards (ATC-14, FEMA 310, and ASCE 31-03). The existing school is classified in ASCE 41 Table 3-1 as a Concrete Shear Wall Building with Rigid Diaphragms, **C2**. Concrete Shear Wall (C2) buildings include those that have bearing walls, wall piers, columns and exterior spandrel beams constructed of reinforced concrete with elevated floor and roof framing structural systems consisting of reinforced concrete slabs and girders.

2.4 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: 1937

Architectural Modernization Year: 1982

Building Code: UBC 1985

Number of Stories: 3
Attic Below Roof: 1
Floor Area: 40,000 SF

The building is a three-story 1930s-era historic elementary school building with a daylight basement. The building has a rectangular floor plan with a ground floor gymnasium, performing arts space above the gymnasium and classrooms on all three levels. The building has a 5-foot, 6-inch-high attic space above the main roof level.

The structural system consists of a non-ductile concrete structure constructed on a sloping site. The roof deck consists of 3-inch thick cast-in-place reinforced concrete roof slab supported by integral cast-in-place reinforced concrete beams at 12 feet on-center. The floor framing systems consist of a 4-inch to 5-inch thick cast-in-place reinforced concrete slab supported by reinforced concrete beams supported by concrete columns, pilasters, and walls. The roof framing over the attic apace appears to consist of plywood sheathing supported by wood joists spanning north-south between 4x6 wood beams that are spaced approximately 10-feet on center. The 4x6 beams are supported on 4x4 wood posts at 6-feet on center along concrete beam at attic level. The lateral-force-resisting system of building is concrete shear walls with concrete diaphragm at floor levels including the attic, and wood diaphragm at the roof level.

The foundation system for the building is comprised of shallow continuous wall footings under exterior and interior concrete walls, and shallow spread footings below concrete columns and exterior pilasters.

3.1.2 Building Use

The school is a K-5 elementary school for over 370 students. The first floor consists of a cafeteria, storage, mechanical rooms, and two classrooms. The second and third floors

predominantly consist of classrooms and a library on the third floor. The school also had two story high gymnasium at first floor. The study hall and performing arts space are above the gymnasium at third floor.

3.1.3 Structural System

Table 3.1.3-1. Structural System Descriptions.

Structural System	Description
Roof Over Attic	The roof over attic appears to be 3/4-inch thick plywood sheathing over 2x6 wood joists at 24-inch on center spanning along north south, supported on 4x6 wood beams that are spaced approximately 10-feet on center. The 4x6 beams are supported on 4x4 wood posts at 6-feet on center along concrete beam at attic level.
Main Roof	The roof deck consists of 3-inch thick cast-in-place reinforced concrete roof slab supported by integral cast-in-place reinforced concrete beams at 12 feet on-center.
First and Second Floor	Elevated floors consist of 3-inch to 4-inch thick cast-in-place reinforced concrete floor slabs supported by integral cast-in-place reinforced concrete beams at 12 feet (nominal) on-center that span from exterior wall piers to interior bearing walls and columns.
Foundation	Foundations consist of cast-in-place reinforced concrete shallow spread footings supporting wall piers and columns and concrete strip footings supporting concrete bearing walls.
Gravity System	The gravity system consists of concrete roof and floors supported by concrete roof and floor beams, supported by wall piers, bearing walls and columns. The wall piers, columns, and bearing walls are supported on shallow concrete spread footings.
Lateral System	The lateral system consists of concrete roof and floors diaphragms, laterally supported by concrete shear walls, wall piers, and columns. Sliding and overturning forces from lateral loads are resisted by concrete spread footings.

Table 3.2.3-2. Structural System Condition Descriptions.

Structural System	Description
Roof	The roof appeared to be in good condition. No cracking was observed. Some peeled paint was observed at the underside of the roof slab.
Attic Floor	The attic floor appeared to be in good condition. No cracking was observed. Some peeled paint was observed at the underside of the roof slab.
Foundations Condition	The foundation wall was observed in the ground level in the boiler room and it appeared to be in good condition. No other foundations were observable.
Gravity System Condition	The condition of the gravity system appears to be functional and intact.
Lateral System Condition	The condition of the lateral system appeared to be intact; however, it should be noted that the lateral system consisting of wall piers along the longitudinal axis of the building is not reliable. Also, considering the building's age and era, there are concerns about lateral system performance.

3.2 Seismic Evaluation Findings

3.2.1 Structural Seismic Deficiencies

Table 3.2.1-1 summarizes the seismic deficiencies in the structural systems. See Appendix A for the Tier 1 screening checklists.

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

Deficiency	Description
Load Path	1930's-era concrete construction has an unreliable load path through nonductile concrete wall piers.
Weak Story	The building appears to be compliant; however, the gymnasium has a first story is approximately twice as tall as the second story. Due to the year of original construction (1938), it is assumed that weak story effects may not have been considered in the design of the gymnasium.
Soft Story	The gymnasium at the first floor is open to the second floor. Due to the year of original construction (1938) it is assumed that soft story effects may not have considered in the design of the gymnasium.
Shear Stress Check	Shear stresses at first floor and second floor is greater than 100 psi.

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

Deficiency	Description
Liquefaction and Slope Failure	Geotechnical investigation should be performed to determine the geological hazard to building during an earthquake.
Reinforcing Steel	The reinforcing steel spacing for concrete and CMU walls is insufficient in both the vertical and horizontal directions, based on the Tier 1 checklist. Concrete and CMU walls with insufficient reinforcing steel behave in a nonductile manner and have limited capacity in resisting seismic forces. Tier 1 requirements indicate that lightly reinforced c concrete and CMU walls, such as these, will behave as unreinforced masonry walls.
Wall Anchorage at Flexible Diaphragms	Attic roof to exterior concrete wall connections types and extent are unknown. Based on the age of the building, it is assumed that the wall anchorage is insufficient.
Transfer to Shear Walls	Attic roof diaphragm to exterior wall anchorage connections may be insufficient to transfer roof diaphragm loads to concrete shear walls.
Straight Sheathing	The attic roof diaphragm aspect ratio is greater than 2-to-1.

3.2.2 Nonstructural Seismic Deficiencies

Table 3.2.2-1 summarizes the seismic deficiencies in the nonstructural systems. See Appendix A for the Tier 1 screening checklists.

Table 3.2.2-1. Identified Nonstructural Seismic Deficiencies based on Tier 1 Checklists.

Deficiency	Description
LSS-1 Fire Suppression Piping	Available record drawings do not have information pertaining to fire suppression piping and unable to verify during site investigation. Based on age of the building, it is assumed that seismic bracing for fire suppression piping does not comply with NFPA-13.
LSS-2 Flexible Couplings	Available record drawings do not have information pertaining to fire suppression piping and unable to verify during site investigation. Based on age of the building, it is assumed the flexible couplings on the fire suppression piping do not comply with NFPA -13.
LSS-3 Emergency Power	Available record drawings do not have information on anchorage or bracing for emergency power equipment and could not verify during site investigation. Based on age of the building, emergency power equipment is

Table 3.2.2-1. Identified Nonstructural Seismic Deficiencies based on Tier 1 Checklists.

Deficiency	Description
	either nonexistence or noncompliant. Emergency power is critical to the post-earthquake recovery; therefore, proper mounting of the component of emergency power system is required for the reliable performance.
LSS-4 Stair and Smoke Ducts	Available record drawings do not have information on stair pressurization and smoke duct and unable to verify during site investigation. Based on age of the building, it is assumed that the duct bracings are nonexistent.
HM-5 Flexible Couplings	Gas piping connections observed to have welded connections.
LF-1 Independent Support	The weight of existing light fixtures is not known. However, the light fixtures are observed to be supported from ceiling grid systems and do not have independent supports.
CF-2 Tall Narrow Contents	Tall bookshelves do not appear to be anchored to floor or adjacent wall. Contents more than 6-feet high with height-to-depth or height-to width ratio greater than 3-to-1 should be anchored to prevent from overturning and falling during an earthquake.
CF-3 Fall-Prone Contents	Overhead projectors that may weigh more than 20-pounds do not appear to be seismically braced or restrained.
ME-1 Fall-Prone Equipment	Several mechanical equipment weighing more than 20-pounds in mechanical room do not appear braced or restrained. Mechanical equipment whose center-of-mass more than 4 feet off the ground should be retained to prevent from falling.

4.0 Conclusion and Recommendations

4.1 Seismic-Structural Upgrade Recommendations

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

4.1.1 Concrete Shotcrete Walls

Concrete shotcrete walls are recommended along the interior and at select locations at exterior walls. The proposed shotcrete walls are recommended over the full height, from the foundation to the roof level, with sufficient strength and stiffness to resist seismic loads in the plane of the wall. A drag strut beam should be added at the end of the concrete wall to transfer diaphragm loading to the new concrete shear walls. Where existing beams occur on the drag strut line, the connections should be upgraded to reliably transfer the seismic loads.

4.1.2 New Transverse Concrete Shear Walls

The building has concrete shear walls at north and south ends of the building to resist the seismic forces along east-west direction creating a long span diaphragm at the middle of the building. The LFRS of the building can be improved by adding a new transverse concrete shear wall along east-west direction at the ground floor and the first floor. The new concrete shear walls should extend from the foundation to the first floor.

4.1.3 Foundation Systems

At the supplemental concrete shotcrete wall locations, foundations should be upgraded to support the lateral load-carrying capacity of the new concrete shear walls. The existing foundation system consists of shallow spread footings. Based on the design of the existing shallow foundation system, the foundation upgrades should be shallow concrete spread footings to match the existing foundation system.

4.1.4 Roof Diaphragm Blocking

The plywood diaphragm at the roof appears to be unblocked. The diaphragm seismic strength and stiffness capacity can be enhanced by adding blocking at the panel edges. Blocked diaphragms at panel edges have more strength to transfer lateral forces than those that are unblocked. Added blocking should be nailed through the existing diaphragm. This may necessitate the installation of a new roof membrane.

4.1.5 Wall Anchorage at Roof

Exterior concrete wall-to-roof diaphragm anchors should be added. These will consist of tension ties between exterior concrete walls and wood roof diaphragms. The tension ties can be Simpson Strong-Tie LTTI31 ties with post-installed embedded concrete anchors or a similar product.

4.1.6 Wood Shear Walls at Attic Level

Additional wood shear walls should be installed within the attic space to provide adequate seismic bracing at this level. Exterior concrete wall-to-roof diaphragm anchors should be installed to transfer seismic loads.

4.2 Seismic-Nonstructural Upgrade Recommendations

Table 3.2.1.2 identifies several non-structural deficiencies that do not meet the performance objective selected for the Lincoln Elementary School. It is recommended that these deficiencies be addressed to provide non-structural performance consistent with the performance of the upgraded structural lateral force resisting system. As-built information for the existing nonstructural systems such as fire sprinklers, mechanical ductworks, and piping are not available for review. Only limited visual observation of the systems were performed during field investigation due to the limited access or visibility to observe existing conditions. The conceptual mitigation strategies provided in this study is preliminary only. The final analysis and design for seismic rehabilitation must include a detailed field investigation.

4.2.1 Life Safety Systems

Life Safety Systems are responsible for protecting and evacuating occupants of a building during emergencies or disasters. These systems include, but are not limited to, fire suppression piping, emergency lighting, and stair and smoke ducts. Proper bracing, coupling, and clearances of fire suppression piping not only increase reliability of performance but also help minimize the damage to pipes and sprinkler heads. Based on the ages of the building, it is likely that the sprinkler systems in the building do not meet the requirements of current NFPA 13 seismic bracing and flexible coupling.

The recommended seismic mitigation for the life safety systems are:

- Provide bracing and flexible couplings of risers, feed mains, cross-mains, and branch lines in accordance with NFPA 13.
- Provide 1-inch sprinkler head clearance holes in ceiling finishes.
- Provide seismic bracing or anchor the emergency power system to the structure.

4.2.2 Hazardous Materials

The extent of hazardous material contents in the building is unknown. Following recommendation should be implement 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 braced or otherwise protected from damage resulting 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.

4.2.3 Architectural Systems

Ceiling

Suspended ceiling in the building appears to be integrated acoustical ceilings tiles supported by steel channel systems. It is common to have lath and plaster ceiling at main entrance and bathrooms. The recommended seismic mitigation for the life safety systems are:

- Provide ceiling attachments to suspended gypsum board, and suspended lath and plaster ceilings that resist seismic forces for every 12 square feet of area. Suspended acoustical ceilings have suffered significant damage in past earthquakes causing the falling hazard to the occupants during an earthquake.
- Provide independent support with a minimum of two wires at diagonally opposite corners of each fixture for the light fixtures that weigh more per square foot than the suspended ceiling they penetrate. Fluorescent light fixtures are often supported by the suspended ceiling system causing the light fixtures to become overhead falling hazard during an earthquake. Therefore, 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.

Overhead Glazing

- For interior and exterior glazing panes more than 16 square feet in area, provide laminated annealed or laminated heat-strengthened glass that detailed to remain in the frame when cracked. Non-laminated glazing shatters during the 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.

Stairs

Stair well at Gymnasium in the west façade of the building has 6.5-foot-wide by 24-foot-tall glass block panels. Glass block walls can pose a severe falling hazard during an earthquake.

- Install horizontal out-of-plane steel framing across the interior face of the glass block at the top, bottom, and at 4-feet max spacing.

Contents and Furnishings

Various tall and narrow furniture such as shelving and storage units that are freestanding away from any backing walls are highly susceptible to toppling if not anchored properly can become a life safety hazard or adversely affect post-earthquake operations.

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

4.2.4 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 their supports or topple equipment to the ground or on to other equipment. Inadequate bracing of piping and ducting, or the inability for piping to tolerate differential movement from the equipment it attached to, can damage or dislodge connections. Such damage in fluid piping can potentially lead to major leaks or the loss and disruption by damaging the contents.

- Provide seismic bracing for the equipment weighing more than 20 pounds whose center of mass is more than 4-feet above the adjacent floor level, and which is not in-line equipment.

4.3 Opinion of Probable Construction Costs

The opinion of probable construction costs to perform the structural and nonstructural seismic upgrade recommendations provided in this report is included in Appendix C. A central-estimate of the costs was developed first, and then a -30%/+50% variance was included to capture the expected range of accuracy. The estimated cost to perform seismic upgrades to the Lincoln Elementary School is expected to be between $3,636,000 and $7,791,000 (-30%/+50%). The central-estimate of the construction costs is $5,194,000. On a per-square-foot basis, the construction cost is estimated to be between $91 per square foot to $195 per square foot, with the central-estimate being $130 per square foot. This opinion of probable cost includes work, materials, and contractor's construction measures directly associated with performing the upgrade, as well as estimated permitting, design, and contingency costs. Costs incurred by the Lincoln Elementary School for internal project management, administration, review, and relocation are not included in the estimate.

APPENDIX A: FIELD INVESTIGATION REPORT AND TIER 1 CHECKLISTS

1.1 Mount Vernon, Lincoln Elementary School, Main Building

1.1.1 Building Description

Building Name:	Main Building
Facility Name:	Lincoln Elementary School
District Name:	Mount Vernon
Latitude:	48.415
Longitude:	-122.328
ICOS Object ID:	795
ICOS County/District ID:	29320
ICOS Building ID:	12009
Enrollment:	373
Gross Sq. Ft. :	40,002
Year Built:	1938
Number of Stories:	3
$S_{XS\ BSE\text{-}2E}$:	1.087
$S_{X1\ BSE\text{-}2E}$:	0.452
ASCE 41 Level of Seismicity:	High
Site Class:	C
Liquefaction Potential #1:	low to moderate
Liquefaction Potential #2:	Low to Moderate
Tsunami Risk:	None

The main building is a three story daylight basement 1930s-era historic elementary school building. The building has a rectangular floor plan with a ground floor gymnasium and performing arts space above the gymnasium. The building is a non-ductile concrete structure constructed on a sloping site. The floor system consists of a reinforced concrete slab supported by reinforced concrete beams. The roof system also consists of a reinforced concrete slab supported by reinforced concrete beams. The lateral-force-resisting system is concrete shear walls.

1.1.1.1 Building Use

The school is a K-5 elementary school for over 370 students. The first floor consists of a cafeteria, storage, mechanical rooms and two classrooms. The second and third floors consist of mainly classrooms, and there is a library on the third floor. The school has an attached gymnasium that is the same height as the 3 story school. The gymnasium has a study hall and performing arts space above it.

1.1.1.2 Structural System

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

Structural System	Description
Structural Roof	The roof deck consists of 3 inch thick cast-in-place reinforced concrete roof slab supported by integral cast-in-place reinforced concrete beams at 12 feet (nominal) on-center.
Structural Floor(s)	Elevated floors consist of 3 inch to 4 inch thick cast-in-place reinforced concrete floor slabs supported by integral cast-in-place reinforced concrete beams at 12 feet (nominal) on-center that span from exterior wall piers to interior bearing walls and columns.
Foundations	Foundations consist of cast-in-place reinforced concrete spread footings supporting wall piers and columns and concrete strip footings supporting concrete bearing walls.
Gravity System	The gravity system consists of concrete roof and floors supported by concrete roof and floor beams, supported by wall piers, bearing walls and columns. The wall piers, columns and bearing walls are supported on concrete spread footings.
Lateral System	The lateral system consists of concrete roof and floors diaphragms, laterally supported by concrete shear walls, wall piers and columns. The sliding and overturning forces from lateral loads are resisted by concrete spread footings.

1.1.1.3 Structural System Visual Condition

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

Structural System	Description
Structural Roof	Good condition. No cracking was observed. Some peeled paint was observed at the underside of the roof slab.
Structural Floor(s)	Good condition. No cracking was observed.
Foundations	The foundation wall was observed in the ground level boiler room and it appeared to be in good condition. No other foundations were observable.
Gravity System	The condition of the gravity system appears functional and intact.
Lateral System	The condition of the lateral system appears intact, however, it should be noted that the lateral system consisting of wall piers along the longitudinal axis of the building is not reliable. Also, considering the building's age and era, that there are concerns about lateral system performance.

Photos:

Figure 1.1-1. Aerial plan view of school building and surrounding areas.

Figure 1.1-2. School building looking northeast. Note concrete exterior walls and gently sloping building site to the west.

Figure 1.1-3. West elevation of school building and adjacent playground.

Figure 1.1-4. School building looking southeast. Note high bay gymnasium on north end of the building with a performing arts space above the gym. Exterior concrete walls and gently sloping building site to the west.

Figure 1.1-5. Photo looking west at the east elevation of building and school grounds on the west side of the school.

Figure 1.1-6. East elevation concrete wall. Notice short wall piers at lowest level.

Figure 1.1-7. Typical interior main central corridor with suspended ceiling.

Figure 1.1-8. Lunchroom. Note hard ceiling, surface mounted light fixtures, with exposed unbraced plumbing and fire protection piping.

Figure 1.1-9. Basement level gymnasium with cast-in-place concrete walls and pilasters. The performing arts space is on level 3 above the gym.

Figure 1.1-10. Exterior non-ductile concrete wall. Deep spandrel beams and narrow non-ductile concrete wall piers.

1.1.2 Seismic Evaluation Findings

1.1.2.1 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 1.1-3. Identified Structural Seismic Deficiencies for Lincoln Elementary School

Deficiency	Description
Load Path	1930's-era concrete construction has an unreliable load path through wall piers.
Weak Story	The main building appears to be compliant, however, the gymnasium has a first story that is approximately twice as tall as the second story. Due to the year of original construction (1938) it is assumed that weak story effects were not taken into account in the design of the gymnasium.
Soft Story	The gymnasium at the first floor is open to the second floor. Due to the year of original construction (1938) it is assumed that soft story effects may not have taken into account in the design of the gymnasium.
Shear Stress Check	Shear stresses at first floor and second floor is greater than 100 psi.
Reinforcing Steel	Reinforcing ratio for vertical direction is less than 0.0012 (#4 at 18\ o.c.). Reinforcing ratio for horizontal direction is less than 0.0020 (#3 at 18\ o.c.).
Wall Anchorage at Flexible Diaphragms	Attic roof to exterior concrete walls are unknown. Based on the age of the building, it is assumed that the wall anchorage are insufficient.
Transfer to Shear Walls	Attic roof diaphragm to exterior wall anchorage are insufficient to transfer roof diaphragm to concrete shear walls.
Straight Sheathing	Attic roof diaphragm aspect ratio is greater than 2-to-1.

1.1.2.2 Nonstructural 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 1.1-4. Identified Nonstructural Seismic Deficiencies for Lincoln Elementary School

Deficiency	Description
LSS-1 Fire Suppression Piping. HR-not required; LS-LMH; PR-LMH.	No available record drawing information on fire suppression piping and unable to verify during site investigation. Based on age of the building, it is assumed that seismic bracing for fire suppression piping do not comply with NFPA-13.
LSS-2 Flexible Couplings. HR-not required; LS-LMH; PR-LMH.	No available record drawing information on fire suppression piping and unable to verify during site investigation. Based on age of the building, it is assumed the flexible couplings on the fire suppression piping do not comply with NFPA -13.
LSS-3 Emergency Power. HR-not required; LS-LMH; PR-LMH.	Available record drawings do not have information on anchorage or bracing for emergency power equipment and could not verify during site investigation. Based on age of the building, emergency power equipment is either nonexistence or noncompliant.
LSS-4 Stair and Smoke Ducts. HR-not required; LS-LMH; PR-LMH.	No available record drawing information on stair pressurization and smoke duct and unable to verify during site investigation. Based on age of the building, it is assumed that the duct bracings are nonexistent.
HM-5 Flexible Couplings. HR-LMH; LS-LMH; PR-LMH.	Gas piping connections appear to be welded in pictures, not flexible.
LF-1 Independent Support. HR-not required; LS-MH; PR-MH.	It is unclear how much the light fixtures weigh, but the light fixtures are not supported independent of the ceiling in the pictures.
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Tall shelving units are not anchored to floor or wall.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Projector that appears to weigh more than 20-lbs is not braced.
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Some equipment in the mechanical room whose center of mass appears to be more than 4ft off the ground is not braced.

Mount Vernon, Lincoln 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			1930's-era concrete construction has an unreliable load path through wall piers.
Adjacent Buildings	The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity. (Tier 2: Sec. 5.4.1.2; Commentary: Sec. A.2.1.2)			X		There are no adjacent buildings on the school site.
Mezzanines	Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Tier 2: Sec. 5.4.1.3; Commentary: Sec. A.2.1.3)			X		There are no interior mezzanine levels.

Building System - Building Configuration

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Weak Story	The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above. (Tier 2: Sec. 5.4.2.1; Commentary: Sec. A.2.2.2)		X			The main building appears to be compliant, however, the gymnasium has a first story that is approximately twice as tall as the second story. Due to the year of original construction (1938) it is assumed that weak story effects were not taken into account in the design of the gymnasium.

Soft Story	The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Tier 2: Sec. 5.4.2.2; Commentary: Sec. A.2.2.3)		X			The gymnasium at the first floor is open to the second floor. Due to the year of original construction (1938) it is assumed that soft story effects may not have taken into account in the design of the gymnasium.
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				All the shear walls are continous from roof to foundation.
Geometry	There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 5.4.2.4; Commentary: Sec. A.2.2.5)	X				The building is rectangular and the geometry is consistent through all three stories.
Mass	There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 5.4.2.5; Commentary: Sec. A.2.2.6)	X				The building is rectangular with consistent geometry through all three stories. There does not appear to be any changes in effective mass from one story to the next.
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	Geotechnical report is not available for review.

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	Geotechnical report is not available for review.
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	Geotechnical report is not available for review.

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				base/height of building is greater than 0.6Sa.
Ties Between Foundation Elements	The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Tier 2: Sec. 5.4.3.4; Commentary: Sec. A.6.2.2)	X				Since the soil site class is C, the soil will provide lateral restraint to the foundations.

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

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

Low and Moderate Seismicity

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Complete Frames	Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system. (Tier 2: Sec. 5.5.2.5.1; Commentary: Sec. A.3.1.6.1)	X				
Redundancy	The number of lines of shear walls in each principal direction is greater than or equal to 2. (Tier 2: Sec.5.5.1.1; Commentary: Sec. A.3.2.1.1)	X				
Shear Stress Check	The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.2 (0.69 MPa) or $2\sqrt{f'c}$. (Tier 2: Sec.5.5.3.1.1; Commentary: Sec. A.3.2.2.1)		X			Shear stresses at first floor and second floor is greater than 100 psi.
Reinforcing Steel	The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. (Tier 2: Sec.5.5.3.1.3; Commentary: Sec. A.3.2.2.2)		X			Reinforcing ratio for vertical direction is less than 0.0012 (#4 at 18" o.c.). Reinforcing ratio for horizontal direction is less than 0.0020 (#3 at 18" o.c.).

Conncections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Wall Anchorage at Flexible Diaphragms	Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7. (Tier 2: Sec.5.7.1.1; Commentary: Sec. A.5.1.1)		X			Attic roof to exterior concrete walls are unknown. Based on the age of the building, it is assumed that the wall anchorage are insufficient.

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			Attic roof diaphragm to exterior wall anchorage are insufficient to transfer roof diaphragm to concrete shear walls.
Foundation Dowels	Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation. (Tier 2: Sec.5.7.3.4; Commentary: Sec. A.5.3.5)	X				

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

Seismic-Force-Resisting System

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Deflection Compatibility	Secondary components have the shear capacity to develop the flexural strength of the components. (Tier 2: Sec.5.5.2.5.2; Commentary: Sec. A.3.1.6.2)			X		
Flat Slabs	Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints. (Tier 2: Sec.5.5.2.5.3; Commentary: Sec. A.3.1.6.3)	X				
Coupling Beams	The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. (Tier 2: Sec.5.5.3.2.1; Commentary: Sec. A.3.2.2.3)			X		No coupling beam

Diaphragms (Stiff or Flexible)

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

Flexible Diaphragms

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Cross Ties	There are continuous cross ties between diaphragm chords. (Tier 2: Sec.5.6.1.2; Commentary: Sec. A.4.1.2)				X	This building does not have any flexible diaphragms.

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			Attic roof diaphragm aspect ratio is greater than 2-to-1.
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				
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	
Other Diaphragms	Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec.5.6.5; Commentary: Sec. A.4.7.1)	X				Diaphragm is concrete or wood.

Connections

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
Uplift at Pile Caps	Pile caps have top reinforcement, and piles are anchored to the pile caps. (Tier 2: Sec.5.7.3.5; Commentary: Sec. A.5.3.8)			X		This building does not have pile foundation.

Mount Vernon, Lincoln 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			No available record drawing information on fire suppression piping and unable to verify during site investigation. Based on age of the building, it is assumed that seismic bracing for fire suppression piping do not comply with NFPA-13.
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			No available record drawing information on fire suppression piping and unable to verify during site investigation. Based on age of the building, it is assumed the flexible couplings on the fire suppression piping do not comply with NFPA -13.
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			Available record drawings do not have information on anchorage or bracing for emergency power equipment and could not verify during site investigation. Based on age of the building, emergency power equipment is either nonexistence or noncompliant.

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			No available record drawing information on stair pressurization and smoke duct and unable to verify during site investigation. Based on age of the building, it is assumed that the duct bracings are nonexistent.
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	No available record drawing information on sprinkle head clearance and unable to verify during site investigation.
LSS-6 Emergency Lighting. HR-not required; LS-not required; PR-LMH	Emergency and egress lighting equipment is anchored or braced. (Tier 2: Sec. 13.7.9; Commentary: Sec. A.7.3.1)			X		Not required for life safety performance level.

Hazardous Materials

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
HM-1 Hazardous Material Equipment. HR-LMH; LS-LMH; PR-LMH.	Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.2)			X		No equipment appears to be mounted on vibration isolaters.
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	Unknown whether the building has hazardous materials.
HM-3 Hazardous Material Distribution. HR-MH; LS-MH; PR-MH.	Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.4)				X	Unknown whether the building has hazardous materials.
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				Gas piping shown in pictures appears to have a shutoff valve.
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			Gas piping connections appear to be welded in pictures, not flexible.
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		Building has no seimic joints.

Partitions

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

Ceilings

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
C-1 Suspended Lath and Plaster. HR-H; LS-MH; PR-LMH.	Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft2 (1.1 m2) of area. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.3)				X	Available record drawings are unclear to whether the building has lath and plaster ceiling.
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	Available record drawings are unclear to whether the building has lath and plaster ceiling.
C-3 Integrated Ceilings. HR-not required; LS-not required; PR-MH.	Integrated suspended ceilings with continuous areas greater than 144 ft2 (13.4 m2) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Tier 2: Sec. 13.6.4; Commentary: Sec. A.7.2.2)			X		Not required for life safety performance level.

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

Light Fixtures

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

Cladding and Glazing

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
CG-1 Cladding Anchors. HR-MH; LS-MH; PR-MH.	Cladding components weighing more than 10 lb/ft2 (0.48 kN/m2) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m) (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.1)			X		The building does not have any exterior cladding components.
CG-2 Cladding Isolation. HR-not required; LS-MH; PR-MH.	For steel or concrete moment-frame buildings, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.3)			X		The building is not a steel or concrete moment frame building.
CG-3 Multi-Story Panels. HR-MH; LS-MH; PR-MH.	For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.4)			X		The building does not have any multi-story panels.
C-4 Threaded Rods. HR-not required; LS-MH; PR-MH.	Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity. (Tier 2: Sec. 13.6.1; Commentary: Sec. A.7.4.9)			X		The building does not have any panel connections.
CG-5 Panel Connections. HR-MH; LS-MH; PR-MH.	Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.5)			X		The building does not have any cladding panels.
CG-6 Bearing Connections. HR-MH; LS-MH; PR-MH.	Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel. (Tier 2: Sec. 13.6.1.4; Commentary: Sec. A.7.4.6)			X		The building does not have any 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 any concrete cladding.

CG-8 Overhead Glazing. HR-not required; LS-MH; PR-MH.	Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft2 (1.5 m2) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Tier 2: Sec. 13.6.1.5; Commentary: Sec. A.7.4.8)			X		The building does not have any glazing panes.

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		The building does not have any masonry veneer.
M-2 Shelf Angles. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.2)			X		The building does not have any masonry veneer.
M-3 Weakened Planes. HR-not required; LS-LMH; PR-LMH.	Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.3)			X		The building does not have any masonry veneer.
M-4 Unreinforced Masonry Backup. HR-LMH; LS-LMH; PR-LMH.	There is no unreinforced masonry backup. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.2)			X		The building does not have any masonry veneer.
M-5 Stud Tracks. HR-not required; LS-MH; PR-MH.	For veneer with coldformed steel stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. (610 mm) on center. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.6.)			X		The building does not have any masonry veneer.
M-6 Anchorage. HR-not required; LS-MH; PR-MH.	For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof. (Tier 2: Sec. 13.6.1.1, 13.6.1.2; Commentary: Sec. A.7.7.1)			X		The building does not have any masonry veneer.
M-7 Weep Holes. HR-not required; LS-not required; PR-MH.	In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Tier 2: Sec. 13.6.1.2; Commentary: Sec. A.7.5.6)			X		Not required for life safety performance level.
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		Not required for life safety performance level.

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		The building does not contain unreinforced masonry parapets.
PCOA-2 Canopies. HR-not required; LS-LMH; PR-LMH.	Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft (3.0 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft (1.8 m). (Tier 2: Sec. 13.6.6; Commentary: Sec. A.7.8.2)	X				
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				Height to thickness ratio for parapet is 1.5.
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				Parapet is poured integral with building wall and reinforcing is continuous from wall through parapet.

Masonry Chimneys

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

Stairs

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
S-1 Stair Enclosures. HR-not required; LS-LMH; PR-LMH.	Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out of plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Tier 2: Sec. 13.6.2, 13.6.8; Commentary: Sec. A.7.10.1)			X		No URM chimney in the building
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		Cast-in-place chimney

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 unit in the building.
CF-2 Tall Narrow Contents. HR-not required; LS-H; PR-MH.	Contents more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.2)		X			Tall shelving units are not anchored to floor or wall.
CF-3 Fall-Prone Contents. HR-not required; LS-H; PR-H.	Equipment, stored items, or other contents weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level are braced or otherwise restrained. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.3)		X			Projector that appears to weigh more than 20-lbs is not braced.
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		Not required for life safety performance level.
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		Not required for life safety performance level.
CF-6 Suspended Contents. HR-not required; LS-not required; PR-H.	Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Tier 2: Sec. 13.8.2; Commentary: Sec. A.7.11.6)			X		Not required for life safety performance level.

Mechanical and Electrical Equipment

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
ME-1 Fall-Prone Equipment. HR-not required; LS-H; PR-H.	Equipment weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level, and which is not in-line equipment, is braced. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.4)		X			Some equipment in the mechanical room whose center of mass appears to be more than 4ft off the ground is not braced.
ME-2 In-Line Equipment. HR-not required; LS-H; PR-H.	Equipment installed in line with a duct or piping system, with an operating weight more than 75 lb (34.0 kg), is supported and laterally braced independent of the duct or piping system. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.5)	X				The equipment does not appear to weigh more than 75lbs.
ME-3 Tall Narrow Equipment. HR-not required; LS-H; PR-MH.	Equipment more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Tier 2: Sec. 13.7.1 13.7.7; Commentary: Sec. A.7.12.6)	X				No tall and narrow equipment in the building.
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		Not required for life safety performance level.
ME-5 Suspended Equipment. HR-not required; LS-not required; PR-H.	Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.8)			X		Not required for life safety performance level.
ME-6 Vibration Isolators. HR-not required; LS-not required; PR-H.	Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Tier 2: Sec. 13.7.1; Commentary: Sec. A.7.12.9)			X		Not required for life safety performance level.
ME-7 Heavy Equipment. HR-not required; LS-not required; PR-H.	Floor supported or platform-supported equipment weighing more than 400 lb (181.4 kg) is anchored to the structure. (Tier 2: Sec. 13.7.1, 13.7.7; Commentary: Sec. A.7.12.10)			X		Not required for life safety performance level.
ME-8 Electrical Equipment. HR-not required; LS-not required; PR-H.	Electrical equipment is laterally braced to the structure. (Tier 2: Sec. 13.7.7; Commentary: Sec. A.7.12.11)			X		Not required for life safety performance level.
ME-9 Conduit Couplings. HR-not required; LS-not required; PR-H.	Conduit greater than 2.5 in. (64 mm) trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Tier 2: Sec. 13.7.8; Commentary: Sec. A.7.12.12)			X		Not required for life safety performance level.

Piping

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
PP-1 Flexible Couplings. HR-not required; LS-not required; PR-H.	Fluid and gas piping has flexible couplings. (Tier 2: Sec. 13.7.3, 13.7.5; Commentary: Sec. A.7.13.2)			X		Not required for life safety performance level.

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

Ducts

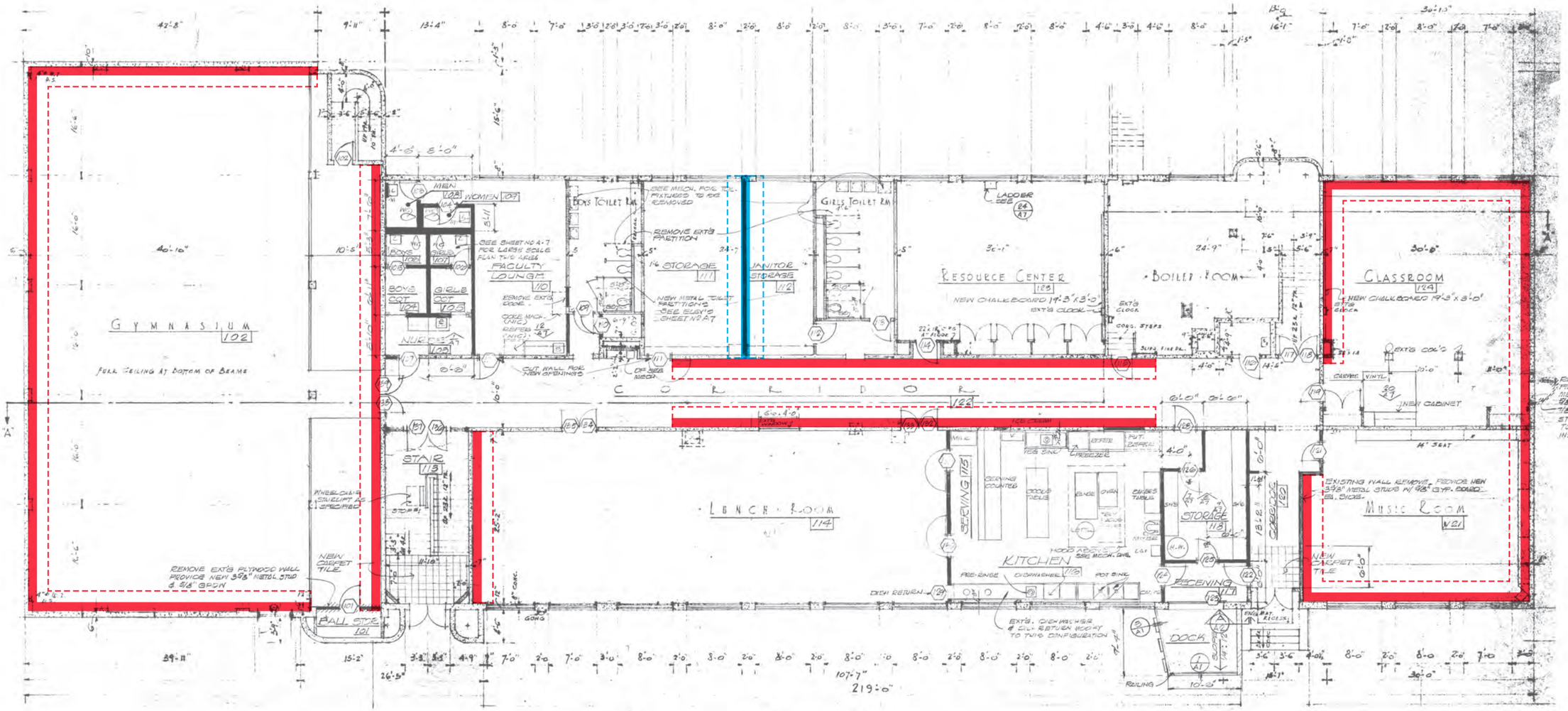
EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
D-1 Duct Bracing. HR-not required; LS-not required; PR-H.	Rectangular ductwork larger than 6 ft2 (0.56 m2) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does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

Elevators

EVALUATION ITEM	EVALUATION STATEMENT	C	NC	N/A	U	COMMENT
EL-1 Retainer Guards. HR-not required; LS-H; PR-H.	Sheaves and drums have cable retainer guards. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.1)			X		The building does not have any elevators.
EL-2 Retainer Plate. HR-not required; LS-H; PR-H.	A retainer plate is present at the top and bottom of both car and counterweight. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.2)			X		The building does not have any elevators.
EL-3 Elevator Equipment. HR-not required; LS-not required; PR-H.	Equipment, piping, and other components that are part of the elevator system are anchored. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.3)			X		Not required for life safety performance level.
EL-4 Seismic Switch. HR-not required; LS-not required; PR-H.	Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.4)			X		Not required for life safety performance level.

EL-5 Shaft Walls. HR-not required; LS-not required; PR-H.	Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.5)			X		Not required for life safety performance level.
EL-6 Counterweight Rails. HR-not required; LS-not required; PR-H.	All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.6)			X		Not required for life safety performance level.
EL-7 Brackets. HR-not required; LS-not required; PR-H.	The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.7)			X		Not required for life safety performance level.
EL-8 Spreader Bracket. HR-not required; LS-not required; PR-H.	Spreader brackets are not used to resist seismic forces. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.8)			X		Not required for life safety performance level.
EL-9 Go-Slow Elevators. HR-not required; LS-not required; PR-H.	The building has a go-slow elevator system. (Tier 2: Sec. 13.7.11; Commentary: Sec. A.7.16.9)			X		Not required for life safety performance level.

APPENDIX B: CONCEPT-LEVEL SEISMIC UPGRADE FIGURES



FIRST FLOOR PLAN

SCALE - 1/8" = 1'-0"

WALL LEGEND

EXISTING CONC. W/ CEM. PLASTER
EXISTING BLOCK W/ CEM. PLASTER
NEW METAL STUDS W/ 5/8" GYPSUM
NEW CEMENT MASONRY
EXT'G WALL TO BE REMOVED

8" Thick Concrete Shotcrete Wall w/ Shallow Footing, Typ.

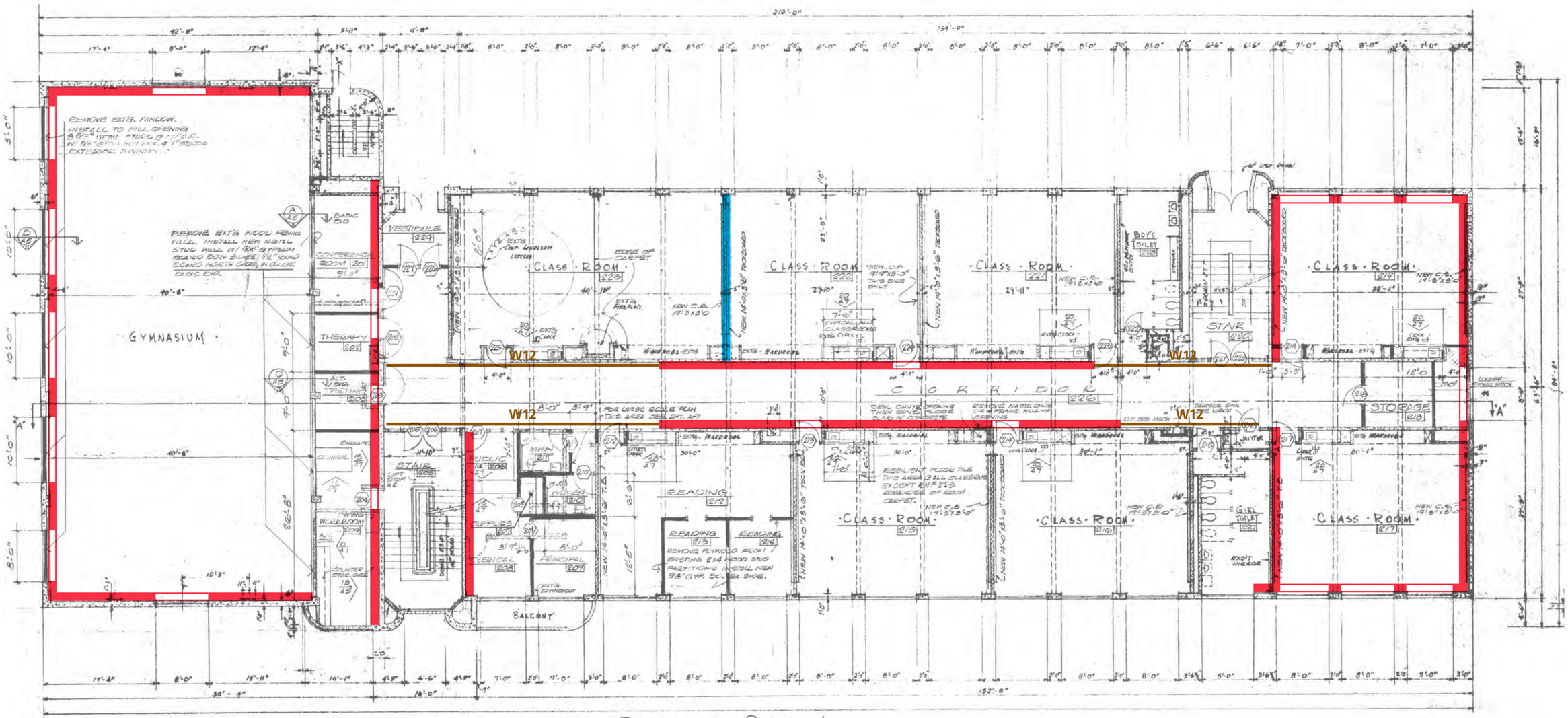
8" Thick Concrete Wall w/ Shallow Footing

ReidMiddleton

Lincoln Elementary School Seismic Upgrades

Mount Vernon School District – September 2018

Figure 1 - First Floor



SECOND FLOOR PLAN
SCALE 1/8" = 1'-0"

WALL LEGEND

- EXISTING CONC. W/ CEM. PLASTER
- EXISTING GYPSUM BLOCK W/ CEMENT PLASTER
- NEW METAL STUDS W/ 5/8" GYPSUM, INSULATION, & SOUND BOARD
- NEW METAL STUDS W/ 5/8" GYPSUM - AT EXTERIOR WALL 7/8" STUCCO EXTERIOR FINISH.
- EXISTING WALL TO BE REMOVED

W12 Steel Drag Strut Beam

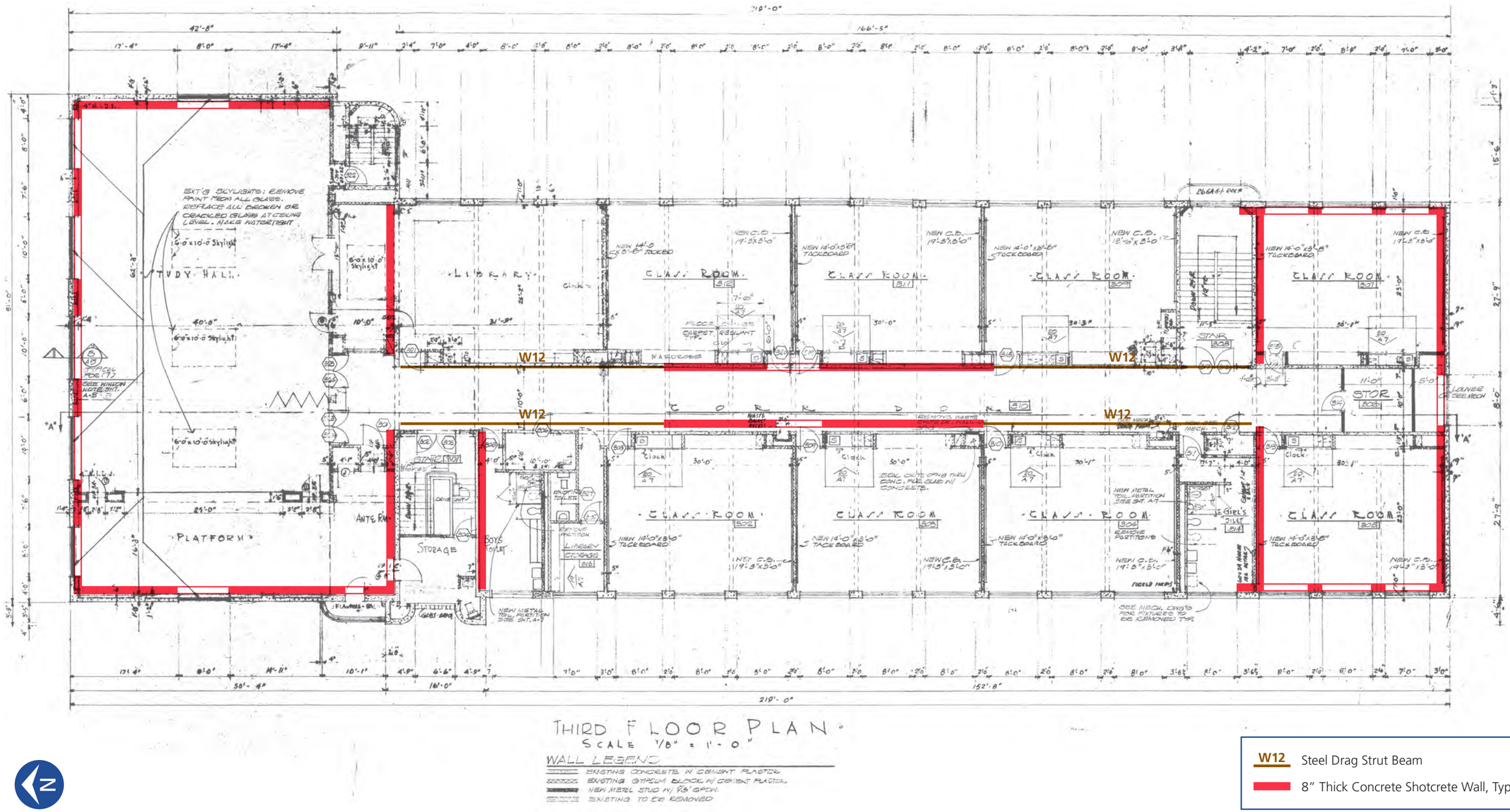
8" Thick Concrete Shotcrete Wall, Typ.

8" Thick Concrete Wall

ReidMiddleton

Lincoln Elementary School Seismic Upgrades
Mount Vernon School District – September 2018

Figure 2 - Second Floor



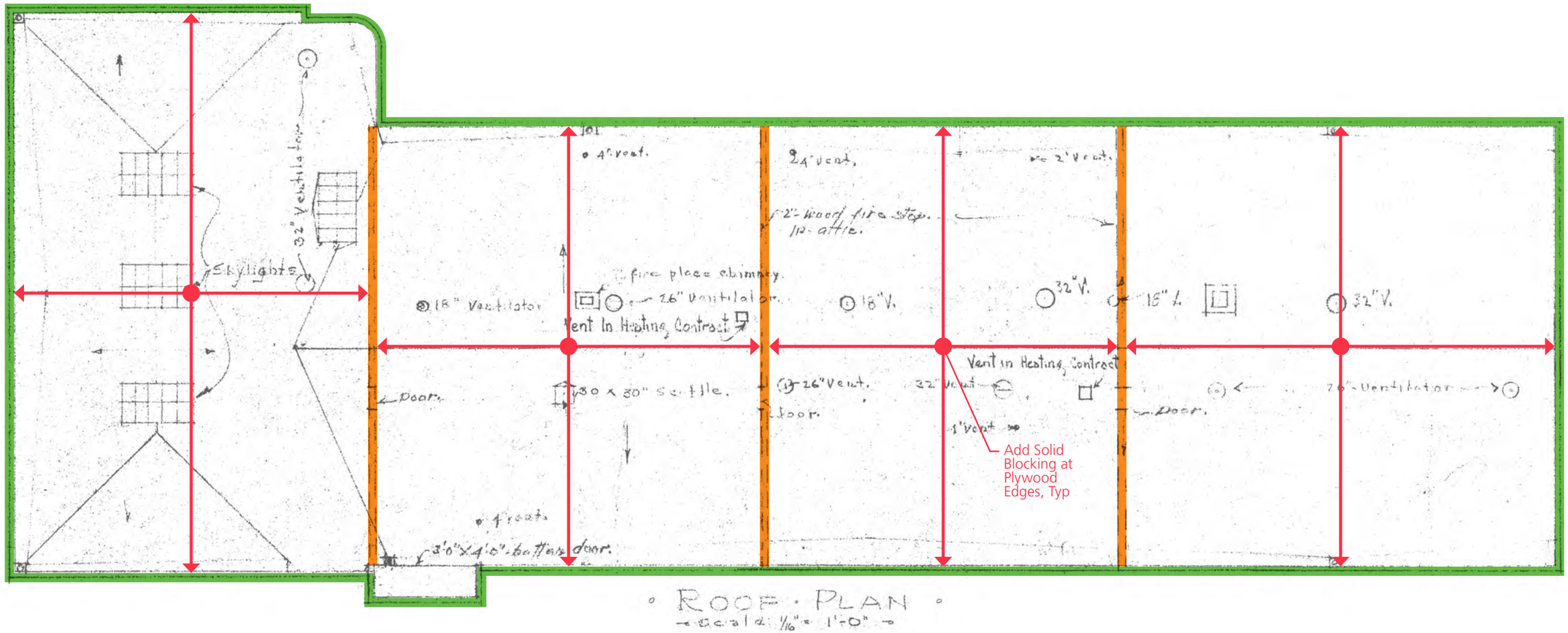
W12 Steel Drag Strut Beam

8" Thick Concrete Shotcrete Wall, Typ.

ReidMiddleton

Lincoln Elementary School Seismic Upgrades
Mount Vernon School District – September 2018

Figure 3 - Third Floor



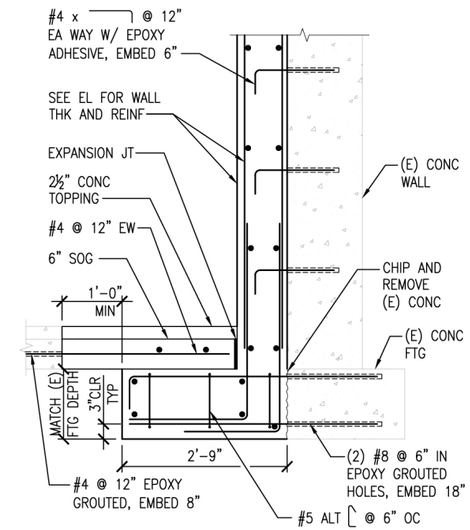
Upgrade Wood Shear Wall. Add Hold Own at Each End

Additional Out of Plane Tie Connections Between Existing Concrete Wall to Roof Diaphragm

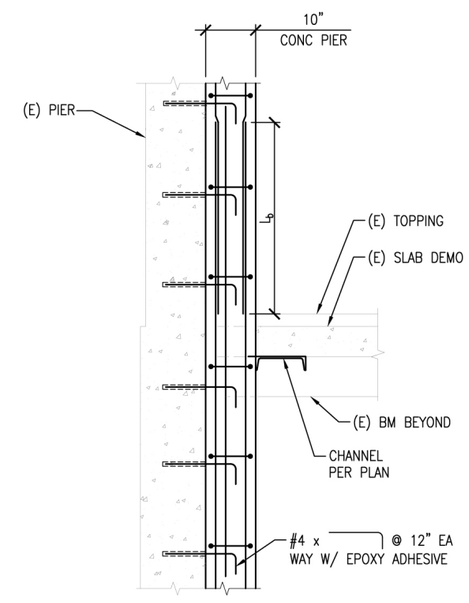
ReidMiddleton

Lincoln Elementary School Seismic Upgrades
Mount Vernon School District – September 2018

Figure 4 - Roof Floor



Conceptual Section Through Shocrete
Shear Wall & Foundation Upgrades



Conceptual Section Through Shocrete
Shear Wall At Elevated Floors

ReidMiddleton

Lincoln Elementary School Seismic Upgrades
Mount Vernon School District – September 2018

Figure 5 - Conceptual Sections

APPENDIX C: OPINION OF PROBABLE CONSTRUCTION COST

ReidMiddleton	OPINION OF PROBABLE CONSTRUCTION COST		Status:	Concept
Client:	DNR		Est By:	BCM
Owner:	Mount Vernon School District		Chk By:	DBS
Project:	Lincoln Elementary School		Date:	September 26, 2018
	Structural/Nonstructural Seismic Retrofit		Job No:	26-18-063

Item No.	Description	Quantity		Engineering Estimate		Item Subtotal
		Number	Unit	Unit Cost	Total	
1	**Seismic Retrofit**					**$1,553,678**
	Concrete Shearwalls (incl fdns)	40002	SF	$23	$914,446	
	Collector Beams	40002	SF	$16	$639,232	
				$0	$0	
				$0	$0	
				$0	$0	
				$0	$0	
				$0	$0	
				$0	$0	
2	**Nonstructural Demo/Restoration***					**$2,027,901**
	Ceilings/Finishes	20001	SF	$65	$1,301,265	
	Mechanical/Electrical/Plumbing	20001	SF	$36	$726,636	
				$0	$0	
	*assumes 50 percent of existing nonstructural			$0	$0	
	systems require upgrades/replacement			$0	$0	
				$0	$0	
				$0	$0	
				$0	$0	

TOTALS

Exclusions: Hazardous Material Abatement/Disposal		Project Sub Total:	$3,581,579
	10%	Mobilization:	$358,158
	9.0%	Sales Tax:	$322,342
	6.0%	Escalation:	$214,895
	20%	Contingency:	$716,316
	(round up to nearest $1000)	**PROJECT TOTAL:**	**$5,194,000**
	(round up to nearest $1000)	**-30% COST VARIANCE:**	**$3,636,000**
	(round up to nearest $1000)	**+50% COST VARIANCE:**	**$7,791,000**

APPENDIX D: EARTHQUAKE PERFORMANCE ASSESSMENT TOOL (EPAT) WORKSHEET

Washington Schools Earthquake Performance Assessment Tool (EPAT)
MAIN PAGE

Full District Name	Mount Vernon		
Point of Contact	Bill Nutting		
Telephone	360-428-6113		
E-Mail	bnutting@mvsd320.org		
File Name	Mount Vernon, Lincoln Elementary School, Main Building EPAT.xlsm	**File Date:**	9/26/2018

District	Mount Vernon
Facility Name	Lincoln Elementary School
Building Part Name	Main Building

Earthquake Ground Motion (% g)		**Earthquake Hazards**	
20% in 50 year PGA	18.6%	**Site Class**	C
10% in 50 year PGA	26.8%	**Ground Shaking Hazard**	High
2% in 50 year PGA	47.7%	**Liquefaction Potential**	Low to Moderate
Percentile S_s *Among all WA Campuses*	48%	**Combined Earthquake Hazard Level**	High

Total Building Part Area (Square Feet)	**Building Evaluated By**	**Input Data by Person(s)**
40,002	DNR, Reid Middleton	Tim Green, 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	Lincoln Elementary School
Building Name	Main Building
Building Use	Assembly

Data Entry Item	User Entered Values	Default Values	Used for BCA
Seismic Data			
Decimal Latitude	48.41525	48.41525	48.41525
Decimal Longitude	-122.327569	-122.327569	-122.327569
Site Class (Soil/Rock Type)	C	D	C
Liquefaction Potential	Low to Moderate	Low to Moderate	Low to Moderate
Geographic Region for Seismic Zones	Puget Sound	Puget Sound	Puget Sound
Building Structural Data			
HAZUS Building Type***	C2	Concrete Shear Walls	C2
Number of Stories (Excluding Basement)***	3		3
Year Built***	1938		1938
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)	<1973		<1973
Severe Vertical Irregularity***	Yes		Yes
Moderate Vertical Irregularity***	No		No
Plan (Horizontal) Irregularity***	No		No

***** Mandatory Data Entry**

Washington Schools Earthquake Performance Assessment Tool (EPAT)
RESULTS SUMMARY

District Name	Mount Vernon	**Existing Building Life Safety Risk & Priority for Retrofit or Replacement**
School Name	Lincoln Elementary School	
Building Name	Main Building	Very High

Building Data

HAZUS Building Type	C2	Concrete Shear Walls
Year Built	1938	These parameters determine the capacity of the existing building to withstand earthquake forces.
Building Design Code	<1973 UBC	
Existing Building Code Level	Pre	
Geographic Area	Puget Sound	
Severe Vertical Irregularity	Yes	Buildings with irregularities have greater earthquake damage than otherwise similar buildings that are regular.
Moderate Vertical Irregularity	No	
Plan Irregularity	No	

Seismic Data

Earthquake Ground Shaking Hazard Level	High	Frequency and severity of earthquakes at this site
Percentile S_s Among WA K-12 Campuses	48%	Earthquake ground shaking hazard is higher than 48% of WA campuses.
Site Class (Soil or Rock Type)	C	Very Dense Soil and Soft Rock
Liquefaction Potential	Low to Moderate	Liquefaction increases the risk of major damage to a building
Combined Earthquake Hazard Level	High	Earthquake ground shaking and liquefaction potential

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

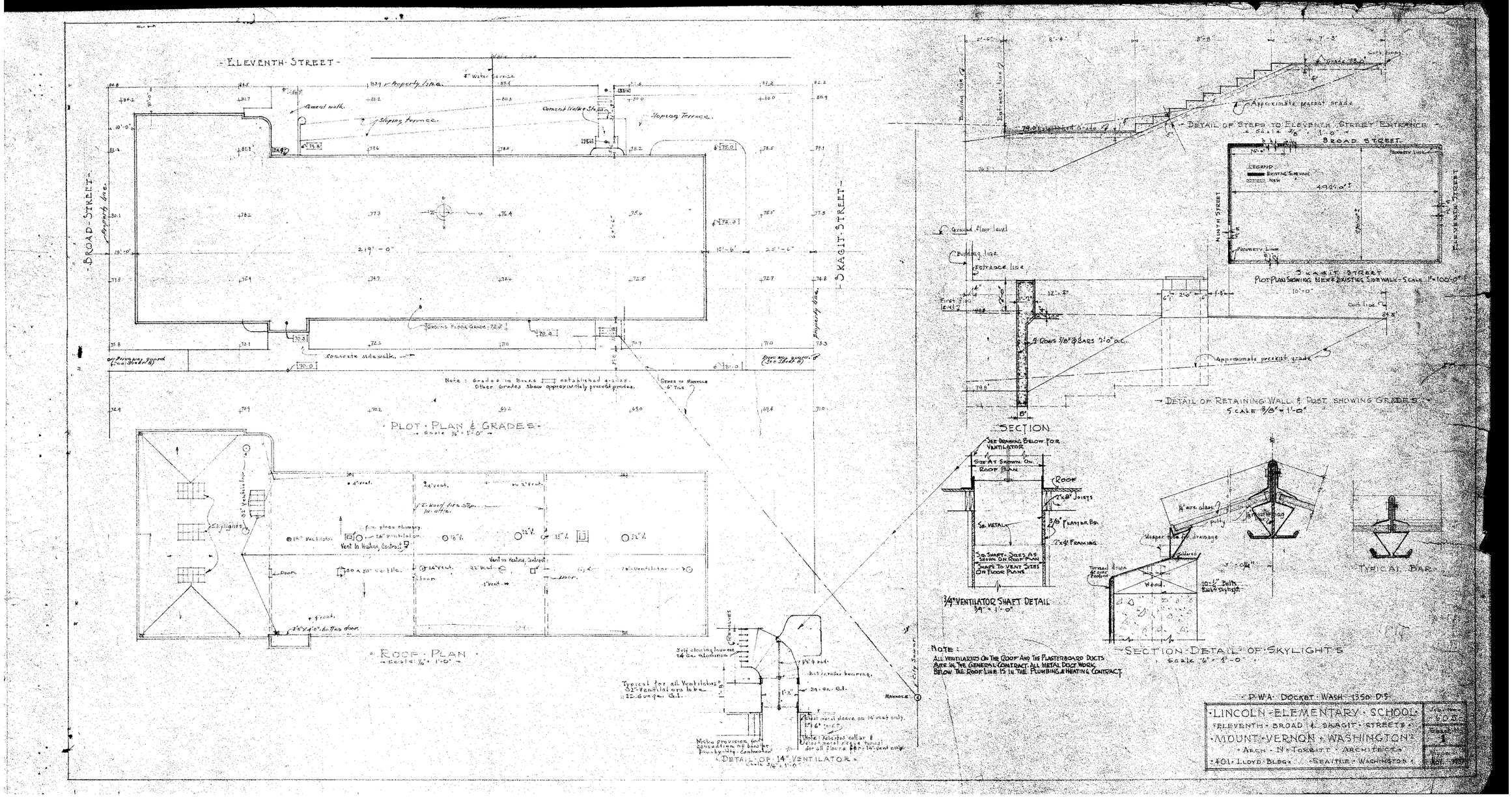
Building State	Building Damage Estimate[2]	Probability Building is not Repairable[3]	Life Safety[4] Risk Level	Most Likely Post-Earthquake Tagging[5]
Existing Building	75%	75%	Very High	Red
Life Safety Retrofit Building	14%	6.6%	Very Low	Green
Current Code Building	11%	4.1%	Very Low	Green

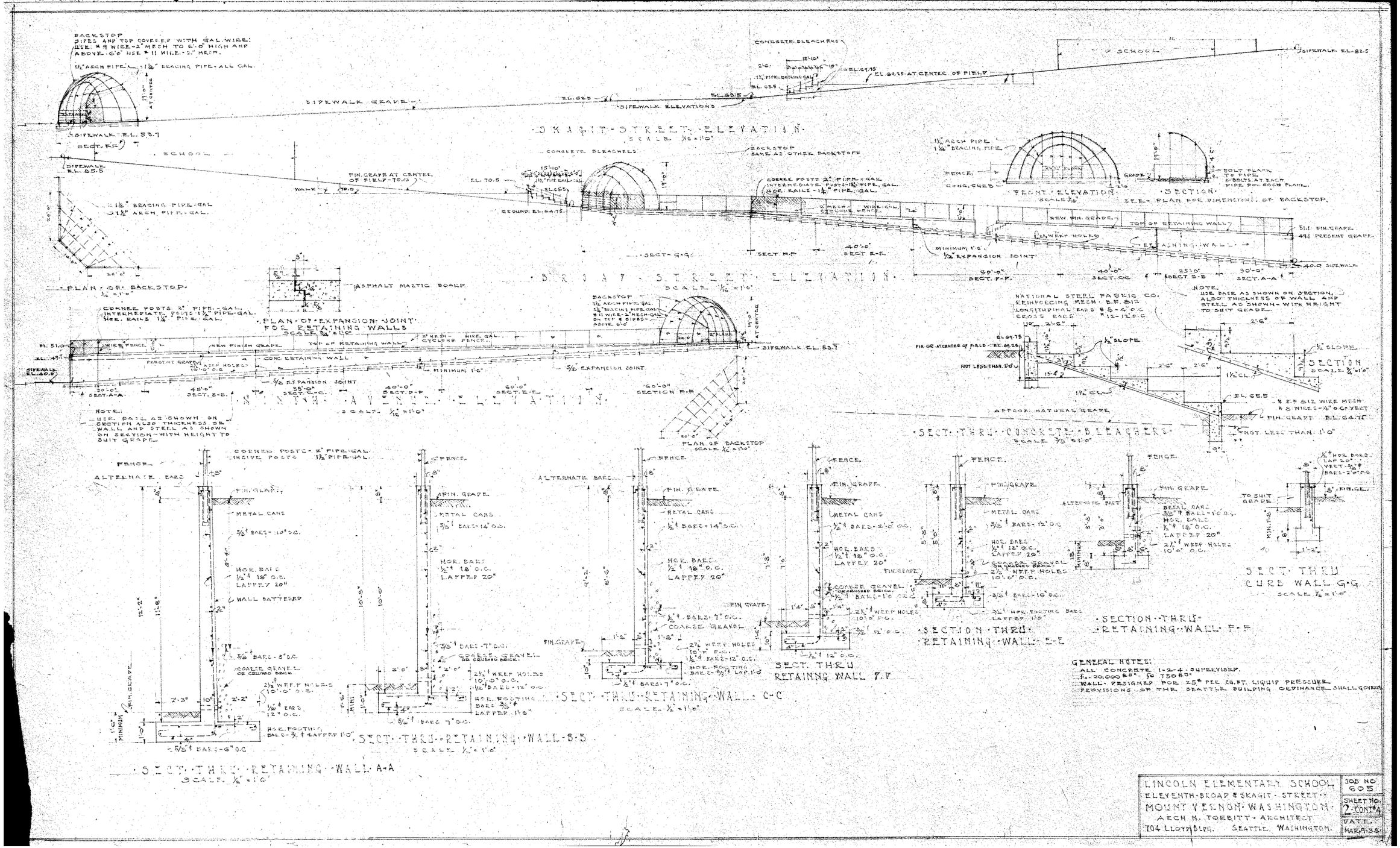
1. 2/3rds of the 2% in 50 year ground motion
2. Percentage of building replacement value.
3. Probability building is in the Extensive or Complete damage states. For existing buildings, the probability that the building is not economically repairable may be higher: some buildings in the Moderate Damage 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.

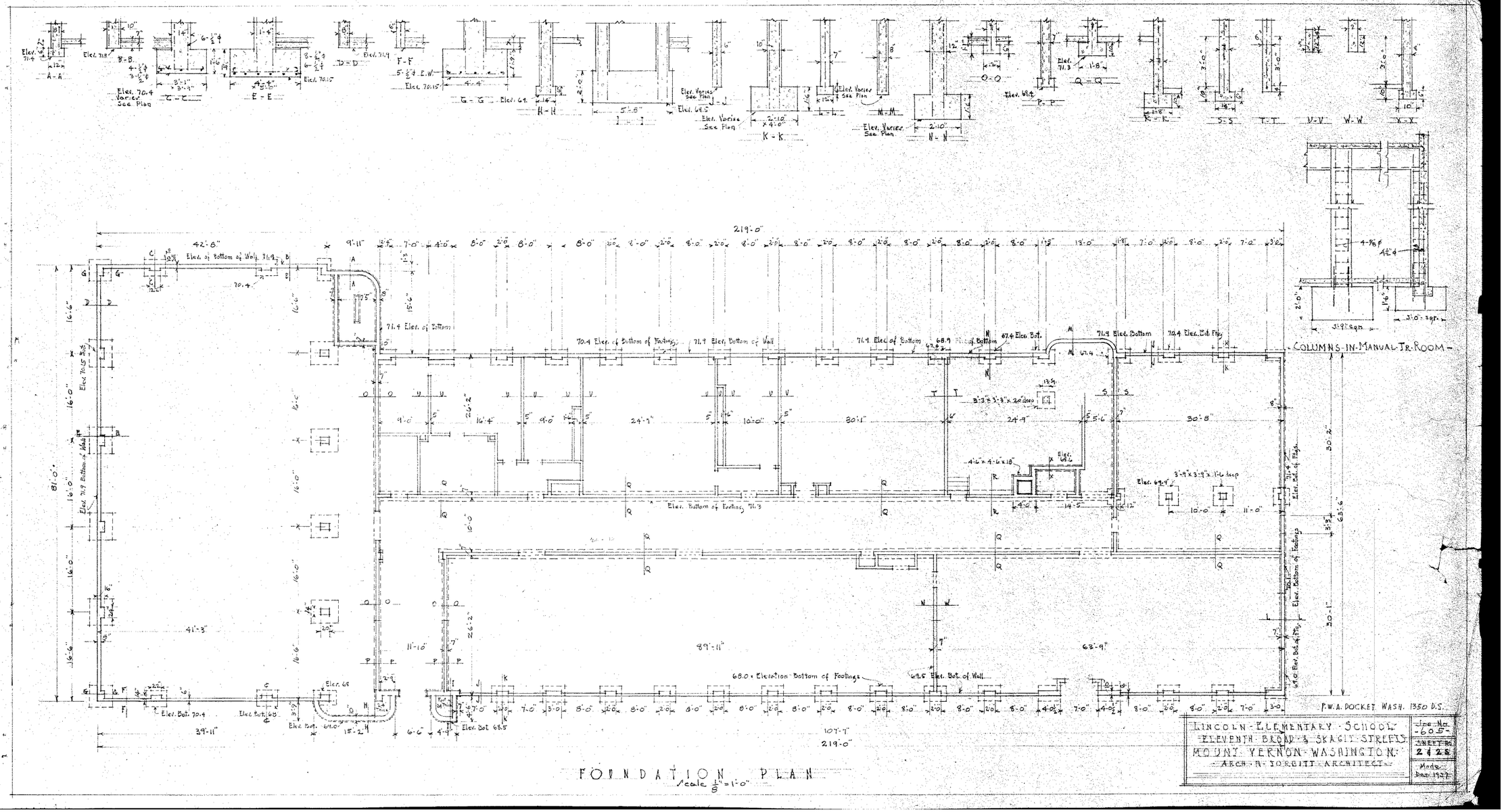
Source for the Data Entered into the Tool

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

APPENDIX E: Lincoln Elementary School Record Drawings

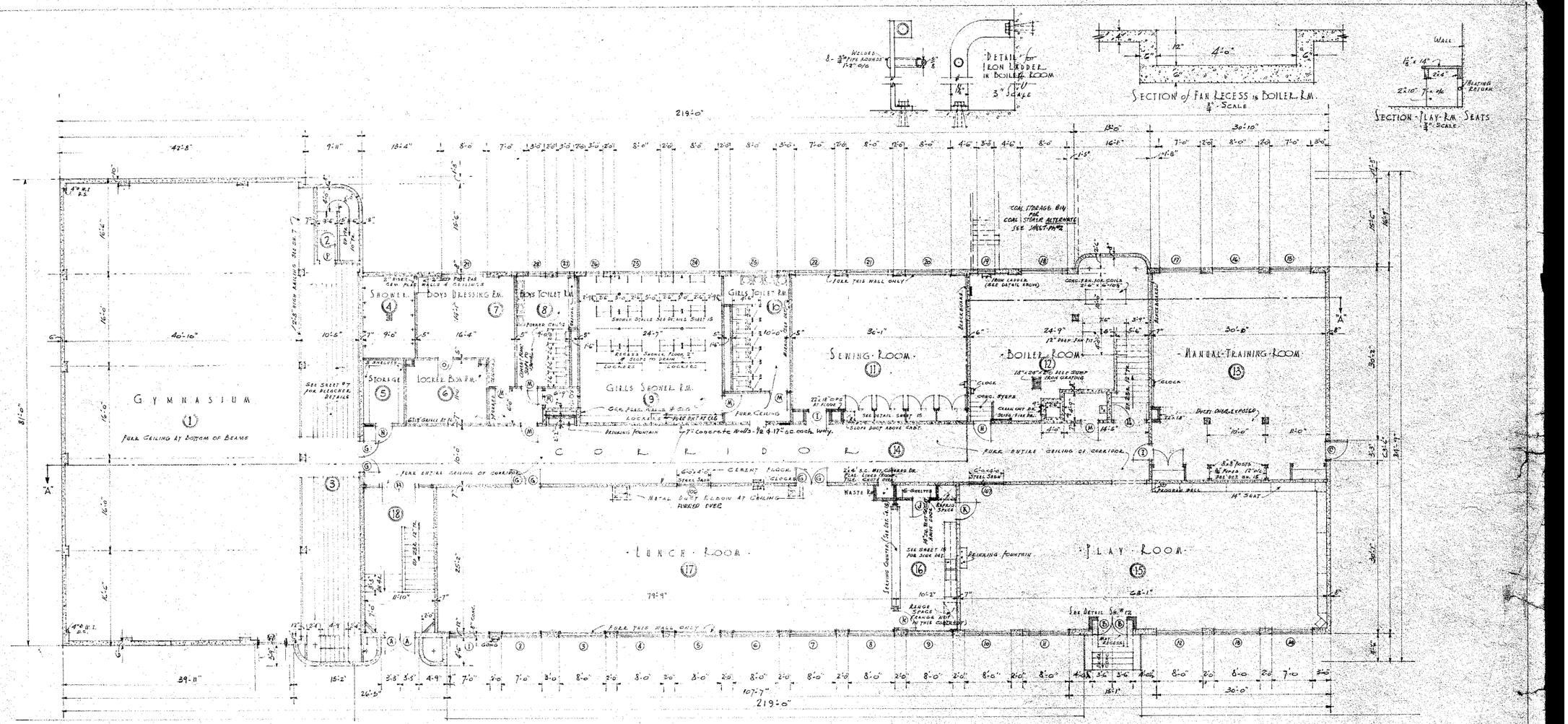

ELEVENTH STREET
BROAD STREET
SKAGIT STREET
Cement walk.
Sloping terrace.
Cement Walks & Steps
Sloping Terrace.
Ground Floor Grade 72.8
Concrete sidewalk.
Note: Grades in Boxes ☐ established grades.
Other grades show approximately present grades.
PLOT PLAN & GRADES
Scale 1/16" = 1'-0"
Skylights
Vent in Heating Contract
Door
ROOF PLAN
Scale 1/16" = 1'-0"
Typical for all Ventilators
DETAIL OF 14" VENTILATOR
Scale 3/4" = 1'-0"
DETAIL OF STEPS TO ELEVENTH STREET ENTRANCE
Scale 3/8" = 1'-0"
Approximate present grade
Ground floor level
Building line
Entrance line
SKAGIT STREET
PLOT PLAN SHOWING NEW & EXISTING SIDEWALK - SCALE 1" = 100'-0"
LEGEND
Existing Sidewalk
New
NINTH STREET
ELEVENTH STREET
DETAIL OF RETAINING WALL & POST SHOWING GRADES
SCALE 3/8" = 1'-0"
SECTION
See Drawing Below For Ventilator
Size As Shown On Roof Plan
Roof
2"x8" Joists
3/8" Plaster Bd.
2"x4" Framing
Sh. Metal
Sq. Shaft - Sizes As Shown On Roof Plan
Shape To Vent Sizes On Roof Plans
3/4" VENTILATOR SHAFT DETAIL
3/4" = 1'-0"
Wood.
Bolts Built-in Skylight
SECTION DETAIL OF SKYLIGHTS
Scale 3/4" = 1'-0"
TYPICAL BAR
Note:
All ventilators on the roof and the plasterboard ducts are in the general contract. All metal duct work below the roof line is in the plumbing & heating contract.
P.W.A. DOCKET WASH. 1350 D.S.
LINCOLN ELEMENTARY SCHOOL
ELEVENTH - BROAD & SKAGIT - STREETS
MOUNT VERNON, WASHINGTON
ARCH. N. TORBITT ARCHITECT
401 LLOYD BLDG. SEATTLE, WASHINGTON
605
1
NOV. 1937


SKAGIT STREET ELEVATION
SCALE 1/16"=1'0"
BROADWAY STREET ELEVATION
SCALE 1/16"=1'0"
NINTH AVENUE ELEVATION
SCALE 1/16"=1'0"
PLAN OF BACKSTOP
PLAN OF EXPANSION JOINT FOR RETAINING WALLS
SECTION
FRONT ELEVATION
SECTION
SECT. THRU CONCRETE BLEACHERS
SECT. THRU RETAINING WALL A-A
SECT. THRU RETAINING WALL B-B
SECT. THRU RETAINING WALL C-C
SECT. THRU RETAINING WALL F-F
SECTION THRU RETAINING WALL E-E
SECT. THRU CURB WALL G-G
SCHOOL
SIDEWALK
CONCRETE BLEACHERS
BACKSTOP
FENCE
GENERAL NOTES:
ALL CONCRETE 1-2-4 SUPERVISED.
WALL DESIGNED FOR 25# PER CU.FT. LIQUID PRESSURE.
PROVISIONS OF THE SEATTLE BUILDING ORDINANCE SHALL GOVERN.
LINCOLN ELEMENTARY SCHOOL
ELEVENTH-BROAD & SKAGIT STREETS
MOUNT VERNON WASHINGTON
ARCH H. TORRITT ARCHITECT
704 LLOYD BLDG. SEATTLE, WASHINGTON.
JOB NO 605
SHEET NO. 2 CONT'D
DATE MAR 21-35



FOUNDATION PLAN

Scale $\frac{1}{8}$" = 1'-0"



GROUND FLOOR PLAN

SCALE 1/8" = 1'-0"

P.W.A. DOCKET WASH. 1350 DS.

LINCOLN ELEMENTARY SCHOOL ELEVENTH BROAD & SKAGIT STREETS MOUNT VERNON - WASHINGTON ARCH. H. TOLBITT ARCHITECT 401 BLOYD BUILDING SEATTLE WASHINGTON	JOB NO. 605 SHEET NO. 3 MADE NOV. 1937

General Notes

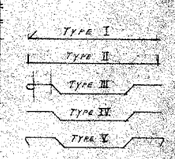
All concrete 1:2:4 Supervised
fs 20,000 #/□" fc 750 #/□" Assumed Live Load 50#/□'
All columns to be lapped 20 diameters Minimum 1'-0"
All footings to have slabs with same lap as noted above
All wall steel to be lapped 40 diameters. Ends hooked 1'-0" at corners
All columns to have 1/4" ⊡ bands 8" centers with 1/4" ⊡ cross bands every 2nd band so arranged as to catch steel
All openings in concrete walls to have 2-5/8" ϕ bars on all sides extending 1'-0" beyond corner.
Place 2 1/2" ϕ - 3'-0" diagonally at each corner.
All slab steel shall have a clearance of 1/2" top & bottom & shall be properly supported on steel or concrete chairs
Beam steel shall have a clearance of 1.5" from bottom & 1" from top. Provide proper support. The two layers of bottom steel shall have a clearance of 1" separated by spacers
Unless otherwise noted the provisions of the Seattle Building Ordinance shall apply & govern
Where slab steel may point to a beam or wall, provide 1/2" ϕ steel 4'-0" long, in top across slab.
When slab is only one side of said wall or beam, bend bars down in outside face
All slab steel to be properly supported on 1/4" ϕ carrying bars
All slabs to have 3/8" ϕ shrinkage steel 18" ctrs. lapped 1'-0"

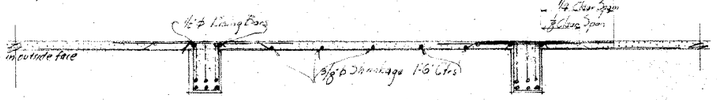
SLAB SCHEDULE

SLAB No.	THICKNESS	STEEL SIZE	STEEL SPACING	REMARKS
1	3"	3/8	4"	
2	3"	1/2	7 1/4"	
3	3 1/4"	1/2	4 1/2"	
4	4"	1/2	4"	
5	4"	1/2	5"	
6	4"	1/2	5 1/2"	

BEAM SCHEDULE

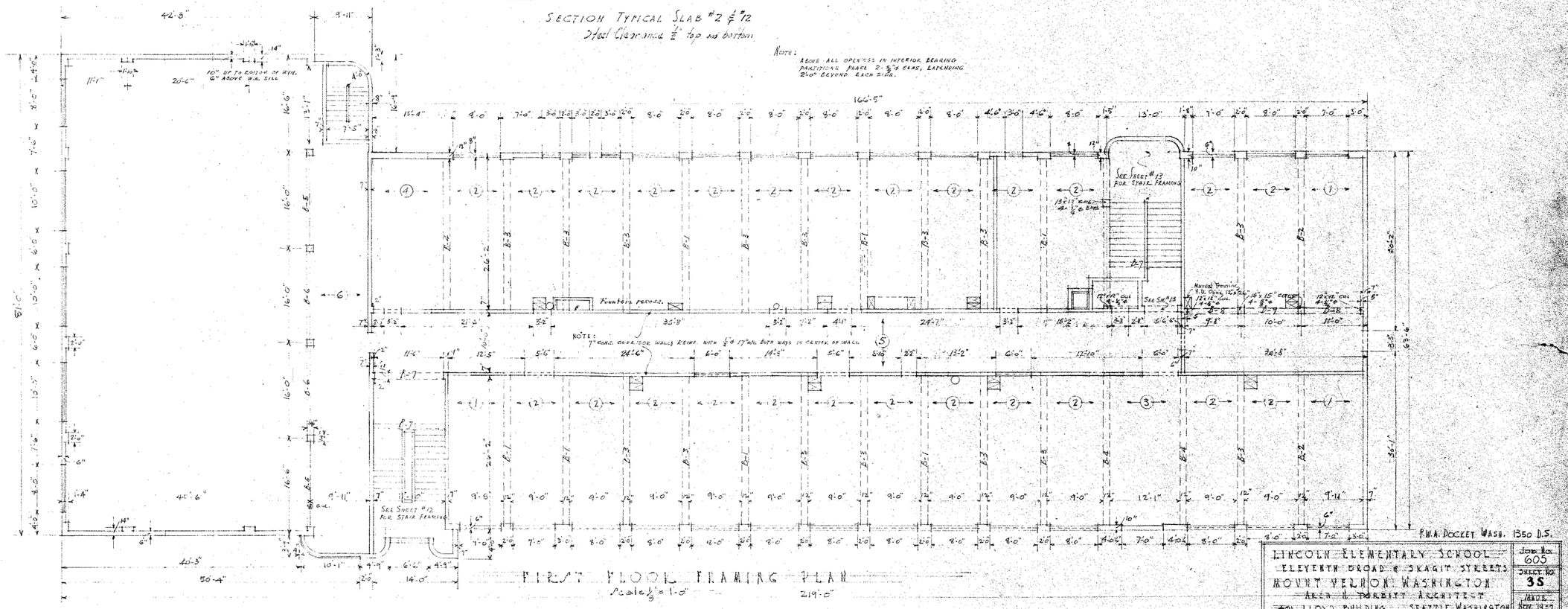
B. No.	SIZE	BOTTOM BARS SIZE	TYPE	STIRRUPS SIZE	TYPE	NO	SIZE	STIRRUPS (SPACING SAME AT OTHER END)
1	12"x 19"	3-1" ϕ	II	3-1" ϕ	V	14	3/8" ϕ	2 @ 9" 2 @ 10 1/2" 2 @ 12"
2	12"x 19"	1-1" ϕ 2-3/4" ϕ	II	3-3/8" ⊡	V	10	3/8" ϕ	4 @ 12"
3	12"x 19"	3-3/4" ϕ	II	3-3/8" ⊡	V	6	3/8" ϕ	2 @ 12"
4	14"x 19"	3-1 3/8" ϕ	II	3-1" ϕ	V	18	3/8" ϕ	2 @ 6" 2 @ 8" 2 @ 10" 2 @ 12"
5	6"x 30"	1-1/2" ϕ	I	1-1/2" ϕ	III	NONE		
6	6"x 30"	1-1/2" ϕ 1-1 3/8" ϕ	ST.	1-1/2" ϕ	IV	NONE		
7	12"x 19"	2-1/2" ⊡	II	2-1/2" ⊡	V	NONE		
8	12"x 24"	3-1/2" ϕ	II	3-3/8" ϕ	III		3/8" ϕ	@ 12" ENTIRE LENGTH - Closed Stirrups Type Bars 1/2" ϕ in one half
9	12"x 24"	" "	"	3-3/8" ϕ	IV		3/8" ϕ	@ 12" ENTIRE LENGTH do Bars 3/8" ϕ





SECTION TYPICAL SLAB #2 & #12
Steel Clearance 1/2" top and bottom

NOTE:
REMOVE ALL OPENINGS IN INTERIOR BEARING PARTITIONS. PLACE 2-5/8" ϕ BARS, EXTENDING 2'-0" BEYOND EACH SIDE.

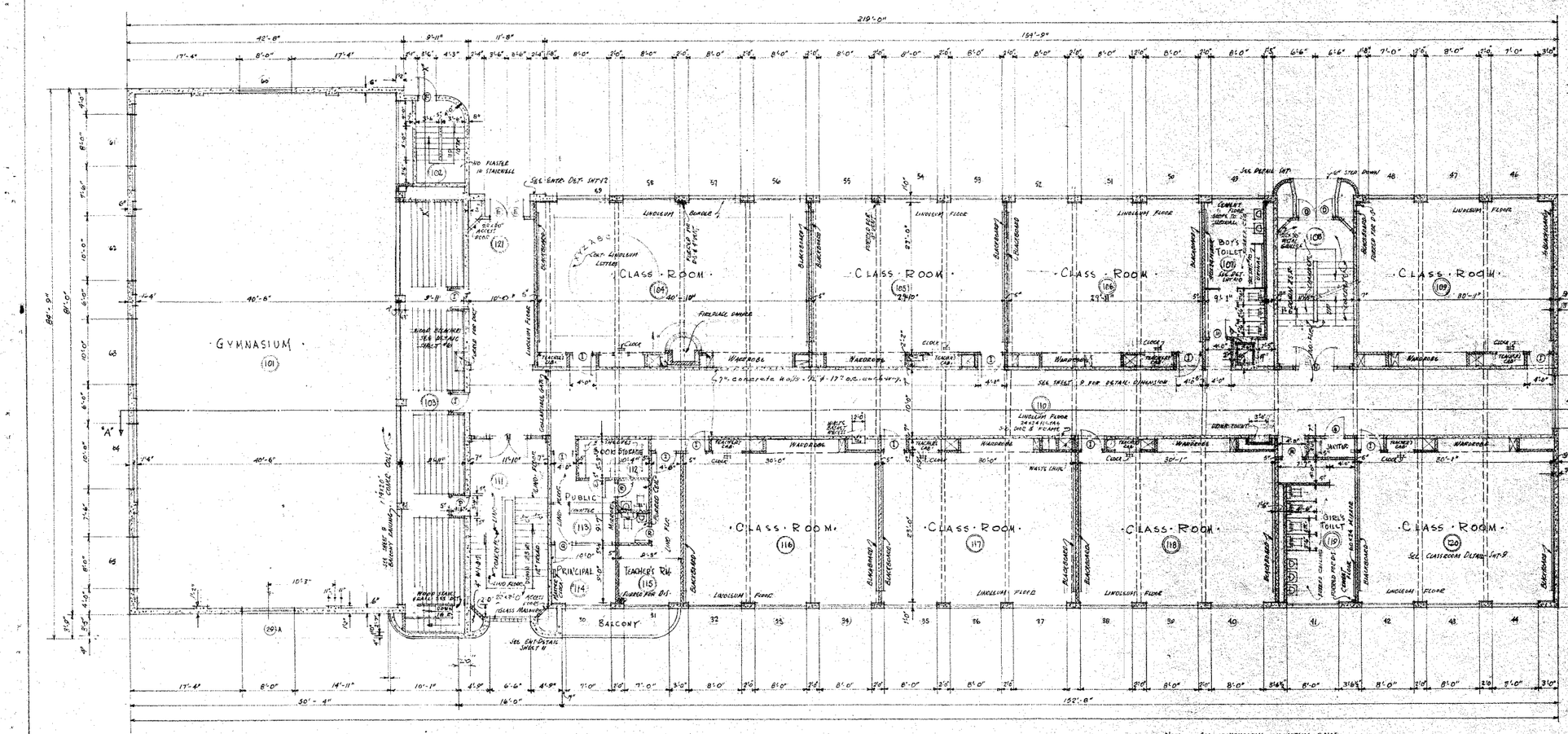


FIRST FLOOR FRAMING PLAN
Scale 1/8" = 1'-0"

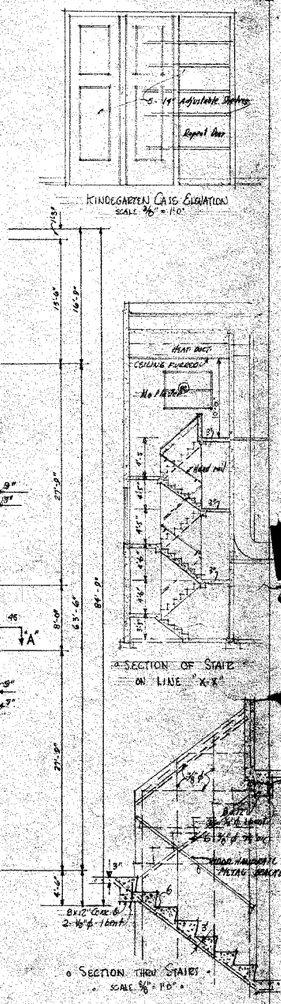
P.W.A. DOCKET WASH. 1350 D.S.

LINCOLN ELEMENTARY SCHOOL
ELEVENTH BROAD & SKAGIT STREETS
MOUNT VERNON WASHINGTON
ALLEN & TOREITT ARCHITECT
801 LLOYD BUILDING SEATTLE WASHINGTON

Job No. 605
Sheet No. 3S
Date Nov. 1937



FIRST FLOOR PLAN
SCALE 1/8" = 1'-0"



Note – All dimensions on outside walls incl. 2" furring unless otherwise indicated. Gymnasium outside walls not furred.

P.W.A. DOCKET WASH. 1350 P.S.

LINCOLN ELEMENTARY SCHOOL
ELEVENTH, BROAD & SKAGIT STREETS
MOUNT VERNON WASHINGTON
ARCH. N. TORBITT – ARCHITECT
401 LLOYD BLDG. SEATTLE WASHINGTON

Job No. 605
Sheet No. 4
Made Nov. 1937

SLAB SCHEDULE

SLAB No.	THICKNESS	STEEL SIZE	STEEL SPACING	REMARKS
11	3"	3/8" ϕ	4"	
12	3"	3/8" ϕ	7 1/2"	
13	3 1/2"	3/8" ϕ	4 1/2"	
14	4"	3/8" ϕ	4"	
15	3 1/2"	3/8" ϕ	5 1/2"	
16	3"	3/8" ϕ	6	
17	3"	3/8" ϕ	7 1/2"	

TYPE I

TYPE II

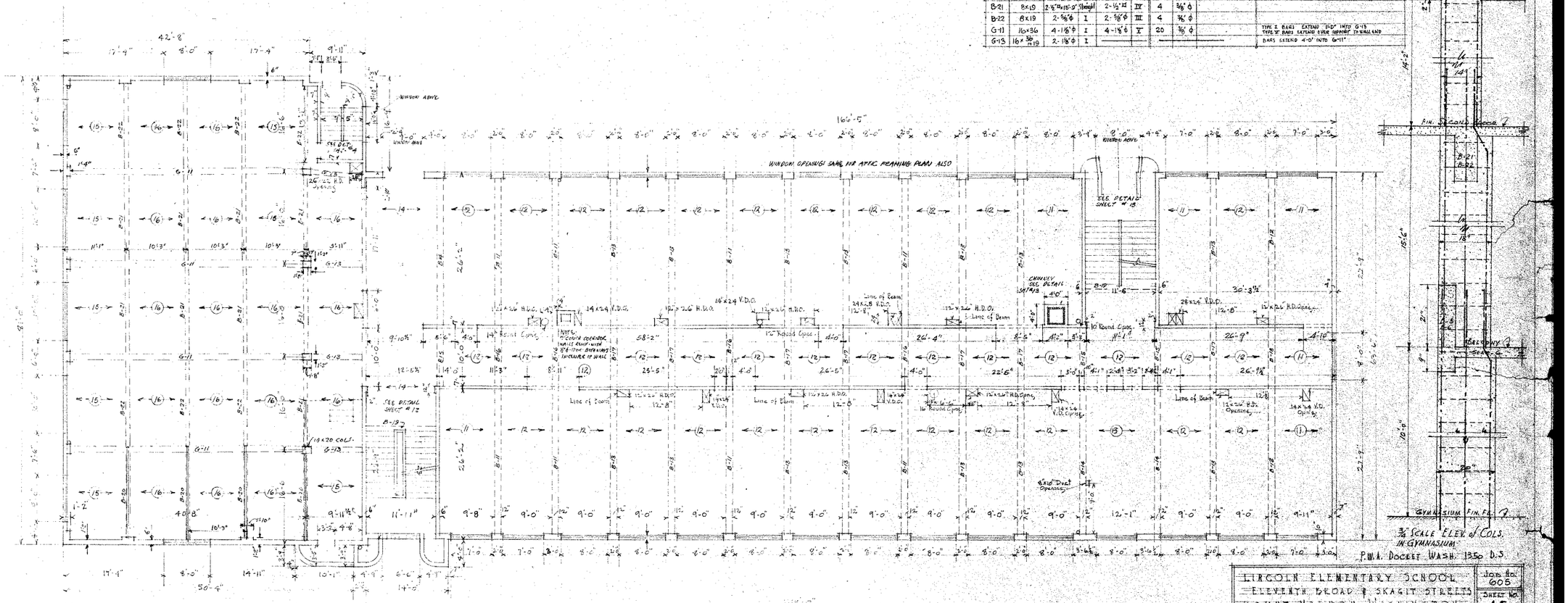
TYPE III

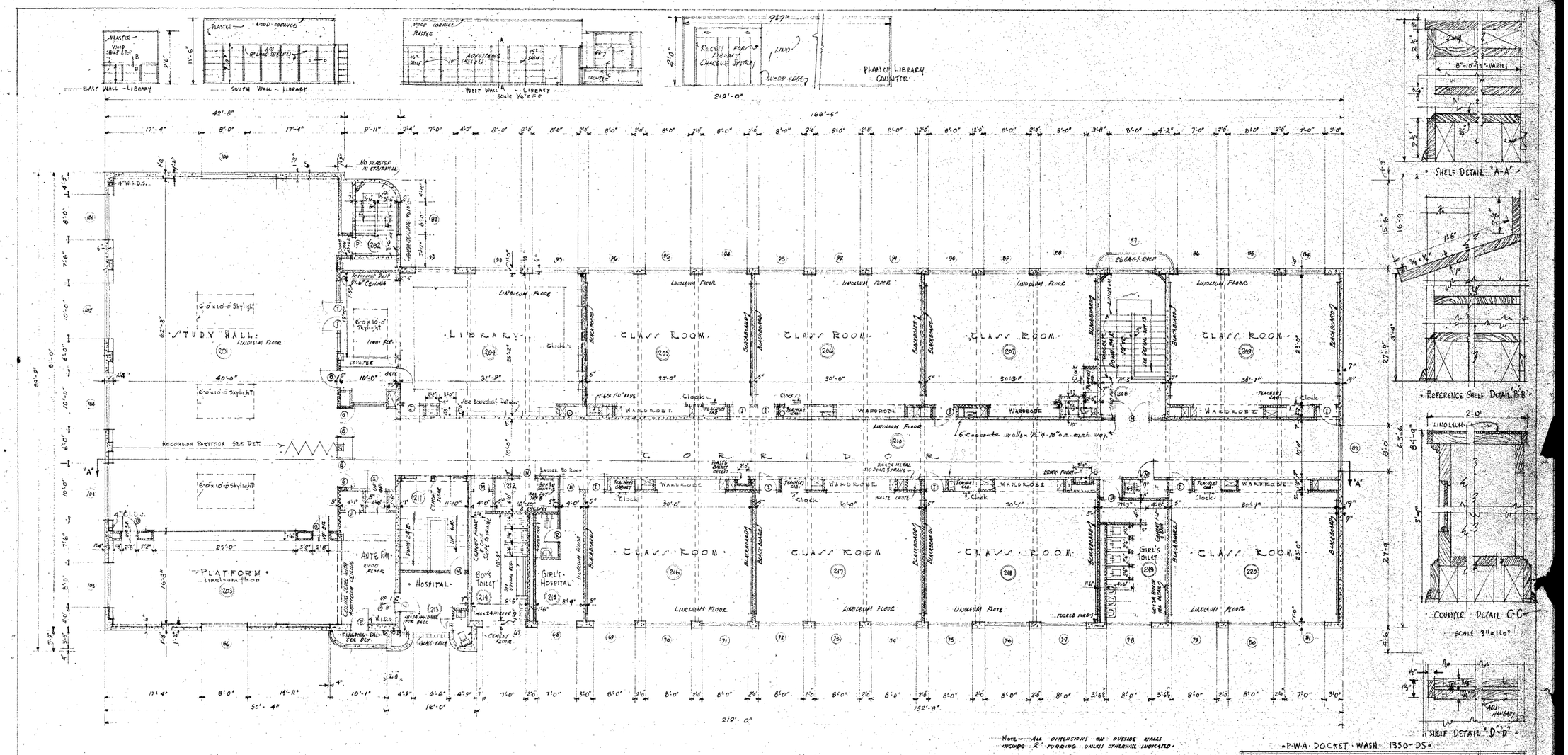
TYPE IV

TYPE V

BEAM SCHEDULE

B. No.	SIZE	BOTTOM BARS SIZE	TYPE	BOTTOM BARS SIZE	TYPE	STIRRUPS No.	STIRRUPS SIZE	STIRRUPS SPACING (EACH END)	REMARKS
B-11	12x19	2-3/4" ϕ	I	3-7/8" ϕ	IV	14	3/8" ϕ	2@8"-5@10"-3@12"	TYPE I BARS EXTEND 2'-0" THRU WALL INTO B-10 TYPE II BARS BENT OUTWARD FROM B-10 TO 1/4 PT. OF OPENING B-11
B-12	12x19	3-3/4" ϕ	I	3-7/8" ϕ	IV	10	3/8" ϕ	4@12"	TYPE I BARS EXTEND 2'-0" THRU WALL INTO B-18 TYPE II BARS EXTEND OUTWARD FROM B-18 TO 1/4 PT. OF OPENING B-12
B-13	12x19	3-3/4" ϕ	I	1-3/4" ϕ 1-3/4" ϕ	IV	6	3/8" ϕ	2@12"	TYPE II BARS EXTEND 2'-0" THRU WALL INTO B-14 TYPE III BARS BENT OUTWARD FROM B-13 TO 1/4 PT. OF OPENING B-13
B-14	12x19	3-1" ϕ	I	1-3/4" ϕ 1-1" ϕ	III	18	5/8" ϕ	2@6"-2@8"-2@10"-2@12"	TYPE I BARS EXTEND 2'-0" THRU WALL INTO B-15 TYPE III BARS EXTEND OUTWARD FROM B-15 TO OPPOSITE END
B-15	12x19	3-1" ϕ	I						TYPE I BARS EXTEND 5'-0" INTO B-14
B-16	12x19	3-1" ϕ + 1-5/8" ϕ + 1-1" ϕ	Straight						BARS EXTEND 5'-0" INTO B-11
B-17	12x19	2-3/4" ϕ + 1-7/8" ϕ	Straight						BARS EXTEND 5'-0" INTO B-13
B-18	12x19	3-3/4" ϕ + 1-7/8" ϕ	Straight						BARS EXTEND 5'-0" INTO B-12
B-19	12x19	2-1/2" □	II	2-1/2" □	V				
B-20	8x24	2-7/8" ϕ	II	2-1/2" □	V				
B-21	8x19	2-1/2" □ + 1-5/8" ϕ	Straight	2-1/2" □	IV	4	3/8" ϕ		
B-22	8x19	2-5/8" ϕ	I	2-5/8" ϕ	III	4	3/8" ϕ		
G-11	16x36	4-1 1/8" ϕ	I	4-1 1/8" ϕ	V	20	3/8" ϕ		TYPE I BARS EXTEND 1'-10" INTO G-13 TYPE V BARS EXTEND OVER SUPPORT TO WALL AND
G-13	16x 36/19	2-1 1/8" ϕ	I						BARS EXTEND 4'-0" INTO G-11"





SECOND FLOOR PLAN
SCALE 1/8" = 1'-0"

P.W.A. DOCKET WASH. 1350-DS

LINCOLN ELEMENTARY SCHOOL ELEVENTH BROAD & SKAGIT STREETS MOUNT VERNON WASHINGTON ARCH. N. TORBITT - ARCHITECT 401 LLOYD BLDG. SEATTLE WASHINGTON	Job No. 605 Sheet No. 5 MABB Nov. 1937

BEAM SCHEDULE

BEAM NO.	SIZE	BOTTOM STEEL SIZE	BOTTOM STEEL TYPE	STIRRUPS SIZE	STIRRUPS TYPE	STIRRUPS NO.	STIRRUPS SIZE	STIRRUPS SPACING FROM ONE END SPACE THE REST AT EQUAL INTERVALS	REMARKS
B-1.	6"x12"	2-½"ϕ-10'-9"	ST.		—	NONE			
B-2	10"x14"	2-½"ϕ	I	2-½"ϕ	III	"			
B-3	10"x14"	2-½"ϕ-15'-9"	ST.	2-½"ϕ	IV	"			
B-4	10"x16"	2-⅝"ϕ	I	2-⅝"ϕ	III	"			
B-5	10"x16"	2-½"ϕ-15'-9"	ST.	2-½"ϕ	IV	"			
B-6	10"x16"	2-⅝"ϕ	II	2-⅝"ϕ	V	"			
B-7	10"x16"	2-½"ϕ-15'-9"	ST.	2-½"ϕ	IV	"			
G-1	14"x28" 48 Cons.	3-1"ϕ	I	3-1"ϕ	V	18	⅜"ϕ	8@15"	Type 2 Bars carried into G-2. 1'-0" Type 2 Bars carried to Support Beyond G-2
G-2		2-⅜"ϕ	I	4-1⅛"ϕ Top.	I	5	⅜"ϕ	2@24"	Bottom Type 1 Bars carried into Support into G-1 4'-0" Top Type 1 " " " " " 1'-10½"
B-8	12"x19"	3-¾"ϕ-17'-0"	ST				NONE		
B-9	12"x19"	3-¾"ϕ	I	3-¾"ϕ	III	6	⅜"ϕ	2@12"	Type 2 Bars carried into Support At B-13 - 1'-0" Over " " " Thru B-13 into Opposite 2'-7 1/2"
B-10	12"x19"	3-¾"ϕ	I	3-¾"ϕ	V	8	⅜"ϕ	3@12"	Type 2 Bars Carried into Support At B-12-2'-0"
B-11	12"x19"	4-¾"ϕ	I	3-¾"ϕ	V	8	⅜"ϕ	3@12"	Type 1 " " " Over " To Other End of B-12
B-12	12"x19"	3-¾"ϕ-17'-0"				NONE			Type 2 " " " Into " At B-9 - 2'-7 1/2"
B-13	12"x19"	2-¾"ϕ-17'-0"				NONE			Type 2 " " " Over " To Other End of B-9

TYPE I

TYPE II

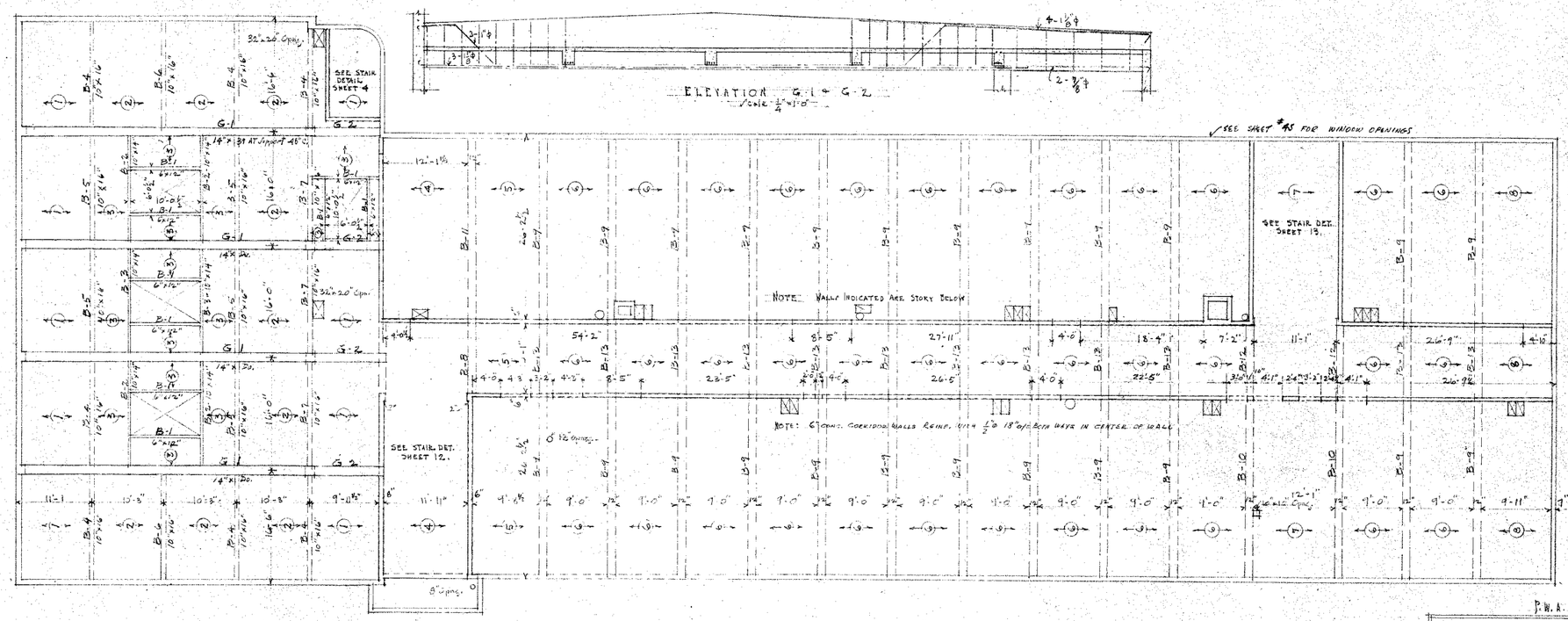
TYPE III

TYPE IV

TYPE V

SLAB SCHEDULE

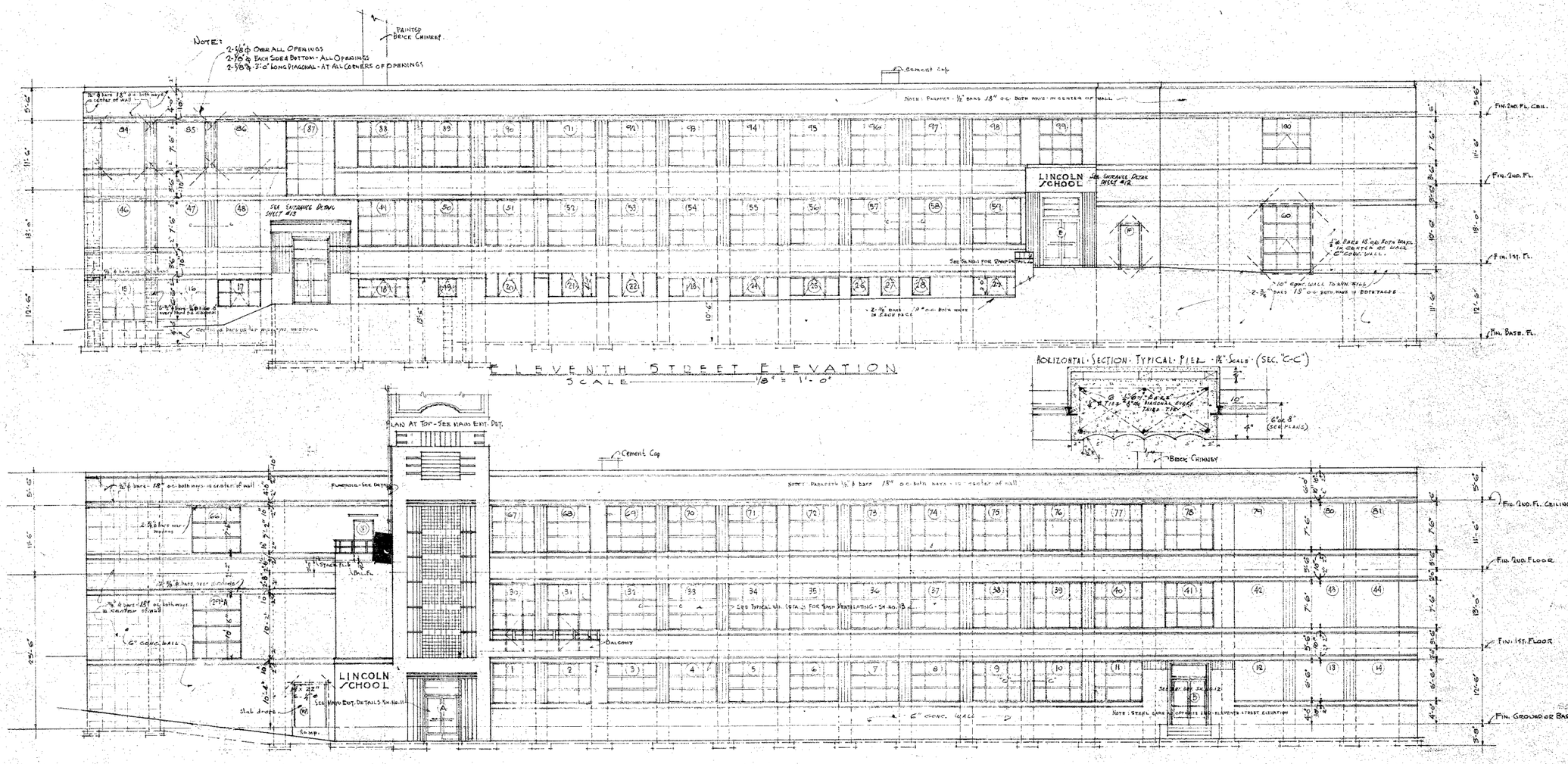
SLAB NO.	THICKNESS	STEEL SIZE	STEEL SPACING	REMARKS
1.	3"	¼"ϕ	4⅞"	
2.	3"	¼"ϕ	6¾"	
3.	3"	¼"ϕ	7½"	
4.	3"	⅜"ϕ	5¾"	
5.	3"	¼"ϕ	6⅞"	
6	3"	¼"ϕ	7½"	
7	3"	⅜"ϕ	7"	
8	3"	⅜"ϕ	5"	



ATTIC FRAMING PLAN

P.W.A. DOCKET WASH. 1350 D.S.

LINCOLN ELEMENTARY SCHOOL ELEVENTH BROAD & SKAGIT STREETS MOUNT VERNON WASHINGTON ARCH. A. TORBITT ARCHITECT 401 LLOYD BUILDING SEATTLE WASHINGTON	Job No. 605 Sheet No. 55 Made Nov. 1937



ELEVENTH STREET ELEVATION
SCALE 1/8" = 1'-0"

HORIZONTAL SECTION TYPICAL PIER 1½" SCALE (SEC. "C-C")

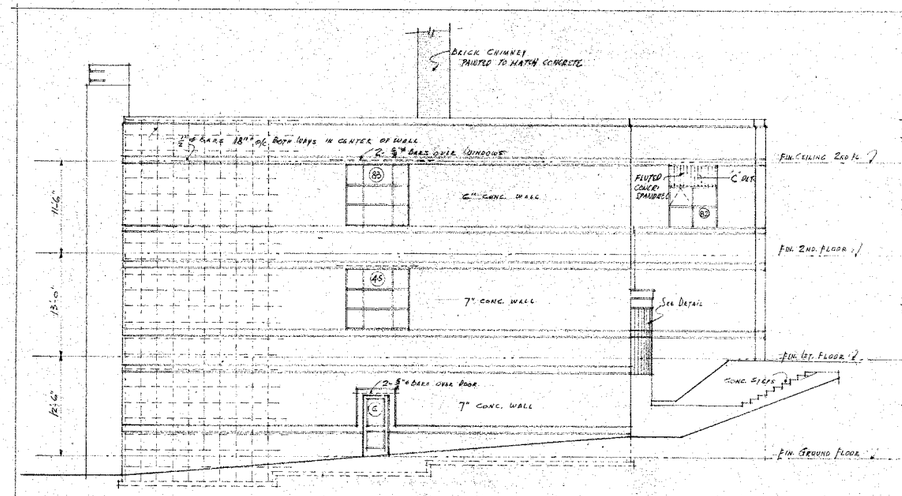
PLAYGROUND ELEVATION
SCALE 1/8" = 1'-0"

NOTE FOR WALL REINFORCING:
ALL 10" CONC. WALLS TO HAVE 5/8" ϕ BARS BOTH WAYS IN EACH FACE
ALL 8" CONC. WALLS TO HAVE 1/2" ϕ BARS BOTH WAYS IN EACH FACE
ALL 6" CONC. WALLS TO HAVE 1/2" ϕ BARS BOTH WAYS IN CENTER OF WALL
ALL PIERS & PILASTERS 6-5/8" ϕ BARS VERT. AND 5/8" ϕ TIES 8" o/c DIAGONAL EVERY THIRD TIE

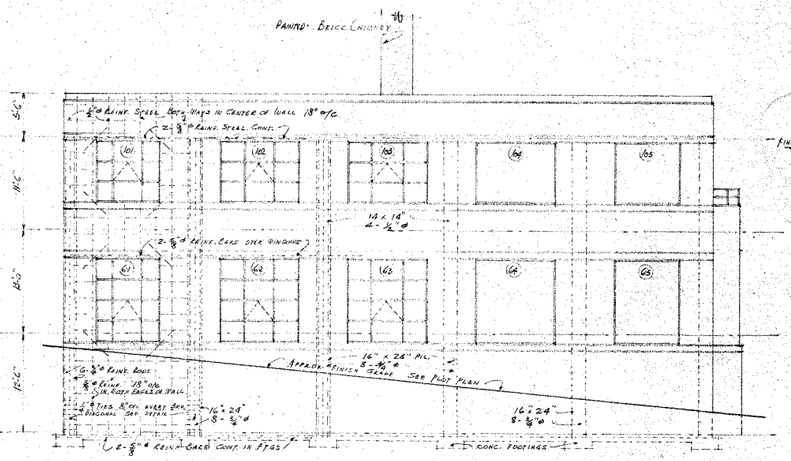
P.W.A. DOCKET WASH. 1350 D.S.

LINCOLN ELEMENTARY SCHOOL
ELEVENTH BROAD & SKAGIT STREETS
MOUNT VERNON WASHINGTON
ARCH. N. TORBITT - ARCHITECT
401 LLOYD BLDG. SEATTLE, WASHINGTON

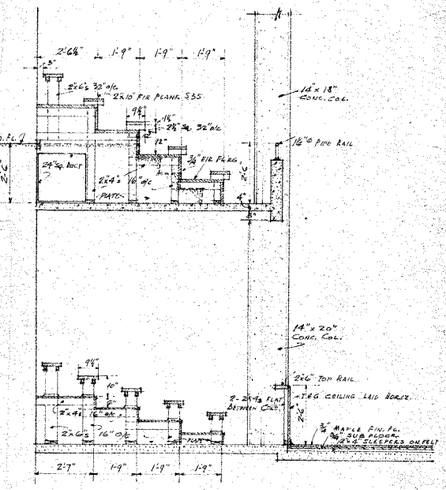
JOB NO. 605
SHEET NO. 6
MADE NOV. 1937



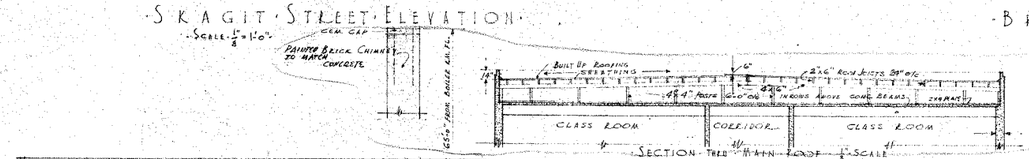
SKAGIT STREET ELEVATION
SCALE 1/8" = 1'-0"



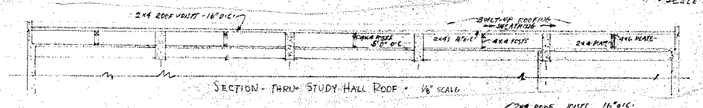
BROAD STREET ELEVATION
SCALE 1/8" = 1'-0"



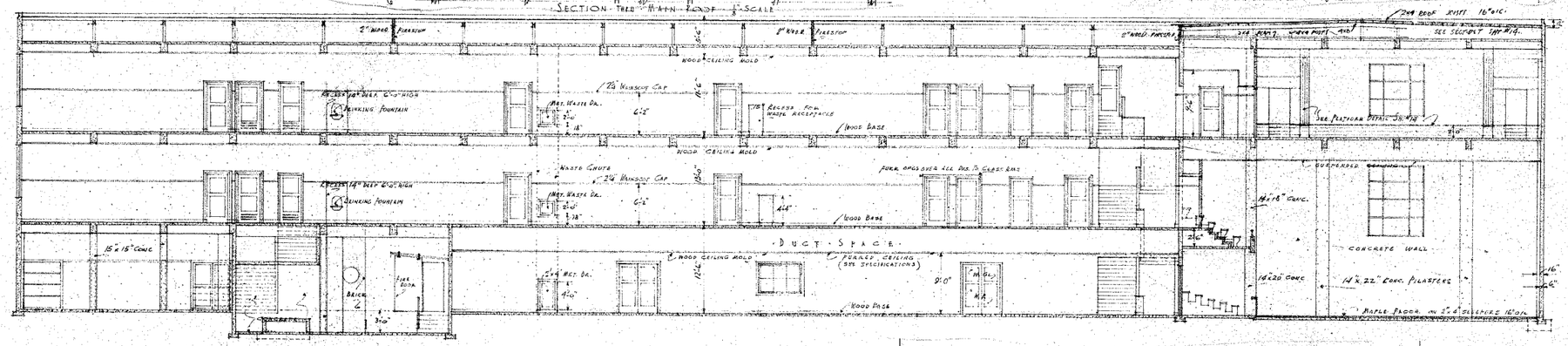
DETAILS OF BLEACHERS ON GYMNASIUM FLOOR & BALCONY
SCALE 3/4" = 1'-0"



SECTION THRU MAIN ROOF
SCALE

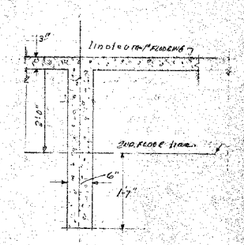


SECTION THRU STUDY HALL ROOF
SCALE

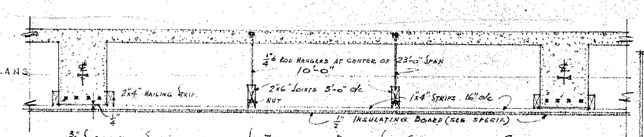


SECTION "A-A"
SCALE 1/8" = 1'-0"

SEE SECTION LINES "A-A" ON GROUND · FIRST · & SECOND FLOOR PLANS



DETAIL OF PLATFORM FRAMING & FLOOR IN STUDY HALL
SCALE 3/4" = 1'-0"



3/4" SCALE · SECTION · of · TYPICAL · BAY · for · SUSPENDED · CEILINGS ·

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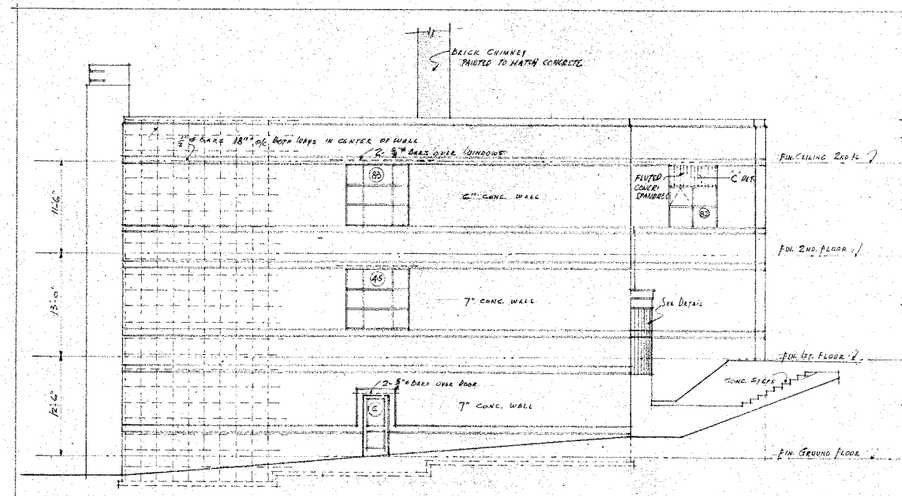
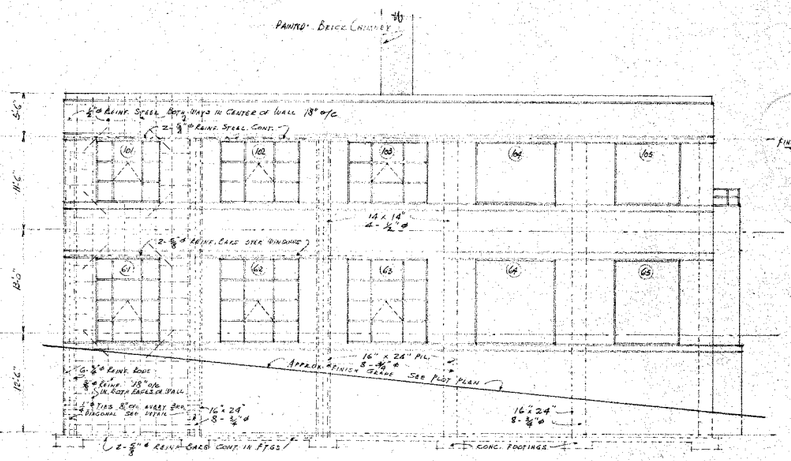
ARCH. N. TORBITT · ARCHITECT
401 LLOYD BUILDING · SEATTLE · WASHINGTON ·

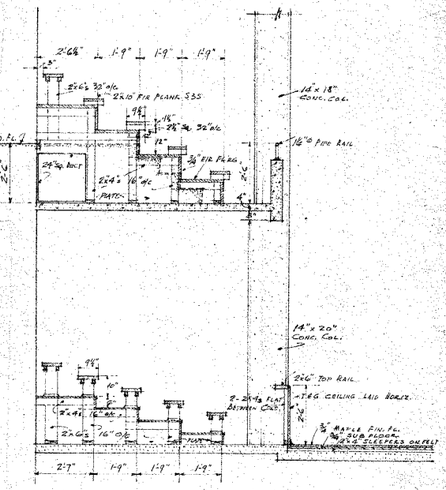
JOB No. 605
SHEET No. 7
MADE Nov. 1937



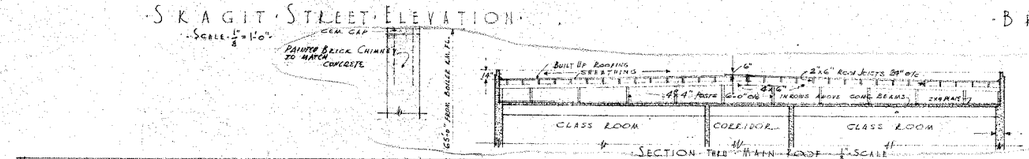
SKAGIT STREET ELEVATION
SCALE 1/8" = 1'-0"



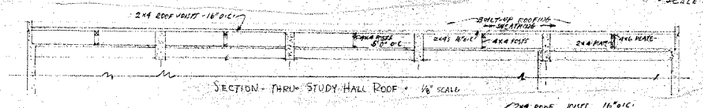
BROAD STREET ELEVATION
SCALE 1/8" = 1'-0"



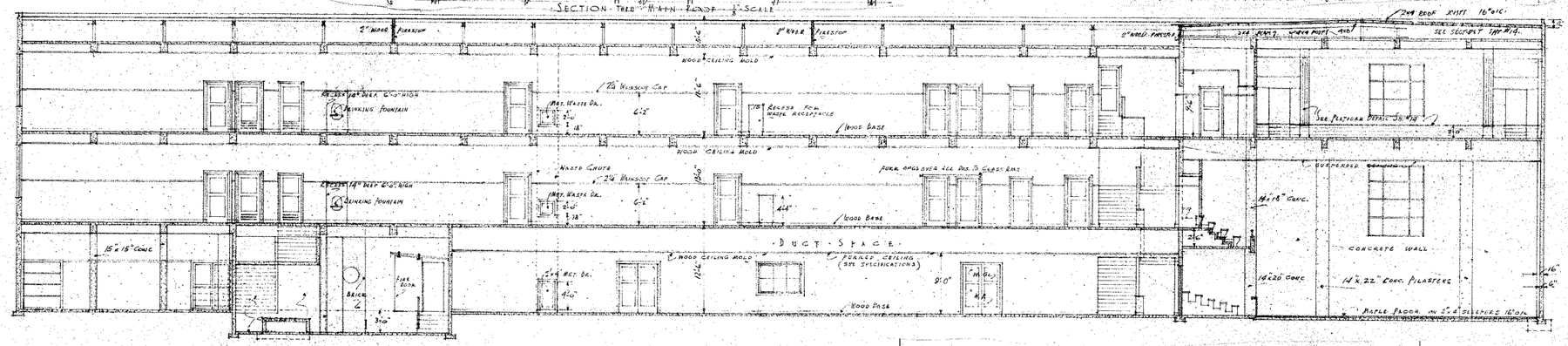
DETAILS OF BLEACHERS ON GYMNASIUM FLOOR & BALCONY
SCALE 3/4" = 1'-0"



SECTION THRU MAIN ROOF
SCALE

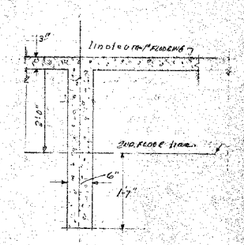


SECTION THRU STUDY HALL ROOF
SCALE

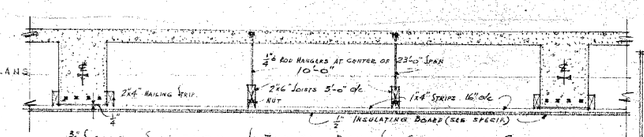


SECTION "A-A"
SCALE 1/8" = 1'-0"

SEE SECTION LINES "A-A" ON GROUND · FIRST · & SECOND FLOOR PLANS



DETAIL OF PLATFORM FRAMING & FLOOR IN STUDY HALL
SCALE 3/4" = 1'-0"



3/4" SCALE · SECTION · of · TYPICAL · BAY · for · SUSPENDED · CEILINGS ·

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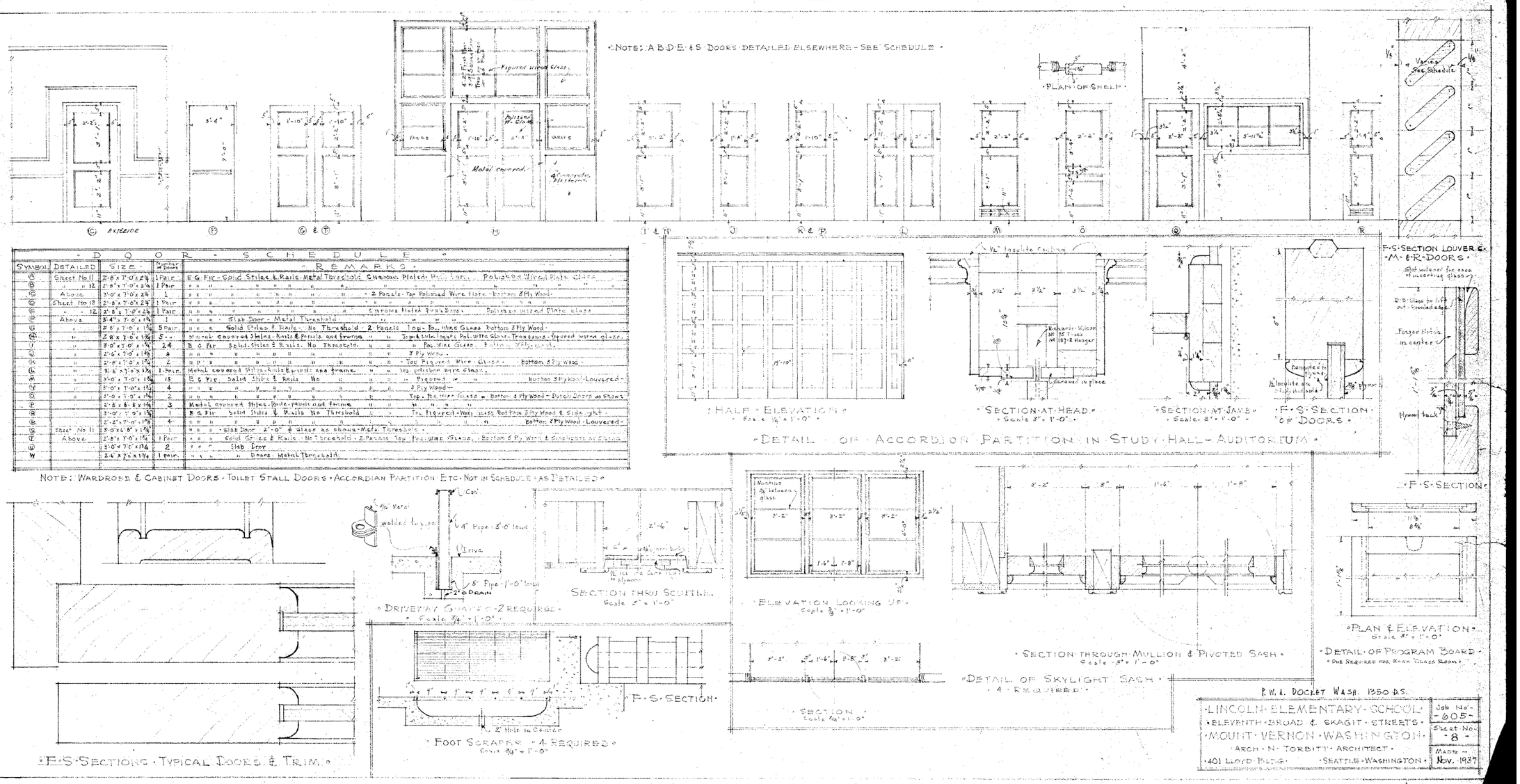
JOB No. 605
SHEET No. 7
MADE Nov. 1937



DOOR SCHEDULE

SYMBOL	DETAILED	SIZE	Number of Doors	REMARKS
A	Sheet No 11	2'-8" x 7'-0" x 2¼"	1 Pair	E.G. Fir - Solid Stiles & Rails - Metal Threshold - Chromium Plated Trim Bars - Polished Wired Plate Glass
B	" " 12	2'-8" x 7'-0" x 2¼"	1 Pair	" " " " " " " " " " " " " " " " " "
C	Above	3'-0" x 7'-0" x 2¼"	1	" " " " " " " " " - 2 Panels - Top Polished Wire Plate - Bottom 3 Ply Wood
D	Sheet No 13	2'-8" x 7'-0" x 2¼"	1 Pair	" " " " " " " " " " " " " " " " " "
E	" " 12	2'-8" x 7'-0" x 2¼"	1 Pair	" " " " " " " " " Chrome Plated Push Bars - Polished Wired Plate Glass
F	Above	3'-4" x 7'-0" x 1¾"	1	" " " - Slab Door - Metal Threshold - " " " "
G	"	2'-8" x 7'-0" x 1¾"	5 Pair	" " " Solid Stiles & Rails - No Threshold - 2 Panels Top - Top Wire Glass Bottom 3 Ply Wood
H	"	2'-8" x 7'-0" x 1¾"	5	Metal covered Stiles - Rails & Panels and Frame " " Top Stile Inset - Polished Glass - Transoms - Figured Wired glass
I	"	3'-0" x 7'-0" x 1¾"	24	E.G. Fir Solid Stiles & Rails - No Threshold " " Top Wire Glass - Bottom 3 Ply Wood
J	"	2'-6" x 7'-0" x 1¾"	3	" " " " " " " " " " " " 3 Ply Wood
K	"	2'-6" x 7'-0" x 1¾"	2	" " " " " " " " " - Top Figured Wire Glass - Bottom 3 Ply Wood
L	"	2'-6" x 7'-0" x 1¾"	1 Pair	Metal covered Stiles - Rails & Panels and Frame " " Top Polished Wire Glass
M	"	3'-0" x 7'-0" x 1¾"	15	E.G. Fir Solid Stiles & Rails No " " " " Figured " " Bottom 3 Ply Wood - Louvered
N	"	3'-0" x 7'-0" x 1¾"	4	" " " " " " " " " " " " 3 Ply Wood
O	"	3'-0" x 7'-0" x 1¾"	2	" " " " " " " " " " " " Top - Polished Wire Glass - Bottom 3 Ply Wood - Dutch Doors as shown
P	"	2'-8" x 6'-8" x 1¾"	3	Metal covered Stiles - Rails - Panels and Frame " " " " " " " " "
Q	"	3'-0" x 7'-9" x 1¾"	1	E.G. Fir Solid Stiles & Rails No Threshold " " Top Figured Wire Glass Bottom 3 Ply Wood & Side light
R	"	2'-2" x 7'-0" x 1¾"	4	" " " " " " " " " " " " " " " " " " Bottom 3 Ply Wood - Louvered
S	Sheet No 11	3'-0" x 6'-8" x 1¾"	1	" " " Slab Door 2'-0" & glass as shown - Metal Threshold
T	Above	2'-8" x 7'-0" x 1¾"	1 Pair	" " " Solid Stiles & Rails - No Threshold - 2 Panels Top Top Wire Glass - Bottom 3 Ply Wood & Sidelights as shown
U	"	3'-0" x 7'-0" x 1¾"	2	" " " Slab Door
W	"	2'-4" x 7'-0" x 1¾"	1 Pair	" " " " Doors - Metal Threshold

NOTE: WARDROBE & CABINET DOORS · TOILET STALL DOORS · ACCORDIAN PARTITION · ETC · NOT IN SCHEDULE · AS DETAILED ·

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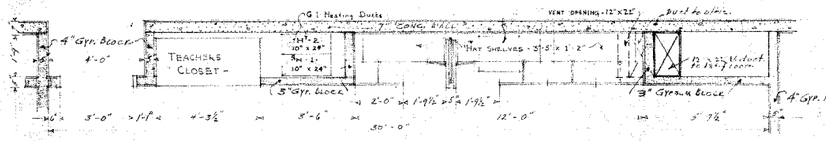
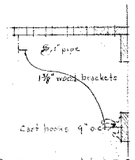
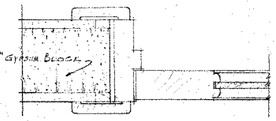
Job No. - 605 -
Sheet No. - 8 -
Made - Nov. 1937



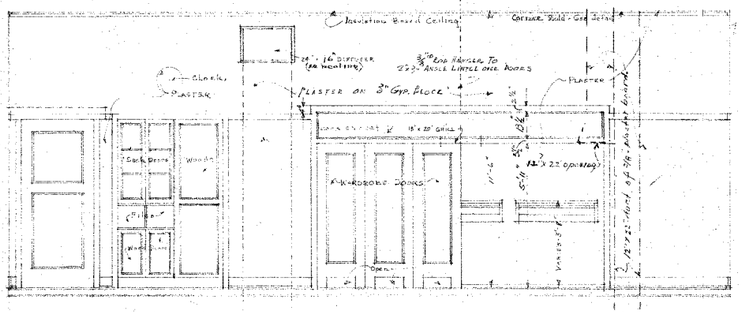
- PLAN - TYPICAL CLOSETS - WARDROBE - & HEATING DUCTS -

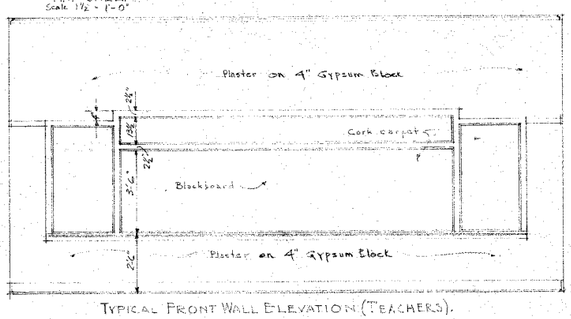


DETAIL OF WARDROBE HAT SHELF
Scale 1½" = 1'-0"

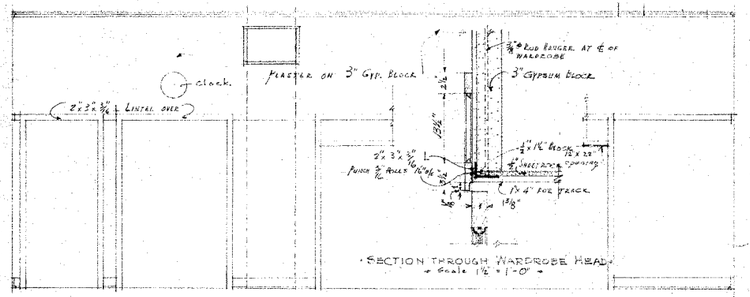


- DETAIL OF INTERIOR DOORS -
- Scale 3" = 1'-0" -



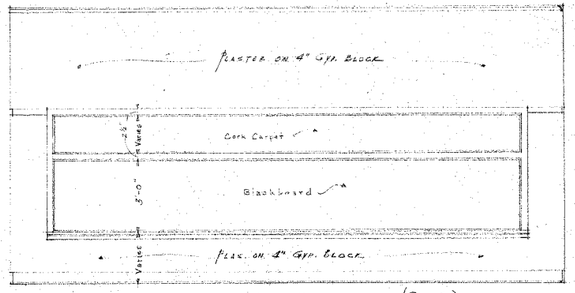


TYPICAL FRONT WALL ELEVATION (TEACHERS).

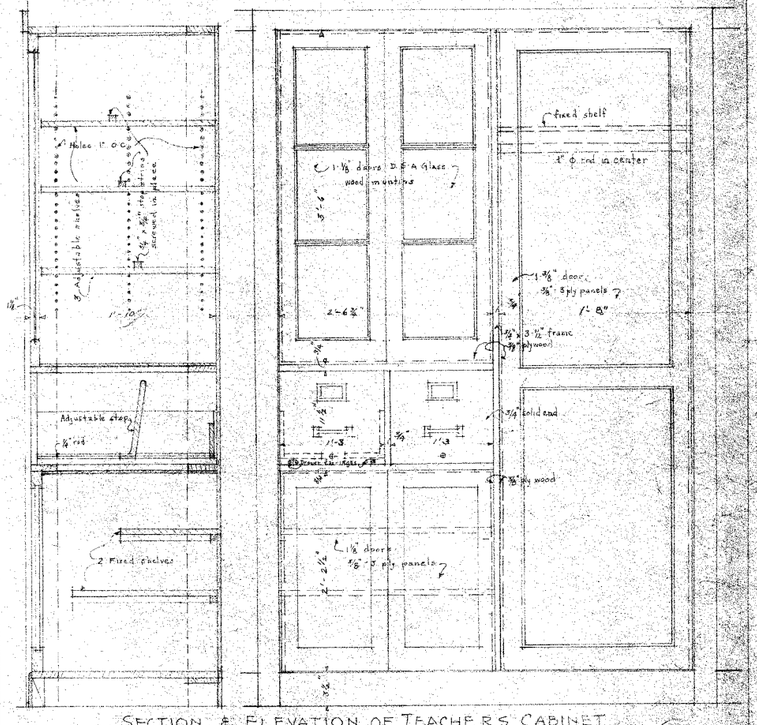


- SECTION THROUGH WARDROBE HEAD -
- Scale 1½" = 1'-0" -

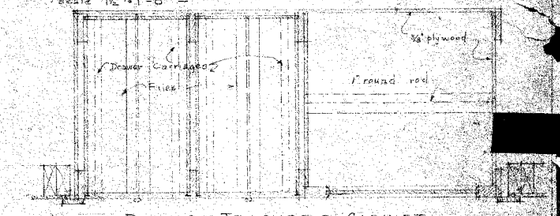
- ELEVATION OF WALLS - FIRST & SECOND FLOOR CLASSROOMS -
- SHOWING ENTRANCE - CLOSETS - WARDROBE - HEATING & VENTILATING DUCTS -
SCALE - ⅜" = 1'-0"



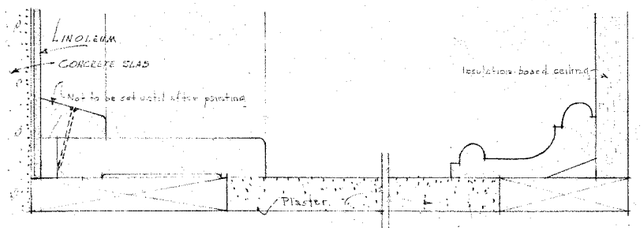
TYPICAL REAR WALL ELEVATION (PUPILS)
SCALE - ⅜" = 1'-0"



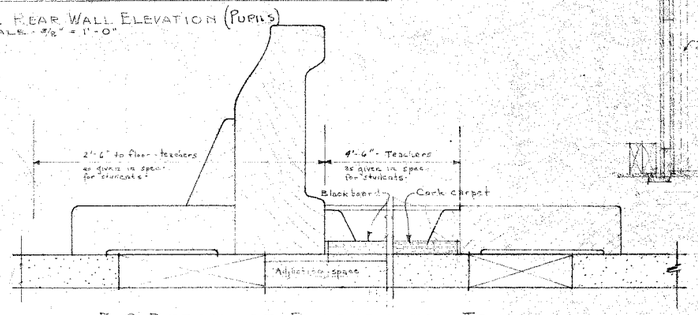
SECTION & ELEVATION OF TEACHERS CABINET
- Scale 1½" = 1'-0" -



PLAN OF TEACHERS CABINET
Scale 1½" = 1'-0"



- F.S. DETAIL OF CORNICE MOLD & BASE -



- F.S. DETAIL OF BLACKBOARD TRIM -

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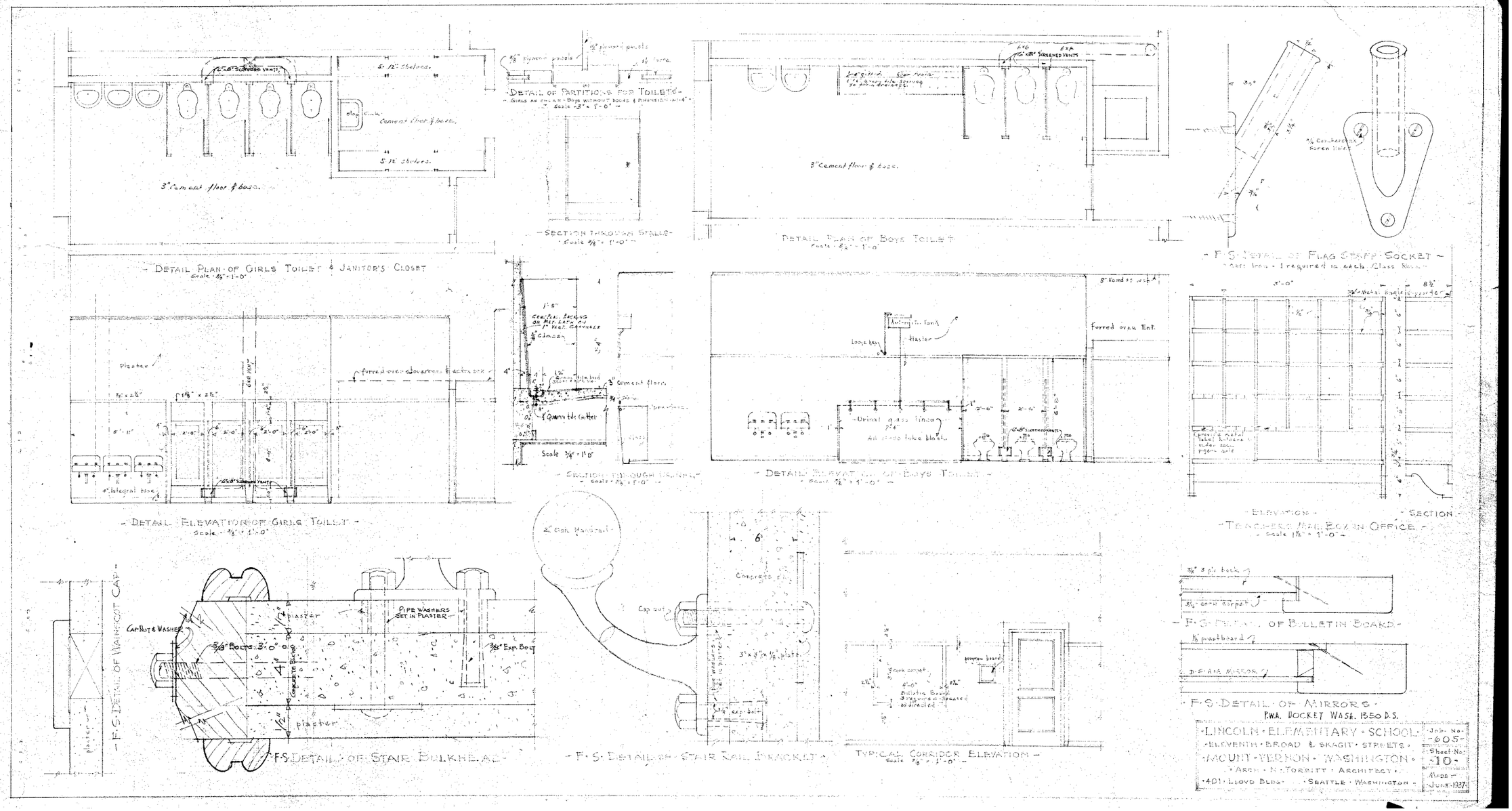
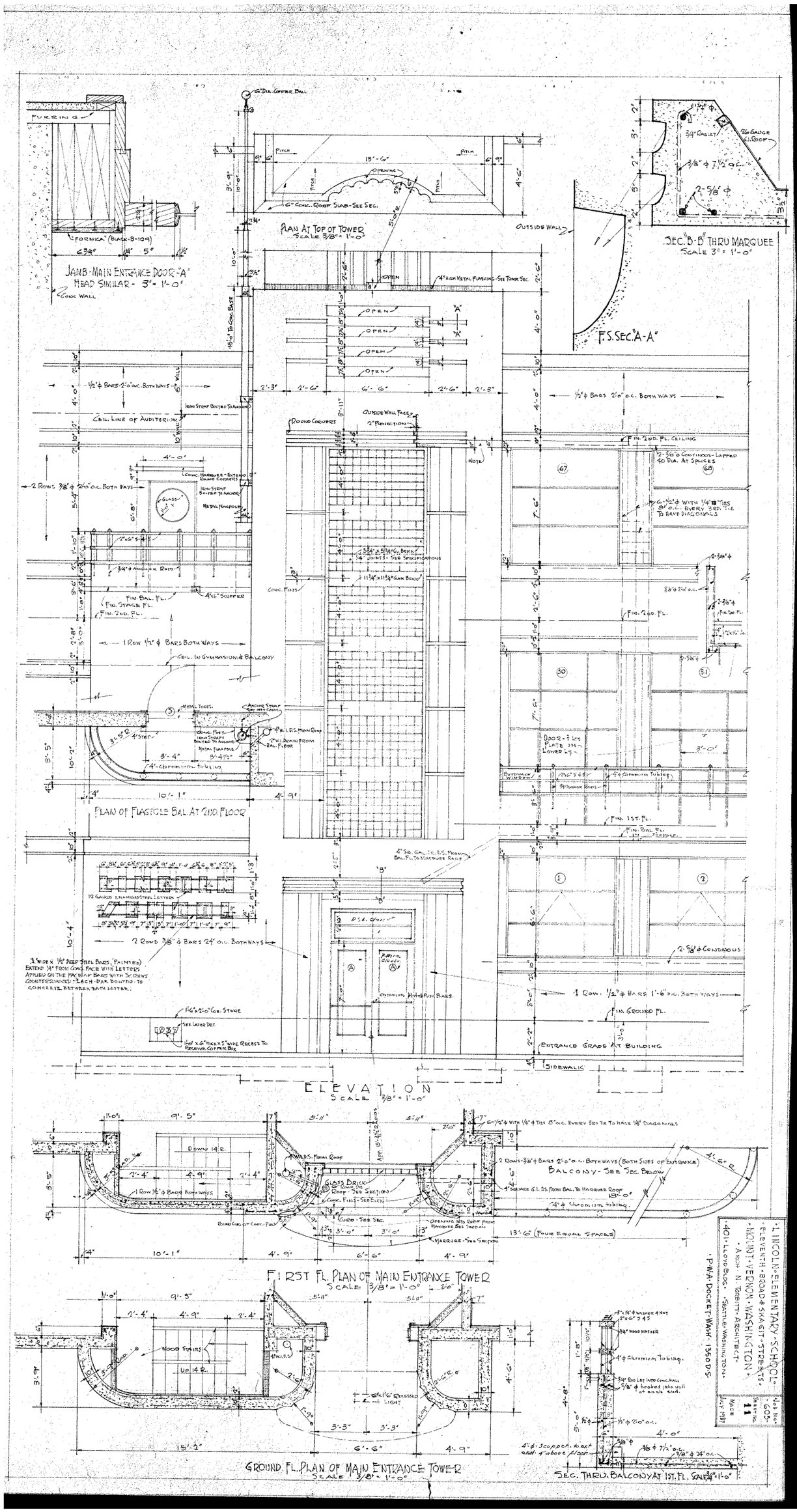
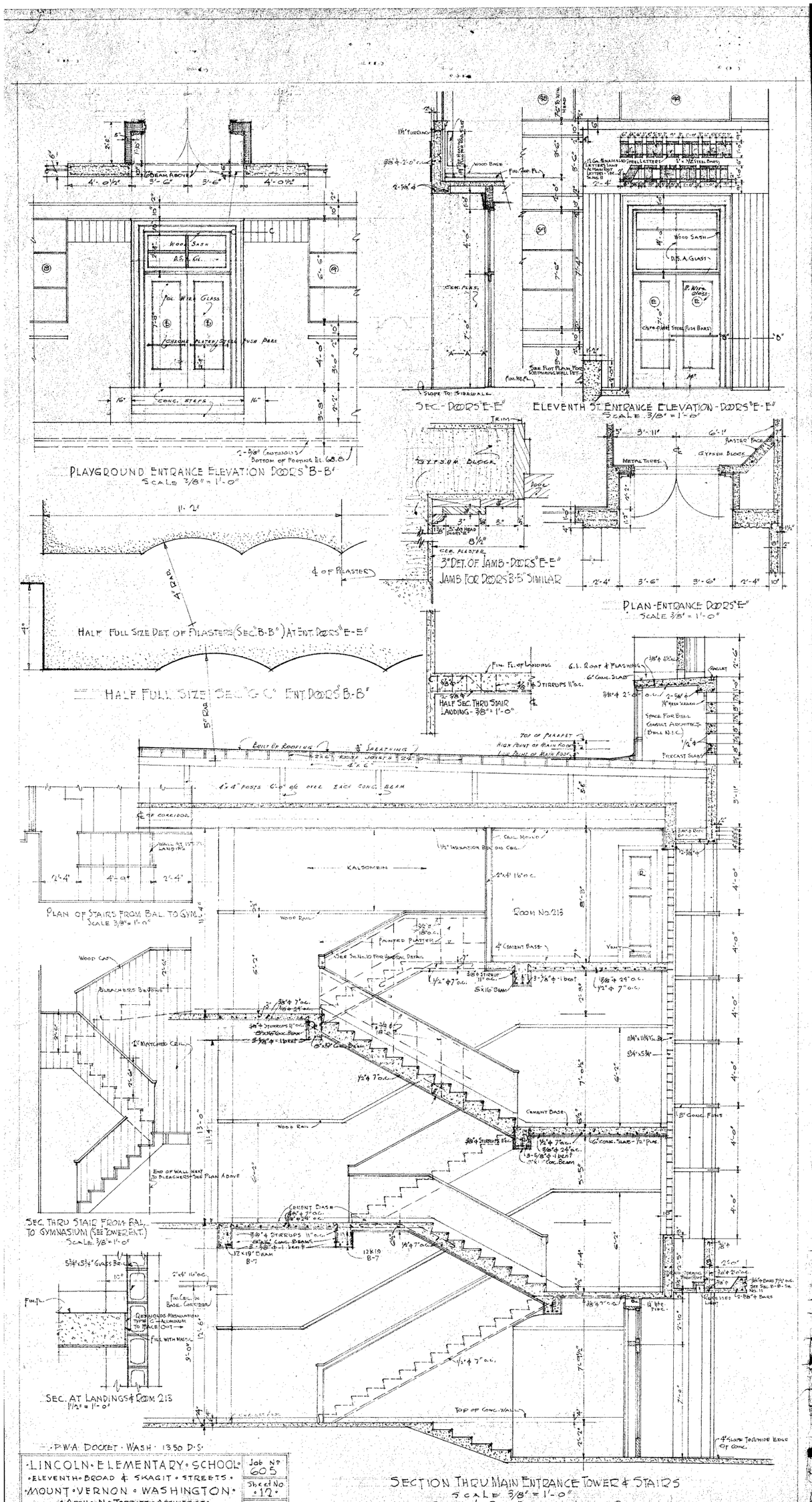
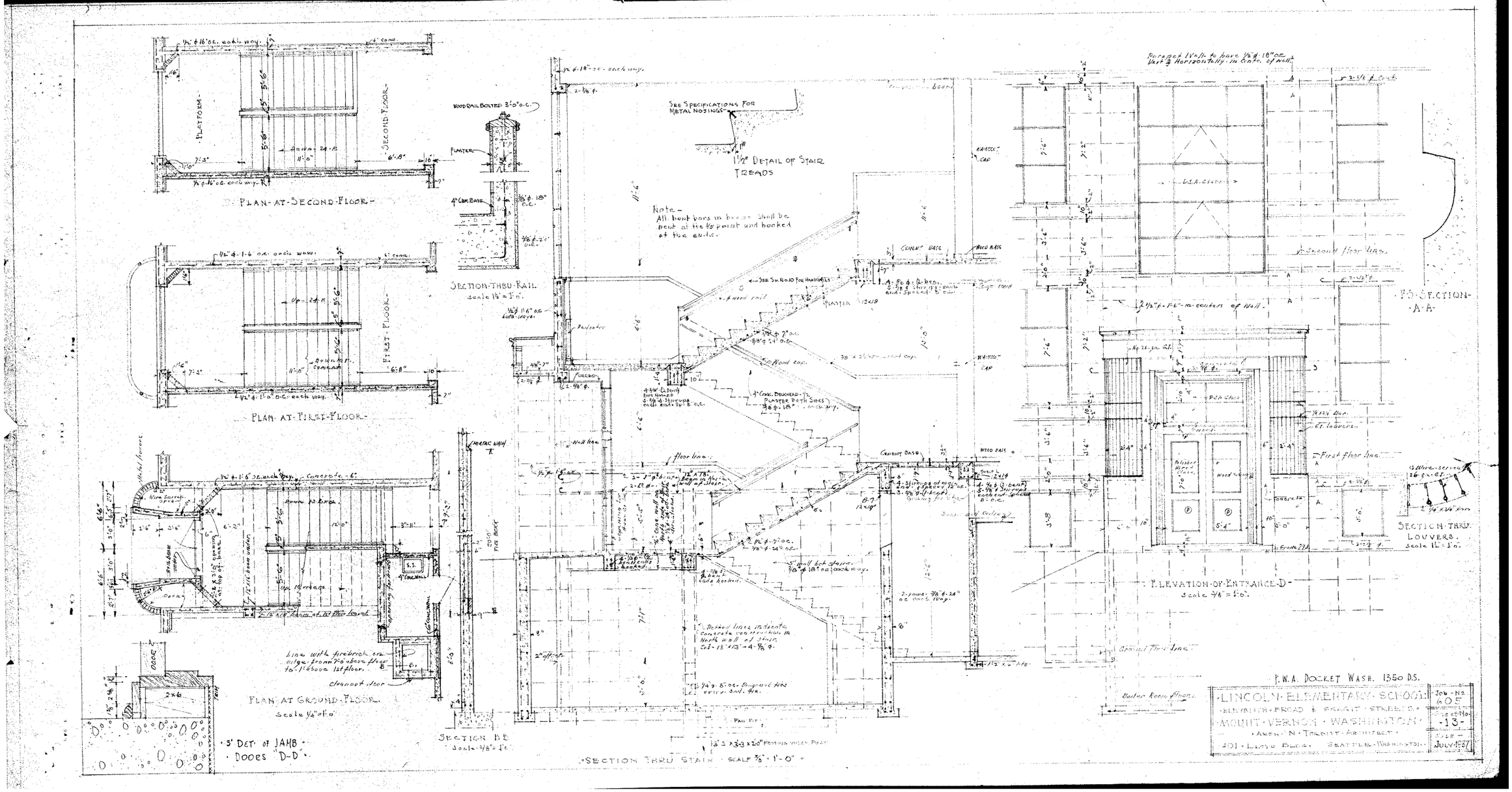
LINCOLN ELEMENTARY SCHOOL
ELEVENTH BROAD & SKAGIT STREETS
MOUNT VERNON WASHINGTON
ARCH. N. TORGITT - ARCHITECT
401 LLOYD BLDG. SEATTLE WASHINGTON

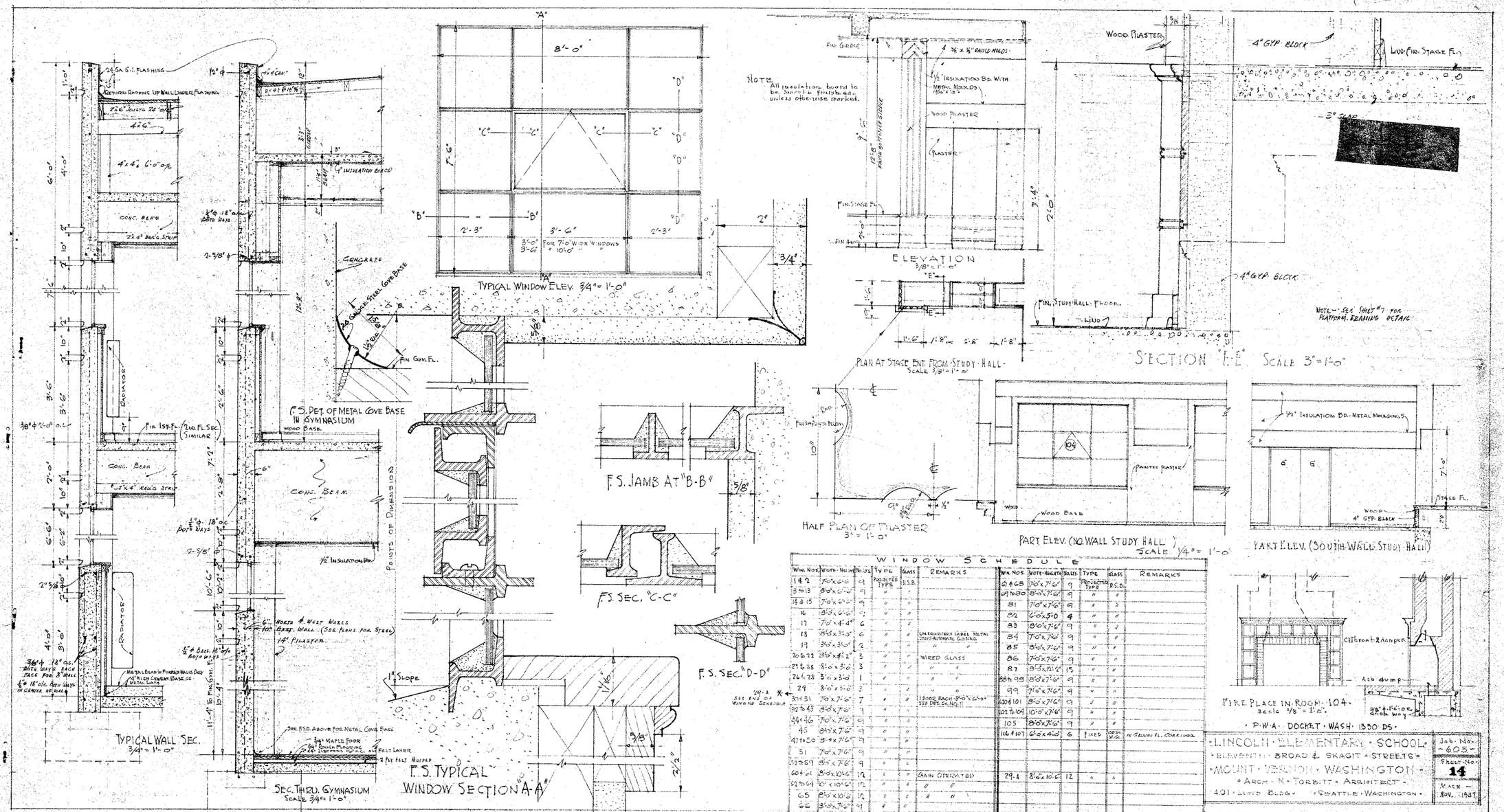
JOB NO. 605
Sheet No. 9
MADE - JUNE 1937


Detail Plan of Girls' Toilet & Janitor's Closet
Scale 3/8" = 1'-0"
Detail Elevation of Girls' Toilet
Scale 3/8" = 1'-0"
Detail of Partitions for Toilets
Girls as shown - Boys without doors & dimensions vary
Scale 3" = 1'-0"
Section through Stalls
Scale 3/8" = 1'-0"
Section through Urinal
Scale 3/4" = 1'-0"
Detail Plan of Boys Toilet
Scale 3/8" = 1'-0"
Detail Elevation of Boys Toilet
Scale 3/8" = 1'-0"
F.S. Detail of Flag Staff Socket
Elevation
Section
Teachers Mail Box in Office
Scale 1 1/2" = 1'-0"
F.S. Detail of Wainscot Cap
F.S. Detail of Stair Bulkhead
F.S. Detail of Stair Rail Bracket
Typical Corridor Elevation
Scale 3/8" = 1'-0"
F.S. Detail of Bulletin Board
F.S. Detail of Mirrors
P.W.A. Docket Wash. 1350 D.S.
Lincoln Elementary School
Eleventh, Broad & Skagit Streets
Mount Vernon, Washington
Arch. N. Torritt, Architect
401 Lloyd Bldg. Seattle, Washington
Job No. 605
Sheet No. 10
Date June 1937


JAMB-MAIN ENTRANCE DOOR-"A"
HEAD SIMILAR - 3" = 1'-0"
PLAN AT TOP OF TOWER
SCALE 3/8" = 1'-0"
SEC. "B-B" THRU MARQUEE
SCALE 3" = 1'-0"
F.S. SEC. "A-A"
PLAN OF FLAGPOLE BAL. AT 2ND. FLOOR
ELEVATION
SCALE 3/8" = 1'-0"
FIRST FL. PLAN OF MAIN ENTRANCE TOWER
SCALE 3/8" = 1'-0"
GROUND FL. PLAN OF MAIN ENTRANCE TOWER
SCALE 3/8" = 1'-0"
SEC. THRU. BALCONY AT 1ST. FL. SCALE 3/4" = 1'-0"
BALCONY - SEE SEC. BELOW
ENTRANCE GRADE AT BUILDING
SIDEWALK
LINCOLN-ELEMENTARY-SCHOOL
ELEVENTH-BROAD & SKAGIT-STREETS
MOUNT-VERNON-WASHINGTON
ARCHITECT
401-LLOYD BLDG.-SEATTLE, WASHINGTON
P.W.A. DOCKET-WASH.-1560 D.S.
SHEET NO. 11


PLAYGROUND ENTRANCE ELEVATION DOORS "B-B"
SCALE 3/8" = 1'-0"
SEC. - DOORS "E-E"
ELEVENTH ST. ENTRANCE ELEVATION - DOORS "E-E"
SCALE 3/8" = 1'-0"
3" DET. OF JAMB - DOORS "E-E"
JAMB FOR DOORS B-B SIMILAR
PLAN - ENTRANCE DOORS "E"
SCALE 3/8" = 1'-0"
HALF FULL SIZE DET. OF PILASTERS (SEC. "B-B") AT ENT. DOORS "E-E"
HALF FULL SIZE SEC. "G-G" ENT. DOORS "B-B"
HALF SEC. THRU STAIR LANDING - 3/8" = 1'-0"
PLAN OF STAIRS FROM BAL. TO GYM.
SCALE 3/8" = 1'-0"
SEC. THRU STAIR FROM BAL. TO GYMNASIUM (SEE LOWER ENT.)
SCALE 3/8" = 1'-0"
SEC. AT LANDINGS & ROOM 213
1/2" = 1'-0"
ROOM No. 213
KALSOMEIN
SECTION THRU MAIN ENTRANCE TOWER & STAIRS
SCALE 3/8" = 1'-0"
SEE SH. No. 11 for PLANS-ELEVATIONS & TOWER DETAILS
P.W.A. DOCKET · WASH · 1350 D-S
LINCOLN · ELEMENTARY · SCHOOL
ELEVENTH · BROAD & SKAGIT · STREETS
MOUNT · VERNON · WASHINGTON
ARCH · N · TORBITT · ARCHITECT
401 · LLOYD BLDG · SEATTLE · WASHINGTON
Job No. 605
Sheet No. 12
MADE NOV. 1937

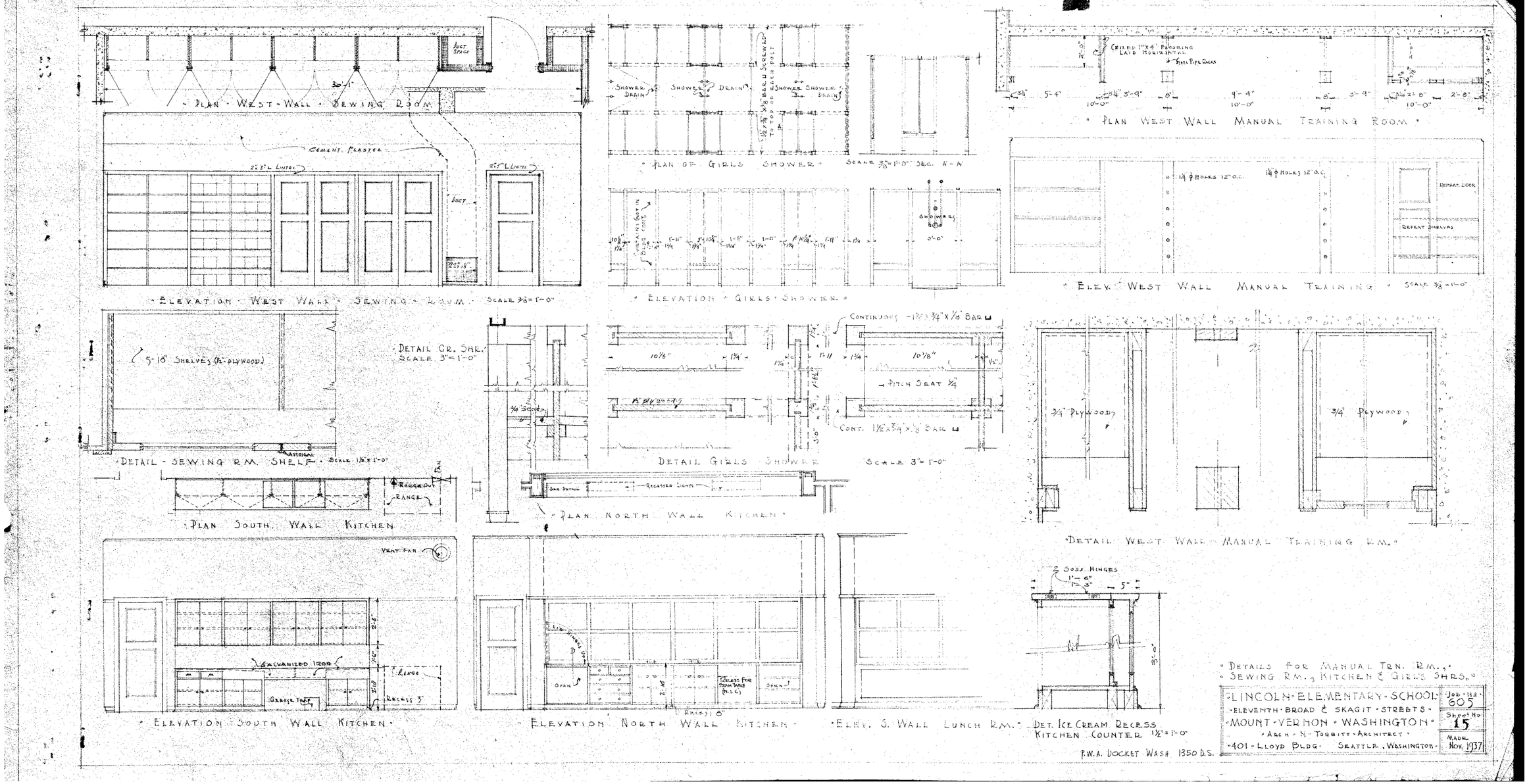

PLAN-AT-SECOND-FLOOR-
PLAN-AT-FIRST-FLOOR-
PLAN AT GROUND-FLOOR-
Scale 1/4"=1'0"
5' DET. OF JAMB
DOORS "D-D"
SECTION-THRU-RAIL
Scale 1½"=1'0"
SECTION B-B
Scale 1/8"=1'0"
SECTION THRU STAIR
SCALE 3/8"=1'-0"
1½" DETAIL OF STAIR TREADS
SEE SPECIFICATIONS FOR METAL NOSINGS
Note-
All bent bars in beams shall be bent at the ½ point and hooked at the ends.
SECTION-A-A
SECTION-THRU-LOUVERS.
Scale 1½"=1'0"
ELEVATION-OF-ENTRANCE-D-
Scale 1/8"=1'0"
P.W.A. DOCKET WASH. 1350 D.S.
LINCOLN ELEMENTARY SCHOOL
ELLIOTT ROAD & GRANITE STREET
MOUNT VERNON WASHINGTON
ARCH. N. TOBNITT ARCHITECT
401 LLOYD BLDG. SEATTLE WASHINGTON
Job No. 605
Sheet No. -13-
Date JULY 1937

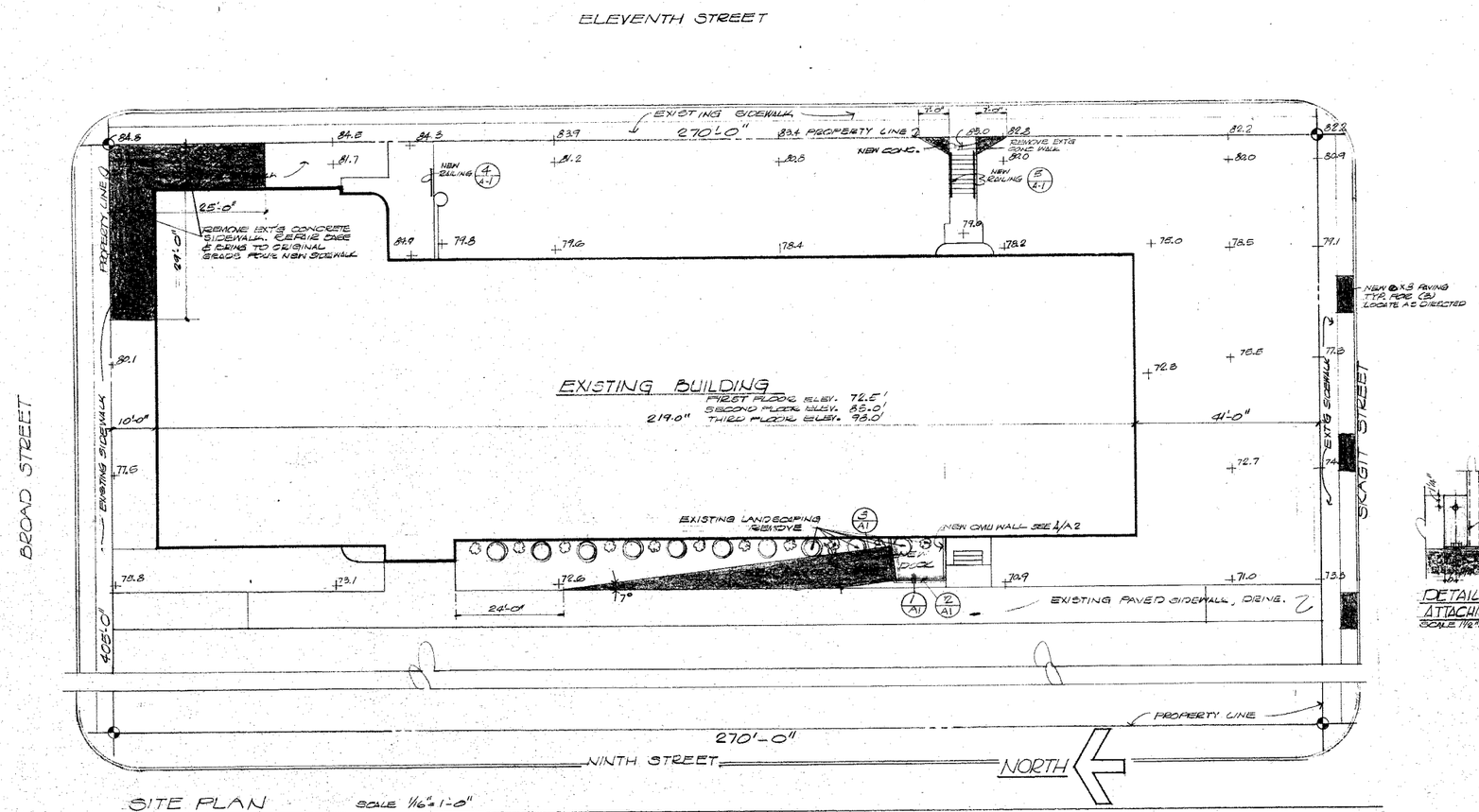


WINDOW SCHEDULE

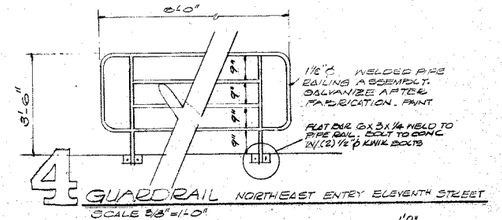
Win. Nos.	Width-Height	No. Lts.	Type	Glass	Remarks
1 & 2	7'0" x 6'0"	9	Projected Type	D.S.B.	
3 to 13	8'0" x 6'0"	9	"	"	
14 & 15	7'0" x 6'0"	9	"	"	
16	8'0" x 6'0"	9	"	"	
17	7'0" x 4'4"	6	"	"	
18	8'0" x 3'0"	6	"	"	Underwriters Label Metal Stops-Automatic Closing
19	3'0" x 3'0"	2	"	"	" "
20 to 22	3'0" x 4'2"	3	"	"	Wired Glass
23 to 25	3'0" x 3'0"	3	"	"	" "
26 & 28	3'0" x 3'0"	1	"	"	" "
29	8'0" x 3'0"	3	"	"	" "
30 & 31	7'0" x 7'6"	7	"	"	1 door each 3'0" x 6'0" see Dtl. Sh. No. 11
32 to 43	8'0" x 7'6"	9	"	"	
44 & 46	7'0" x 7'6"	9	"	"	
45	8'0" x 7'6"	9	"	"	
47 to 50	8'0" x 7'6"	9	"	"	
51	7'0" x 7'6"	9	"	"	
52 to 59	8'0" x 7'6"	9	"	"	
60 & 61	8'0" x 10'6"	12	"	"	Chain Operated
62 to 64	10'0" x 10'6"	12	"	"	" "
65	8'0" x 10'6"	12	"	"	" "
66	8'0" x 7'6"	9	"	"	

Win. Nos.	Width-Height	No. Lts.	Type	Glass	Remarks
67 & 68	7'0" x 7'6"	9	Projected Type	D.S.B.	
79 to 80	8'0" x 7'6"	9	"	"	
81	7'0" x 7'6"	9	"	"	
82	6'0" x 5'0"	4	"	"	
83	8'0" x 7'6"	9	"	"	
84	7'0" x 7'6"	9	"	"	
85	8'0" x 7'6"	9	"	"	
86	7'0" x 7'6"	9	"	"	
87	8'0" x 10'6"	15	"	"	
88 & 98	8'0" x 7'6"	9	"	"	
99	7'0" x 7'6"	9	"	"	
100 & 101	8'0" x 7'6"	9	"	"	
102 to 104	10'0" x 7'6"	9	"	"	
105	8'0" x 7'6"	9	"	"	
106 & 107	6'0" x 4'0"	6	Fixed	Obs. W.G.	To Ground Fl. Corridor
29-A	8'0" x 10'6"	12	"	"	

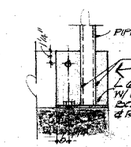

PLAN WEST WALL SEWING ROOM
CEMENT PLASTER
DUCT
ELEVATION WEST WALL SEWING ROOM SCALE 3/8"=1'-0"
PLAN OF GIRLS SHOWER
SCALE 3/8"=1'-0" SEC. A-A
ELEVATION GIRLS SHOWER
PLAN WEST WALL MANUAL TRAINING ROOM
ELEV. WEST WALL MANUAL TRAINING
SCALE 3/8"=1'-0"
DETAIL GR. SHE.
SCALE 3"=1'-0"
5-18" SHELVES (1/2" PLYWOOD)
DETAIL SEWING RM. SHELF
SCALE 1½"=1'-0"
DETAIL GIRLS SHOWER
SCALE 3"=1'-0"
CONTINUOUS 1½"x¾"x⅛" BAR
PITCH SEAT ¼"
CONT. 1½"x¾"x⅛" BAR
3/4" PLYWOOD
DETAIL WEST WALL MANUAL TRAINING RM.
PLAN SOUTH WALL KITCHEN
RANGE
PLAN NORTH WALL KITCHEN
RECESSED LIGHTS
VENT FAN
GALVANIZED IRON
GREASE TRAP
RECESS 3"
ELEVATION SOUTH WALL KITCHEN
ELEVATION NORTH WALL KITCHEN
RECESS 8"
ELEV. S. WALL LUNCH RM.
DET. ICE CREAM RECESS
KITCHEN COUNTER 1½"=1'-0"
SOSS HINGES
DETAILS FOR MANUAL TRN. RM.,
SEWING RM., KITCHEN & GIRLS SHRS.
LINCOLN ELEMENTARY SCHOOL
ELEVENTH BROAD & SKAGIT STREETS
MOUNT VERNON WASHINGTON
ARCH. N. TORBITT ARCHITECT
401 LLOYD BLDG. SEATTLE, WASHINGTON
JOB NO. 605
SHEET NO. 15
MADE NOV. 1937
P.W.A. DOCKET WASH 1350 D.S.



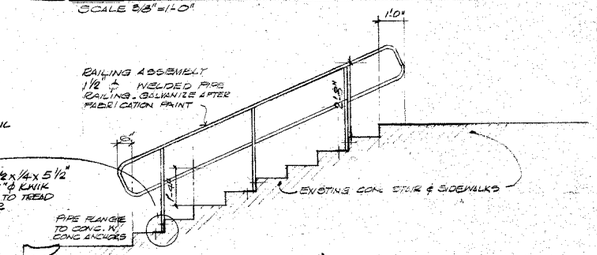
SITE PLAN SCALE 1/16"=1'-0"



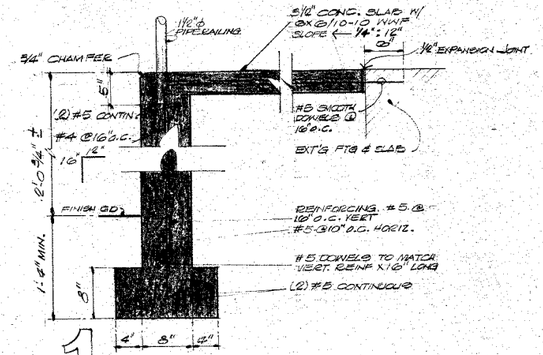
4 GUARDRAIL NORTHEAST ENTRY ELEVENTH STREET
SCALE 3/8"=1'-0"



DETAIL RAIL ATTACHMENT
SCALE 1 1/2"=1'-0"

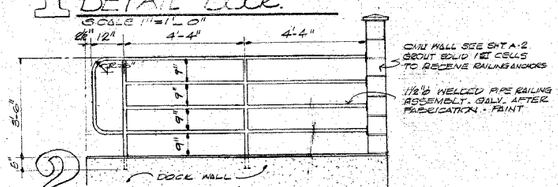


5 STAIR RAILING SOUTHEAST ENTRY ELEVENTH STREET
SCALE 3/8"=1'-0"



1 DETAIL DOCK.
SCALE 1"=1'-0"

3 DETAIL DOCK BUMPER
SCALE 1"=1'-0"



2 GUARDRAILING AT NEW LOADING DOCK
SCALE 3/8"=1'-0"

INDEX TO THE DRAWINGS

SHEET NO.	TITLE
A-1	SITE PLAN & DETAILS
A-2	FIRST FLOOR PLAN
A-3	SECOND FLOOR PLAN
A-4	THIRD FLOOR PLAN
A-5	ROOM FINISH SCHEDULE & DETAILS
A-6	DOOR SCHEDULE & DETAILS
A-7	EXTERIOR ELEVATIONS
A-8	EXTERIOR ELEVATIONS & SECTION.
A-9	INTERIOR ELEVATIONS.

LEGAL DESCRIPTION

ALL OF BLOCK 16 & LOTS NUMBERED FROM 1 TO 12 INCLUSIVE IN BLOCK 17 OF MILLETT'S ADDITION TO THE TOWN OF MOUNT VERNON WASHINGTON.

GOVERNING AGENCIES

STATE OF WASHINGTON
DEPARTMENT OF LABOR & INDUSTRIES - ELECTRICAL DIVISION.
SUPERINTENDENT OF PUBLIC INSTRUCTION
DEPARTMENT OF ECOLOGY
WASHINGTON STATE ENERGY OFFICE
COUNTY OF SKAGIT
SKAGIT COUNTY HEALTH DEPARTMENT
CITY OF MOUNT VERNON
FIRE MARSHAL
BUILDING DEPARTMENT

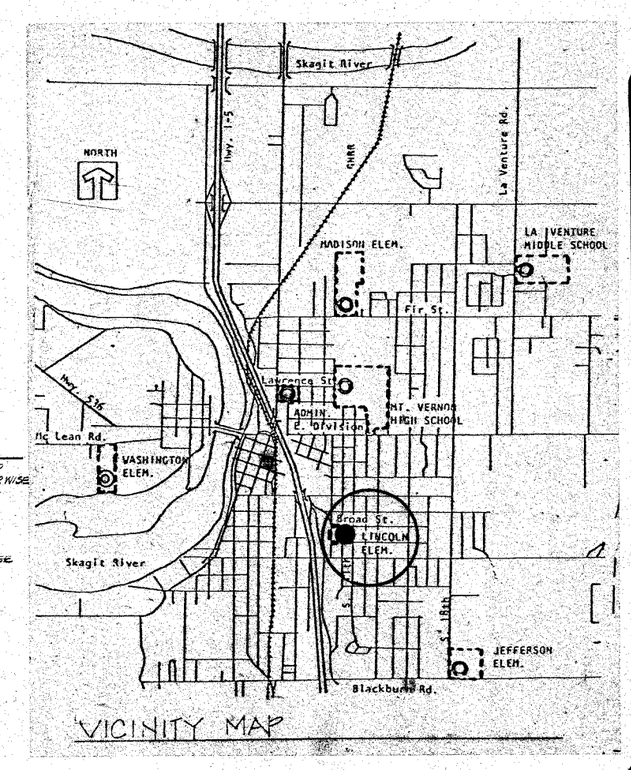
BUILDING CLASSIFICATION

TYPE OF CONSTRUCTION	I
OCCUPANCY	E I
NUMBER OF STORIES	3
BUILDING HEIGHT	42'-6"
FLOOR AREA FIRST FLOOR: EXT'G	14,301.9 SF
SECOND FLOOR:	10,724.2 SF
THIRD FLOOR:	14,301.9 SF
TOTAL	39,328.0 SF
UNIFORM BUILDING CODE	1979 EDITION

DEMOLITION NOTES

1. ALL ITEMS SHOWN HATCHED OR NOTED ARE TO BE REMOVED, UNLESS NOTED OTHERWISE.
2. EXTENT OF DEMOLITION IS LIMITED THAT SHOWN ON THE PLANS OR NOTED.
3. PROTECT ALL LANDSCAPING.
4. REMOVE EXISTING CEILINGS IN EXT'G KITCHEN, FOOD STORAGE, JANITOR STORAGE AND KITCHEN SERVICE CORRIDOR.

NOTE: SEE SHT A-3 FOR GENERAL NOTES.



VICINITY MAP

REGISTERED ARCHITECT 1359 LARRY KEEL EVERSHAM STATE OF WASHINGTON

56

Larry Eversham & Associates
p.o. box 1125 - mount vernon, wa 98273
(206) 336-5765
Donald Williams - Bucknum, Inc.
2900 eastlake avenue east - suite 200
seattle, wa 98102 - (206) 322-2610

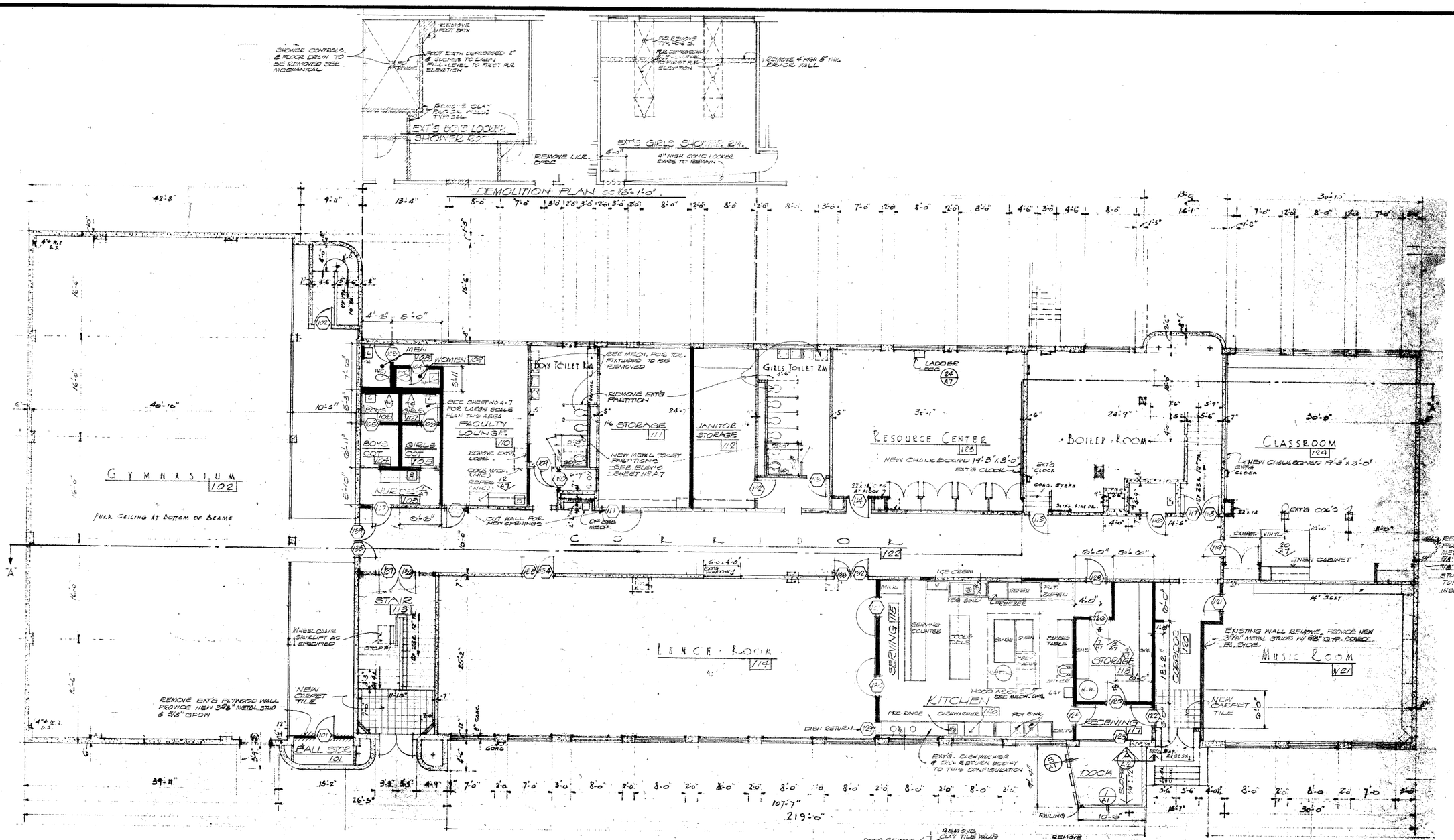
ALEA-CMB
ARCHITECTS IN ASSOCIATION

SITE PLAN
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

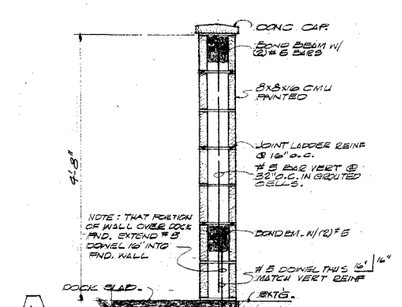
date	2/1/82
drawn	A
checked	
revised	
approved	

412-1

A 1



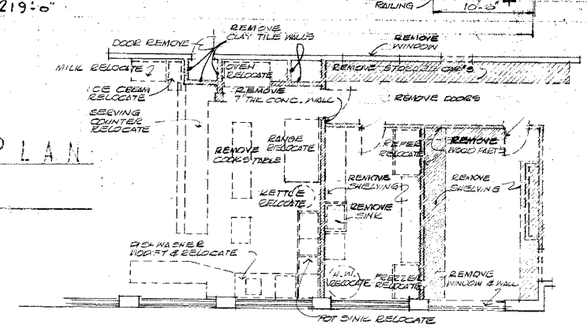
FIRST FLOOR PLAN
SCALE 1/8" = 1'-0"



A SECTION CMU WALL @ NEW DOCK
SCALE 3/4" = 1'-0"

WALL LEGEND

- EXISTING CONC. W/ CEM. PLASTER
- EXISTING BLOCK W/ CEM. PLASTER
- NEW METAL STUDS W/ 5/8" GYP.
- NEW CEMENT MASONRY
- EXT'S WALL TO BE REMOVED



KITCHEN DEMOLITION PLAN
SCALE 1/8" = 1'-0"

Larry Erickson & Associates
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2307 mariners • mount vernon, wa 98273
(360) 336-5600
Chalom • Murakami • Brummitt Inc.
2601 westlake avenue east, suite 200
seattle, wa 98102 (206) 323-5915

REGISTERED ARCHITECT
LARRY NEIL ERICKSON
STATE OF WASHINGTON

ALEA-CMB
ARCHITECTS IN ASSOCIATION

FIRST FLOOR PLAN
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA

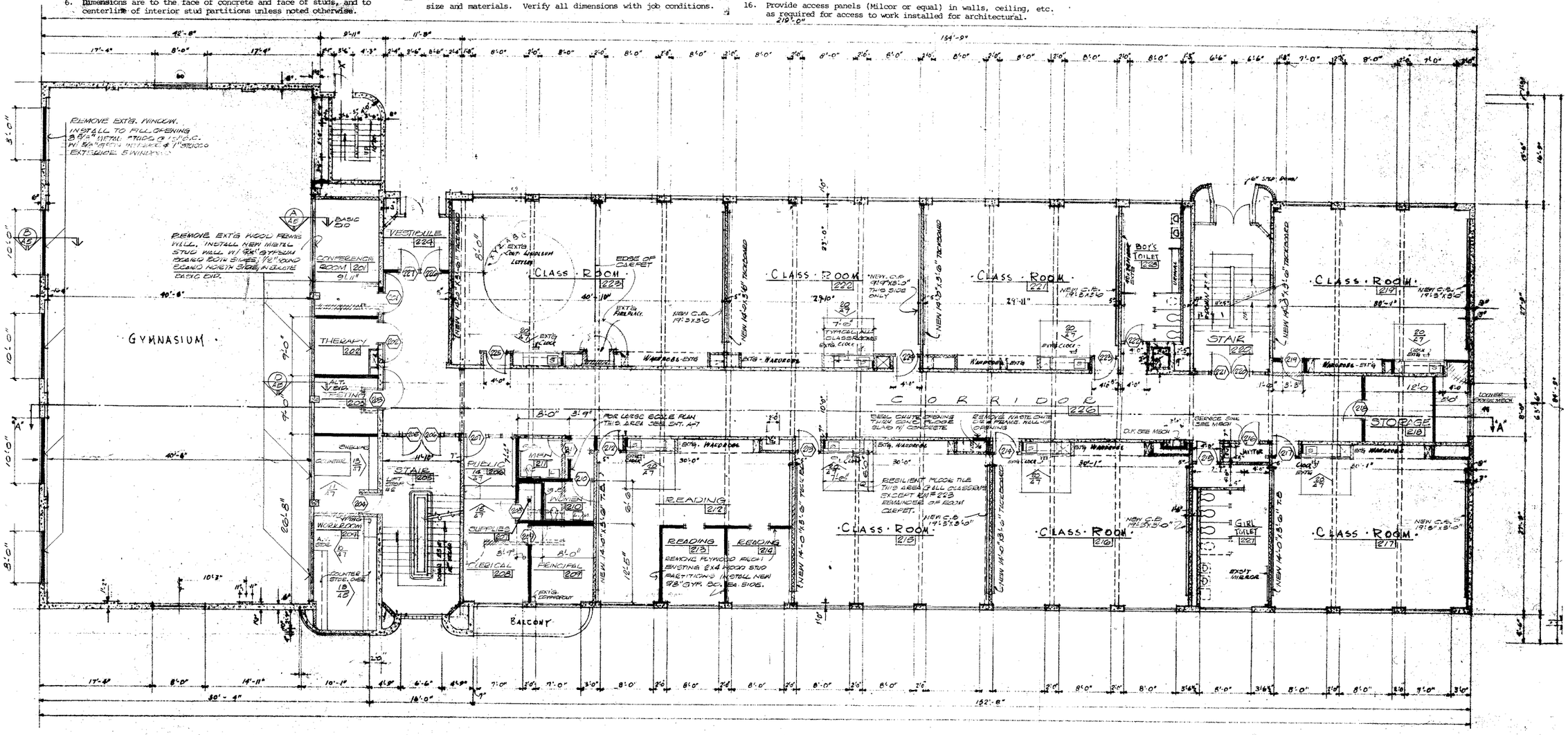
date 6/11/82
drawn A
checked
revised
approved

412-1

A2

GENERAL NOTES

1. All work to conform to applicable codes, ordinances and regulations.
2. These drawings are only part of the contract documents, which includes the contract document book with the specifications.
3. Refer to mechanical and electrical drawings for additional work not described on architectural drawings.
4. Verify all grades, dimensions and existing conditions on job and notify Architect of any conflicts prior to proceeding with the work.
5. Dimensions noted take precedence over scaled dimensions.
6. Dimensions are to the face of concrete and face of studs, and to centerline of interior stud partitions unless noted otherwise.
7. Contractor shall consult drawings of all trades for ducts, piping, conduits, lighting, cabinets & equipment, and shall verify size and location of openings through floors, walls, ceilings and roofs with other trades, resolving any conflicts with the Architect.
8. Contractor shall verify all rough-in dimensions for equipment by self and others. Provide blocking as required; and resolve any conflicts with Architect.
9. Contractor shall provide furring, curbs, anchors, inserts, rough bucks, blocking, backings, etc. as required to complete the work.
10. All stud partitions are 3-5/8" metal stud at 16" O.C. with 5/8" GWB both sides except as noted.
11. Refer to interior elevations and cabinet details for casework size and materials. Verify all dimensions with job conditions.
12. All materials indicated to match existing shall do so in respect to size, shape, & color; and shall be approved by the Architect before use. Existing materials shall be reused where indicated on the drawings or authorized by Architect. Existing materials not reused remain the property of the Owner at his option. Contractor to dispose of remainder.
13. Repetitive features are drawn only once and shall be completely provided as if drawn in full.
14. Install dust barriers as required to protect existing equipment and facilities. Coordinate location with Owner. Maintain required exist at all times.
15. Repair and patch all portions of building and site disturbed during construction operations to match original finish.
16. Provide access panels (Milcor or equal) in walls, ceiling, etc. as required for access to work installed for architectural.



SECOND FLOOR PLAN
SCALE 1/8" = 1'-0"

WALL LEGEND

- EXISTING CONC. W/ CEM. PLASTER
- EXISTING GYPSUM BLOCK W/ CEMENT PLASTER
- NEW METAL STUDS W/ 5/8" G.P.D.W., INSULATION, & SOUND BOARD
- NEW METAL STUDS W/ 5/8" G.P.D.W. AT EXTERIOR WALL, 7/8" STUCCO EXTERIOR FINISH.
- EXISTING WALL TO BE REMOVED

REGISTERED ARCHITECT
1329
LARRY HOE ERICKSON
STATE OF WASHINGTON

Larry Erickson & Associates
P.O. Box 1725
Oregon • Mount Vernon, wa 98273
Oregon • Murakami • Brummitt Inc
P.O. Box 1000 • Mount Vernon, wa 98273
Seattle, wa 98102 • (206) 325-0010

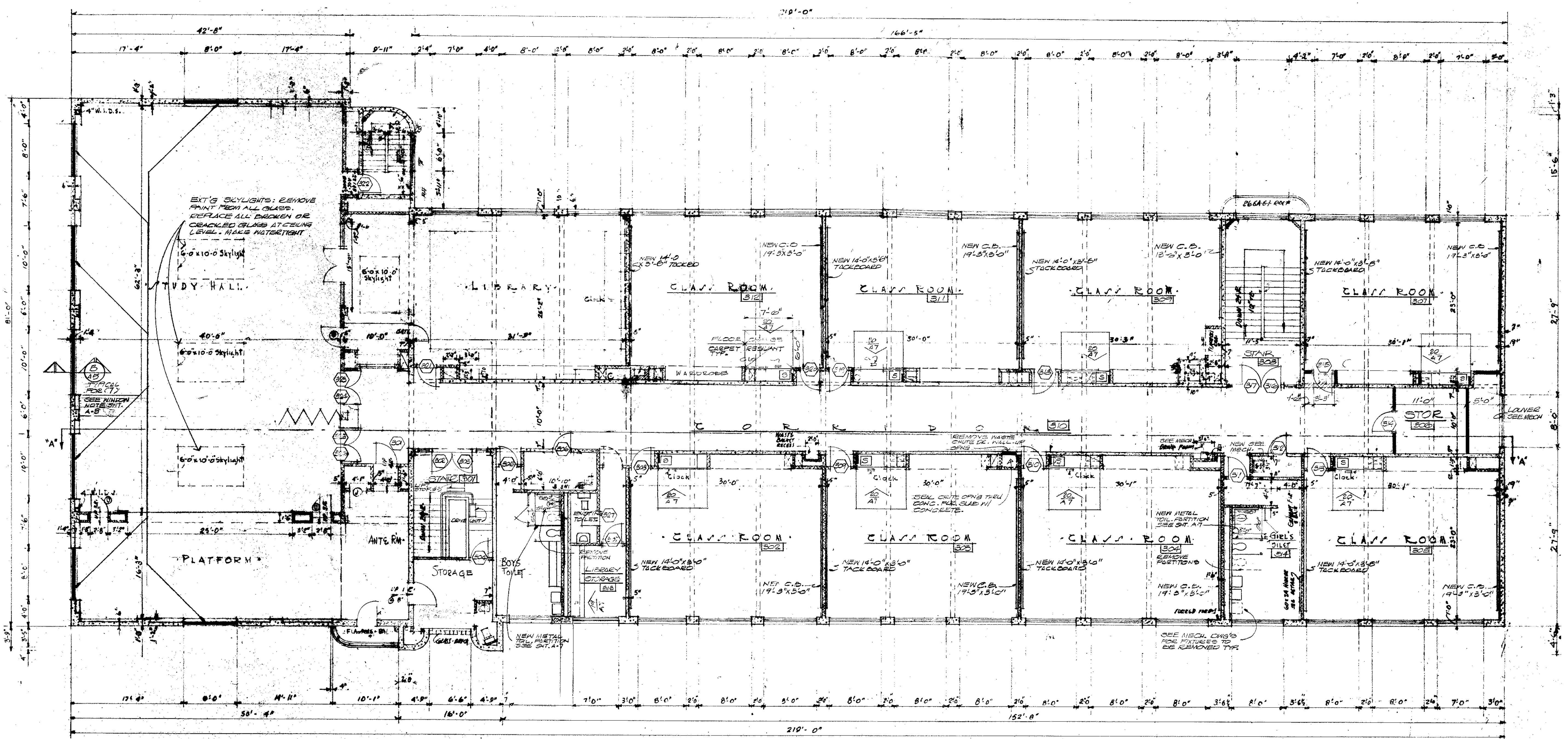
ALEA-CMB
ARCHITECTS IN ASSOCIATION

SECOND FLOOR PLAN
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

date	2/11/80
drawn	A
checked	E
revised	
approved	

412-1

A 3



THIRD FLOOR PLAN.
SCALE 1/8" = 1'-0"

WALL LEGEND
EXISTING CONCRETE W/ CEMENT PLASTER
EXISTING GYPSUM BLOCK W/ CEMENT PLASTER
NEW METAL STUD W/ 5/8" GPDW.
EXISTING TO BE REMOVED

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(206) 336-5765
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2900 eastlake avenue east • suite 200
seattle, wa 98102 • (206) 322-0810

ALEA-CMB
ARCHITECTS IN ASSOCIATION

THIRD FLOOR PLAN
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

date 6/1/82
drawn
checked
revised
approved

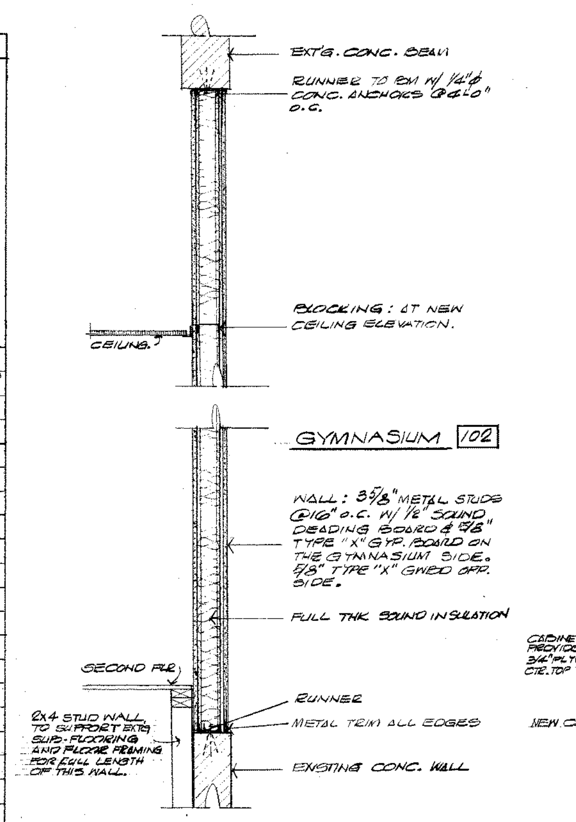
412-1

A 4

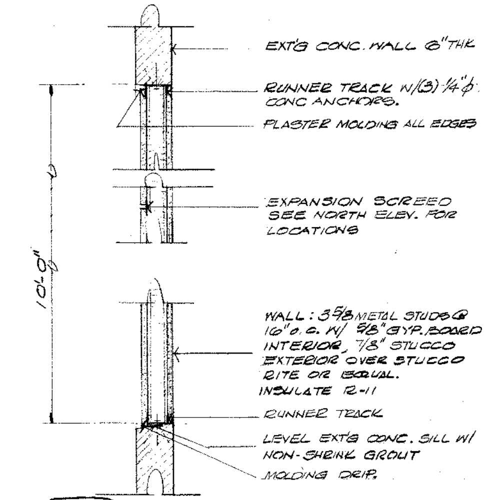
ROOM FINISH SCHEDULE

Legend (Remarks column): N/E/W ⊗ = WALL LOCATION; ● = FINISH ALL WALL; ◐ = FINISH WALL SHOWN SHADED

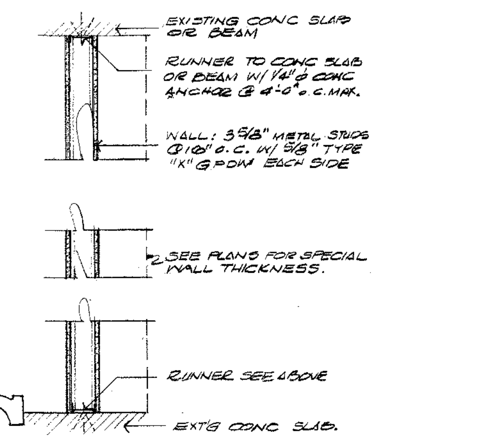
NO	DESIGNATION	FLOOR: EXISTING RESILIENT	FLOOR: NEW RESILIENT	FLOOR: NEW CARPET	FLOOR: EXISTING CONC	FLOOR:	BASE: EXISTING	BASE: NEW WOOD	BASE: NEW TOP SET VINYL	WALLS: EXISTING PLASTER	WALLS: NEW 5/8" GYPSUM BOARD	WALLS: NEW W.R.GPBD	CEILINGS: EXISTING	CEILINGS: NEW SUSPENDED AC TILE	CEILINGS: NEW GYP BOARD	HEIGHT	REMARKS
first floor																	
101	BALL STORAGE	●					◐	◐		◐	◐		●				
102	GYMNASIUM	●					●			◐	◐		●				PAINT NEW GPDW. NORTH WALL @ WINDOWS SOUTH WALL SECOND FLOOR ELEVATION.
103	NURSE			●					●	◐	◐			●		8'-0"	
104	BOYS COT			●					●	◐	◐			●		8'-0"	
105	GIRLS COT			●					●		●			●		8'-0"	
106	BOYS		●						●			●		●		8'-0"	NORTH WALL GPDW OVER 7/8" FURRING C'S
107	GIRLS		●						●			●		●		8'-0"	
108	MEN		●						●			●		●		8'-0"	NORTH & EAST WALLS OVER 7/8" FURRING CHANNELS
109	WOMEN		●						●			●		●		8'-0"	
110	FACULTY LOUNGE			●					●	◐	◐			●		8'-6"	
111	STORAGE				●			●		◐	◐		●				
112	JANITOR STORAGE				●			●		◐	◐		●				
113	STAIR		●				●			●			●				NEW RESILIENT FLR. @ LANDINGS ONLY
114	LUNCH ROOM	●					◐	◐		◐	◐		●				NEW SOUTH WALL 1 HR CONSTRUCTION
115	SERVING	●							●	◐	◐			●		9'-6"	
116	KITCHEN		●						●	◐	◐			●		9'-6"	
117	RECEIVING				●				●	◐	◐			●		10'-6"	
118	STORAGE				●				●		●			●		8'-6"	
119	DELETED																
120	CORRIDOR			●			●			◐	◐		●				
121	MUSIC ROOM			●					●	◐	◐			●		8'-6"	
122	CORRIDOR			●			●			●			●				
123	RESOURCE CENTER	●	●				●			●				●		8'-6	
124	CLASSROOM	●	●				●			●				●		9'-0	
second floor																	
201	CONFERENCE ROOM			●					●	◐	◐			●		8'-6	
202	THERAPY			●					●	◐	◐			●		8'-0"	
203	TESTING			●					●	◐	◐			●		8'-0"	
204	WORKROOM			●					●	◐	◐			●		8'-0"	
205	STAIR		●				●			●			●				NEW RESILIENT FLR @ LANDINGS ONLY
206	PUBLIC			●					●	◐	◐			●		8'-6"	
207	SUPPLIES			●					●		●			●		8'-0"	
208	CLERICAL			●					●	◐	◐			●		8'-6"	NO. WALL REMOVE CEDAR PANELING PATCH PLASTER AS REQ'D.
209	PRINCIPAL			●					●	◐	◐			●		8'-6"	NO. WALL REMOVE CEDER PANELING PATCH PLASTER AS REQ'D.
210	WOMEN		●						●	●		●		●		8'-0"	SO. WALL GPDW OVER FURRING CHANNELS
211	MEN		●						●	●		●		●		8'-0"	NO. WALL GPDW OVER FURRING CHANNELS
212	READING			●					●	◐	◐			●		8'-6	
213	READING			●					●	◐	◐			●		8'-6	
214	READING			●					●	◐	◐			●		8'-6	
215	CLASSROOM		●	●			●			●				●		8'-6"	
216	CLASSROOM		●	●			●			●				●		8'-6"	
217	CLASSROOM		●	●			●			●				●		8'-6"	
218	STORAGE	●					◐	◐		◐	◐		●			7'-4	
219	CLASSROOM		●	●			●			●				●		8'-6"	
220	STAIR		●				●			●			●				NEW RESILIENT FLR. @ LANDINGS ONLY
221	CLASSROOM		●	●			●			●				●		8'-6"	
222	CLASSROOM		●	●			●			●				●		8'-6"	
223	CLASSROOM		●	●			●			●				●		8'-6"	
224	CLASSROOM		●	●			●			●				●		8'-6"	
225	VESTIBULE	●					◐	◐		◐	◐			●		8'-6"	
226	CORRIDOR			●			◐	◐		◐	◐			●		9'-0"	
227	GIRLS TOILET									◐							REPAIR & PAINT NORTH WALL TO MATCH EXTG
228	BOYS TOILET									◐							REPAIR & PAINT SOUTH WALL TO MATCH EXTG.
third floor																	
301	STAIR		●				●			●			●				NEW RESILIENT FLR. @ LANDINGS ONLY
302	CLASSROOM		●	●			●			●				●		8'-6"	
303	CLASSROOM		●	●			●			●				●		8'-6	
304	CLASSROOM		●	●			●			●				●		8'-6	
305	CLASSROOM		●	●			●			●				●		8'-6	
306	STORAGE	●					◐	◐		◐	◐		●				
307	CLASSROOM		●	●			●			●				●		8'-6	
308	STAIR		●				●			●			●				NEW RESILIENT FLR. @ LANDINGS ONLY
309	CLASSROOM		●	●			●			●				●		8'-6	
310	CORRIDOR			●		◐	◐			◐	◐			●		9'-0"	
311	CLASSROOM		●	●			●			●				●		8'-6	
312	CLASSROOM		●	●			●			●				●		8'-6"	
313	LIBRARY STORAGE	●					◐		◐	●			●				TOP SET BASE AT NEW CABINET TOE SPACE
314	GIRLS TOILET									◐							REPAIR & PAINT NORTH WALL TO MATCH EXT'G.



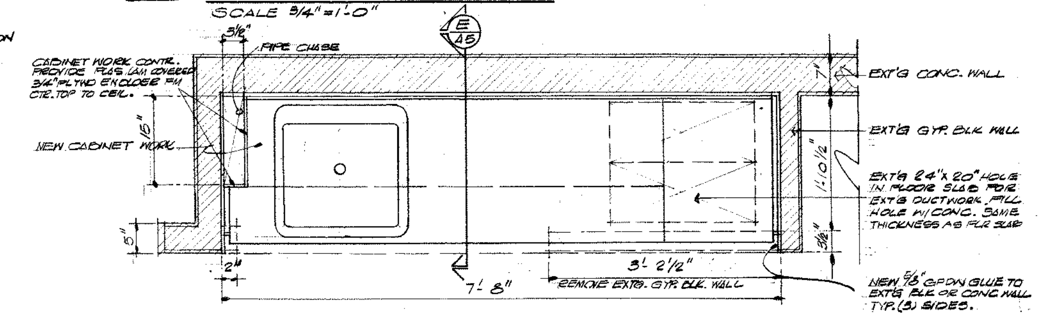
A SECTION GYM. SOUTH WALL (BASIC BID) SECOND FLOOR
SCALE 3/4" = 1'-0"



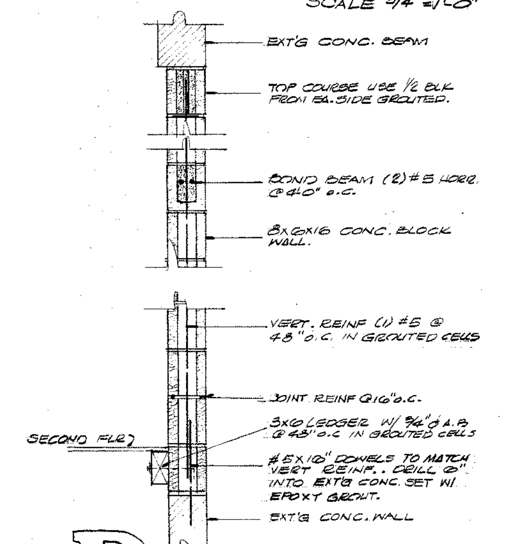
B SECTION GYM. NORTH WALL
SCALE 3/4" = 1'-0"



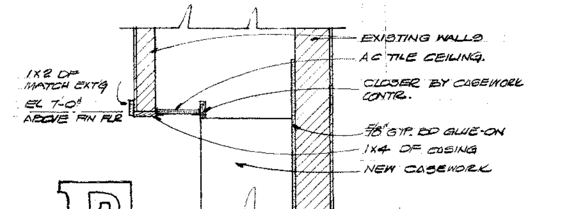
C SECTION TYPICAL INTERIOR PARTITION
SCALE 3/4" = 1'-0"



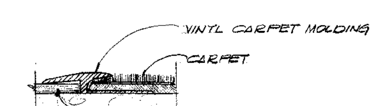
PLAN CLASSROOM CABINETS TYPICAL.
SCALE 3/4" = 1'-0" NOTE: ALL CLASSROOMS TO RECEIVED THIS CABINET EXCEPT CLASSROOM #124. SUPPLY CABINET WITHOUT SINK.



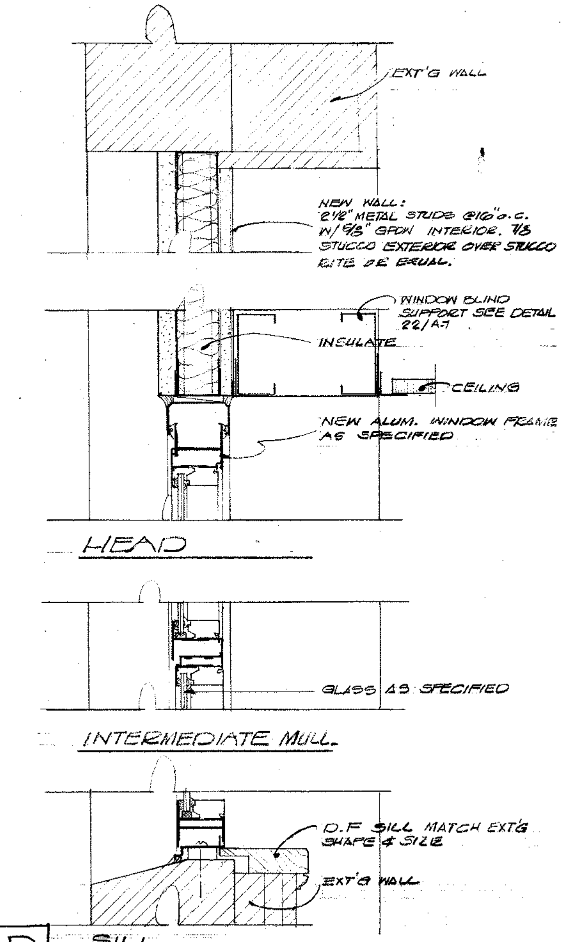
D SECTION GYM. SOUTH WALL ALT. BID #5
SCALE 3/4" = 1'-0"



E SECTION TOP OF NEW CLASSRM CABINETS
SCALE 3/4" = 1'-0"



1 DETAIL FLOOR CHANGE.
NO SCALE.



F SECTION CLASSROOM WINDOW ALT. BID #4
SCALE 3" = 1'-0" SEE WINDOW ELEV. SHEET A-6

NOTES:

1. ROOMS NO. 201, 202, 203, 204 PROVIDE WOOD FLOOR UNDERLAY TO LEVEL FLOORS WITH EXISTING CONC SLAB ELEVATION 3/4" ±.
2. STAIR NO. 205, & 301 REMOVE TRANSOM FRAME & GLASS PROVIDE & INSTALL TYPICAL INTERIOR PARTITION (SEE SECTION "C" THIS SHEET) FLUSH GPDW WITH EXISTING PLASTER ON THE CORRIDOR SIDE. PAINT BOTH SIDES.
3. ALL NEW INTERIOR PARTITIONS SHALL EXTEND FROM FINISH FLOOR TO UNDERSIDE OF SLAB ABOVE. PROVIDE 5/8" GWBD TAPED ABOVE THE FINISH CEILINGS.
4. EXISTING WOOD BASE ALL ROOMS SCHEDULED FOR NEW FLOOR COVERING REMOVE WOOD BASE SHOE. INSTALL NEW FLOOR COVERING, INSTALL NEW WOOD SHOE SHAPE TO MATCH EXISTING.
5. REMOVE EXT'G LINOLEUM FLOOR COVERING FROM ALL AREAS WHERE NEW RESILIANT FLOORING IS SCHEDULED.
6. ALL ROOMS WHERE NEW CHALKBOARD, TACKBOARDS ARE INDICATED. REMOVE EXT'G. WOOD TRIM AROUND EXISTING CHALKBOARDS INSTALL NEW CHALKBOARDS & NEW TACKBOARDS. W/ ADHESIVE AS SPECIFIED TO EXISTING SLATE CHALKBOARDS INSTALL NEW WOOD TRIM PAINT TO MATCH ALL OTHER TRIM.
7. EXISTING BOYS & GIRLS TOILET ROOMS ALL FLOORS; SEE ALTERNATE BID #3 FOR NEW CEILINGS. CEILING HEIGHT 8'-6".
8. SEE ALTERNATE BID #1 FOR STUDY HALL, PLATFORM CEILING.
9. SEE ALTERNATE BID #2 FOR LIBRARY CEILING.
10. CUT, PATCH & REPAIR & LEVEL FLOORS WHERE WALLS ARE REMOVED AND PREPARE FOR NEW FLOORING.
11. WHERE CARPET IS INSTALLED OVER EXT'G LINOLEUM OR VAT, STRIP ALL WAX FINISH WITH LIQUID STRIPPER & PREPARE SURFACE FOR ADHESIVE INSTALLATION.
12. WHERE WALLS ARE REMOVED TO INSTALL PLUMBING FIXTURES, PATCH BACK TO MATCH EXT'G.
13. PAINT OR STAIN & VARNISH NEW WOOD TRIM (OR PATCHES) TO MATCH EXISTING.
14. PAINT ENTIRE WALL WHERE PATCHING OCCURES NEW WALL IS ADDED, OR IF ANY WORK IS SCHEDULED ON AN EXISTING WALL.
15. STUDY HALL & LIBRARY SUSPENDED CEILINGS ALT. BID #1 & #2. NEW CEILING TO BE 4" MAX BELOW EXISTING CEILINGS. PAINT EXT'G BEAM WHERE TRIM IS REMOVED.

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ALEA-CMB
ARCHITECTS IN ASSOCIATION

ROOM FINISH SCHEDULE
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

date 6/11/82
drawn A
checked E
revised
approved

412-1

A 5

DOOR SCHEDULE

first floor

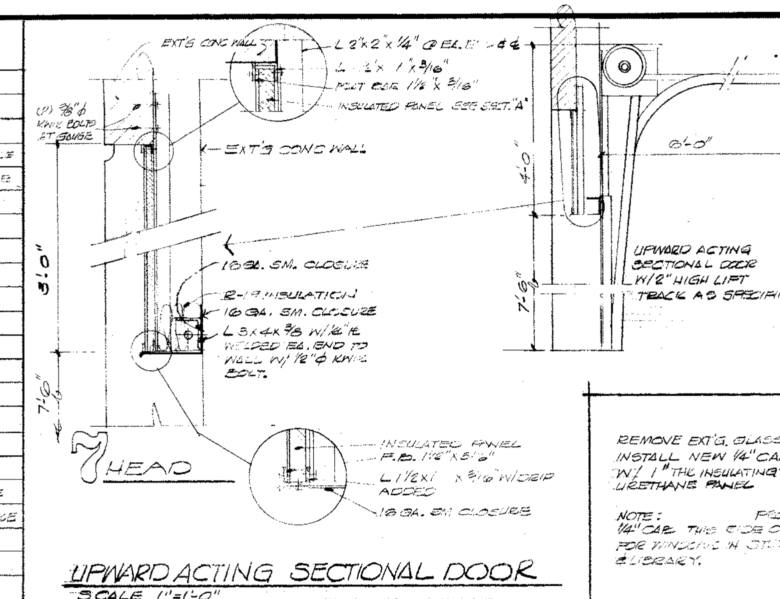
NO	TYPE	WIDTH	DOOR MATERIAL	DOOR FINISH	FRAME MATERIAL	FRAME FINISH	DETAILS HEAD	DETAILS JAMB	DETAILS SILL	REMARKS
101	A	3'-0"	WOOD	PAINT	H.M.	PAINT	5/A6	5/A6		1 HR "B" LABEL
102	A	2'-8"					6/A6	6/A6		1 HR "B" LABEL
103	A	2'-8"					5/A6	5/A6		
104	A	2'-8"					5/A6	5/A6		
105	A	2'-8"					5/A6	5/A6		
106	A	2'-8"					5/A6	5/A6		
107	A	3'-0"			↓		6/A6	6/A6		20 MIN. LABEL
108	B	3'-0"			H.M.		6/A6	6/A6		20 MIN. LABEL
109	A	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
110	A	3'-0"			H.M.		6/A6	6/A6		1 HR "B" LABEL
111	A	3'-0"			H.M.		6/A6	6/A6		1 HR "B" LABEL
112	A	3'-0			H.M.		6/A6	6/A6		1 HR "B" LABEL
113	A	3'-0			WOOD		11/A6	11/A6		20 MIN
114	B	3'-0"			WOOD		11/A6	11/A6		20 MIN
115	A	3'-0"			H.M.		6/A6	6/A6		1 HR "B" LABEL
116	A	3'-0"			H.M.		6/A6	6/A6		1 HR "B" LABEL
117	—	2'-8"			WOOD		/	/		EXT'G DR SEE HDWD SCHEDULE
118	—	2'-8"					/	/		EXT'G DR. SEE HDWD. SCHEDULE
119	B	3'-0"			↓		11/A6	11/A6		20 MIN LABEL
120	A	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
121	B	3'-0"	↓		H.M.		5/A6	5/A6		20 MIN LABEL
122	A	3'-0	WOOD		H.M.		6/A6	6/A6		1 HR "B" LABEL
123	C	8'-0"	METAL		STEEL		7/A6			
124	A	3'-0"	WOOD		H.M.		5/A6	5/A6		
125	A	3'-0"	WOOD	↓	H.M.	↓	5/A6	5/A6		1 HR. "B" LABEL
126	A	3'-0	WOOD	PAINT	H.M.	PAINT	5/A6	5/A6		1 HR "B" LABEL
127		—	D	E	L	E	T	E	D	—
128	A	3'-0"	WOOD	PAINT	H.M.	PAINT	6/A6	6/A6		1 HR "B" LABEL
129	D	1'-8"	SS. STL	FACTORY	H.M		7/A6	/	10/A6	1 HR "B" LABEL
130	A	3'-0"	WOOD	PAINT	H.M		5/A6	5/A6		1 HR. "B" LABEL
131	A	3'-0"			H.M		5/A6	5/A6		1 HR "B" LABEL
132	B	2'-8"			WOOD		11/A6	11/A6		20 MIN LABEL
133	B	2'-8"					11/A6	11/A6		20 MIN LABEL
134	B	2'-8"					11/A6	11/A6		20 MIN LABEL
135	B	2'-8"					11/A6	11/A6		20 MIN LABEL
136	—	2'-8"					/	/		EXT'G DR SEE HDWD SCHEDULE
137	—	2'-8"					/	/		EXT'G DR. SEE HDWD SCHEDULE
138	B	2'-8"	↓	↓	↓	↓	11/A6	11/A6		20 MIN LABEL
139	B	2'-8"	WOOD	PAINT	WOOD	PAINT	11/A6	11/A6		20 MIN LABEL

second floor

NO	TYPE	WIDTH	DOOR MATERIAL	DOOR FINISH	FRAME MATERIAL	FRAME FINISH	DETAILS HEAD	DETAILS JAMB	DETAILS SILL	REMARKS
201	B	3'-0"	WOOD	PAINT	H.M.	PAINT	6/A6	6/A6		20 MIN. LABEL
202	B	3'-0"			H.M.		6/A6	6/A6		20 MIN. LABEL
203	B	3'-0"			H.M.		6/A6	6/A6		20 MIN. LABEL
204	B	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
205	—	2'-8"			WOOD		/	/		EXT'G. DR. SEE HDWD SCHEDULE
206	—	2'-8"			WOOD		/	/		EXT'G. DR. SEE HDWD. SCHEDULE
207	B	3'-0"			H.M.		6/A6	6/A6		20 MIN. LABEL
208	A	2'-6"					5/A6	5/A6		
209	A	3'-0"					5/A6	5/A6		
210	A	3'-0"			↓		5/A6	5/A6		20 MIN LABEL
211	A	3'-0"			H.M		5/A6	5/A6		20 MIN. LABEL
212	B	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
213	B	3'-0"					11/A6	11/A6		20 MIN LABEL
214	B	3'-0'			↓		11/A6	11/A6		20 MIN LABEL
215	A	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
216	A	3'-0"			H.M		6/A6	6/A6		1 HR. "B" LABEL
217	B	3'-0"			WOOD		5/A6	5/A6		20 MIN. LABEL
218	A	3'-0"			H.M.		5/A6	5/A6		1 HR. "B" LABEL
219	B	2'-8"			H.M.		5/A6	5/A6		20 MIN. LABEL
220	—	2'-8"			WOOD		/	/		EXT'G. DR. SEE HDWD SCHEDULE
221	—	3'-0"					/	/		EXT'G. DR. SEE HDWD SCHEDULE
222	A	3'-0"					11/A6	11/A6		20 MIN LABEL
223	B	3'-0"					11/A6	11/A6		20 MIN LABEL
224	B	3'-0"			↓		11/A6	11/A6		20 MIN LABEL
225	B	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
226	E	2'-8"	↓	↓	H.M.	↓	5/A6	5/A6		
227	E	2'-8"	WOOD	PAINT	H.M.	PAINT	5/A6	5/A6		

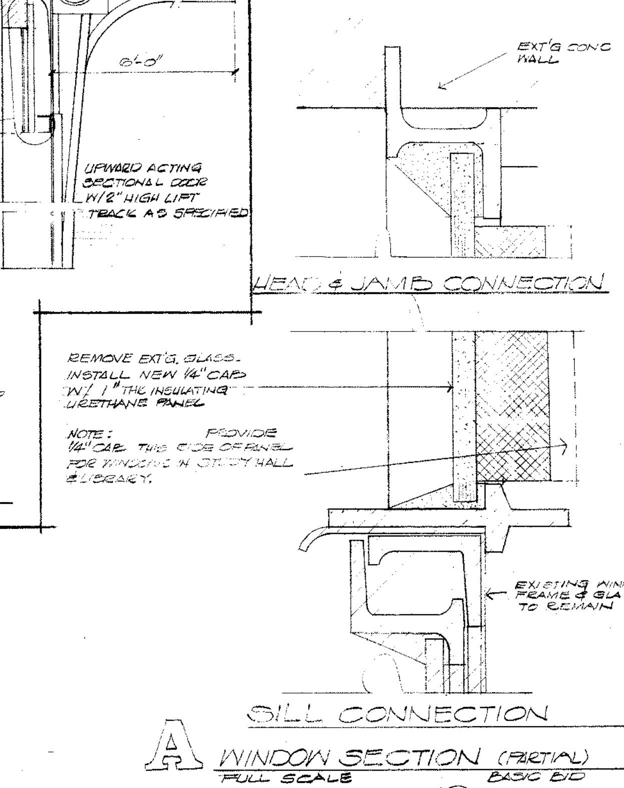
third floor

NO	TYPE	WIDTH	DOOR MATERIAL	DOOR FINISH	FRAME MATERIAL	FRAME FINISH	DETAILS HEAD	DETAILS JAMB	DETAILS SILL	REMARKS
301	B	3'-0"	WOOD	PAINT	WOOD	PAINT	11/A6	11/A6		20 MIN LABEL
302	—	2'-8"			WOOD		/	/		EXT'G. DR SEE HDWD SCHEDULE
303	—	2'-8"			WOOD		/	/		EXT'G DR. SEE HDWD. SCHEDULE
304	A	3'-0"			H.M.		6/A6	6/A6		1 HR "B" LABEL
305	A	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
306	A	3'-0"			H.M.		5/A6	5/A6		1 HR "B" LABEL
307	A	3'-0"			H.M.		11/A6	11/A6		20 MIN LABEL
308	B	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
309	B	3'-0"					11/A6	11/A6		20 MIN LABEL
310	B	3'-0"			↓		11/A6	11/A6		20 MIN LABEL
311	A	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
312	A	3'-0"			H.M.		6/A6	6/A6		1 HR "B" LABEL
313	B	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
314	A	3'-0"			H.M.		5/A6	5/A6		1 HR "B" LABEL
315	B	3'-0"			H.M		5/A6	5/A6		20 MIN LABEL
316	—	2'-8"			WOOD		/	/		EXT'G. DR. SEE HDWD SCHEDULE
317	—	2'-8					/	/		EXT'G. DR. SEE HDWD. SCHEDULE
318	B	3'-0"					11/A6	11/A6		20 MIN LABEL
319	B	3'-0"					11/A6	11/A6		20 MIN LABEL
320	B	3'-0"			↓		11/A6	11/A6		20 MIN LABEL
321	B	3'-0"			WOOD		11/A6	11/A6		20 MIN LABEL
322	A	2'-8"			H.M		6/A6	6/A6		1 HR "B" LABEL
323	B	2'-8"			WOOD		11/A6	11/A6		20 MIN LABEL
324	B	2'-8"					11/A6	11/A6		20 MIN LABEL
325	B	2'-8"					11/A6	11/A6		20 MIN LABEL
326	B	2'-8"	↓	↓	↓	↓	11/A6	11/A6		20 MIN LABEL
327	A	2'-2"	WOOD	PAINT	WOOD	PAINT	11/A6	11/A6		20 MIN LABEL

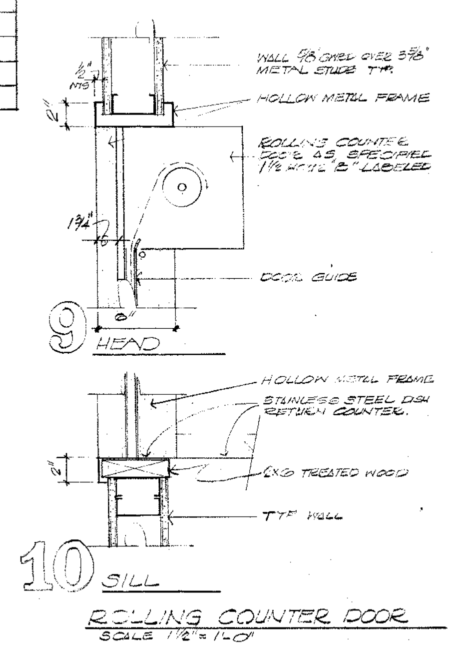


7 HEAD

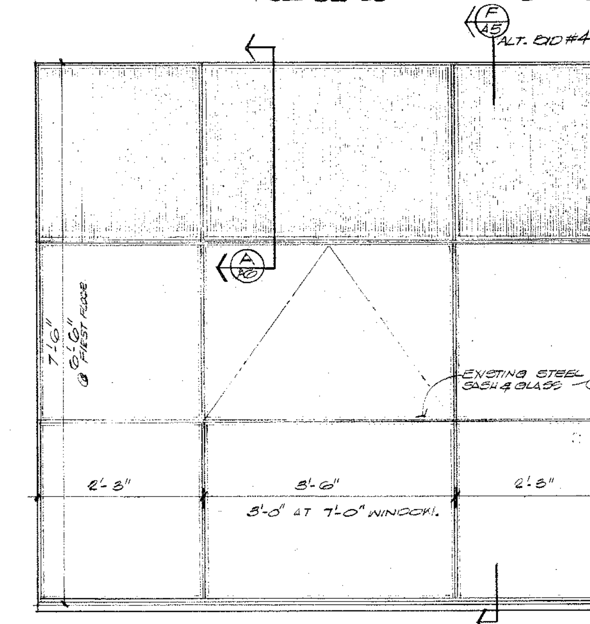
UPWARD ACTING SECTIONAL DOOR
SCALE 1"=1'-0"



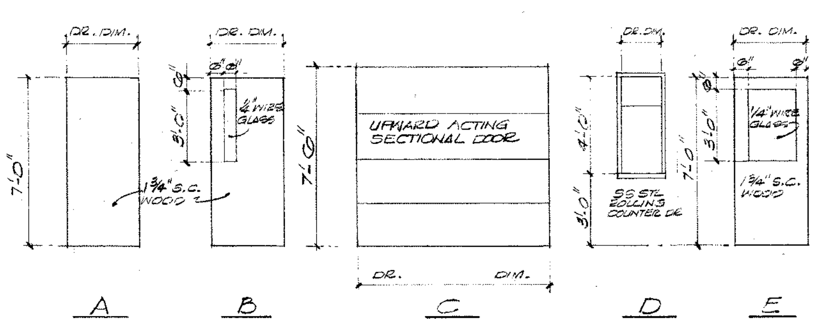
A WINDOW SECTION (PARTIAL)
FULL SCALE



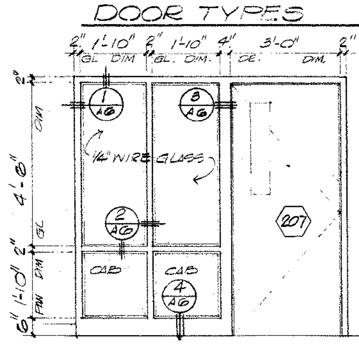
ROLLING COUNTER DOOR
SCALE 1 1/2"=1'-0"



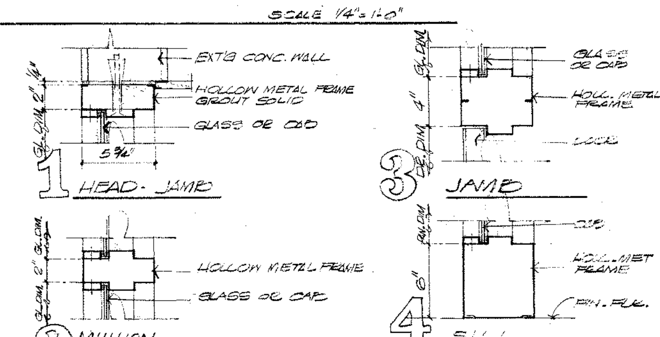
TYPICAL WINDOW ELEVATION SCALE 3/4"=1'-0"



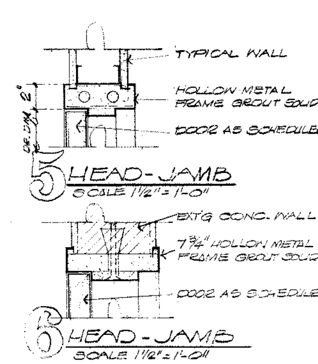
DOOR TYPES
SCALE 1/4"=1'-0"

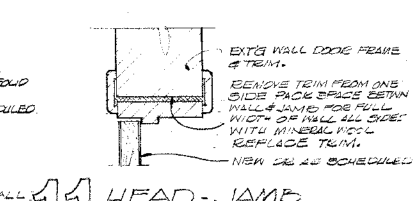


RELITE ELEVATION
SCALE 3/8"=1'-0"



RELITE DETAILS
SCALE 1 1/2"=1'-0"





11 HEAD - JAMB
SCALE 1 1/2"=1'-0"

REGISTERED ARCHITECT
LARRY NEIL ERICKSON
STATE OF WASHINGTON

ALEA-CMB
ARCHITECTS IN ASSOCIATION

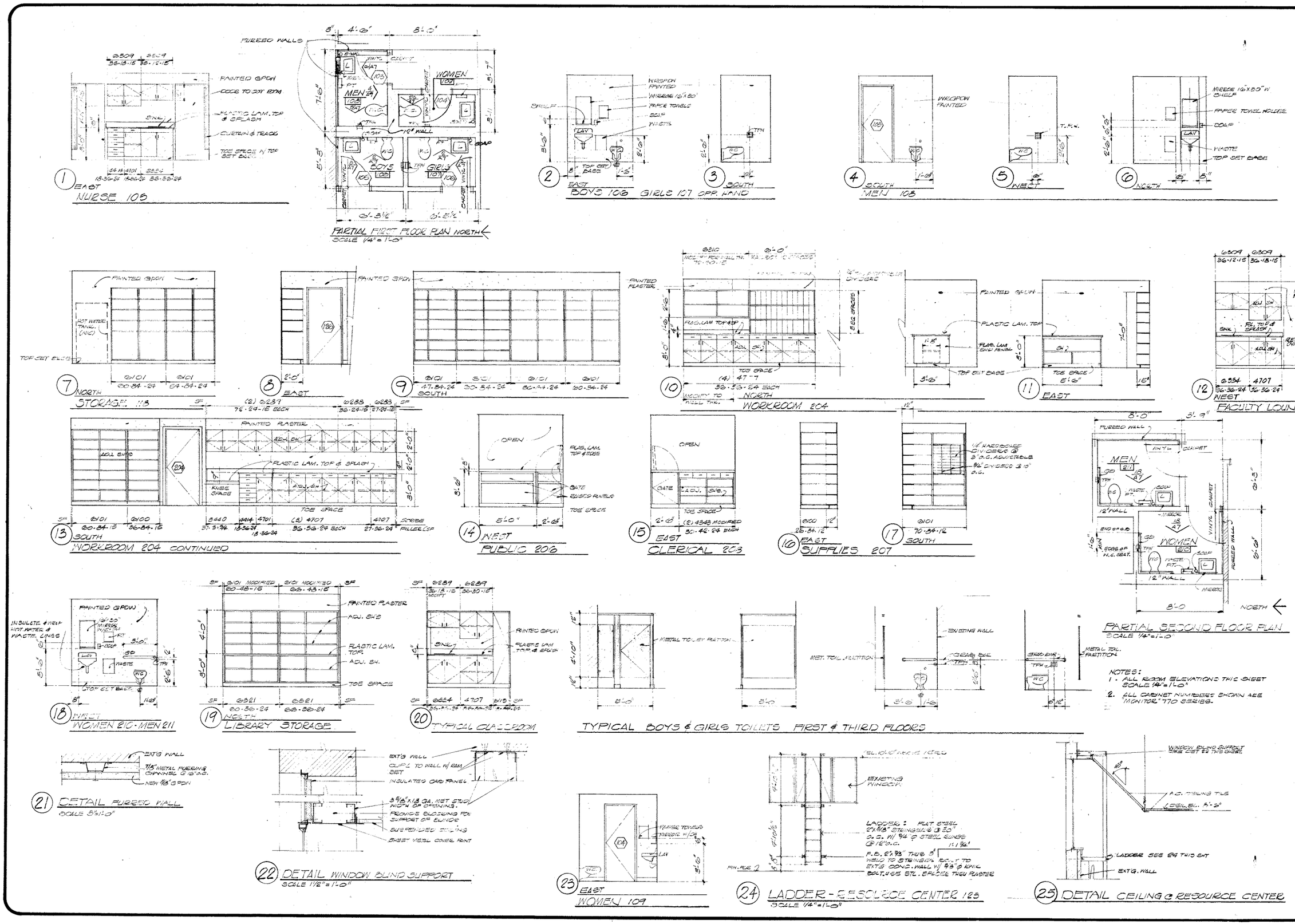
DOOR SCHEDULE DETAILS

MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

date	6/1/82
drawn	A
checked	E
revised	
approved	

412-1

A6



NOTES:
1. ALL ROOM ELEVATIONS THIS SHEET SCALE 1/4" = 1'-0"
2. ALL CABINET NUMBERS SHOWN ARE "MONITOR" 770 SERIES.

REGISTERED ARCHITECT
STATE OF WASHINGTON

Larry Erickson & Associates
p.o. box 1000 • bremerton, wa 98273
(206) 376-5765
Cole Erickson Williams • Bruneman, Inc.
2900 westlake avenue north • suite 200
seattle, wa 98102 • (206) 322-0810

ALEA-CMB
ARCHITECTS IN ASSOCIATION

ROOM ELEVATIONS
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

date	6/1/82
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checked	
revised	
approved	

412-1

A 7

EAST ELEVATION
SCALE 1/8" = 1'-0"

WEST ELEVATION
SCALE 1/8" = 1'-0"

REGISTERED ARCHITECT
LARRY HENDRICKSON
STATE OF WASHINGTON

Larry Erickson & Associates
1315 Cedar St. • Mount Vernon, wa 98273
(206) 336-5765
Chiquoine • Murakami • Blumont Inc
1000 Second Avenue Building • Suite 2000
seattle, wa 98102 • (206) 322-0810

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ARCHITECTS IN ASSOCIATION

EXTERIOR ELEVATIONS
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

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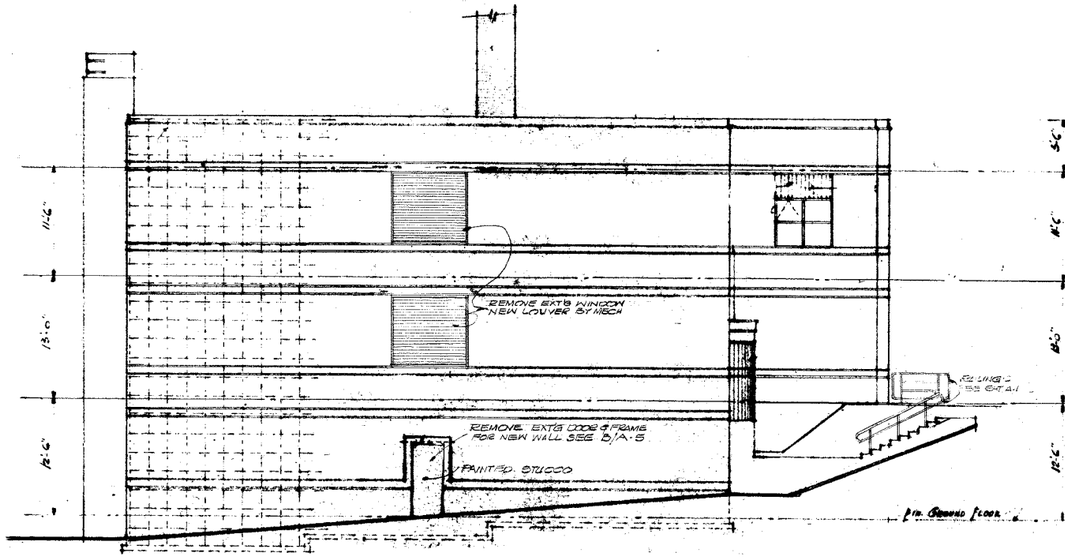
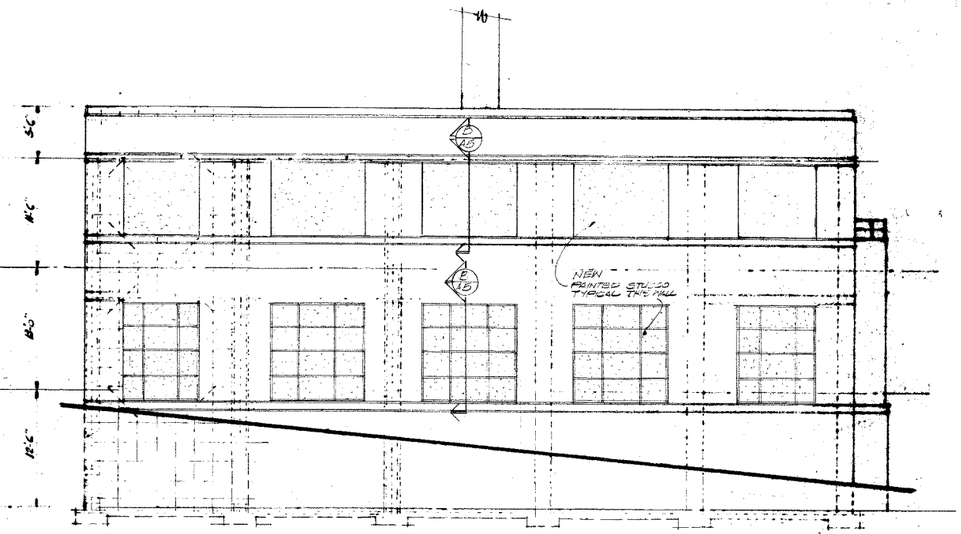
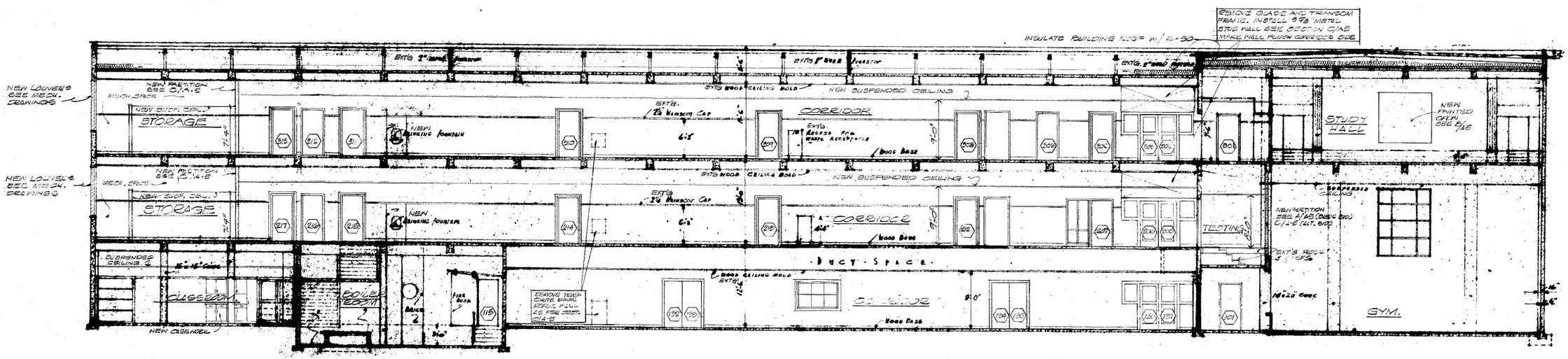
A8



SKAGIT STREET ELEVATION
SCALE 1/8" = 1'-0"



BROAD STREET ELEVATION
SCALE 1/8" = 1'-0"



SECTION "A-A"
SCALE 1/8" = 1'-0"

Larry Erickson & Associates
p.o. box 1175 • mount vernon, wa 98273
(206) 336-5765
Chicom + Muksaim + Blummit Inc
Consulting structural engineers
seattle, wa 98102 • (206) 322-0810

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ARCHITECTS IN ASSOCIATION

SECTION & ELEVATIONS
MODERNIZATION OF
LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

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revised	
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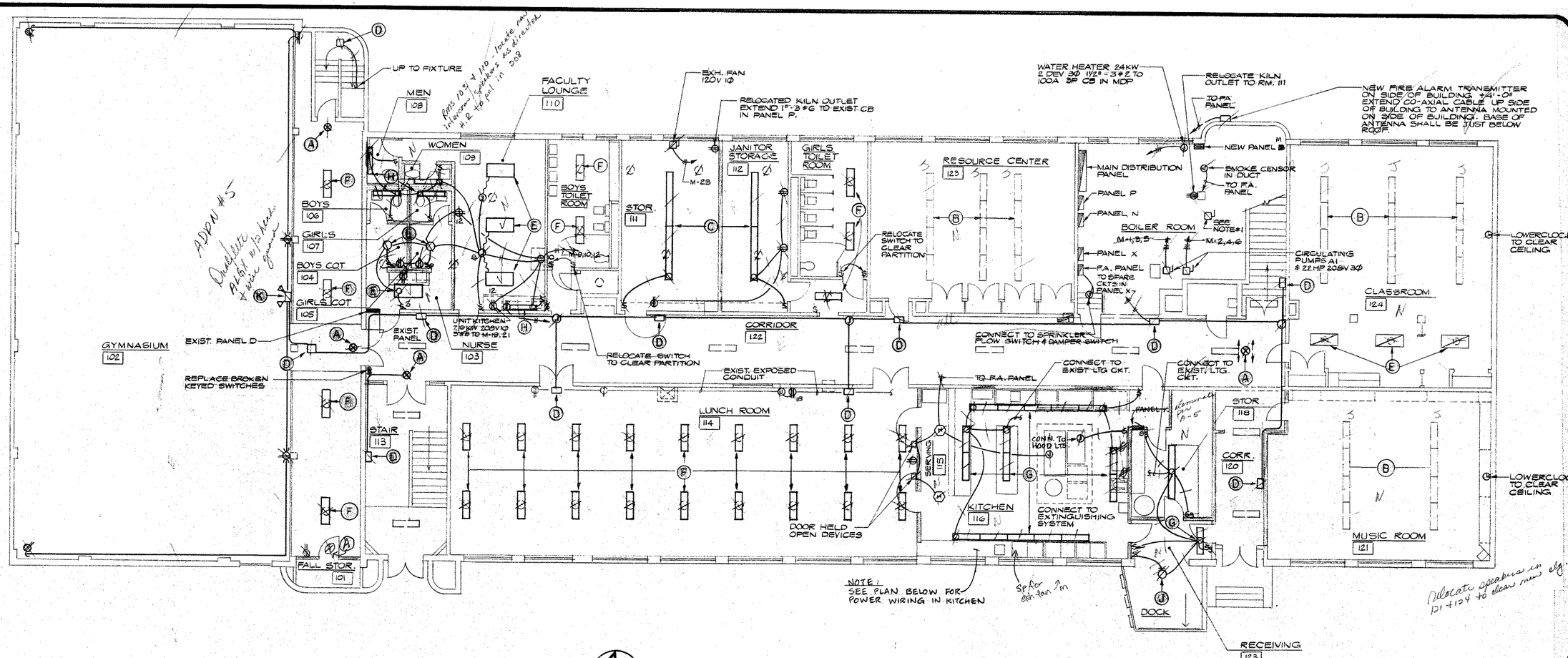
412-1

A 9



FIRST FLOOR PLAN - ELECTRICAL

SCALE: 1/8" = 1'-0"

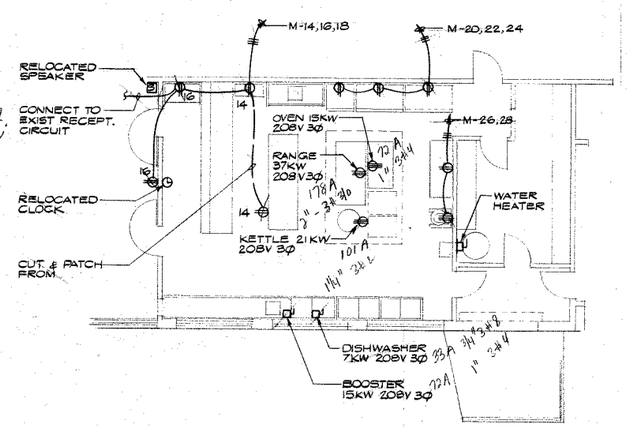
LIGHT FIXTURE SCHEDULE				
TYPE	MAKE & MODEL		LAMPS	REMARKS
(A)	DUAL LITE	WRWW5G	SUPPLIED W/FIXTURE	REMOVE EXIST. EXIT LIGHT & MOUNT NEW FIXTURE
(B)	EXISTING			REMOUNT EXIST. FIXTURE ON NEW SUSPENDED CEILING
(C)	LITHONIA	BTC 240	2F40T12 CW	CHAIN HUNG STRIP FLUORESCENT
(D)	DUAL LITE	SDG	SUPPLIED W/FIXTURE	SELF-CONTAINED EMERGENCY PATHWAY LIGHT
(E)	LITHONIA	2GS 340 A	3F40T12 CW	2 x 4 RECESSED FLUORESCENT
(F)		VC 240	2F40T12 CW	REMOVE EXIST. FIXTURE - CONNECT TO EXIST. CKT
(G)		DL 240A	2F40T12 CW	SURFACE MOUNTED
(H)	ALKCO	S24S	2F40T12 CW	MOUNT AT CEILING OR UNDER CABINET
(J)	AUTH	B1B604/120	70W HPS	WALL MOUNT ABOVE DOOR
(K)		B15-211/120-WG-15L-FF-SQ-GRC	250W METAL HALIDE	REMOVE EXIST. FIXTURE. PROVIDE METAL PLATE OVER CEILING.
(L)	Nicolite	488-3 W/100W-A-19 lamp		

Dual lite AFGH w/ plate + wire guard

Addn #3
A.E.
Emerg. lite AD
Exit CEFG
Lith A+D
Addn #5
A.E.
Metalux CEG
Elbow P

NOTES:

1. CHANGE 30A 3P C.B. SEWING FAN MOTOR IN BOILER ROOM TO 70A 3P. RUN 3/4" - 3#3 FROM 30A 3P DISC TO THIS C.B.



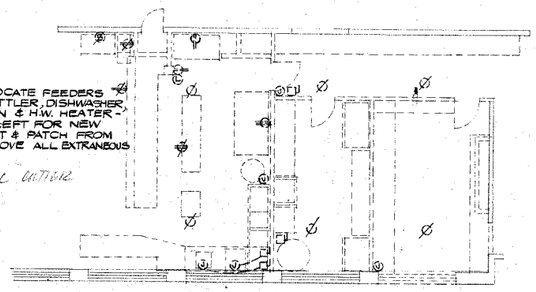
KITCHEN PLAN

SCALE: 1/8" = 1'-0"

NOTES:

REMOVE & RELOCATE FEEDERS TO RANGE, KETTLER, DISHWASHER BOOSTER, OVEN & H.W. HEATER - SEE PLAN AT LEFT FOR NEW LOCATIONS. CUT & PATCH FROM AS REQ'D. REMOVE ALL EXTRANEOUS WIRING.

1 DPX CONC CUTOUT
8 #2
3/8 D CONC



KITCHEN DEMOLITION PLAN

SCALE: 1/8" = 1'-0"

No lamp guard

Larry Eccles & Associates
P.O. Box 1000 • Mount Vernon, WA 98273
(206) 336-5766
Donald Murphy & Burnett, Inc.
Dexter Horton Building, Suite 700
Seattle, WA 98104 • (206) 622-0810

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ARCHITECTS IN ASSOCIATION

MODERNIZATION OF
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MOUNT VERNON SCHOOL DISTRICT NO 320 -
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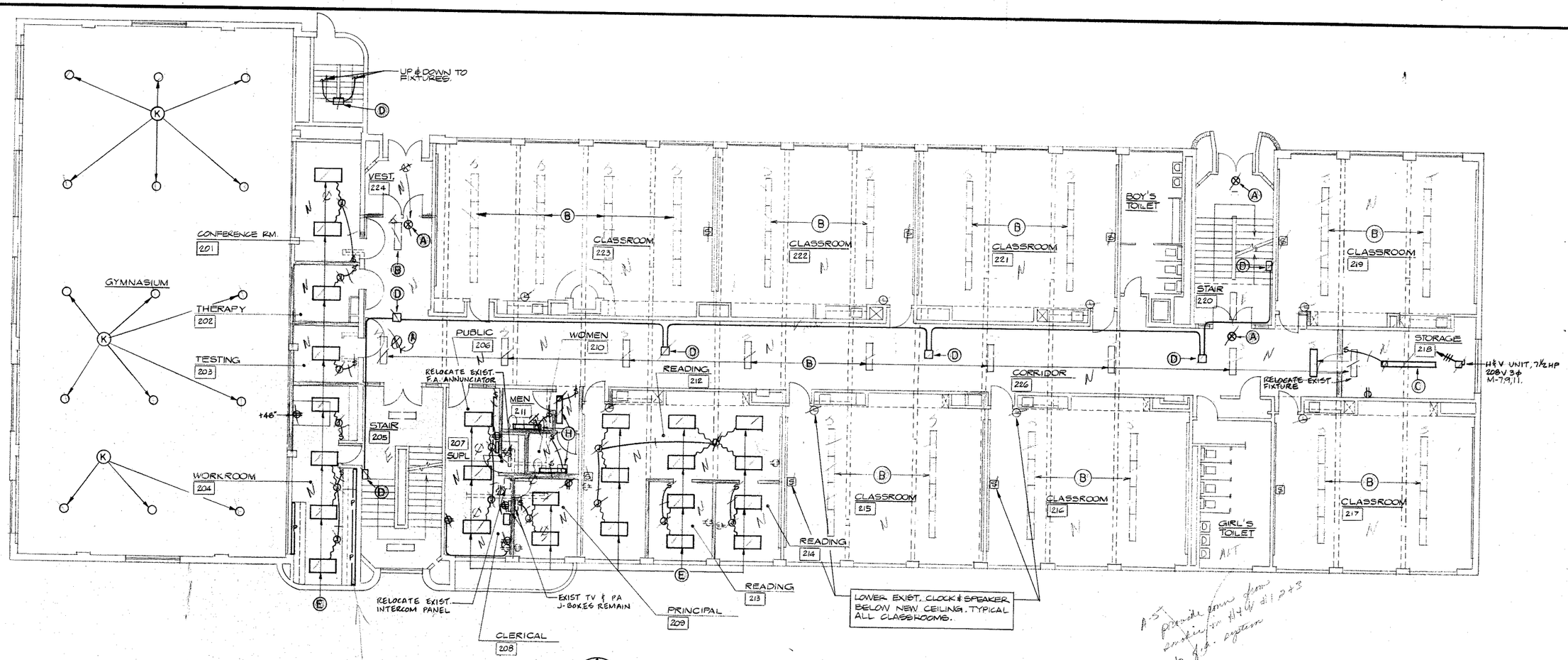
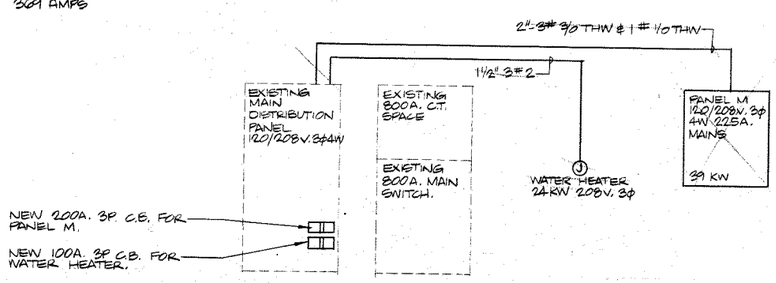


SECOND FLOOR PLAN - ELECTRICAL

SCALE: 1/8" = 1'-0"

NOTE:
POWER CO. RECORDS INDICATE THE MAXIMUM DEMAND AT THE SCHOOL IN THE LAST YEAR HAS BEEN 70 KW OR 194 AMPS. THE ADDED LOAD IS 63 KW FOR A TOTAL OF 369 AMPS



RISER DIAGRAM

NO SCALE

PANEL M SCHEDULE

120/208 V. 3φ 4W. — 225 A. MAINS

CIRC.	AMPS	POLE	SERVICE	WATTS A	WATTS B	WATTS C	SERVICE	AMPS	POLE	CIRC.
1	20	3	PUMP #1	770 / 770			PUMP #2	20	3	2
3					770 / 770					4
5						770 / 770				6
7	50	3	H&V #1 & 2	2920 / 1000			LIGHTING	20	1	8
9					2920 / 800		COKE MACHINE			10
11						2920 / 1000	RECEPTACLES			12
13	50	3	H&V #3	2920 / 800						14
15					2920 / 800					16
17						2920 / 800				18
19	40	2	UNIT KITCHEN	3800 / 800						20
21					3800 / 800					22
23	20	1	EXH. FAN			200 / 800				24
25			SPARE	/ 800						26
27					/ 800					28
29						/	SPACE			30
31				/						32
33					/					34
35						/				36
			TOTAL WATTS	14,580	14,380	9980				
			AMPS	122	120	83				

A-5 provide power from existing in H&V #1 panels to fire system

Lathrop Eastman & Associates
Consulting Mechanical Engineers
(206) 336-5765
Dorsey, Marsden, Blumhart, Inc.
Consulting Structural Engineers
(206) 322-0810

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MODERNIZATION OF
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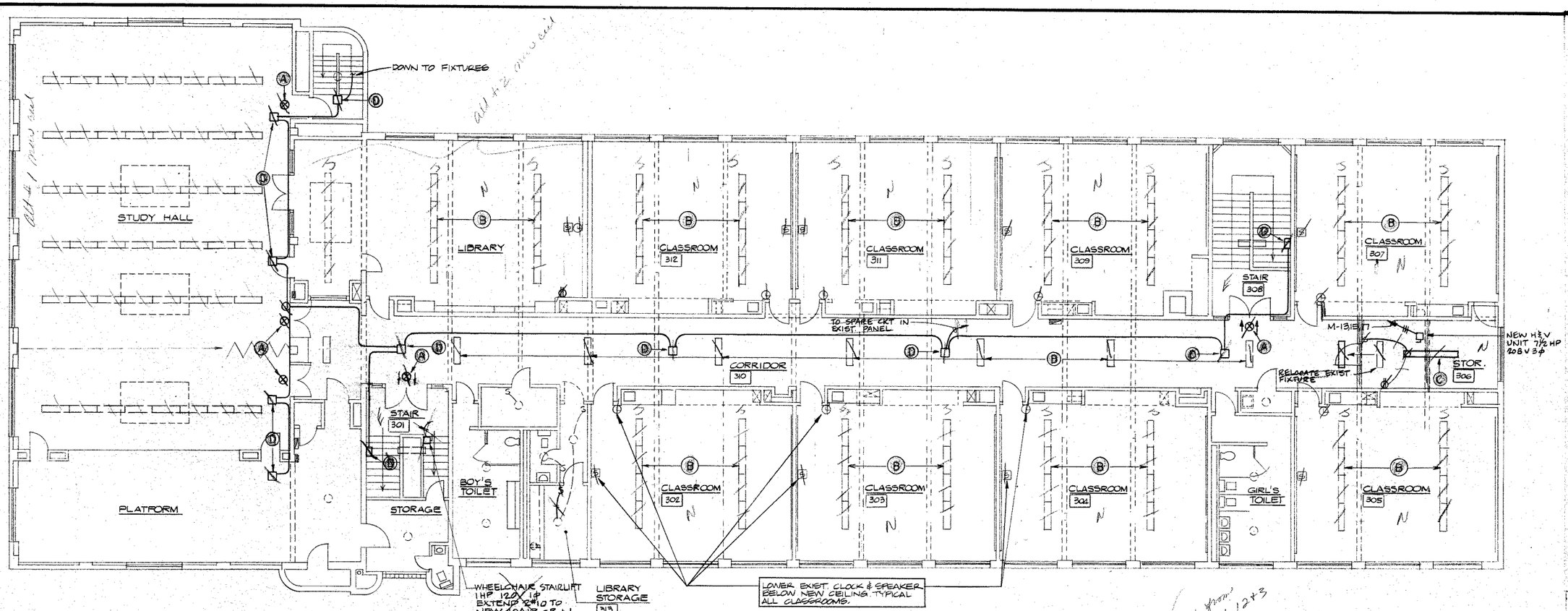
E-2



Delete

Verify elect location 3 new outlets on stage Addn #3

A-5 provide conn from smoke in AHU 1, 2+3 to f.a. system

THIRD FLOOR PLAN - ELECTRICAL

SCALE: 1/8" = 1'-0"

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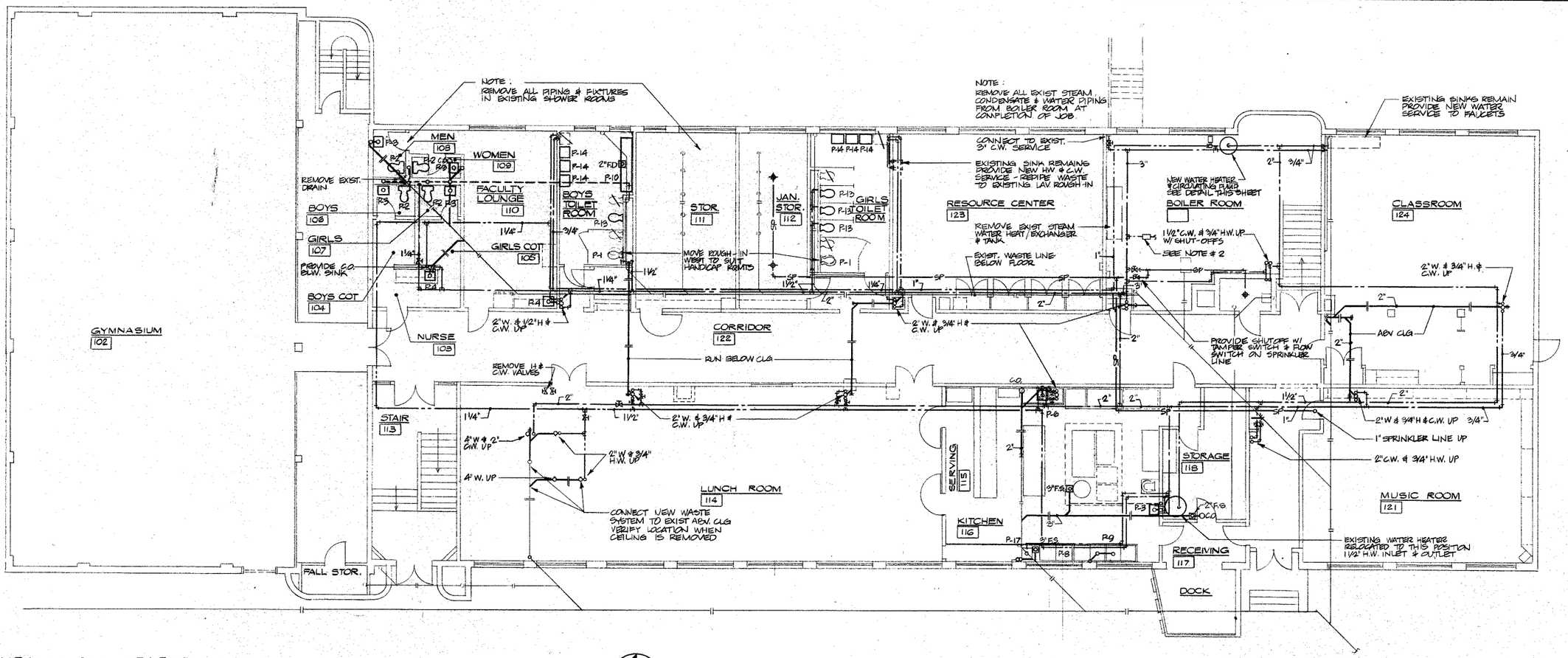
412-1

E-3



FIRST FLOOR PLAN - PLUMBING

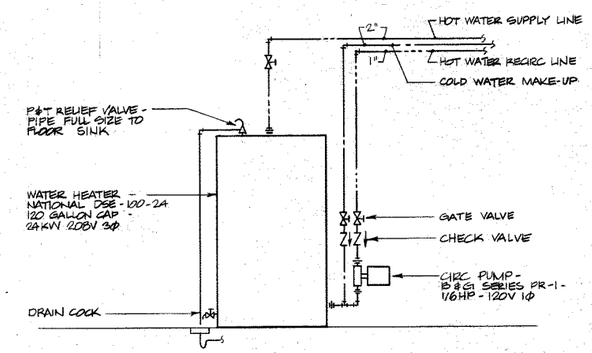
SCALE: 1/8" = 1'-0"

MECHANICAL LEGEND

- WASTE PIPING
- VENT PIPING
- COLD WATER PIPING
- HOT WATER PIPING
- RECIRCULATING HOT WATER PIPING
- F.D. FLOOR DRAIN
- SP SPRINKLER PIPING
- CEILING SUPPLY DIFFUSER (ARROWS DENOTE THROW)
- CEILING EXHAUST OR RETURN GRILLE
- WALL SUPPLY REGISTER
- WALL EXHAUST OR RETURN GRILLE
- VOLUME DAMPER
- FLEXIBLE DUCT RUNOUT
- SOUNDLINED DUCT
- SECTION THRU SUPPLY DUCT
- SECTION THRU EXHAUST OR RETURN DUCT
- T THERMOSTAT
- F.D. FIRE DAMPER
- HWS HEATING WATER SUPPLY PIPING
- HWR HEATING WATER RETURN PIPING

NOTES:

1. RELOCATE EXISTING FIRE HYDRANT AT THE CORNER OF 9TH & BROAD STREETS TO PROVIDE 3' CLEARANCE AROUND HYDRANT FOR PROPER OPERATION.
2. PROVIDE NEW COLD WATER FEED FOR BOILER SEE DETAIL SHEET M-2.



WATER HEATER PIPING DIAGRAM

NO SCALE

Larry Erickson & Associates, p.o. box 1125, 1000 e. college, mount vernon, wa 98273
Olson - Murpurn - Bowman inc. 2800 westlake avenue north, suite 200 seattle, wa 98109 (206) 282-0500

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ARCHITECTS IN ASSOCIATION

FIRST FLOOR PLAN - PLUMBING
MODERNIZATION OF
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MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

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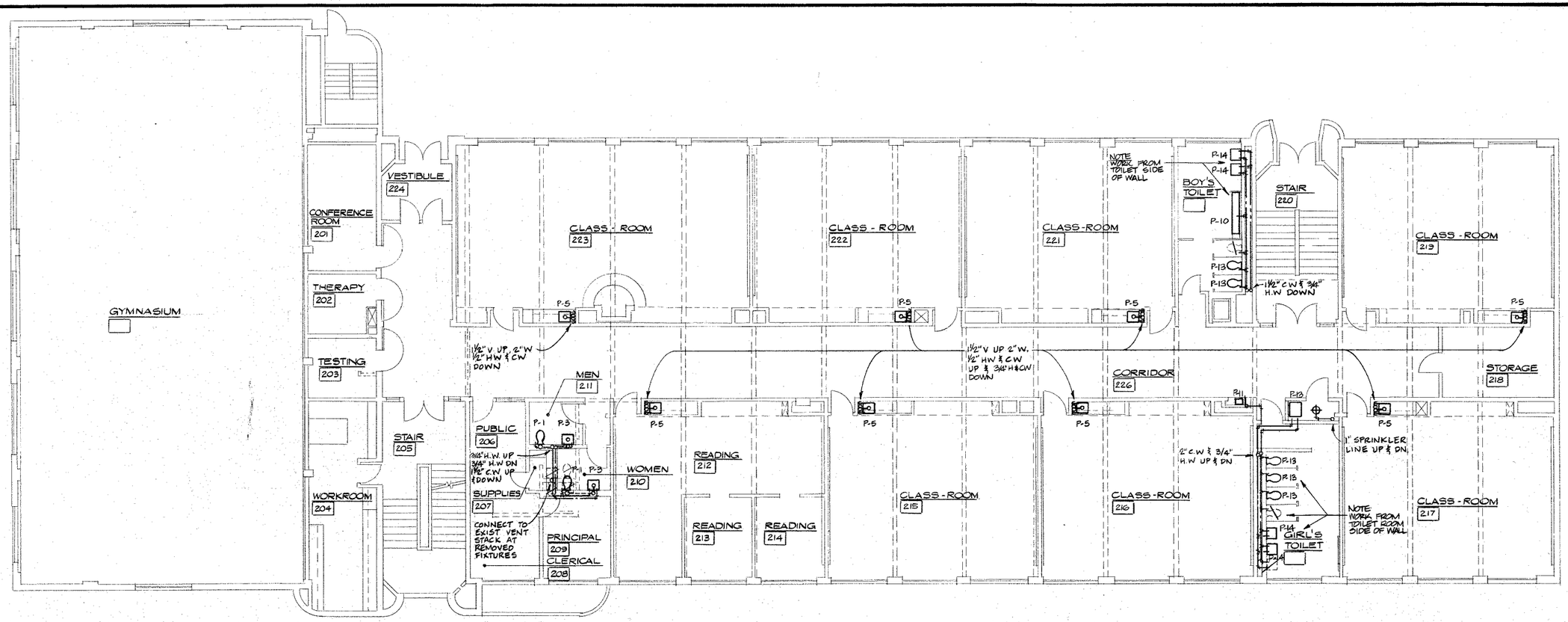
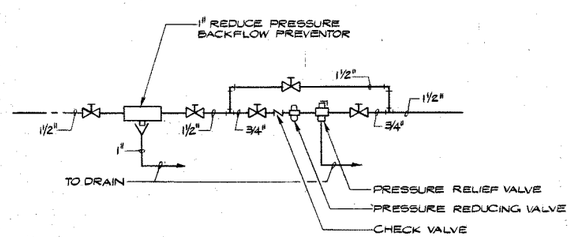


SECOND FLOOR PLAN - PLUMBING

SCALE: 1/8" = 1'-0"

FIXTURE CONNECTION SCHEDULE						
P. NO	FIXTURE	WASTE	VENT	COLD WATER	HOT WATER	REMARKS
1	WATER CLOSET (FLUSH VALVE)	4"	2"	1"	—	
2	WATER CLOSET (FLUSH TANK)	4"	2"	1/2"	—	
3	LAVATORY	1½"	1½"	1/2"	1/2"	
4	SINK	2"	1½"	1/2"	1/2"	
5	CLASSROOM SINK	2"	1½"	1/2"	1/2"	
6	VEGETABLE SINK	2" F.S.	2"	1/2"	1/2"	
7	RINSE SINK	2"	2"	1/2"	1/2"	
8	DISHWASHER	3" F.S	2"	1/2"	3/4"	
9	POT SINK	2-2"	2-2"	1/2"	1/2"	
10	URINAL - REPLACEMENT	—	—	1"	—	
11	DRINKING FOUNTAIN - REPLACEMENT	—	—	1/2"	—	
12	SERVICE SINK - REPLACEMENT	—	—	3/4"	3/4"	
13	WATER CLOSET - REPLACEMENT	—	—	1"	—	
14	LAVATORY - REPLACEMENT	—	—	1/2"	1/2"	



HEATING SYSTEM WATER SUPPLY DETAIL

NO SCALE

Lew Erickson & Associates
P.O. Box 1135 • Mount Vernon, WA 98273
(206) 336-5760
Chris Bullard Architects • Bullard, Inc.
2900 Rockefeller Ave. • Box 1117 • Suite 200
Everett, WA 98201 • (206) 252-5510

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SECOND FLOOR PLAN - PLUMBING

MODERNIZATION OF

LINCOLN Elementary School

MOUNT VERNON SCHOOL DISTRICT NO 320

MOUNT VERNON, WA.

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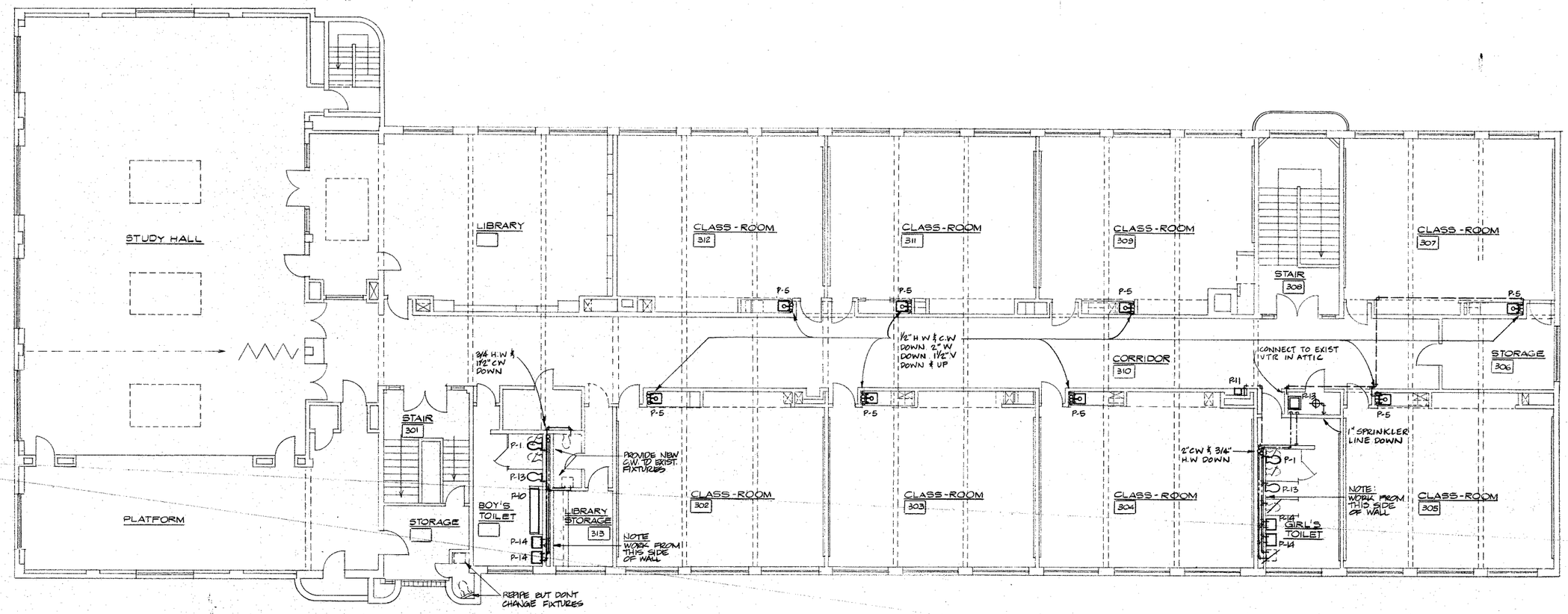
M-2



THIRD FLOOR PLAN – PLUMBING
SCALE: 1/8" = 1'-0"

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ARCHITECTS IN ASSOCIATION

THIRD FLOOR PLAN – PLUMBING
MODERNIZATION OF
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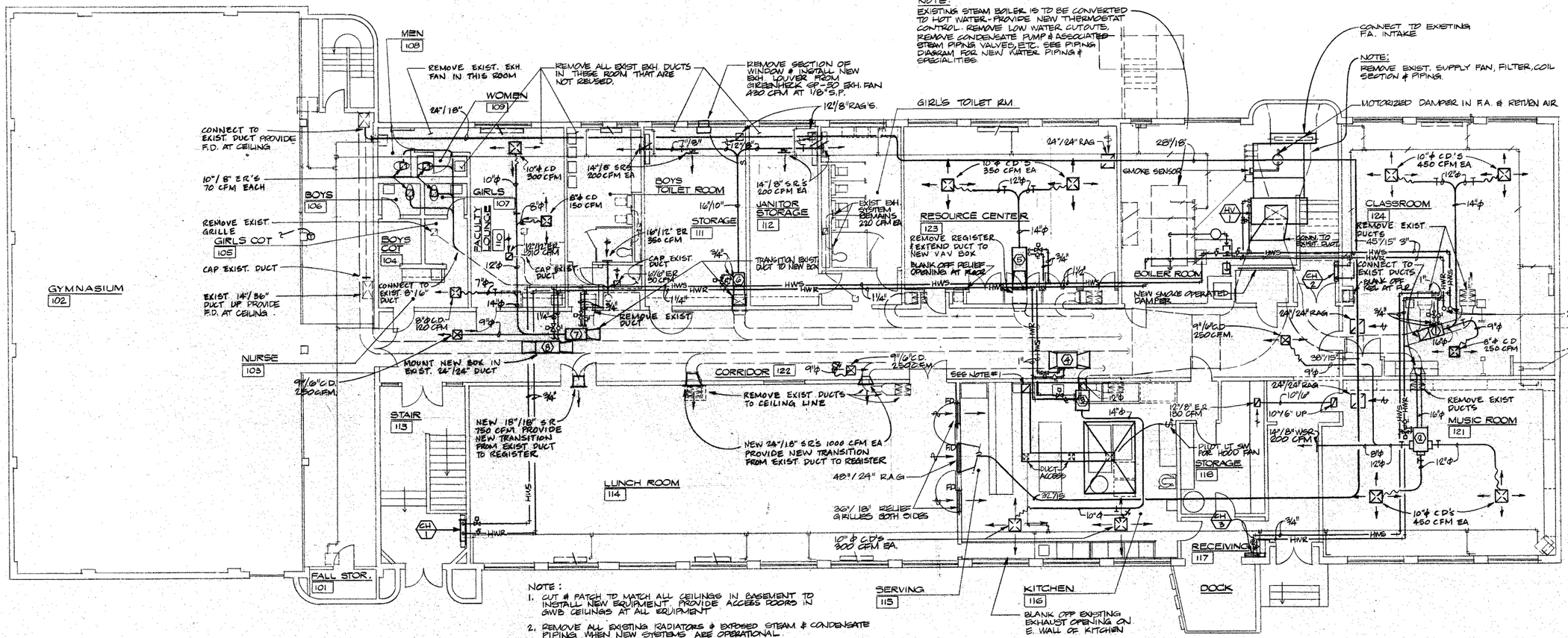
M-3

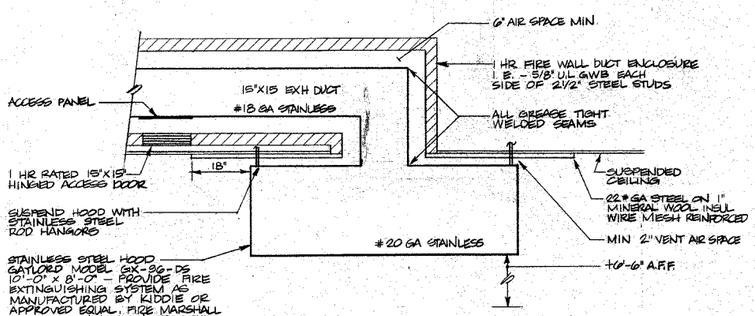


NOTE:
1. CUT & PATCH TO MATCH ALL CEILINGS IN BASEMENT TO INSTALL NEW EQUIPMENT. PROVIDE ACCESS DOORS IN GWB CEILINGS AT ALL EQUIPMENT.
2. REMOVE ALL EXISTING RADIATORS & EXPOSED STEAM & CONDENSATE PIPING WHEN NEW SYSTEMS ARE OPERATIONAL.

FIRST FLOOR PLAN - HEATING

SCALE: 1/8" = 1'-0"

NOTES:
1. PROVIDE 15"/15" KITCHEN EXHAUST DUCT UP TO UPBLAST UTILITY FAN ON ROOF. PROVIDE 18 GA. STAINLESS STEEL DUCTWORK W/ ACCESS PANELS FOR CLEANING AS SHOWN ON PLAN AT EACH LEVEL.

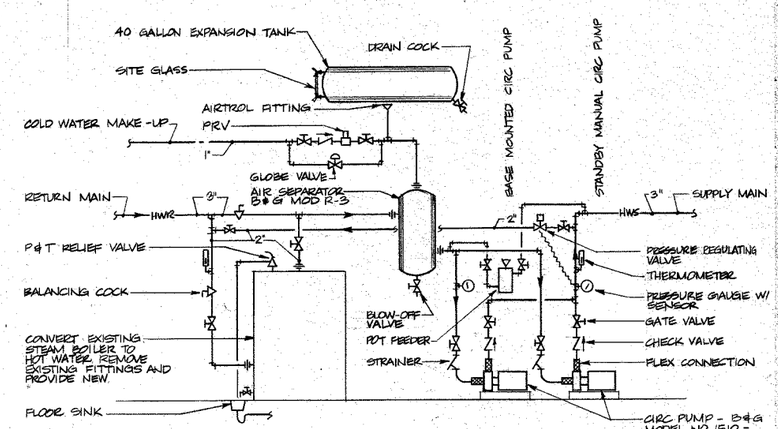


KITCHEN HOOD DETAIL

NO SCALE

CABINET HEATER SCHEDULE

HTR. NO.	MAKE & MODEL	HEATING CAPACITY @ 180° E.W.T.	GPM	CFM	REMARKS
CH 1	STERLING F-C 30-2	14.5 MBH	2.0	200	18.7° WATER TEMP DROP
CH 2	F-C 30-2	14.5 MBH	2.0	200	↓
CH 3	F-C 30-1	7.0 MBH	0.5	200	36.4°
CH 4	F-C 30-1	7.0 MBH	0.5	200	↓



BOILER PIPING DIAGRAM

NO SCALE

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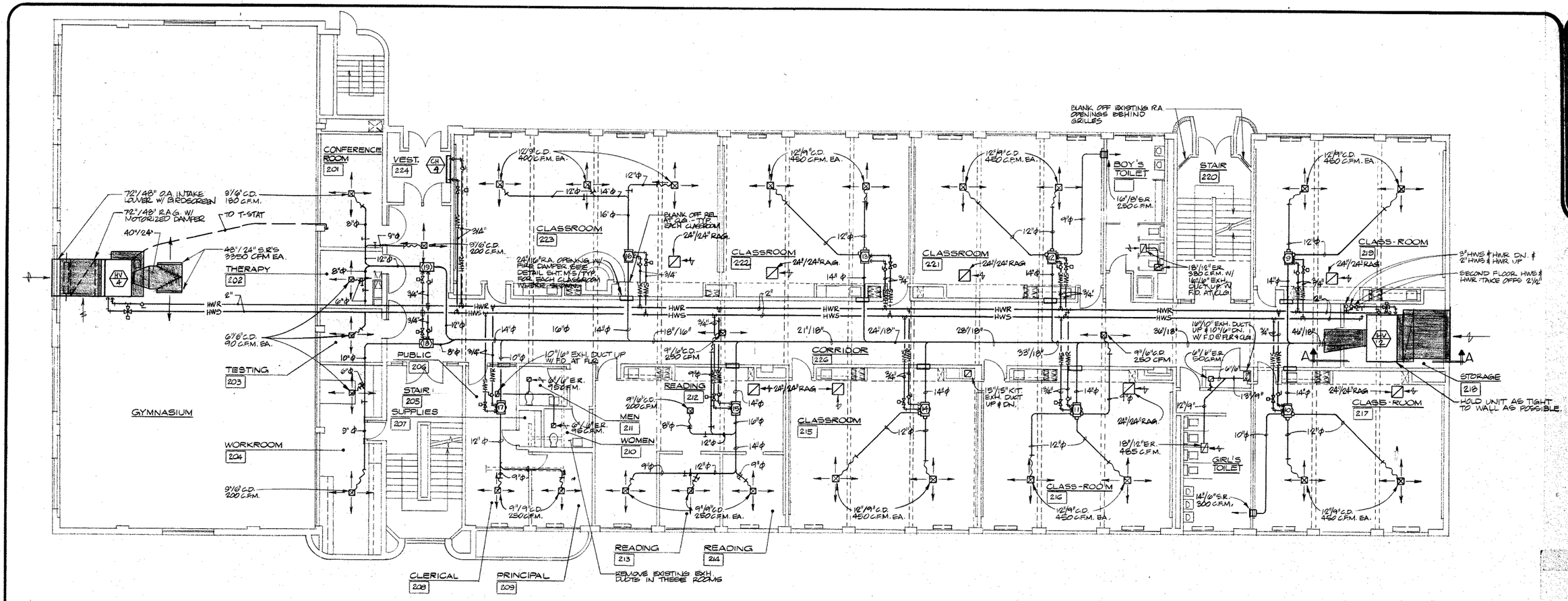
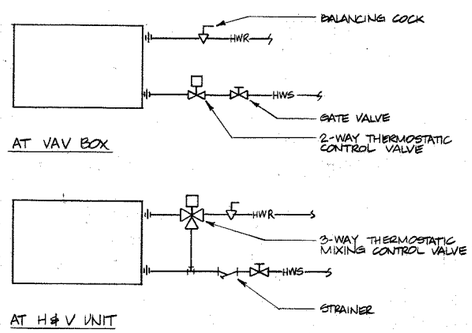
M-4



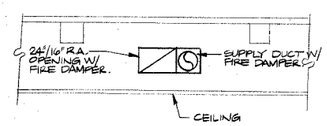
SECOND FLOOR PLAN - HEATING

SCALE: 1/8" = 1'-0"



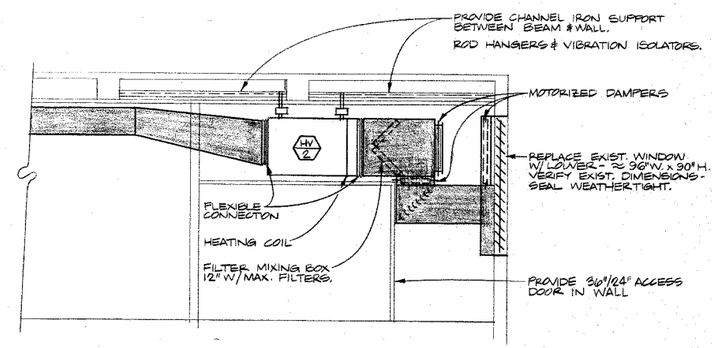
COIL PIPING DIAGRAMS

NO SCALE



TYPICAL CORRIDOR WALL PENETRATION DETAIL AT CLASSROOMS, OFFICES, ETC.

SCALE: 1/4" = 1'-0"



SECTION A-A (HV-3 SIMILAR)

SCALE: 1/4" = 1'-0"

Lund Eccles & Associates
P.O. Box 1000 • Bellingham, WA 98273
(206) 336-5765
Cornerstone Associates • Bellingham, Inc.
2900 Meridian Avenue North • Suite 200
Seattle WA 98103 • (206) 322-0810

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ARCHITECTS IN ASSOCIATION

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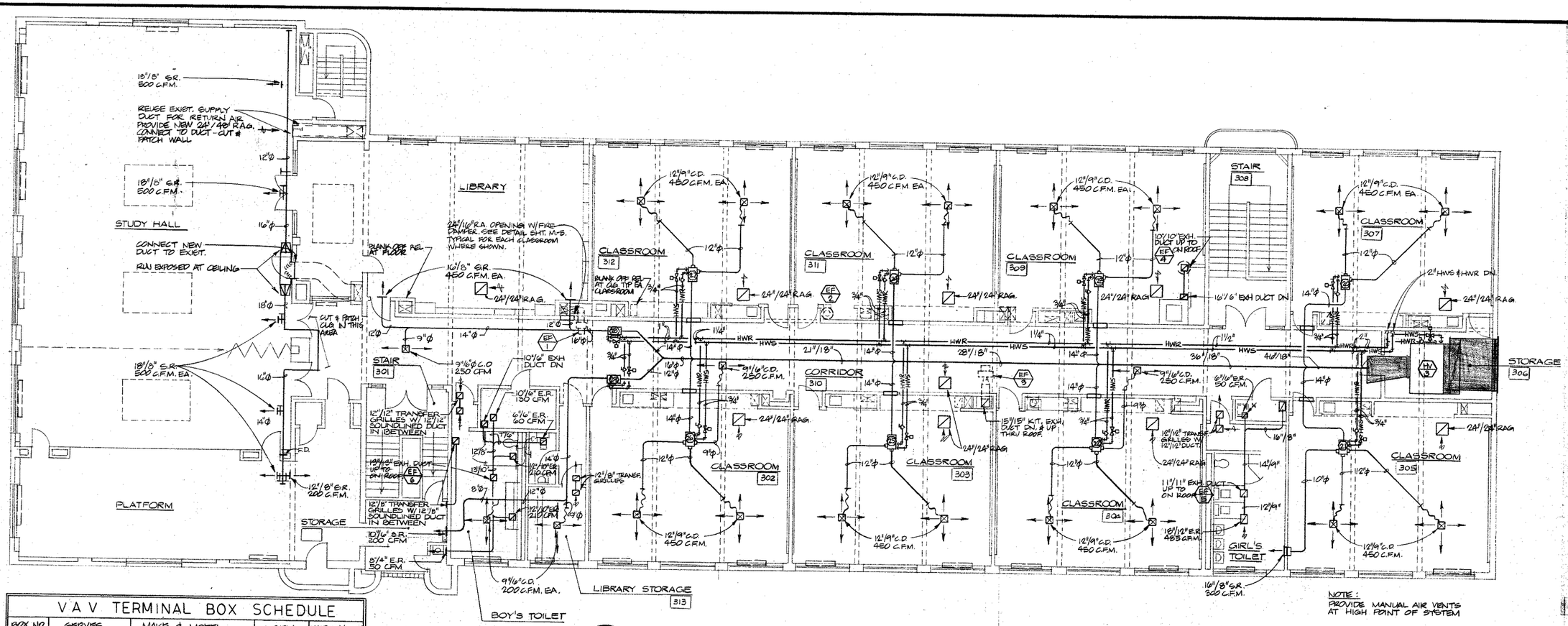
M-5



THIRD FLOOR PLAN - HEATING

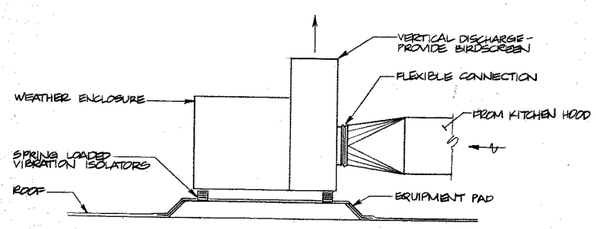
SCALE: 1/8" = 1'-0"

V A V TERMINAL BOX SCHEDULE

BOX NO.	SERVES	MAKE & MODEL	CFM	DUCT CONNECTION
1	CLSRM 124	TEMPMASTER TYPE S-5 1200	1150	10" OVAL
2	MUSIC 121	1600	1350	12" OVAL
3	KITCHEN 116	600	600	7"ϕ
4	LUNCHRM 114	3000	3000	16" OVAL
5	RESOURCE 123	800	700	8"ϕ
6	TOILETS BOYS, GIRLS 1ST FLOOR	↓	800	↓
7	FAC. LOUNGE 110	1200	820	10" OVAL
8	STUDY HALL 3RD FL	3000	2700	16" OVAL
9	CLSRM 219	1200	900	10" OVAL
10	CLSRM 217	↓	1200	↓
11	CLSRM 216		1150	
12	CLSRM 221		1150	
13	CLSRM 222		900	
14	CLSRM 215		900	
15	READING 212-214		1250	
16	CLSRM 223	↓	1200	↓
17	CLERK 208 PRIN 209	600	500	7"ϕ
18	WKRM 204	400	290	6"ϕ
19	CONF 201, THER 202 TEST 203	600	560	7"ϕ
20	CLSRM 307	1200	900	10" OVAL
21	CLSRM 305		1200	
22	CLSRM 304		1150	
23	CLSRM 309		900	
24	CLSRM 311		900	
25	CLSRM 303		900	
26	CLSRM 302		1150	
27	CLSRM 312		900	
28	LIBRARY	↓	1150	↓
29	BOYS TOILET	600	600	7"ϕ

H & V UNIT SCHEDULE

UNIT NO	MAKE & MODEL	CFM	ESP	RPM	MOTOR	HEATING CAP AT 170° AWT.	GPM	REMARKS
HV 1	TRANE NO. 21C HDT	11120	2.5"	820	10 HP 208V 3ϕ	160 MBH	16	TYPE W HEAT COIL 72"x30" - 2 ROW 80 FINS/FT. 20° WTD
HV 2	NO. 17A HDT	9950	2.0"	740	7 1/2 HP 208V 3ϕ	85 MBH	8.5	TYPE W HEAT COIL 66x30" - 2 ROW 85 FINS/FT 20° WTD
HV 3	NO. 17A HDT	9750	2.0"	735	7 1/2 HP 208V 3ϕ	85 MBH	8.5	
HV 4	NO. 14A	6700	0.7"	440	2 HP 208V 3ϕ	167 MBH	16.7	



EXHAUST FAN #3 DETAIL

NO SCALE. E.F. #1 SIMILAR W/ HORIZONTAL DISCHARGE

EXHAUST FAN SCHEDULE

FAN NO.	MAKE & MODEL	CFM	ESP	RPM	MOTOR	REMARKS
EF 1	GREENHECK 12 SWB	990	.6	1300	1/3 HP 120V 1ϕ	
EF 2	G-95D	440	.5	1550	1/8 HP 120V 1ϕ	PROVIDE SOLID STATE SPEED CONTROLLER MTD INSIDE FAN
EF 3	15 SWB	2500	.75	1500	1 HP 208V 3ϕ	
EF 4	G-85D	380	.3	1550	1/20 HP 120V 1ϕ	PROVIDE SOLID STATE SPEED CONTROLLER MTD INSIDE FAN
EF 5	GB-14-4	1285	.4	940	1/4 HP 120V 1ϕ	
EF 6	GB-10-4	850	.4	1300	1/4 HP 120V 1ϕ	

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LINCOLN Elementary School
MOUNT VERNON SCHOOL DISTRICT NO 320
MOUNT VERNON, WA.

date	6-1-82
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checked	LB
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approved	

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APPENDIX F: PERFORMANCE-BASED EARTHQUAKE ENGINEERING (PBEE)

Performance Based Earthquake Engineering (PBEE)

The seismic evaluation of this structure is based on performance-based earthquake engineering (PBEE) guidelines presented in ASCE 41-17 *Seismic Evaluation and Retrofit of Existing Buildings* (American Society of Civil Engineers, 2017). A general background of PBEE and an overview of seismic retrofit objectives, seismic hazard levels, seismic performance levels, and seismic evaluation and retrofit procedures are included in this section.

1.0 Background

Performance Based Earthquake Engineering (PBEE) can be defined as the engineering of a structure to resist earthquake demands while also meeting the needs and objectives of building owners and other stakeholders. PBEE allows for the design and analysis of structures for different levels of seismic performance and allows these different levels of seismic performance to be related to the relative seismic hazard.

Seismic analysis and design of structures traditionally focused on one performance level – reducing the risk to loss of life in a design earthquake. The concept of designing essential facilities, which are needed immediately after an earthquake, to a higher performance standard evolved after hospitals and other critical facilities were damaged in the 1971 San Fernando, California earthquake. That concept is balanced by the recognition that the cost of retrofitting existing buildings to higher levels of seismic performance may be onerous to both stakeholders and policy makers.

A comprehensive program was started in 1991, in cooperation with FEMA, to develop guidelines tailored to address this variation of performance levels. The first formal applications of performance-based evaluation and design guidelines were the FEMA 310 *Handbook for the Seismic Evaluation of Buildings – A Prestandard (1998)* and FEMA 273 *NEHRP Guidelines for the Seismic Rehabilitation of Buildings (1997).* Following the release of these documents in the 1990s, (3) additional documents were released in the following years. Another prestandard document, FEMA 356 *Prestandard and Commentary for the Seismic Rehabilitation of Buildings*, was released in the year 2000. Then, the first national standard seismic evaluation document, ASCE 31-03 *Seismic Evaluation of Existing Buildings*, was released in the year 2003. Following the release of ASCE 31-03, the first national standard seismic rehabilitation document, ASCE 41-06 *Seismic Rehabilitation of Existing Buildings*, was released in the year 2007. ASCE 31-03 and ASCE 41-06 superseded the PBEE documents produced in the previous decade. ASCE 31-03 and ASCE 41-06 used the general framework outlined by previous documents but were updated to incorporate the latest standard of PBEE for the time.

ASCE 31-03 and ASCE 41-06 still had flaws and, soon after the release of ASCE 41-06, there was an effort undertaken to combine ASCE 31-03 and ASCE 41-06 into a single national standard document in an attempt to streamline the documents and eliminate discrepancies. The newest PBEE document, ASCE 41-17 *Seismic Evaluation and Retrofit of Existing Buildings*, combines information from all of the previous documents, and reflects advancements in technology, advancement in analysis techniques and incorporates case studies and lessons learned from recent earthquakes.

ASCE 41-17 provides criteria by which existing structures can be seismically evaluated and retrofitted to attain a wide range of different performance levels when subjected to earthquakes of varying severity.

2.0 Seismic Hazard Levels

Earthquake ground motions are variable and complicated, and every earthquake is different. In addition, an earthquake's intensity and energy magnitude depend on fault type, fault movement, depth to epicenter, and soil strata. In earthquake prone areas, often very small and frequent earthquakes occur every few days or weeks without being noticed by humans but large earthquakes that occur much less frequently can have a devastating effect on infrastructure and can result in the temporary displacement of large amounts of people. In addition, earthquakes are unpredictable and the precise location, intensity and start time of an earthquake cannot be predicted before an event occurs. However, earthquake hazards for certain geographic areas are well understood based on historical patterns of earthquakes from the geologic record, measured earthquake ground motions, understanding of plate tectonics and seismological studies.

Geologists, seismologists and geotechnical engineers have categorized the seismic hazard for particular locations using probabilistic seismic hazard levels. Each seismic hazard level describes a different probabilistic earthquake magnitude based on the probability of a certain magnitude earthquake occurring in a given time period. Table E.2.1 shows commonly used seismic hazard levels, their corresponding probabilities of exceedance and mean return periods.

Table E.2.1. Probabilistic Seismic Hazard Levels and Mean Return Period.

Seismic Hazard Level	Probability of Exceedance in 50 Years	Mean Return Period (Years)
50%/50-year	50%	72
20%/50-year (BSE-1E)	20%	225
10%/50-year	10%	475
5%/50-year (BSE-2E)	5%	975
2%/50-year (BSE-2N)	2%	2,475

Seismic events with longer mean return periods and smaller probabilities of exceedance are seismic events that are associated with stronger seismic motions, larger ground accelerations and more potential to damage facilities. Consequently, structures designed or retrofit to a seismic hazard level with a longer return period will generally experience better performance in an earthquake than a structure designed or retrofit to a lower seismic hazard level.

ASCE 41-17 codifies four different Seismic Hazard Levels at which to evaluate or retrofit structures. For voluntary seismic evaluations and voluntary seismic upgrades, the owner of a structure and the structural engineer can decide the Seismic Hazard Level at which it is appropriate to evaluate or retrofit a structure. The codified Seismic Hazard Levels are grouped into two categories: two Seismic Hazard Levels (BSE-1E and BSE-2E) associated with the Basic Performance Objectives for Existing Buildings (BPOE) and two Seismic Hazard Levels (BSE-1N and BSE-2N) associated with the Basic Performance Objectives Equivalent to New Building Standards (BPON).

Please note that the ASCE 41-17 defined Seismic Hazard Levels are shown in Table B.2.1 along with their respective probabilities of exceedance in and mean return period; however, the BSE-1N Seismic Hazard Level is not shown in Table B.2.1 because ASCE 41-17 defines the BSE-1N Seismic Hazard Level as being taken as two-thirds of the BSE-2N Seismic Hazard Level. So, the BSE-1N Seismic Hazard Level cannot be directly related to a probability of exceedance or mean return period. Historically (and in previous standards), the BSE-1N Seismic Hazard Level was taken as the 10%/50-year earthquake.

Historically, existing buildings have been seismically evaluated and retrofitted to a lower Seismic Hazard Level than would be typical in new building design. This approach has been historically justified for three primary reasons:

- Ensures recently constructed structures are not immediately rendered seismically deficient due to minor building code changes.
- Existing buildings often have a shorter remaining life than a new building would, and, therefore, lower structural resiliency is tempered by a decreased probability of a major seismic event.
- Often the burdensome cost of retrofitting historic structures to a “new building equivalence” performance level is disproportionate to the incremental benefit.

3.0 Building Performance Levels and Seismic Upgrade Objectives

A target building performance level must be selected for the design of a seismic retrofit or upgrades to a structure. The target building performance levels are discrete damage states selected from among the infinite spectrum of possible damage states that a building could experience during an earthquake. The terminology used for target building performance levels is intended to represent goals for design, but not necessarily predict building performance during an earthquake.

Since actual ground motions during an earthquake are seldom comparable to that used for design, the target building performance level may only determine relative performance during most events but not predict the actual level of damage following an event. Even given a ground motion similar to that used in design, variations from stated performance objectives should be expected. Variations in actual performance could be associated with differences in the level of workmanship, variations in actual material strengths, deterioration of materials, unknown geometry and sizes of existing members, differences in assumed and actual live loads in the building at the time of the earthquake, influence of nonstructural components, and variations in response of soils beneath the building.

ASCE 41-17 describes performance levels for structural components and nonstructural components of a structure. Historically, much attention was provided to the seismic performance of structural components. However, in recent years, it has been realized that attention to the seismic performance of nonstructural components can be just as important as or more important than the seismic performance of structural components. The ASCE 41-17 identified Structural Performance Levels can be seen in Table E.3.1 and the ASCE 41-17 identified Nonstructural Performance Levels can be seen in Table E.3.2.

Table E.3.1. Identified Structural Performance Levels.

Performance Level Abbreviation	Performance Level Name
S-1	Immediate Occupancy
S-2	Damage Control
S-3	Life Safety
S-4	Limited Safety
S-5	Collapse Prevention
S-6	Structural Performance Not Considered

Table E.3.2. Identified Nonstructural Performance Levels.

Performance Level Abbreviation	Performance Level Name
N-A	Operational
N-B	Position Retention
N-C	Life Safety
N-D	Nonstructural Performance Not Considered

Individual Structural Performance Levels and Nonstructural Performance Levels can be aggregated to form a combined Building Performance Level. Structural performance during an earthquake is related to the amount of lateral deformation or drift of the structure and the capacity or ability of the structure to deform. Any Structural Performance Level can be combined with any Nonstructural Performance Level, although it is not recommended to combine high levels of structural performance with low levels of nonstructural performance and vise-versa.

Theoretically, there are (23) different Building Performance Levels that are combinations of different Structural Performance Levels and Nonstructural Performance Levels. However, ASCE 41-17 recommends that only (15) Building Performance Levels be used in practice due to their recommendation of avoiding mis-matching high and low levels of nonstructural and structural performance. ASCE 41-17 defines (4) specific common Building Performance Levels which can be seen in Table E.3.3 and a visual representation of these common Building Performance Levels plotted against lateral deformation can be seen in Figure E.3.1.

Table E.3.3. Specific Common Building Performance Levels.

Performance Level Abbreviation	Performance Level Name	Structural & Nonstructural Performance Level Combination
1-A	Operational	S-1 & N-A
1-B	Immediate Occupancy	S-1 & N-B
3-C	Life Safety	S-3 & N-C
5-D	Collapse Prevention	S-5 & N-D

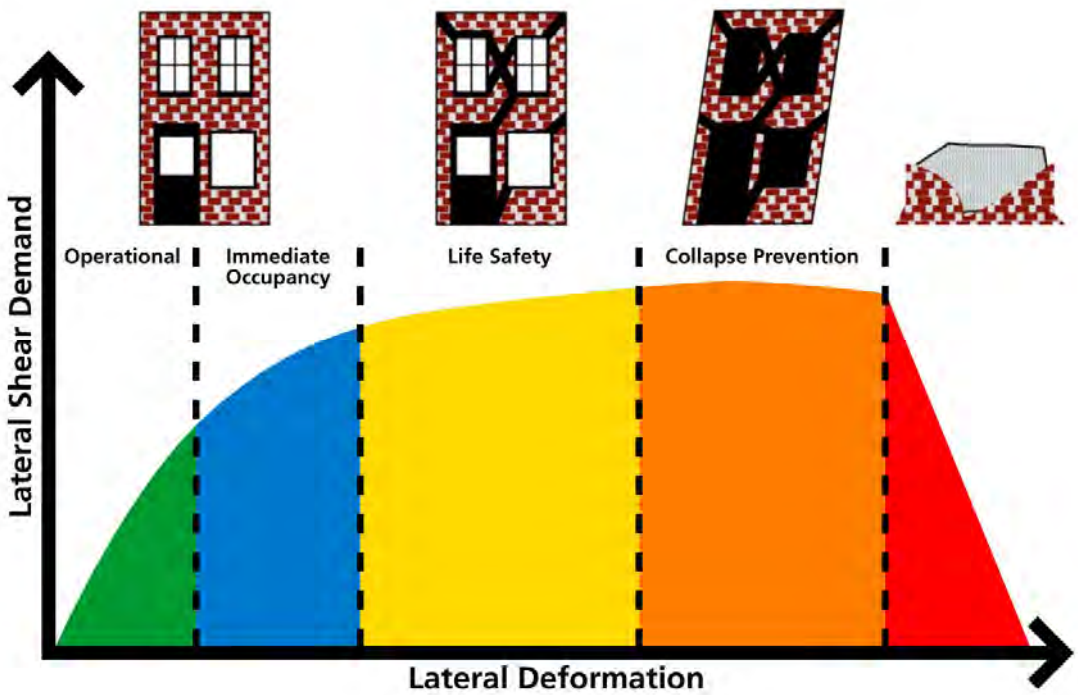


Figure E.3.1. Building Performance Levels.

A decision must be made for each structure as to the acceptable behavior for different levels of seismic hazard, balanced with the construction cost of retrofitting a structure to obtain that behavior. ASCE 41-73 defines "baseline" basic performance objectives for structures based on their defined Risk Category. The Risk Category is the same that is defined in the International Building Code and ASCE 7. For example, for a Risk Category II structure retrofitted to the BPON standards, the structure would need to be retrofitted for the 3-B Building Performance Level at the BSE-1N Seismic Hazard Level and the 5-D Building Performance Level at the BSE-2N (2%/50-year) Seismic Hazard Level. ASCE 41-17 allows for higher (enhanced) or lower (limited) objectives to been selected based on the essential nature of the facility, the expected remaining life of the building, and the associated cost and feasibility. For example, it may not be economically feasible to retrofit historic structures to the BPON standards and ASCE 41 allows for selection of a limited objective for such situations.

Table E.3.4 summarizes the approximate levels of structural and nonstructural damage that may be expected at the damage states that define the structural performance levels.

Table E.3.4. Approximate Expected Damage for Different Building Performance Levels[1]

	Building Performance Levels			
	Collapse Prevention	Life Safety	Immediate Occupancy	Operational
Overall Damage	Severe.	Moderate.	Light.	Very Light.
Permanent Drift	Large. 1% to 5%.	Some. 0.3% to 1%.	Negligible.	Same as Immediate Occupancy.

Table E.3.4. Approximate Expected Damage for Different Building Performance Levels[1]

	Building Performance Levels			
	Collapse Prevention	Life Safety	Immediate Occupancy	Operational
Remaining Strength and Stiffness After Earthquake	Little. Gravity system (columns and walls) functions, but building is near collapse.	Some. Gravity system functions, but building may be beyond economical repair.	Significant strength remaining. Minor cracking of structural elements.	Same as Immediate Occupancy.
Examples of Damage to Concrete Framing	Extensive cracking and spalling of concrete members. Crack widths greater than 1/4 inch.	Extensive cracking and spalling of concrete. Crack widths typically less than 1/4 inch and less than 1/8 inch in columns and joints.	Crack widths typically less than 1/8 inch and less than 1/16 inch in columns and joints.	Same as Immediate Occupancy.
Examples of Damage to Steel Framing	Extensive yielding and buckling of steel members. Significant connection failures.	Local buckling of steel beams and braces. Moderate amount of connection failures.	Minor deformation of steel members, no connection failures.	Same as Immediate Occupancy.
Other General Description	Structure likely not repairable and not safe for reoccupancy due to potential collapse in aftershock.	Repair may be possible, but may not be economically feasible. Repairs may be required prior to reoccupancy.	Minor repairs may be required, but building is safe to occupy.	Same as Immediate Occupancy.
Nonstructural Components	Extensive damage. Some exits blocked. Infills and unbraced parapets failed or at incipient failure.	Falling hazards mitigated, but many architectural, mechanical, and electrical systems are damaged.	Minor cracking of facades, partitions, and ceilings. Equipment and contents are generally secure, but may not operate due to lack of utilities.	Negligible damage. All systems important to normal operation are functional. Power and other utilities are available, possibly from standby sources.
Comparison with New Building Design	Significantly more damage and greater risk.	Somewhat more damage and slightly higher risk.	Much less damage and lower risk.	Much less damage and lower risk.

[1] Adapted from American Society of Civil Engineers, "*Prestandard and Commentary for the Seismic Rehabilitation of Buildings*," FEMA-356, Federal Emergency Management Agency, Washington, D.C., November 2000.

4.0 Seismic Performance, Safety, Reliability and Construction Cost

The seismic performance, safety and reliability of a facility must be weighed against the relative importance and construction costs associated with a facility. It is impractical for the average building to be seismically designed or retrofitted to experience no damage following a major earthquake. However, steps can be taken to mitigate seismic hazards for new and existing structures.

Some facilities have more community importance or pose special risks to a community following an earthquake (for example hospitals, fire stations, community shelters, or facilities housing highly toxic substances). It is reasonable that important facilities be designed or retrofitted to a higher performance standard than the average structure. The relative importance of a facility must be weighed against the relative construction costs associated with facility construction. There are two types of construction costs associated with seismic hazards: the cost of initial construction or seismic retrofit construction and the costs to repair or replace a facility following an earthquake. The better a structure performs during an earthquake, the faster a structure can be returned to service and the less the repair costs will be for a structure following an earthquake. So, building expected damage states during a seismic event can be directly linked to:

- Repair/Replacement Costs – Cost of restoring the facility to pre-earthquake condition.
- Public Safety – Number of critical injuries and casualties to building occupants.
- Downtime – Length of time taken to make repairs to return a structure back to service.

Figure E.4.1. is a graphic showing estimated performance-related consequences compared with different increasing post-earthquake structural damage states (which correspond to the design Structural Performance Levels for a given seismic hazard).

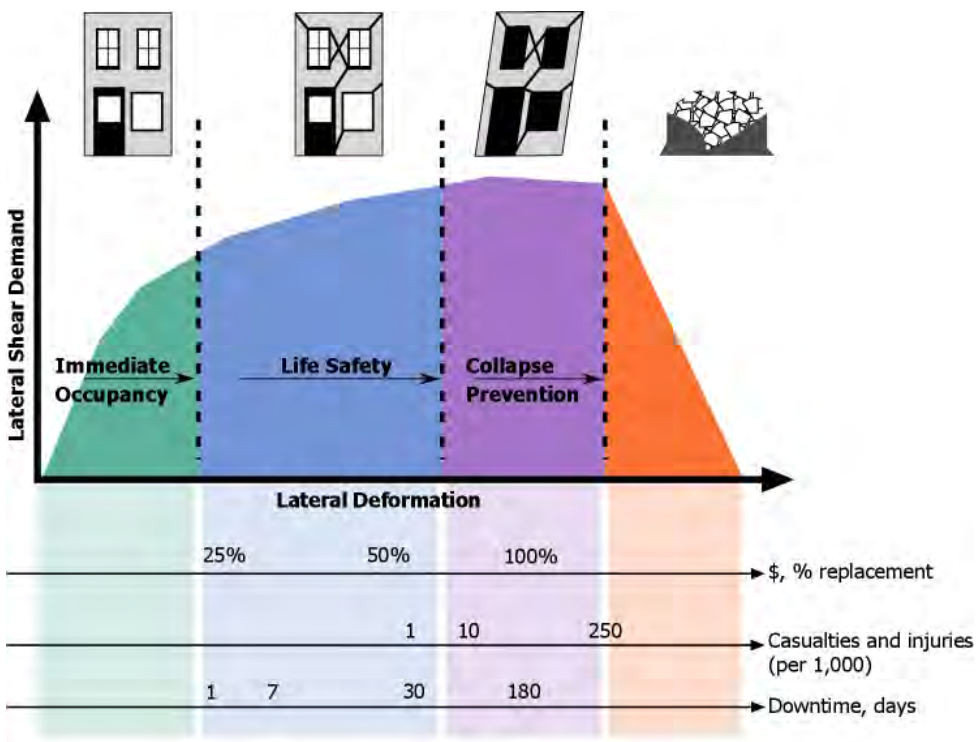


Figure E.4.1. Estimated Performance-Related Consequences at Different Structural Performance Levels.[2]

Figure E.4.2 presents the schematic relationship between different retrofit building performance objectives and probable retrofit program cost.

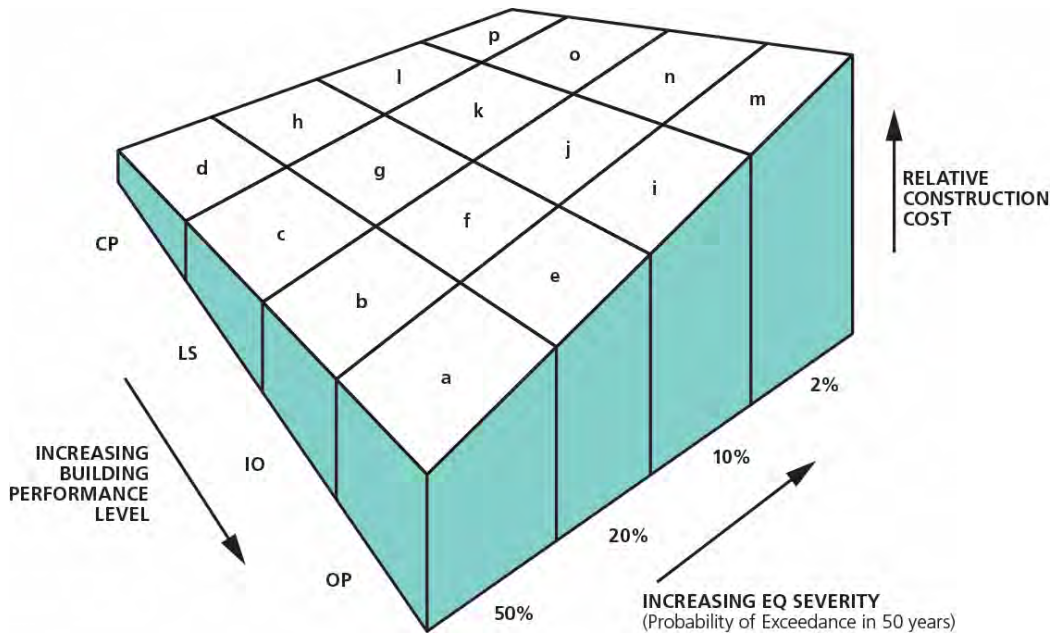


Figure E.4.2. Surface Matrix of ASCE 41 Building Performance Levels Compared with Construction Cost.[3]

[2] J. Moehle, "A Framework for Performance-Based Earthquake Engineering," *Proceedings from ATC 15-9, 10th US-Japan Workshop on the Improvement of Structural Design and Construction Practices*, Applied Technology Council, Makena, Hawaii, 2003.

[3] Adapted from Applied Technology Council, "*NEHRP Commentary for the Seismic Rehabilitation of Buildings*," FEMA-274, Federal Emergency Management Agency, Washington, D.C., October 1997.

5.0 Seismic Performance of Nonstructural Components

Mitigation of nonstructural seismic hazards is a complex issue that is addressed independently in the evaluation and retrofit guidelines. For much of the 20th century, little attention was given to designing nonstructural components and their anchorage for forces induced by earthquakes. Nonstructural component damage witnessed during earthquakes in recent years has demonstrated the importance of nonstructural component performance during earthquakes for life safety, and post-earthquake safety and building function.

In addition to the hazards to life safety posed by nonstructural components, the cost to repair nonstructural components following an earthquake can be high. In many cases the cost to repair/replace nonstructural components can be higher than the cost of repairing structural components following an earthquake. The relative monetary importance of nonstructural components can be seen in Figure E.5.1 by comparing the relative construction costs of the contents, nonstructural components and the structural components of three types of typical new buildings. In offices and hotels the building nonstructural components cost the most to construct, by a significant margin. In hospitals, the costs of constructing the building contents and nonstructural components are similar, but still far exceed the cost of the building structural systems.

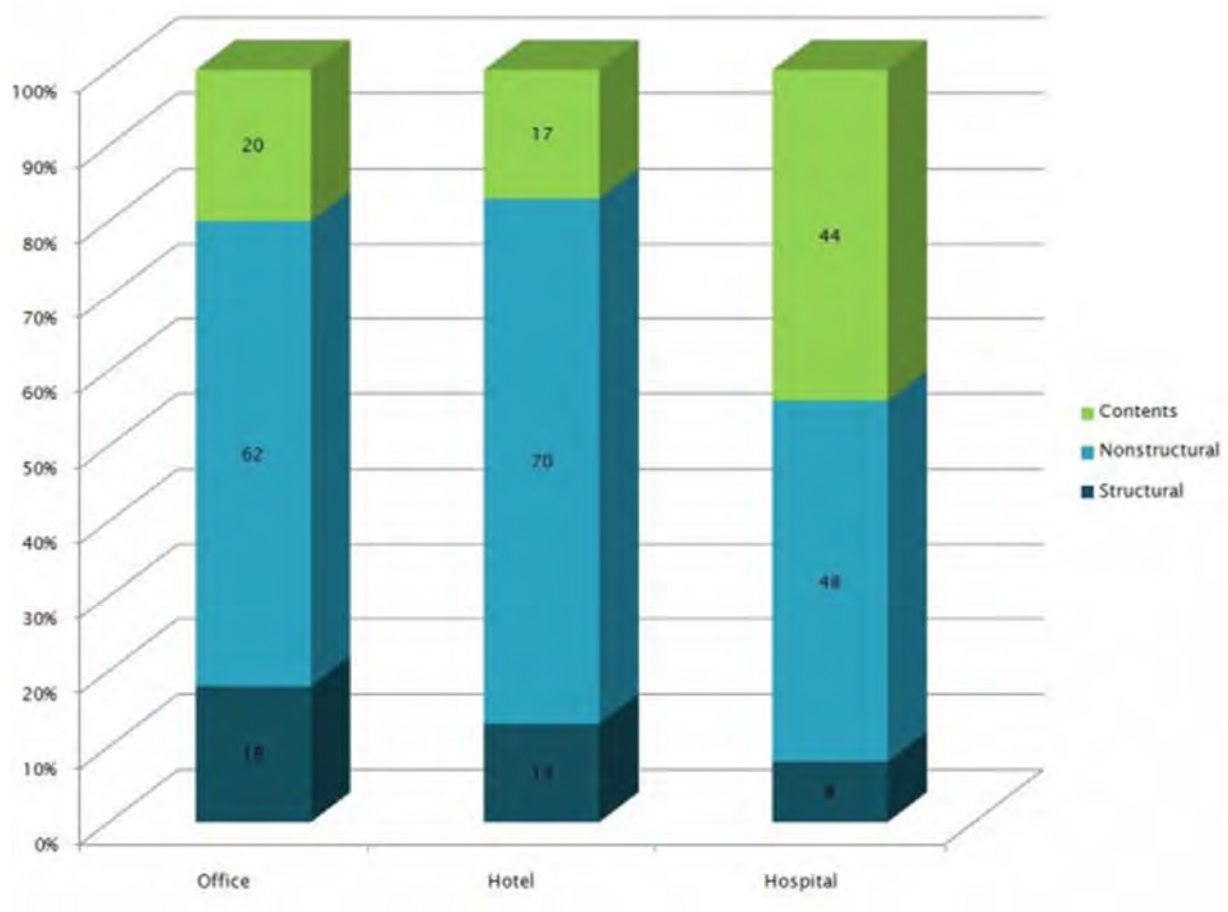


Figure E.5.1. Typical Construction Costs for Different Building Components.[4]

[4] Federal Emergency Management Agency, "*Reducing the Risks of Nonstructural Earthquake Damage – A Practical Guide*," FEMA E-74, Federal Emergency Management Agency, Washington, D.C., December 2012.

Many nonstructural components, if adequately secured to the structure, are seismically rugged. However, mitigation of some nonstructural hazards (such as bracing for mechanical and electrical components within suspended ceiling systems or the improvement of ceiling systems themselves) can result in extensive disruption of occupancy. However, repairing or replacing these components following an earthquake can also be very costly. These costs and benefits need to be taken into consideration when determining desired nonstructural performance levels and the goals of any seismic evaluation or retrofit.

Finally, the use of the structure and required level of building performance also needs to be taken into consideration. For example, essential facilities that are expected to have minimal structural damage following the design earthquake must have nonstructural components that are designed to match the seismic performance level of the facility.

6.0 Seismic Evaluation Procedure

ASCE 41-17 provides a three-tiered evaluation procedure using performance-based criteria. The process for seismic evaluation is depicted in Figure E.6.1. The evaluation process consists of the following three tiers: Screening Phase (Tier 1), Evaluation Phase (Tier 2), and Detailed Evaluation Phase (Tier 3). A summary of each phase follows.

TIER 1 – Screening Procedure

- 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 – Deficiency-Based Evaluation Procedure

- "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 – Systematic Evaluation Procedure

- Component-based evaluation of entire building
- 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

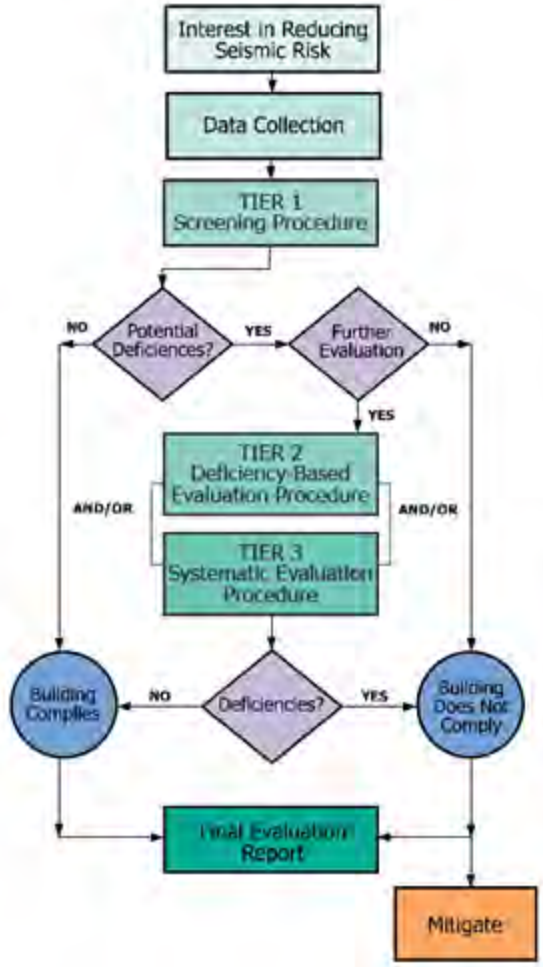


Figure E.6.1. Flow Chart and Description of ASCE 41 Seismic Evaluation Procedure.

7.0 Seismic Retrofit/Upgrades Procedure

If seismic deficiencies are identified in the evaluation process, the owner and design team should review all initial conditions before proceeding with the hazard mitigation. Many conditions may affect the retrofit design significantly – results of the seismic evaluation and seismic hazard study, building use and occupancy requirements, presence of hazardous materials, and other anticipated building remodeling. The basic process for performance-based retrofit design is illustrated in Figure E.7.1.

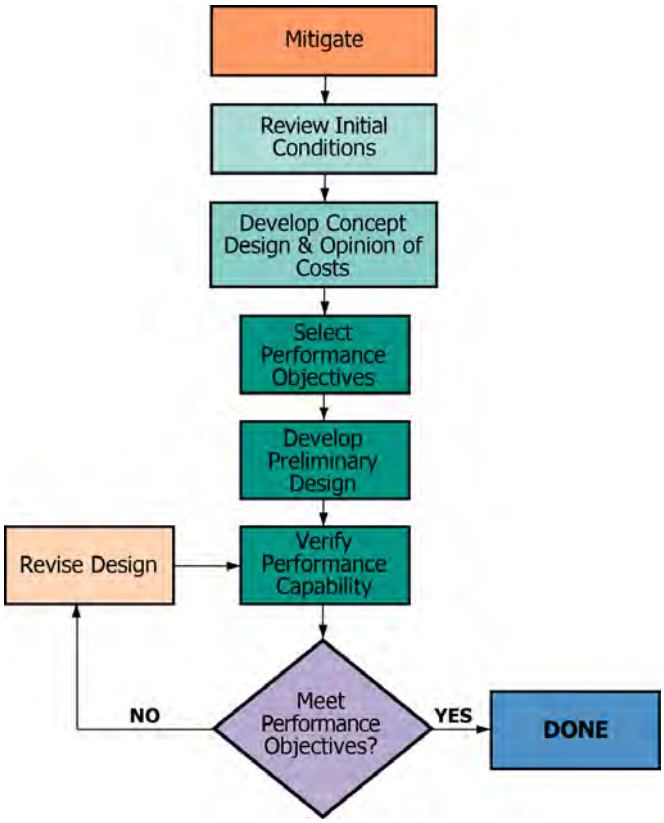


Figure E.7.1. Seismic Rehabilitation Flow Diagram.

Following the review of initial conditions, concept designs may be performed in order to develop rough opinions of probable construction costs for one or more performance objectives. The owner and design team can then develop a rehabilitation strategy considering the associated costs and feasibility. Schematic and final design can then proceed through an iterative process until verification of acceptable building performance is obtained.

APPENDIX G: FEMA E-74 NONSTRUCTURAL SEISMIC BRACING EXCERPTS

Life Safety Systems

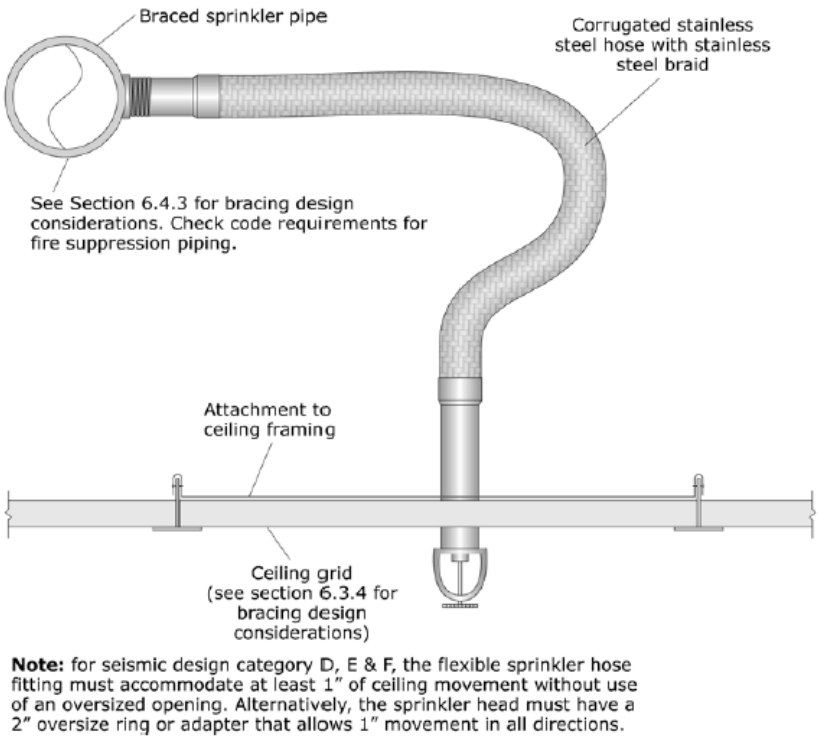


Figure G.1: Flexible Sprinkler Drop

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

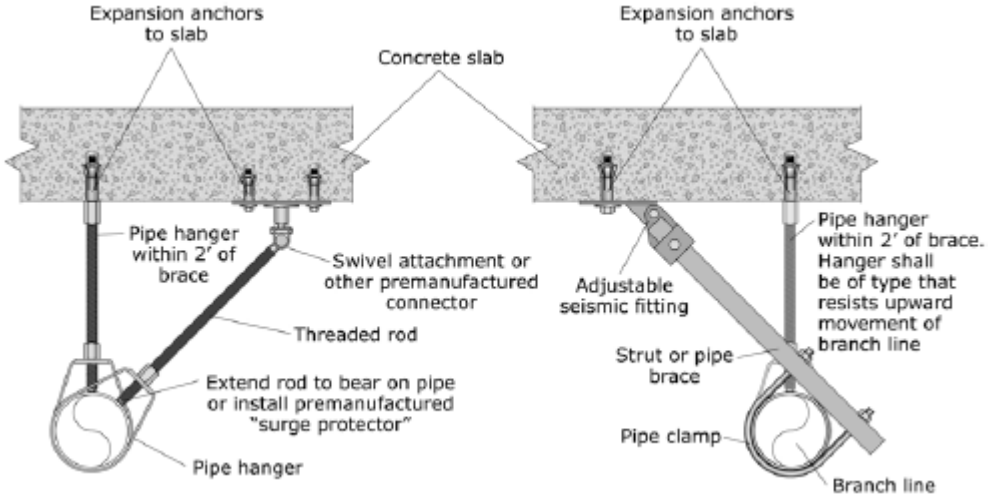


Figure G.2: End of Line Restraint

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

Partitions

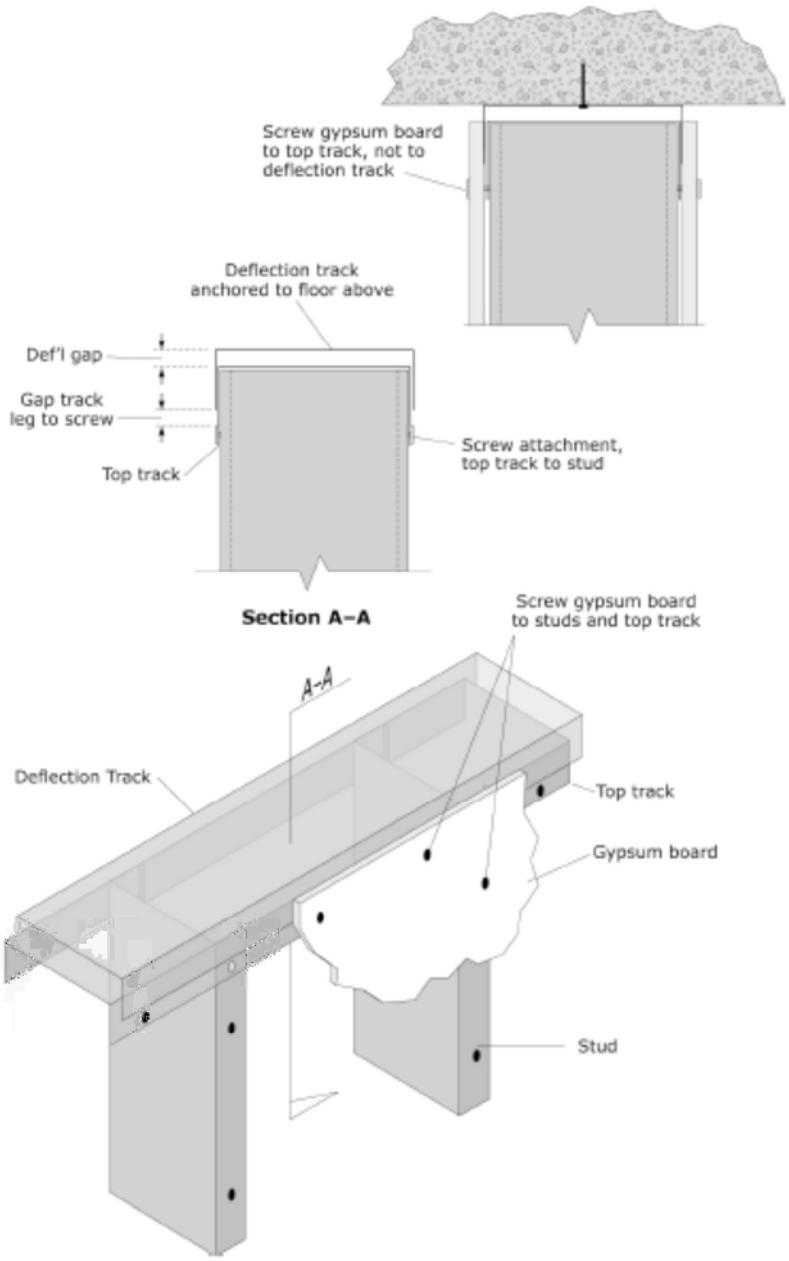


Figure G.3: Mitigation schemes for bracing the tops of metal stud partitions walls (FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)

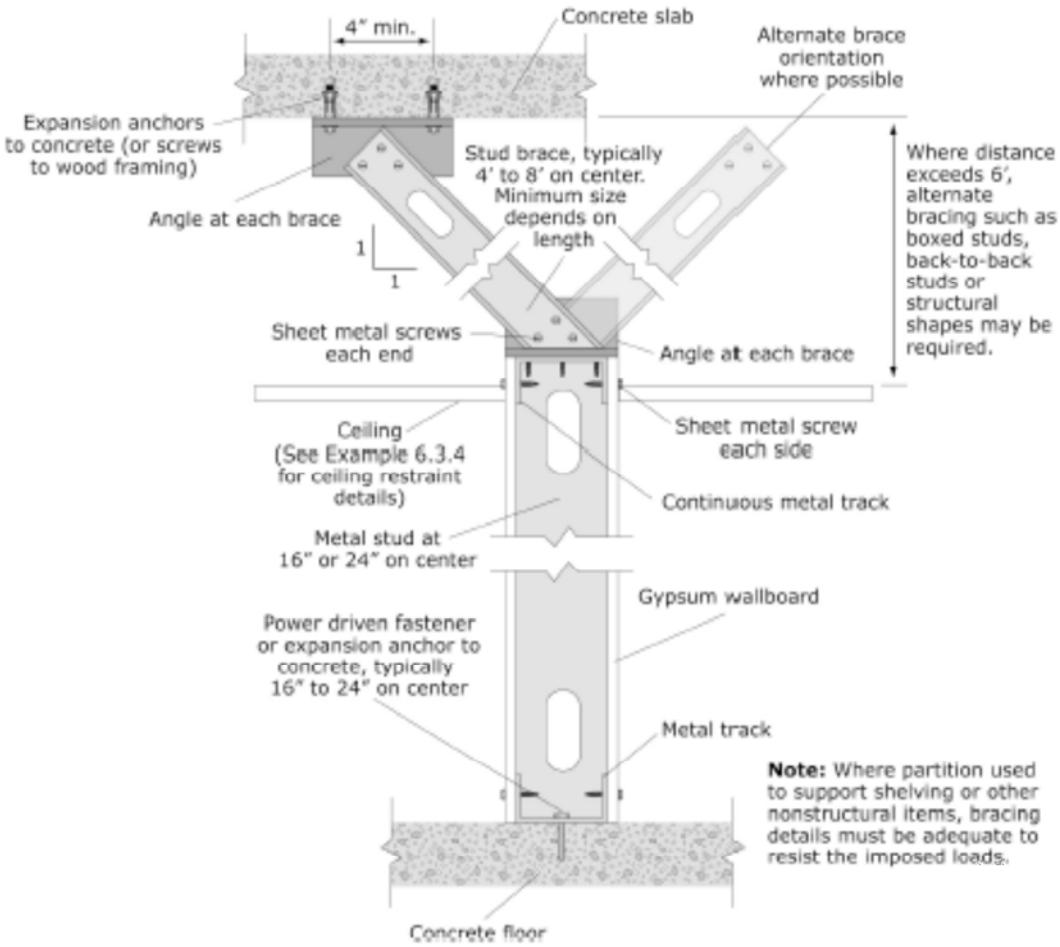
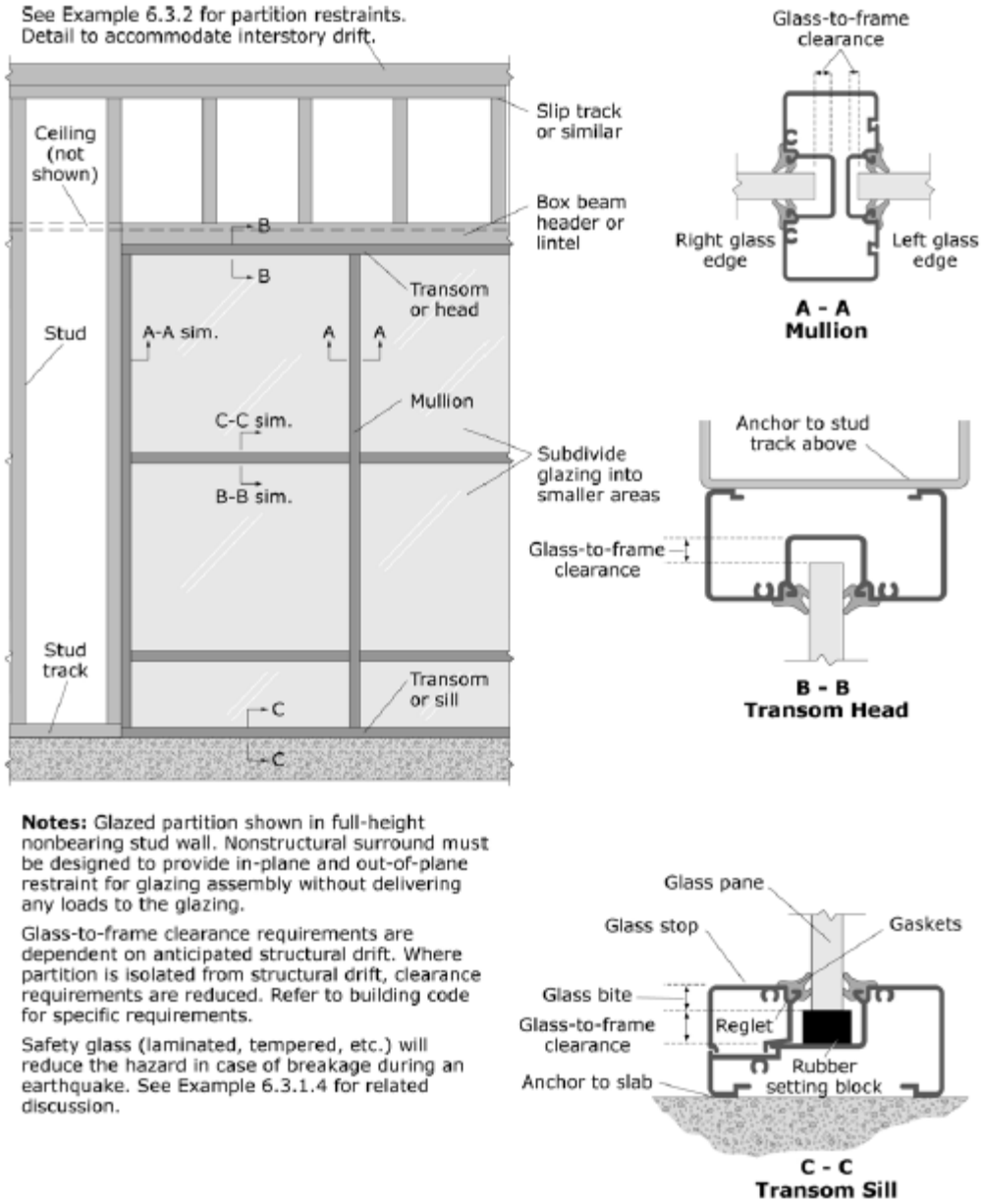


Figure G4: Mitigation schemes for bracing the tops of metal stud partitions walls (FEMA E-74, 2012, Reducing the Risks of Nonstructural Earthquake Damage)



Notes: Glazed partition shown in full-height nonbearing stud wall. Nonstructural surround must be designed to provide in-plane and out-of-plane restraint for glazing assembly without delivering any loads to the glazing.

Glass-to-frame clearance requirements are dependent on anticipated structural drift. Where partition is isolated from structural drift, clearance requirements are reduced. Refer to building code for specific requirements.

Safety glass (laminated, tempered, etc.) will reduce the hazard in case of breakage during an earthquake. See Example 6.3.1.4 for related discussion.

Figure G.5: Full-height Glazed partition

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

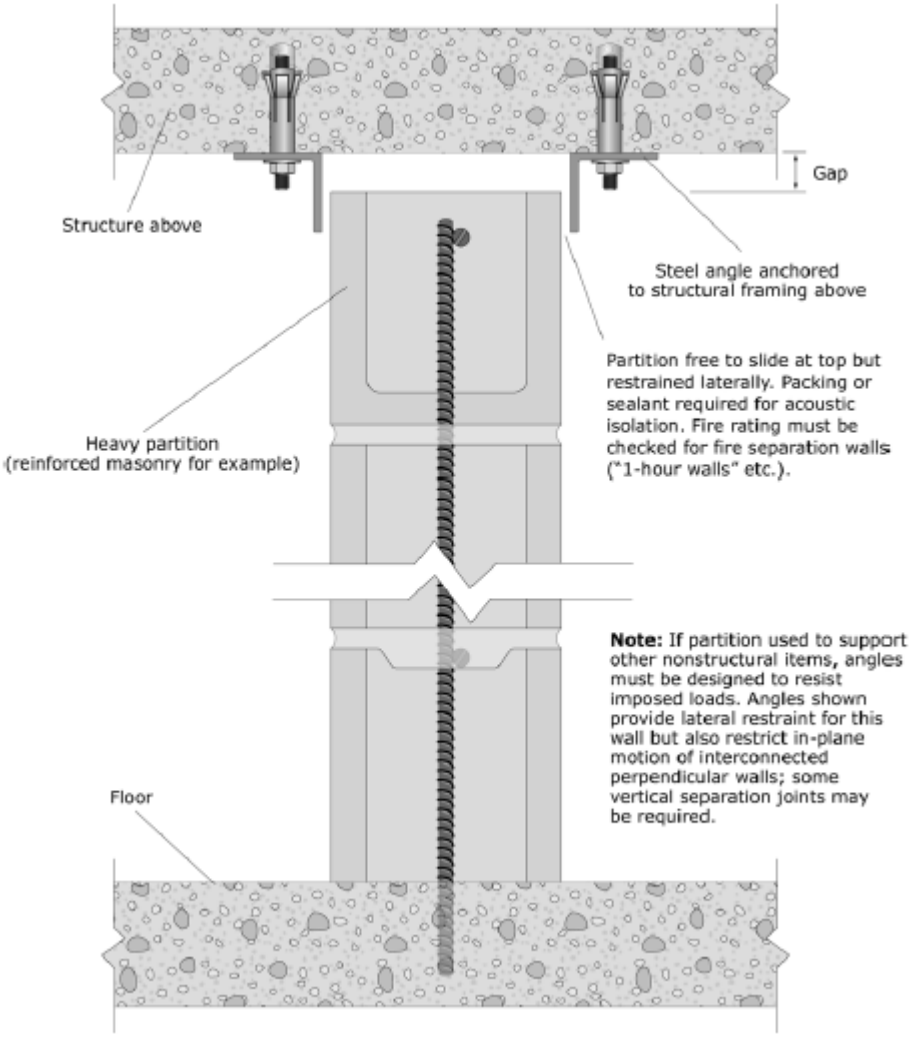


Figure G.6: Full Height Heavy Partition

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

Ceilings

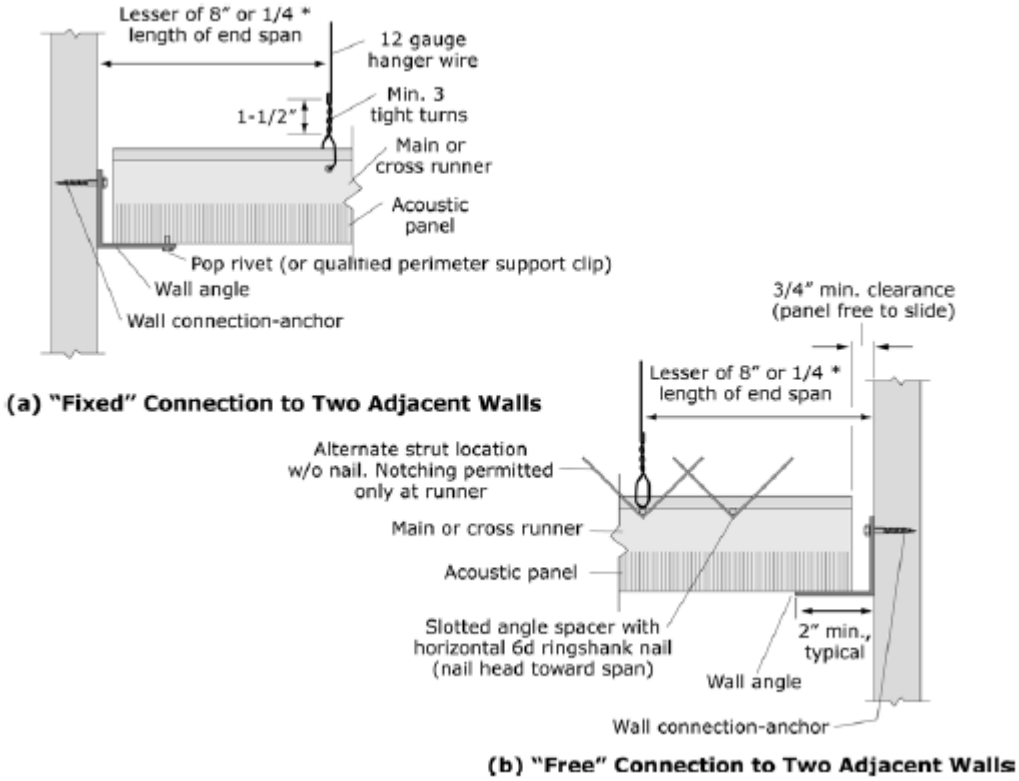
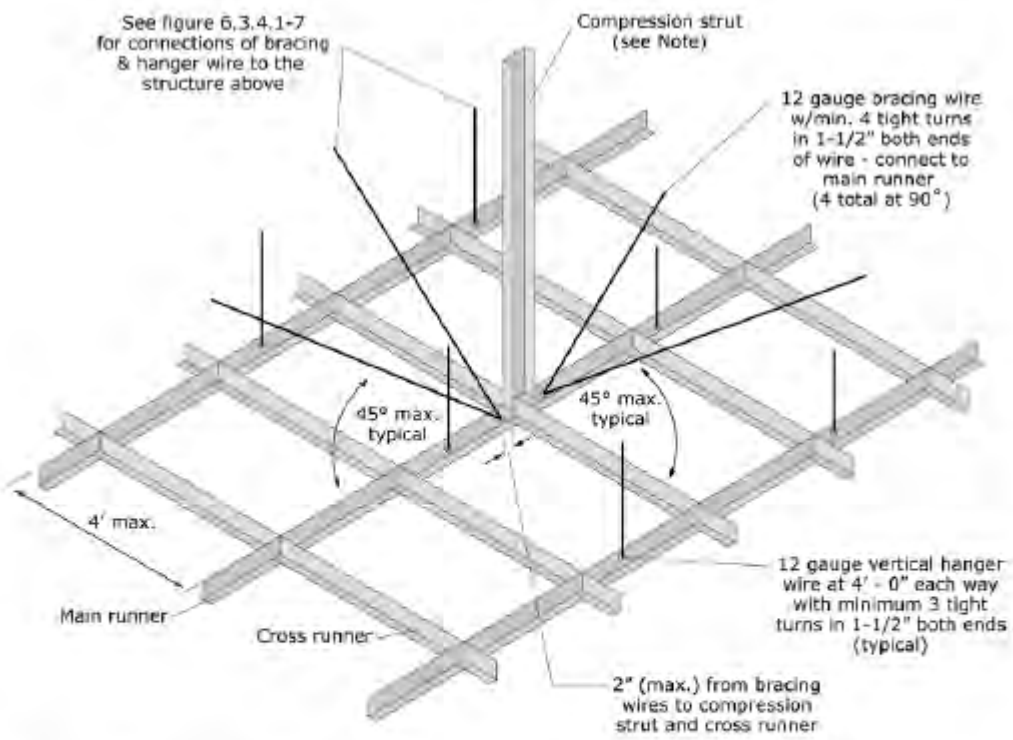


Figure G.7: Suspension System for Acoustic Lay-in Panel Ceilings – Edge Conditions

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



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

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

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

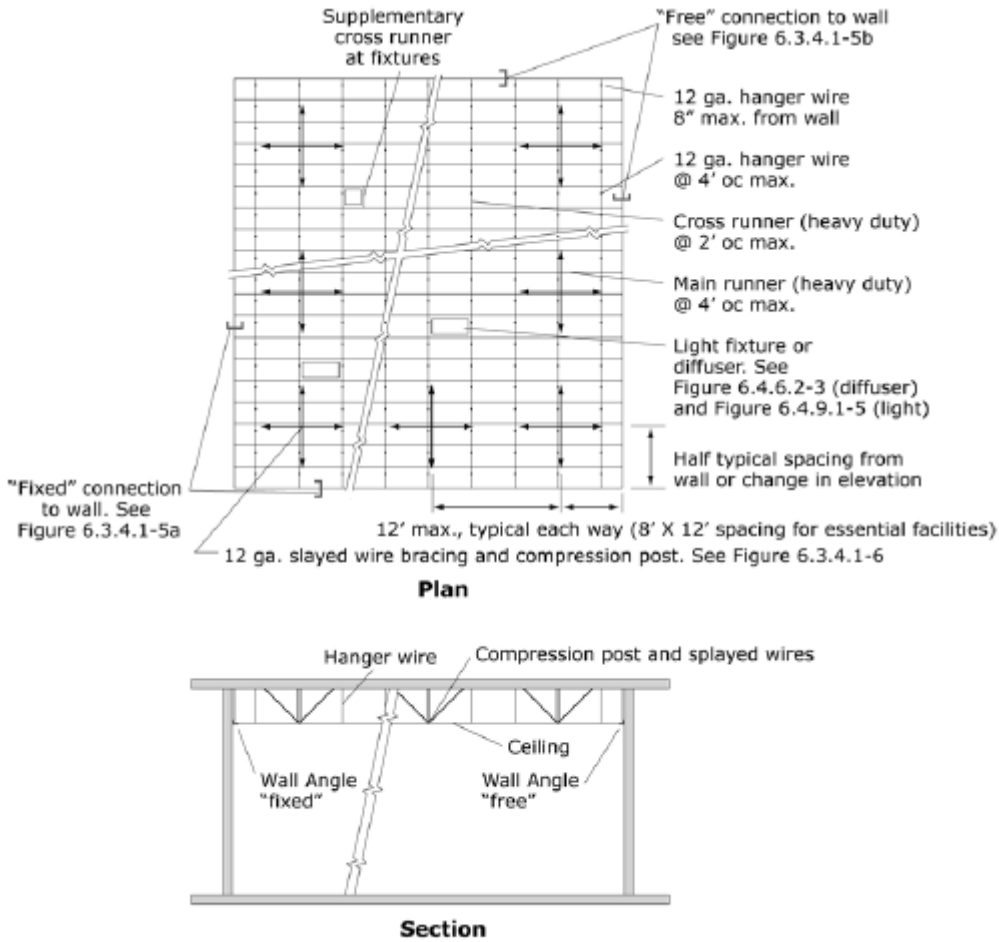


Figure G.9: Suspension System for Acoustic Lay-in Panel Ceilings – General Bracing Layout (FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage)*

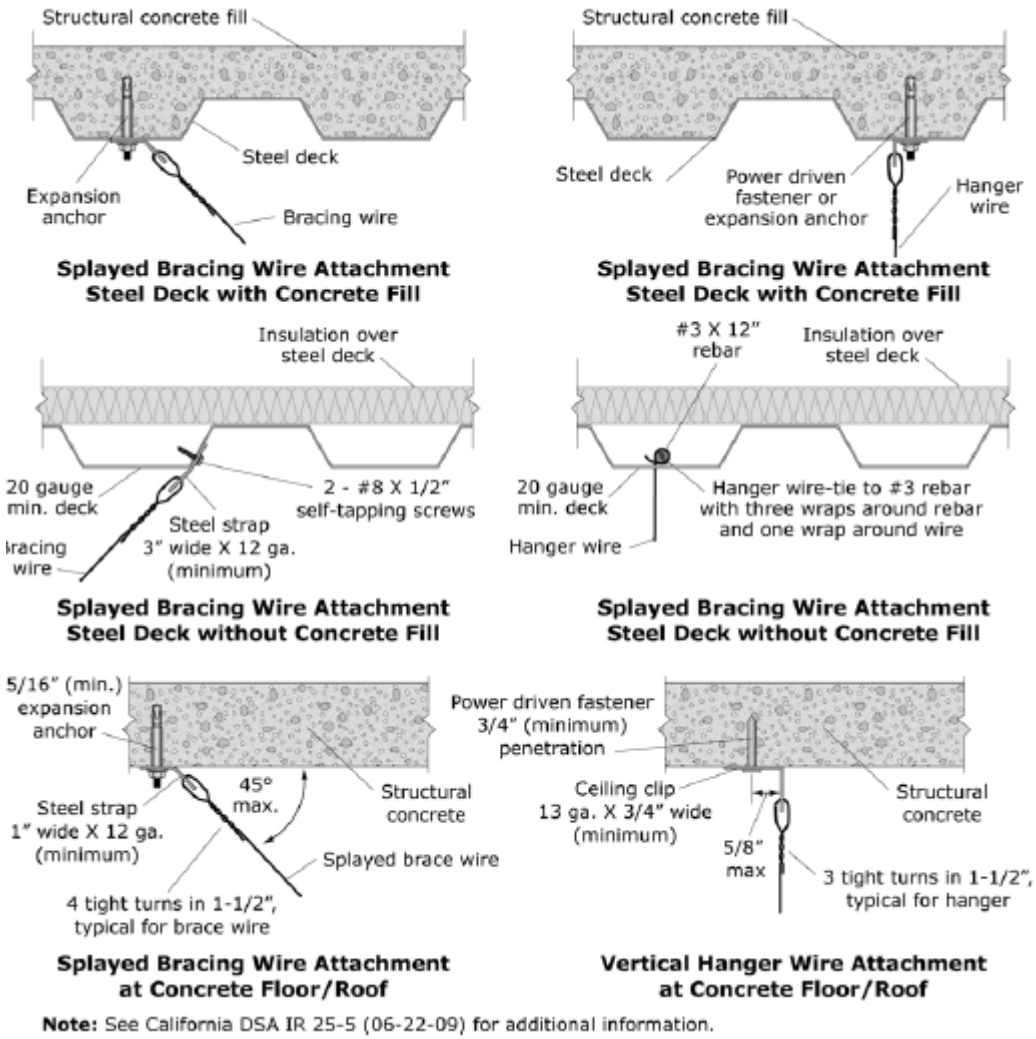


Figure G.10: Suspension System for Acoustic Lay-in Panel Ceilings – Overhead Attachment Details (FEMA E-74, 2012, *Reducing the Risks of Nonstructural Earthquake Damage)*

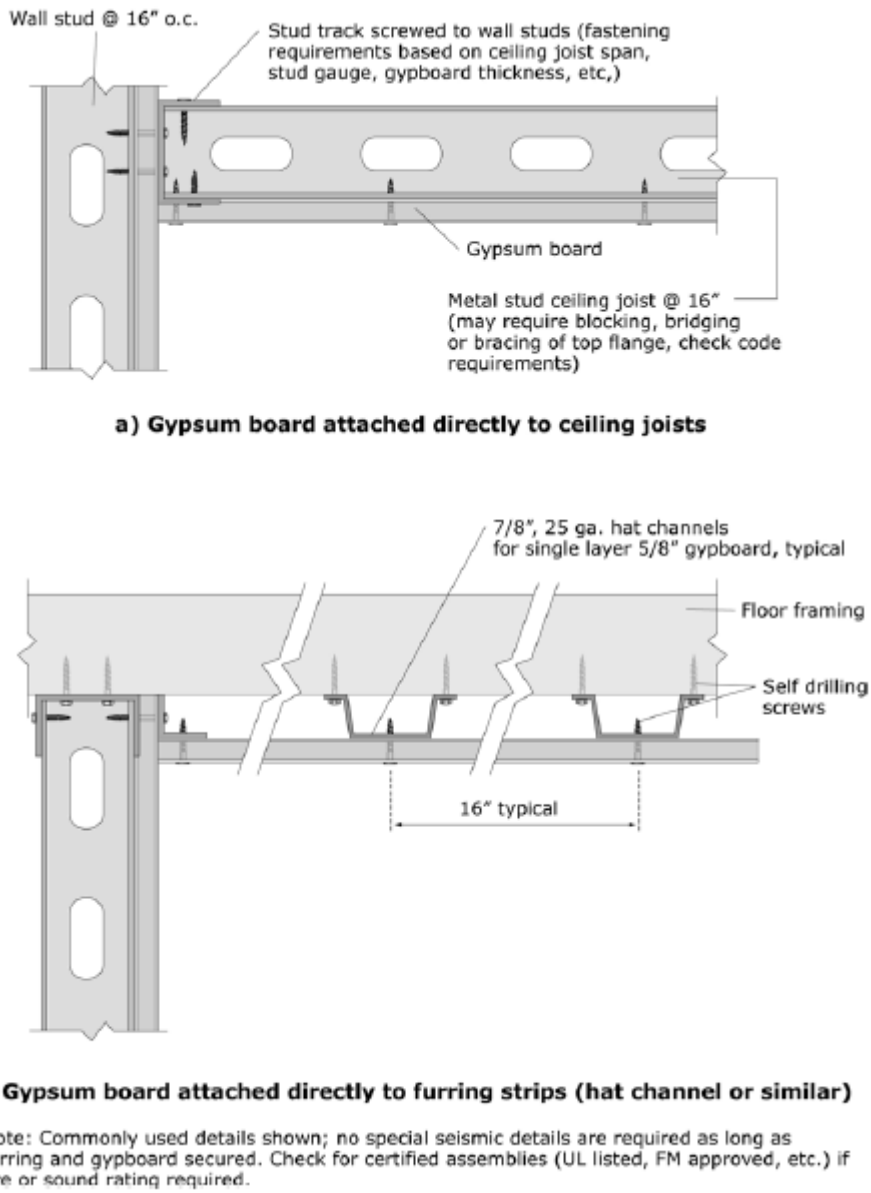


Figure G.11: Gypsum Board Ceiling Applied Directly to Structure

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

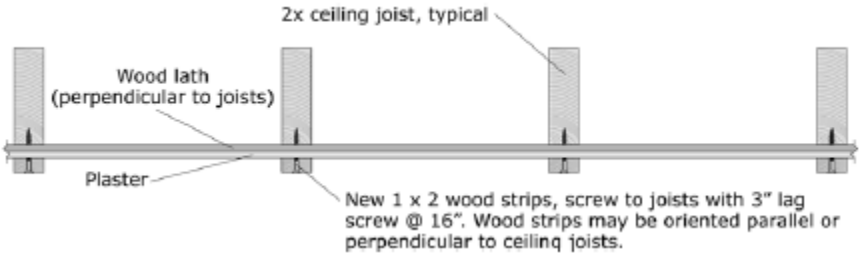


Figure G.12: Retrofit Detail for Existing Lath and Plaster

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

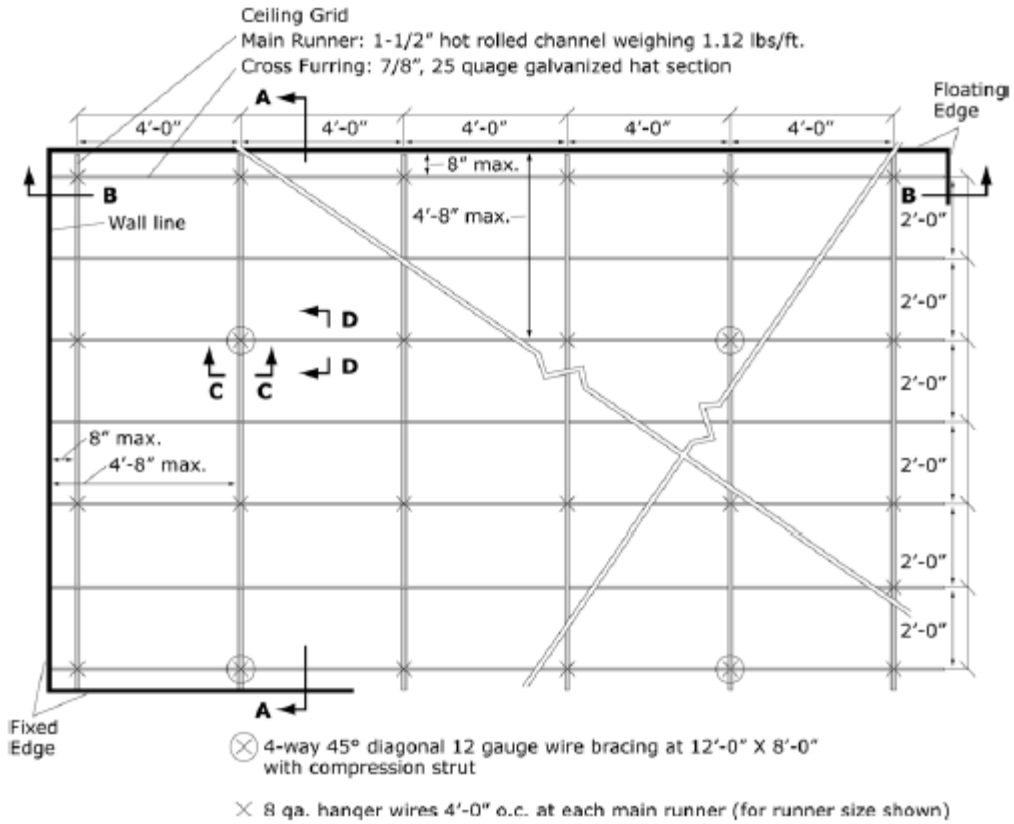


Figure G13: Diagrammatic View of Suspended Heavy Ceiling Grid and Lateral Bracing

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

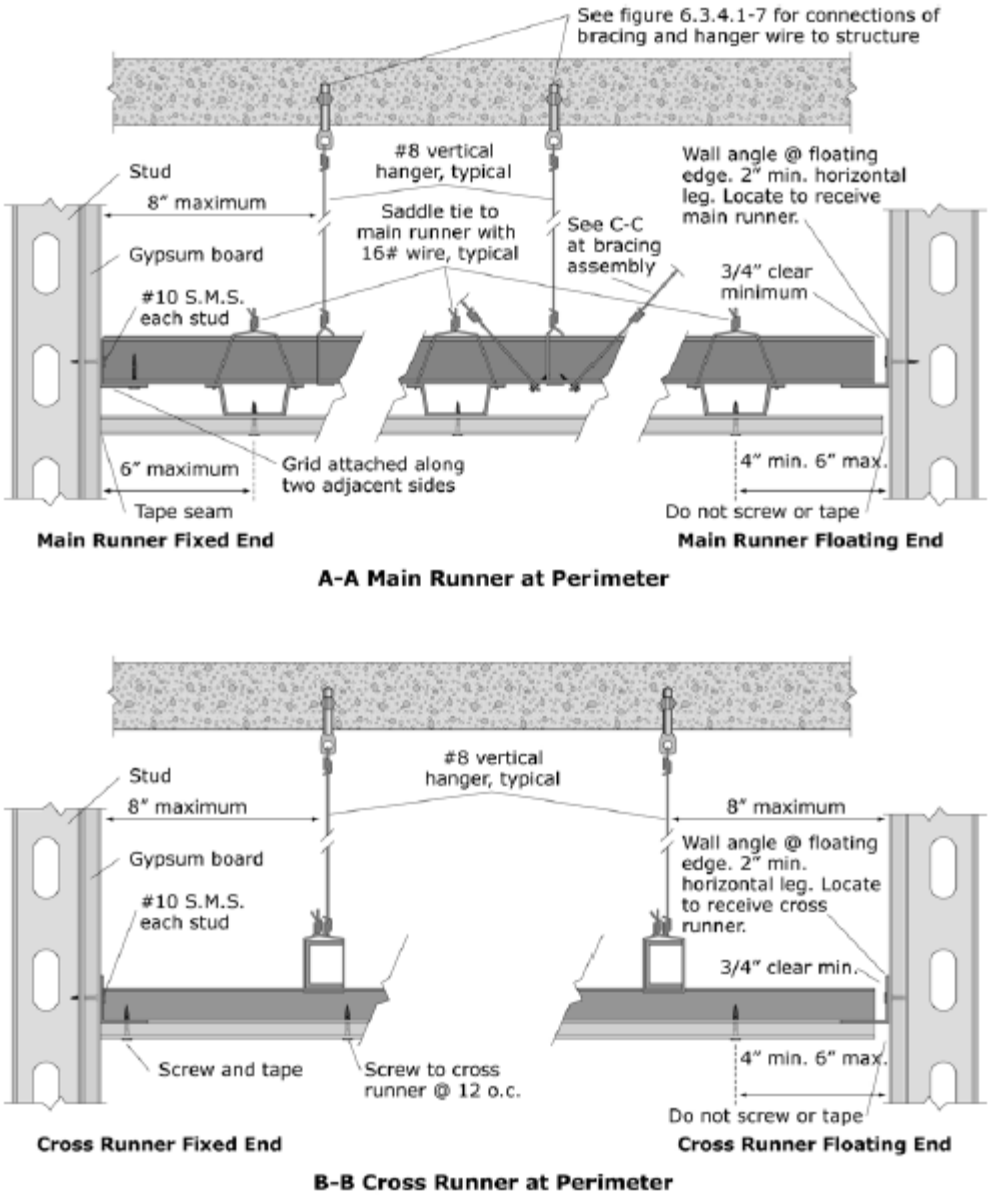
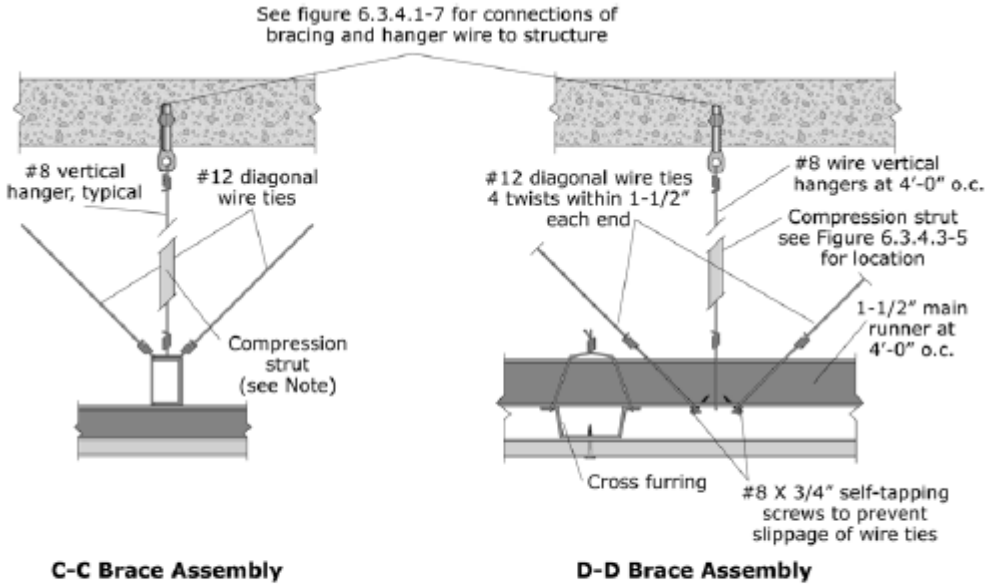


Figure G.14: Perimeter Details for Suspended Gypsum Board Ceiling

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



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

Figure G.15: Details for Lateral Bracing Assembly for Suspended Gypsum Board Ceiling

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

Light Fixtures

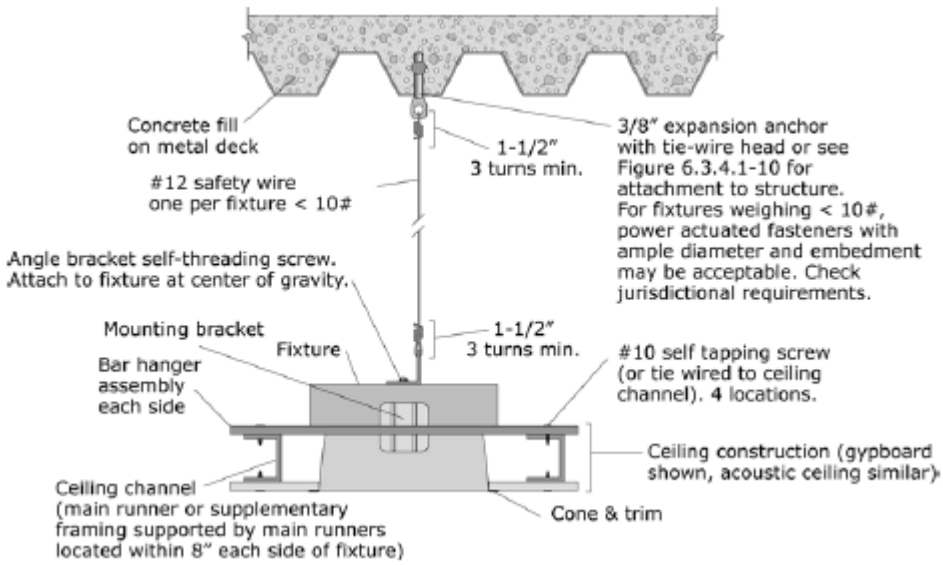


Figure G.16: Recessed Light Fixture in suspended Ceiling (Fixture Weight < 10 pounds)

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

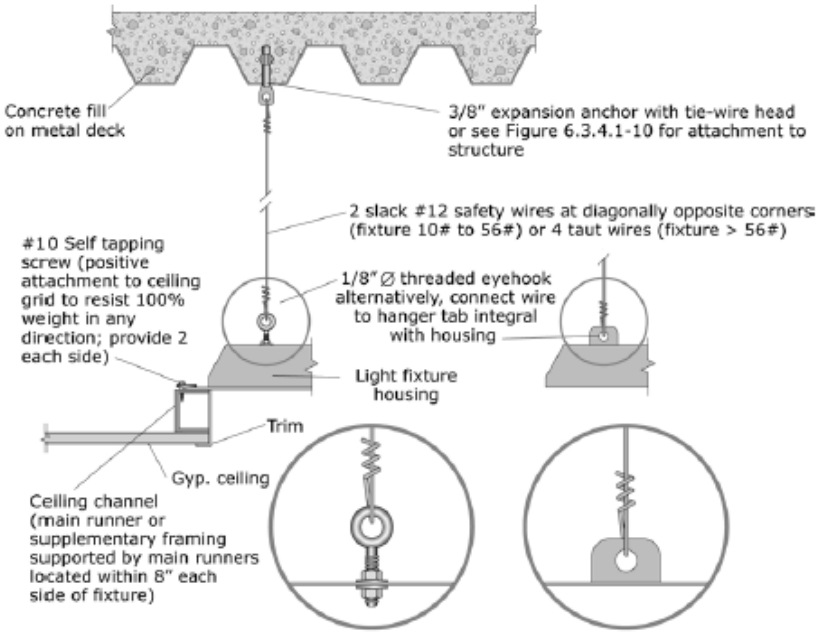


Figure G.17: Recessed Light Fixture in suspended Ceiling (Fixture Weight 10 to 56 pounds)

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

Contents and Furnishings

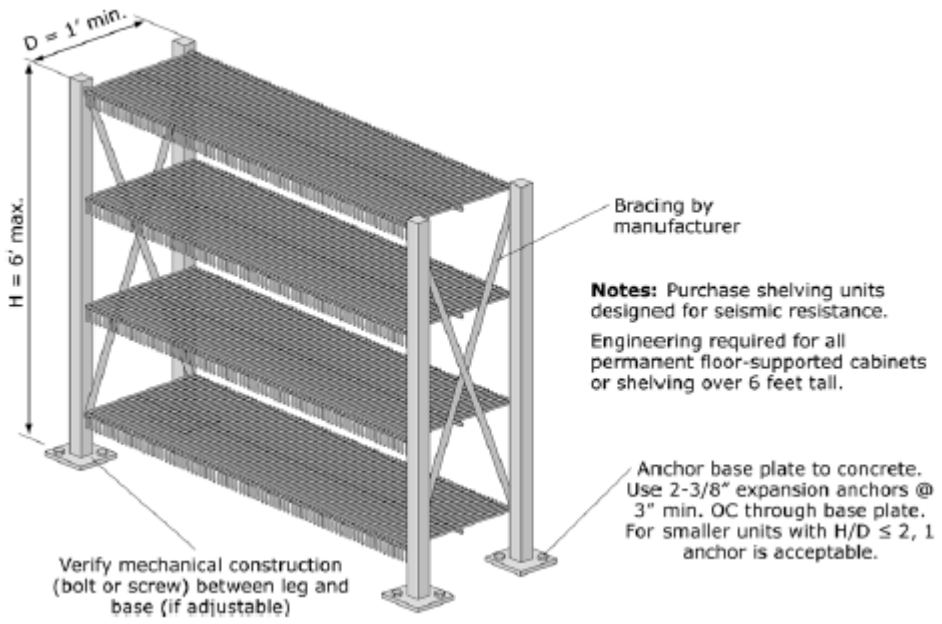
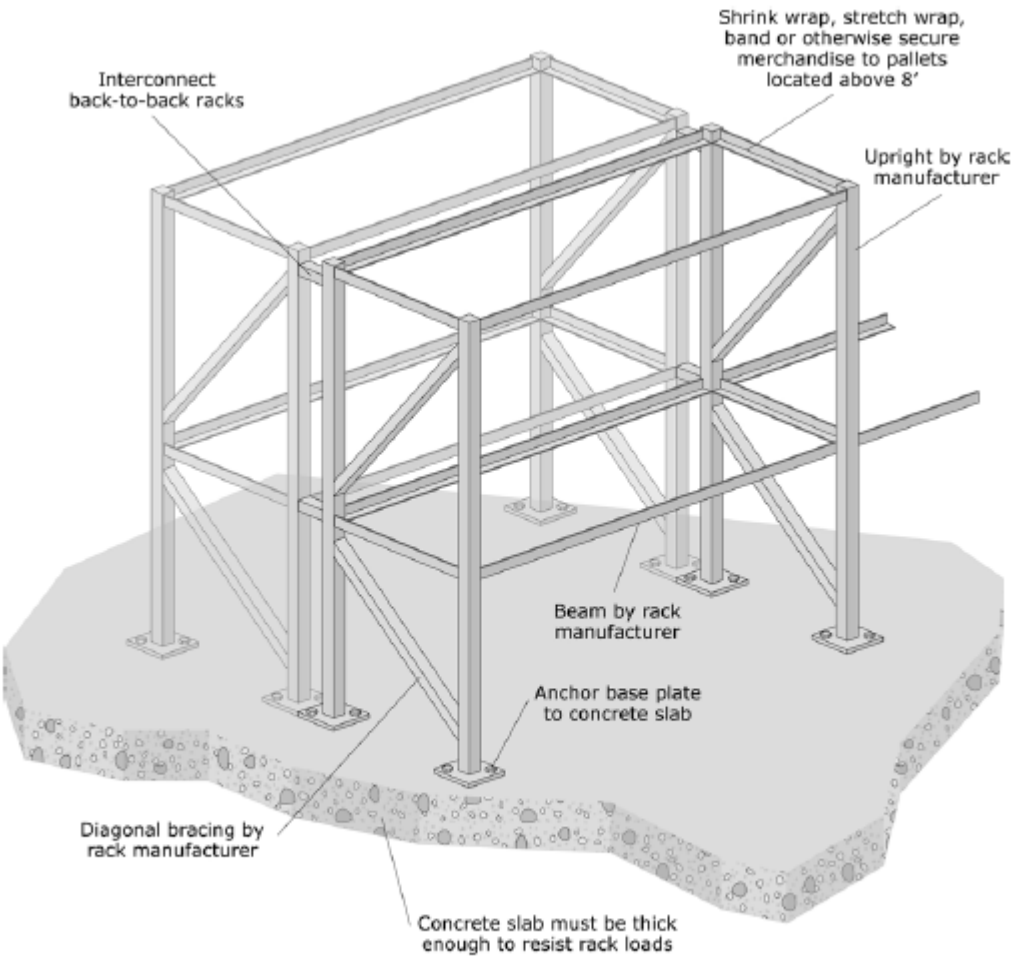


Figure G.18: Light Storage Racks

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



Note: Purchase storage racks designed for seismic resistance. Storage racks may be classified as either nonstructural elements or nonbuilding structures depending upon their size and support conditions. Check the applicable code to see which provisions apply.

Figure G.19: Industrial Storage Racks

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

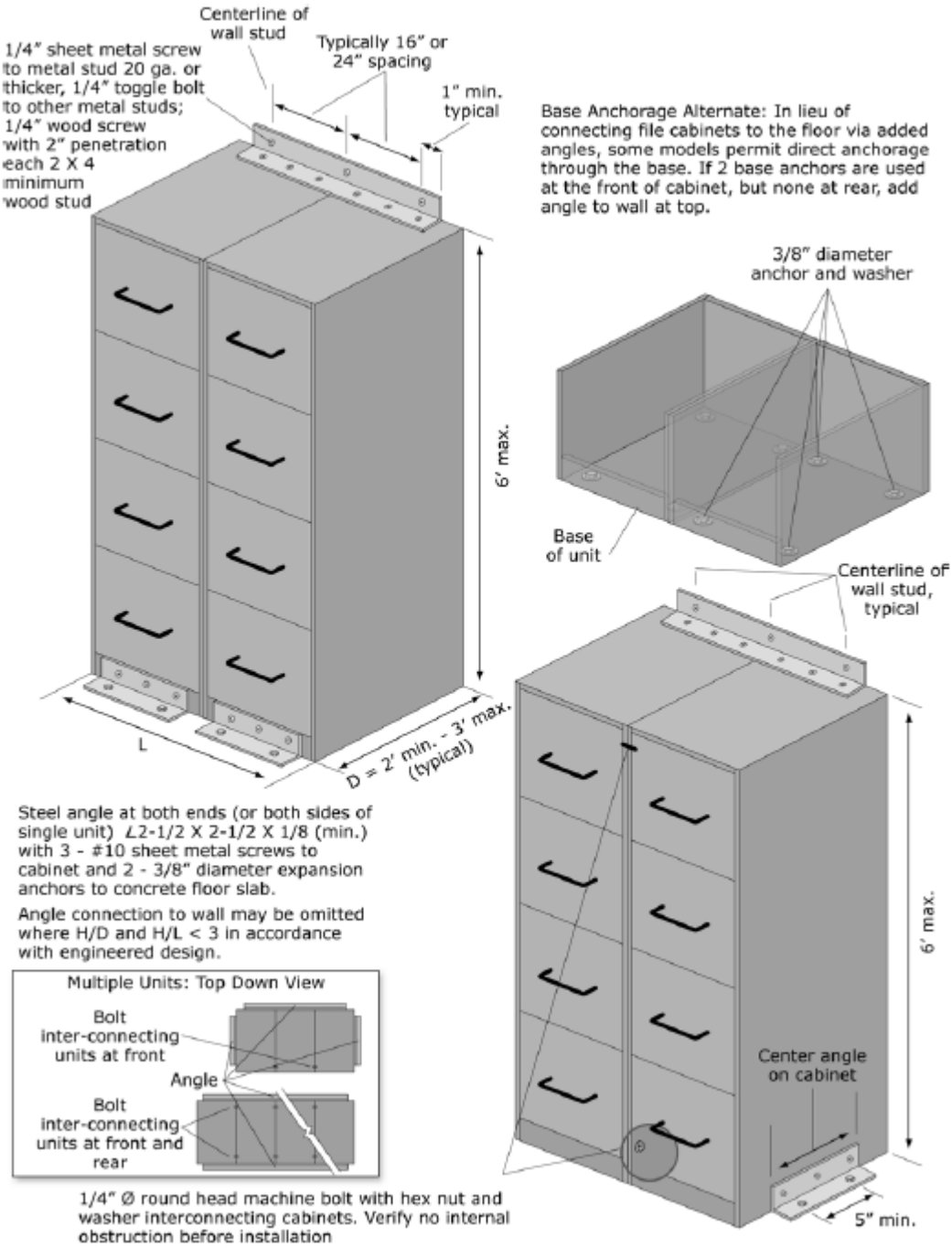


Figure G.20: Wall-mounted File Cabinets

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

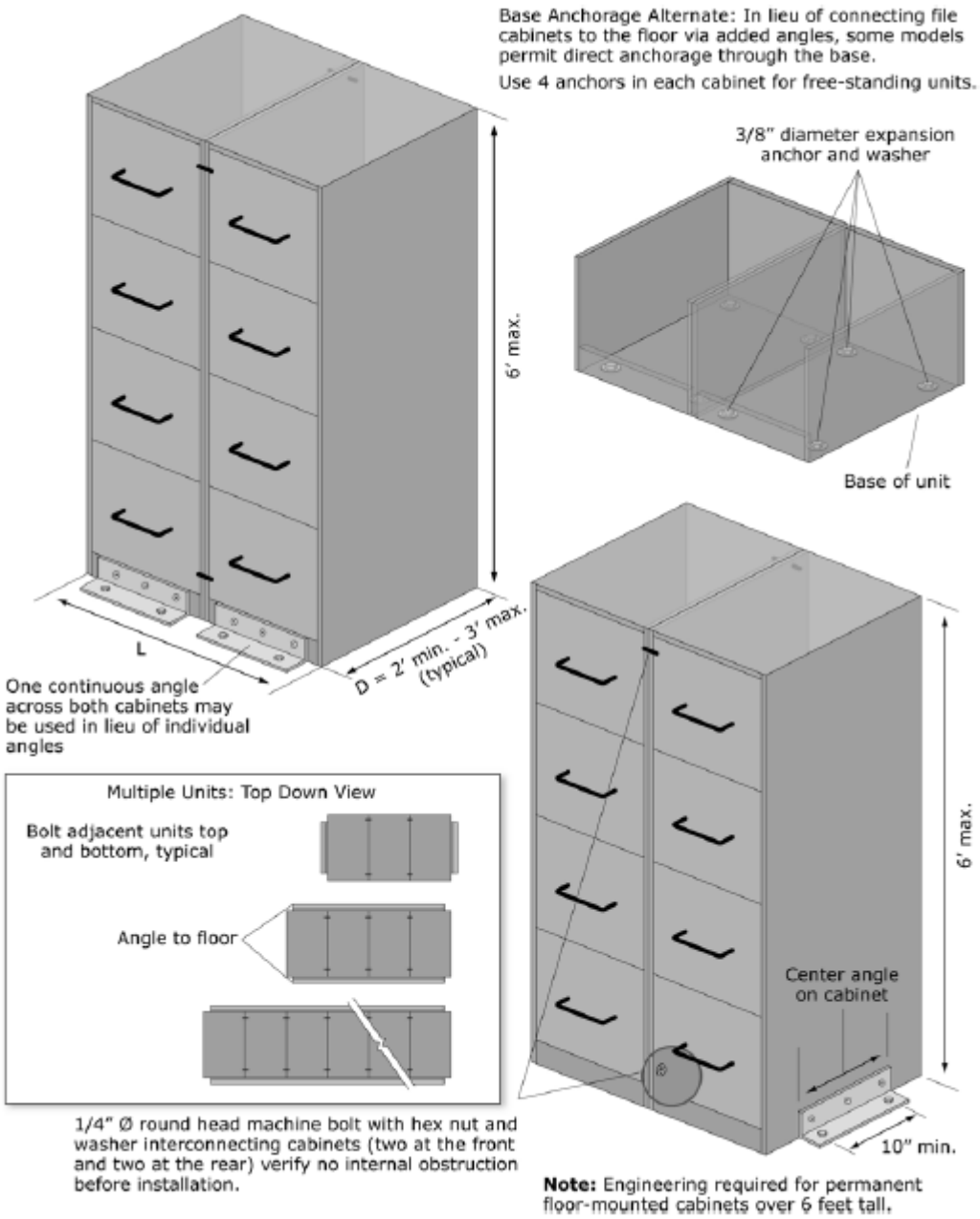
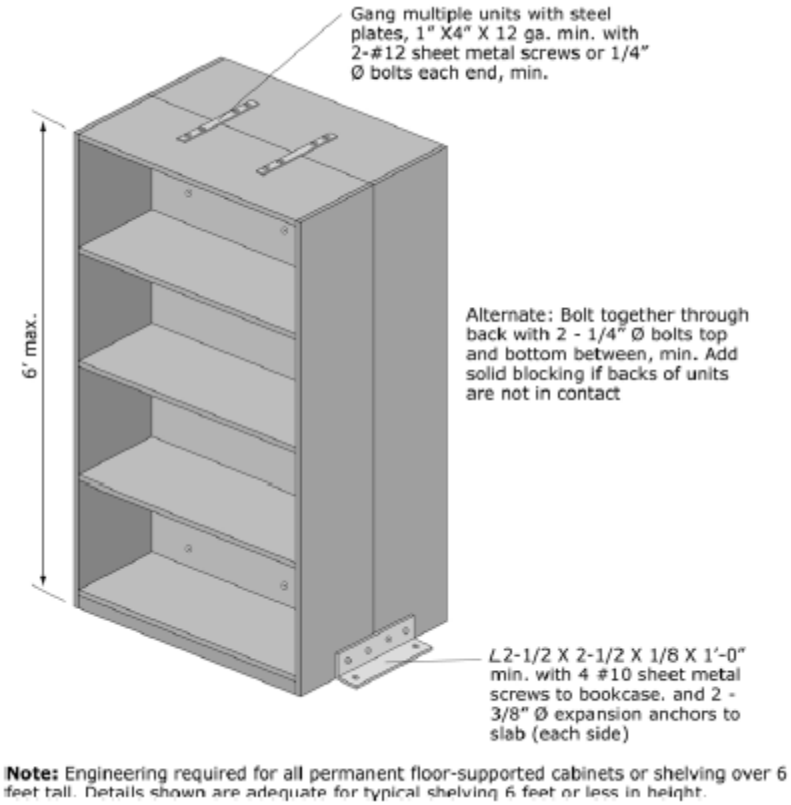


Figure G.21: Base Anchored File Cabinets

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



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

Figure G.22: Anchorage of Freestanding Book Cases Arranged Back to Back

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

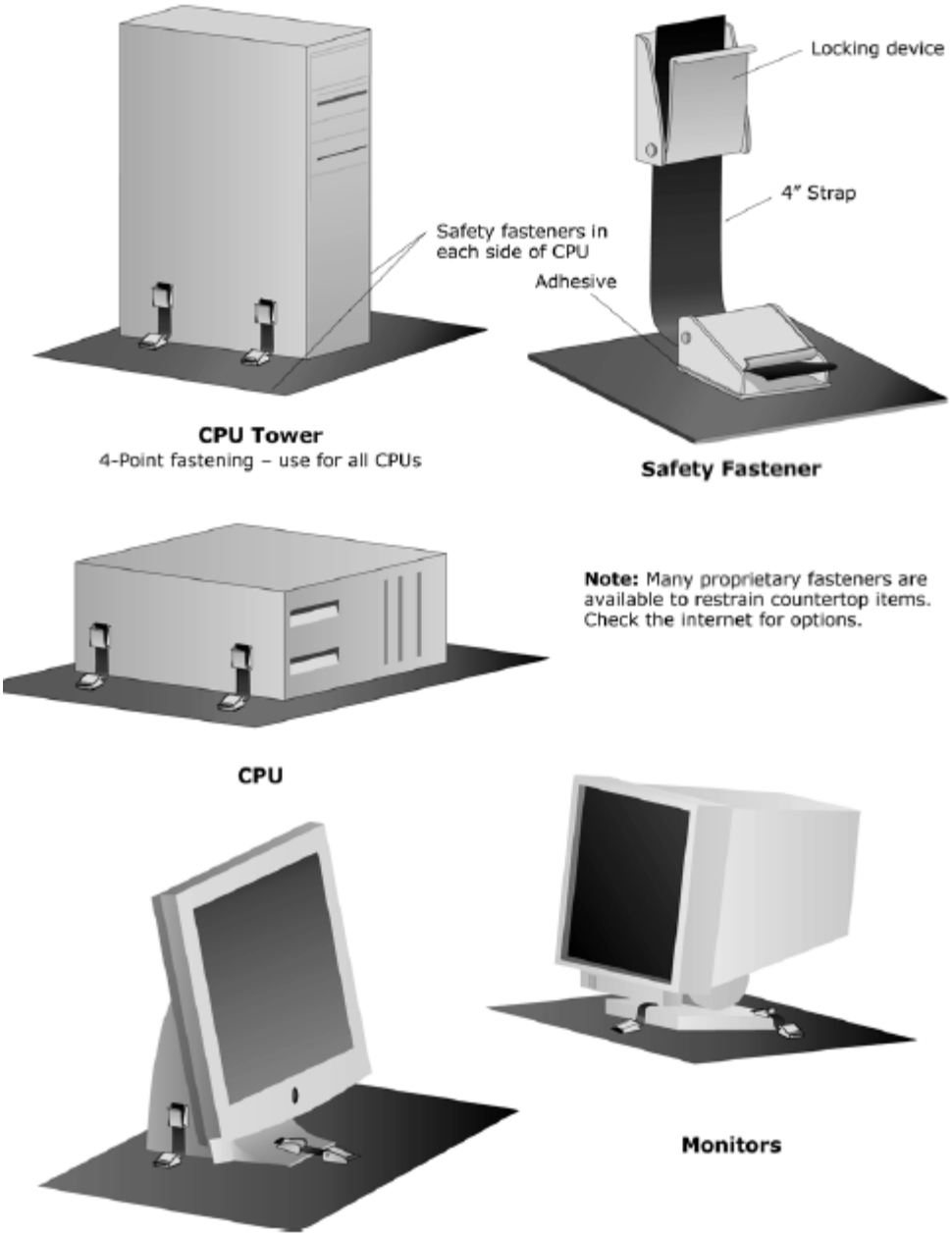
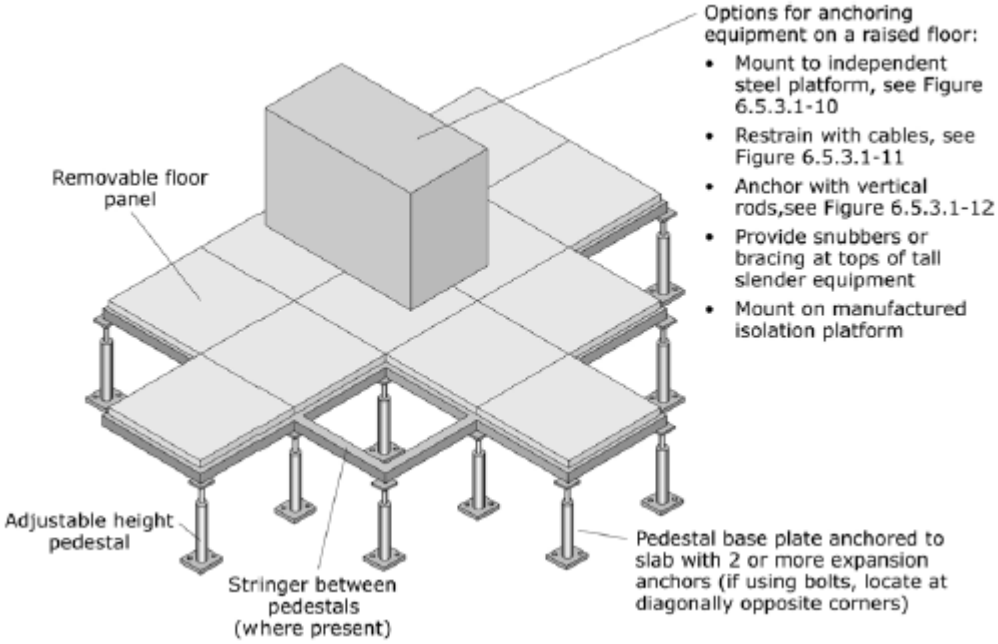
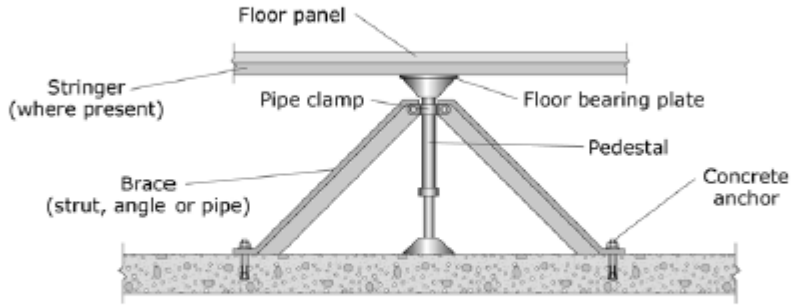


Figure G.23: Desktop Computers and Accessories

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



Cantilevered Access Floor Pedestal



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

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

Figure G.24: Equipment Mounted on Access Floor

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

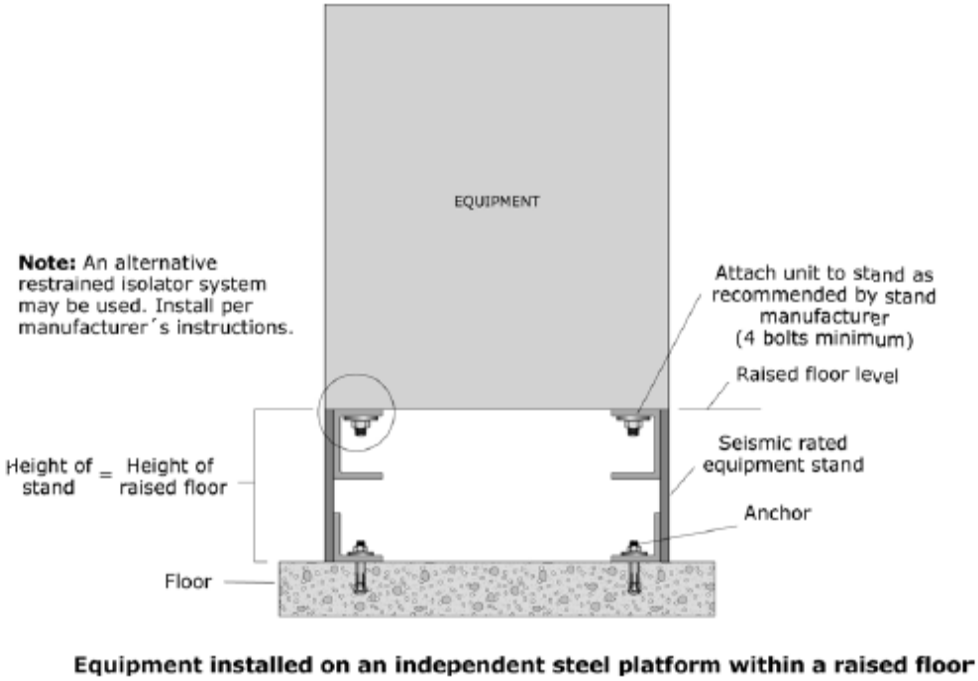


Figure G.25: Equipment Mounted on Access Floor – Independent Base

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

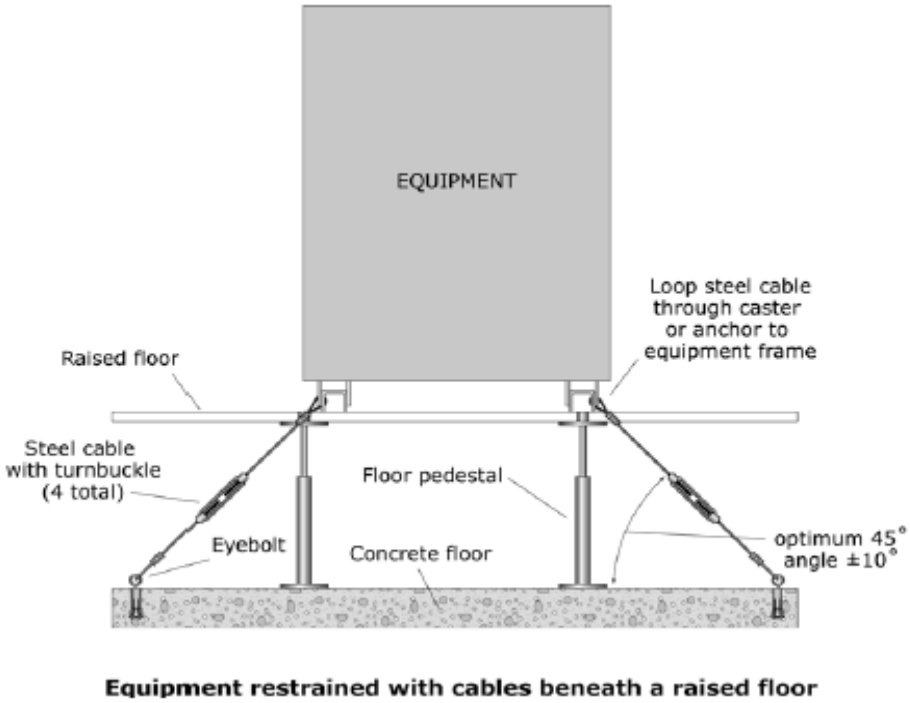
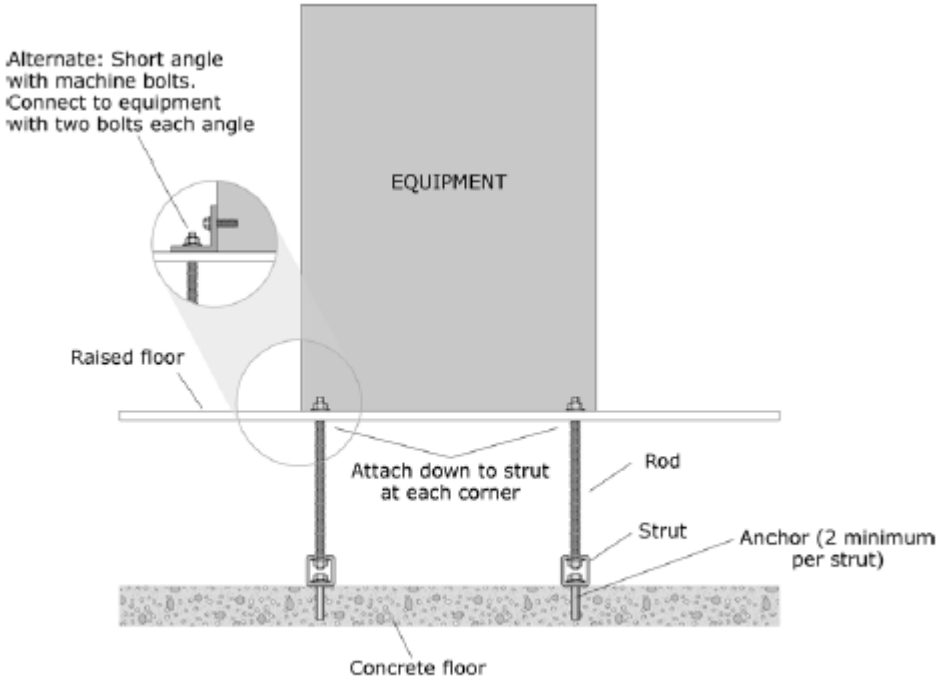


Figure G.26: Equipment Mounted on Access Floor – Cable Braced

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

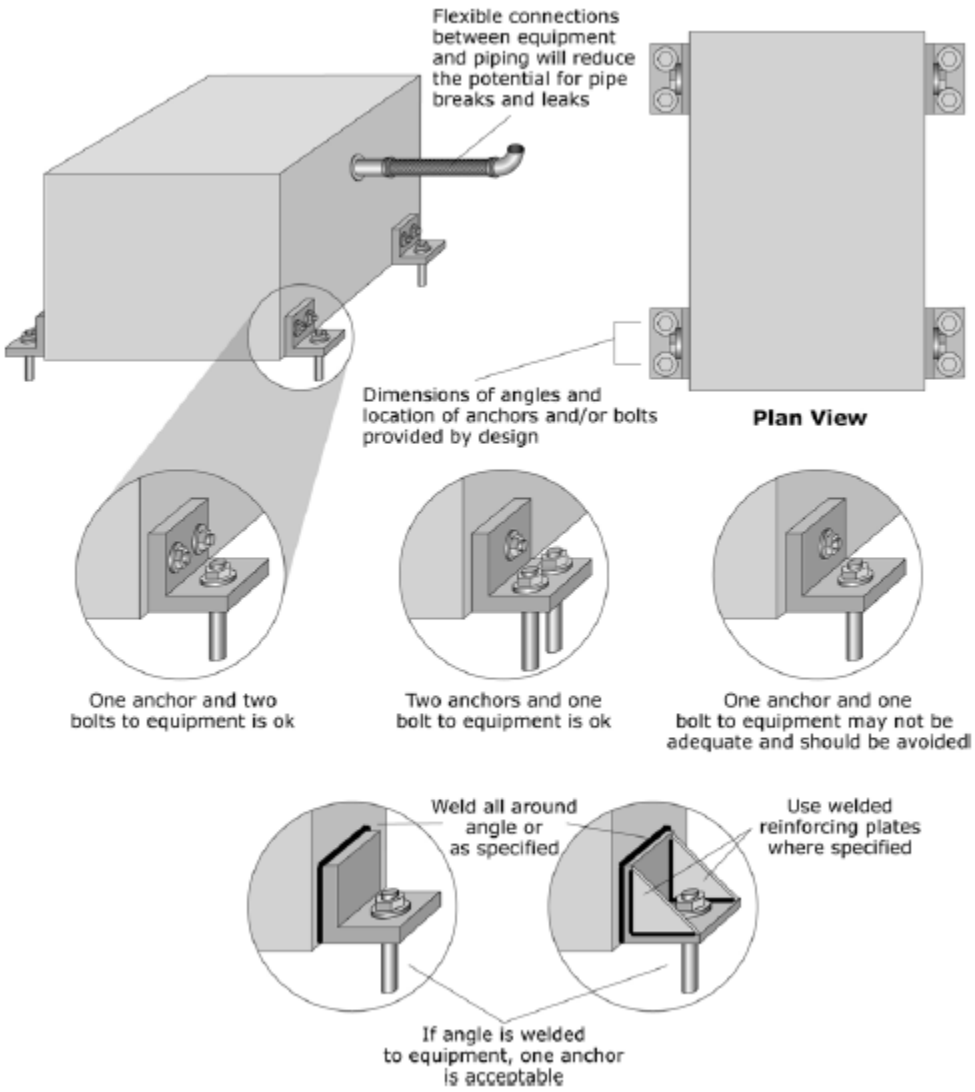


Equipment anchored with vertical rods beneath a raised floor

Figure G.27: Equipment Mounted on Access Floor – Tiedown 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.28: Rigidly Floor-mounted Equipment with Added Angles

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

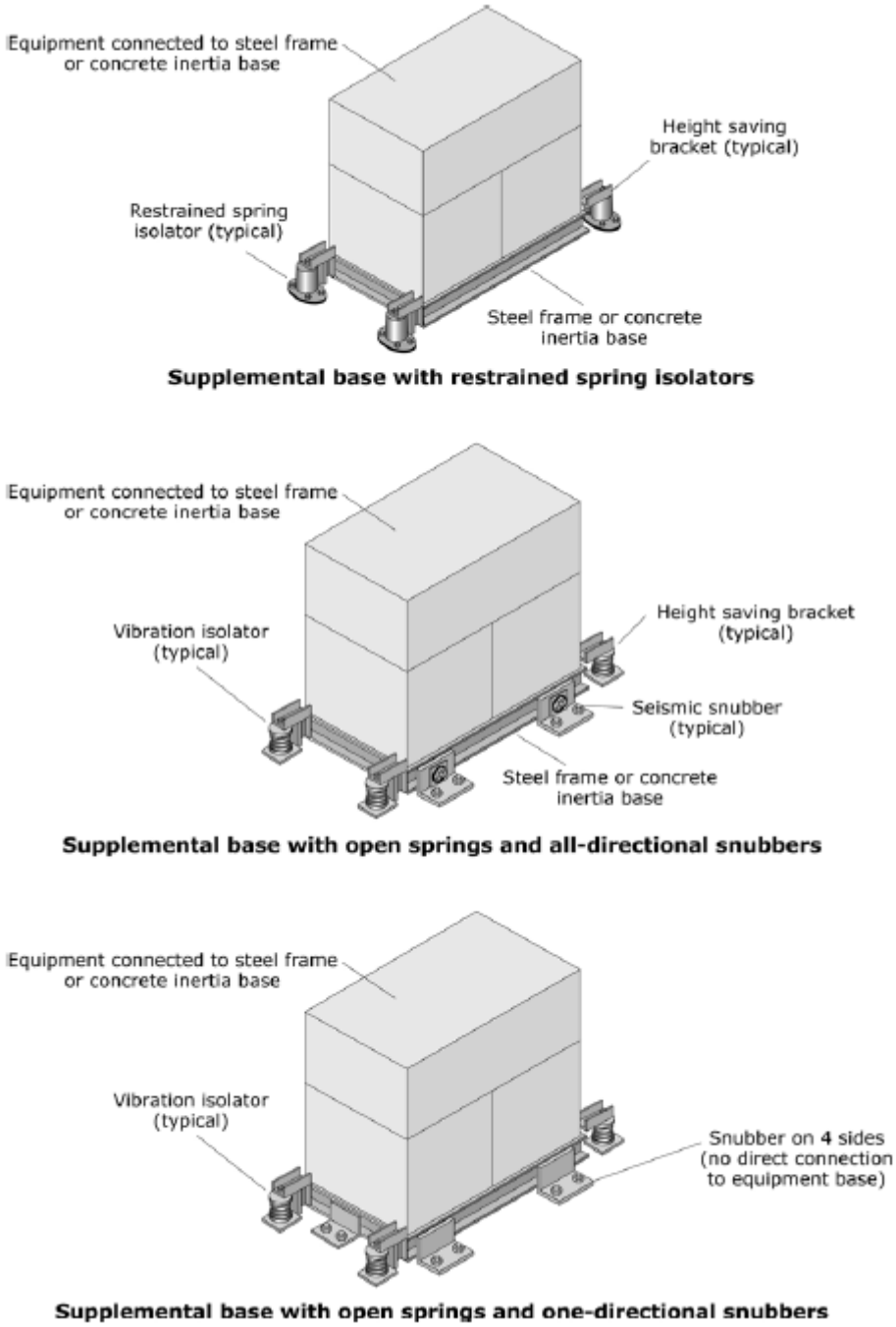


Figure G.29: HVAC Equipment with Vibration Isolation

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

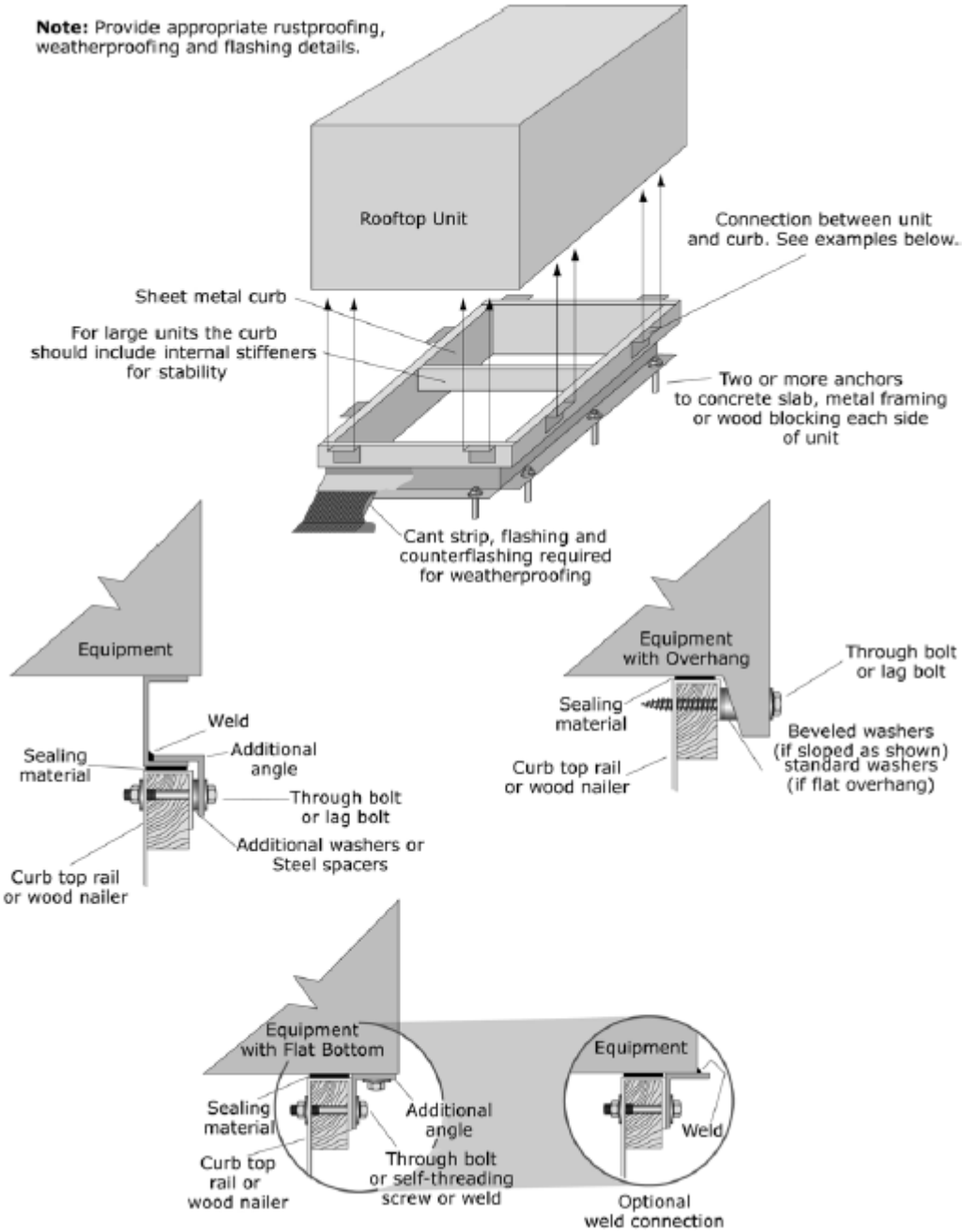


Figure G.30: Rooftop HVAC Equipment

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

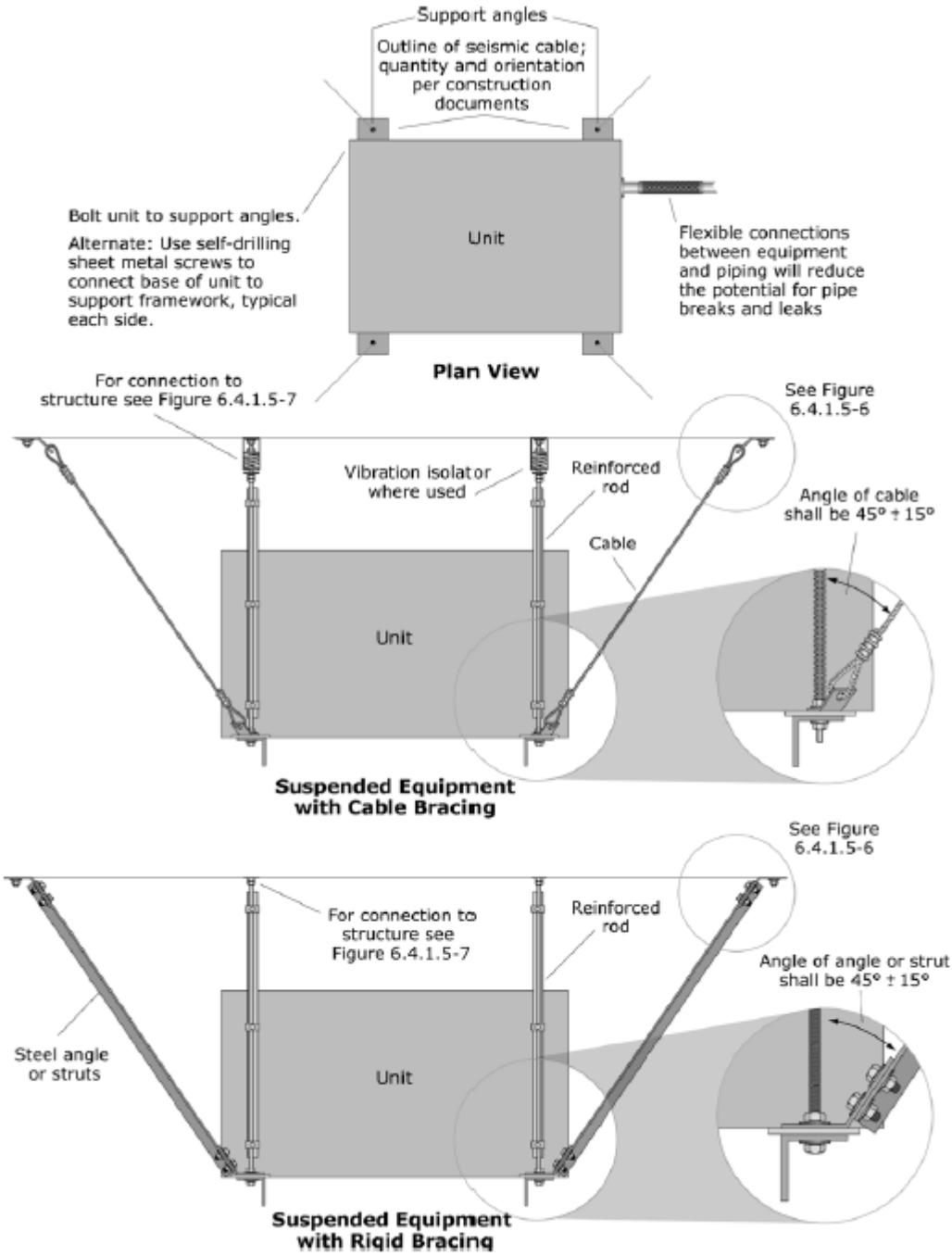


Figure G.31: Suspended Equipment

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

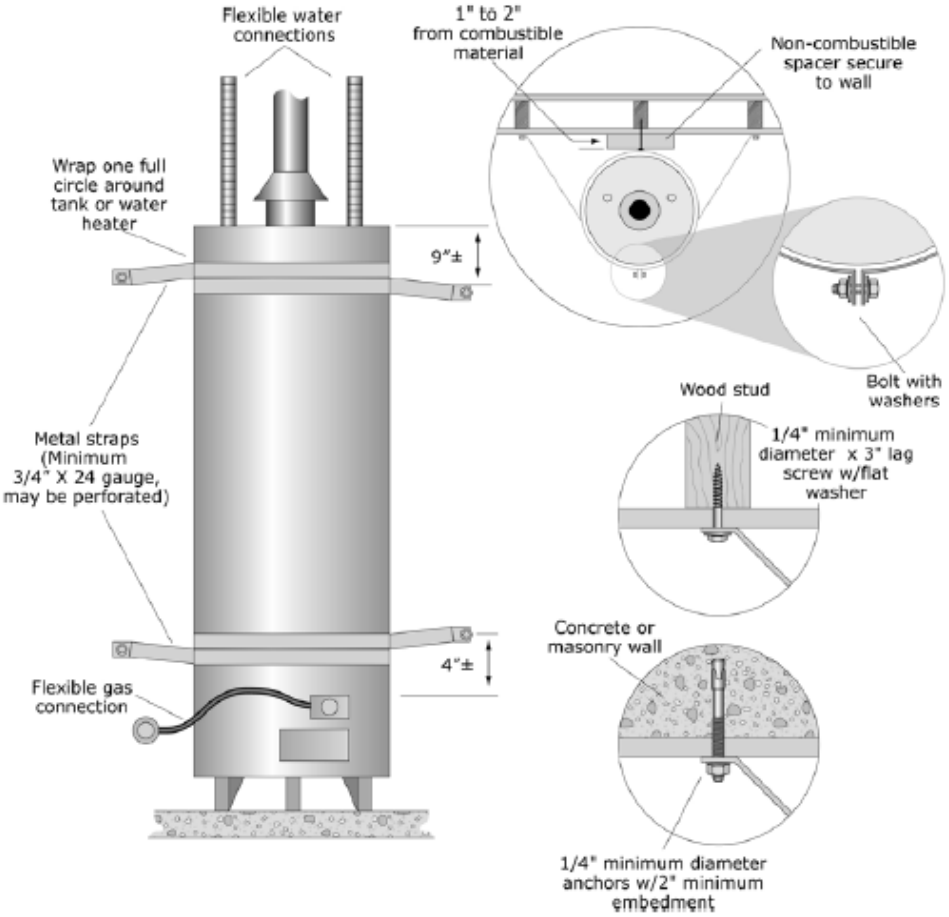


Figure G.32: Water Heater Strapping to Backing Wall

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

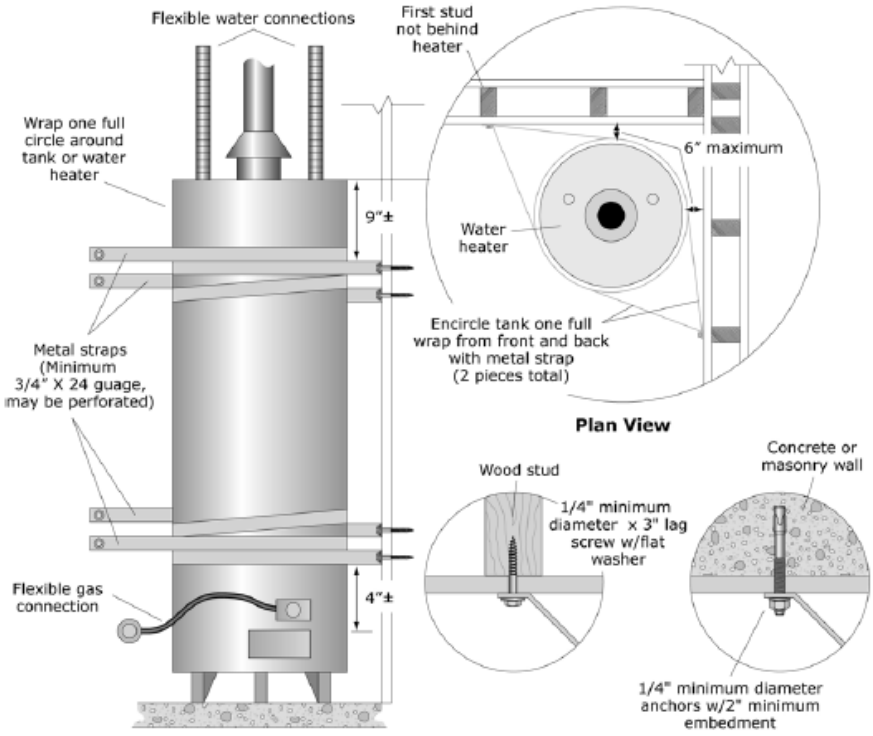


Figure G.33: Water Heater – Strapping at Corner Installation

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

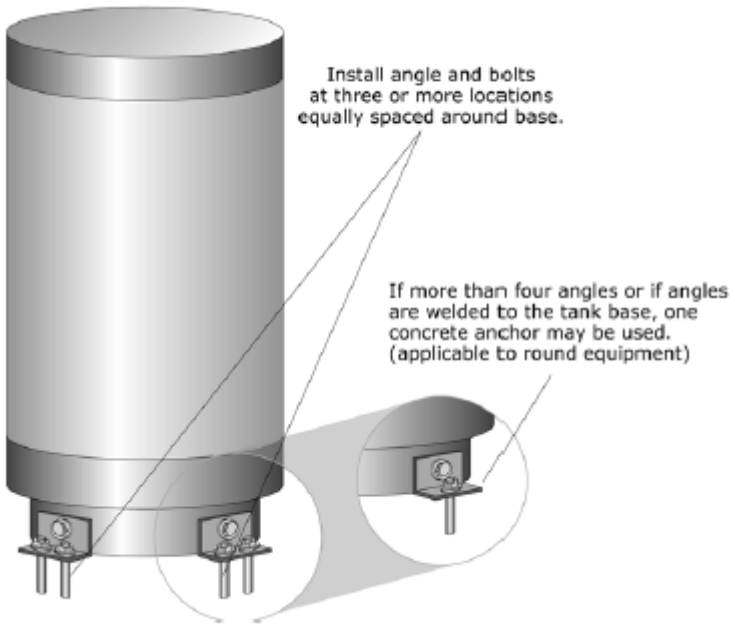


Figure G.34: Water Heater – Base Mounted

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

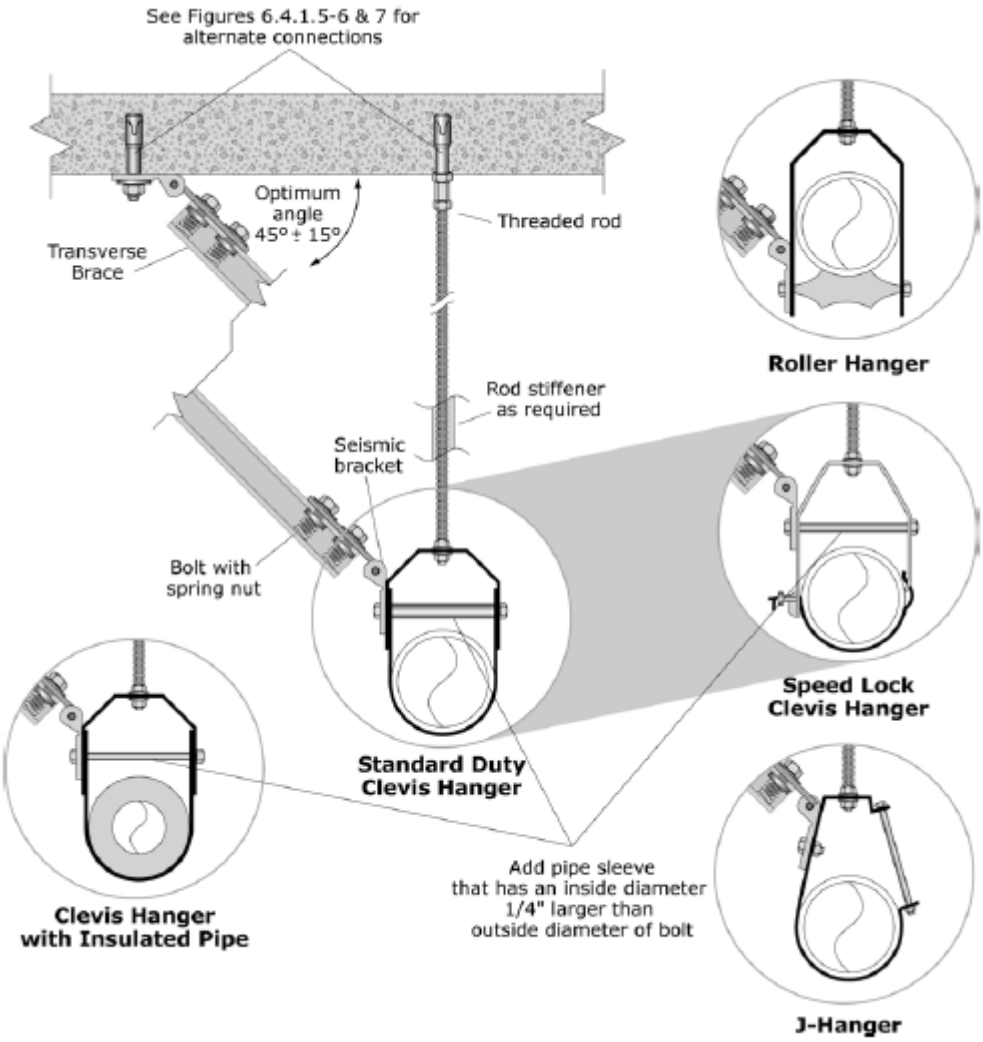


Figure G.35: Rigid Bracing – Single Pipe Transverse

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

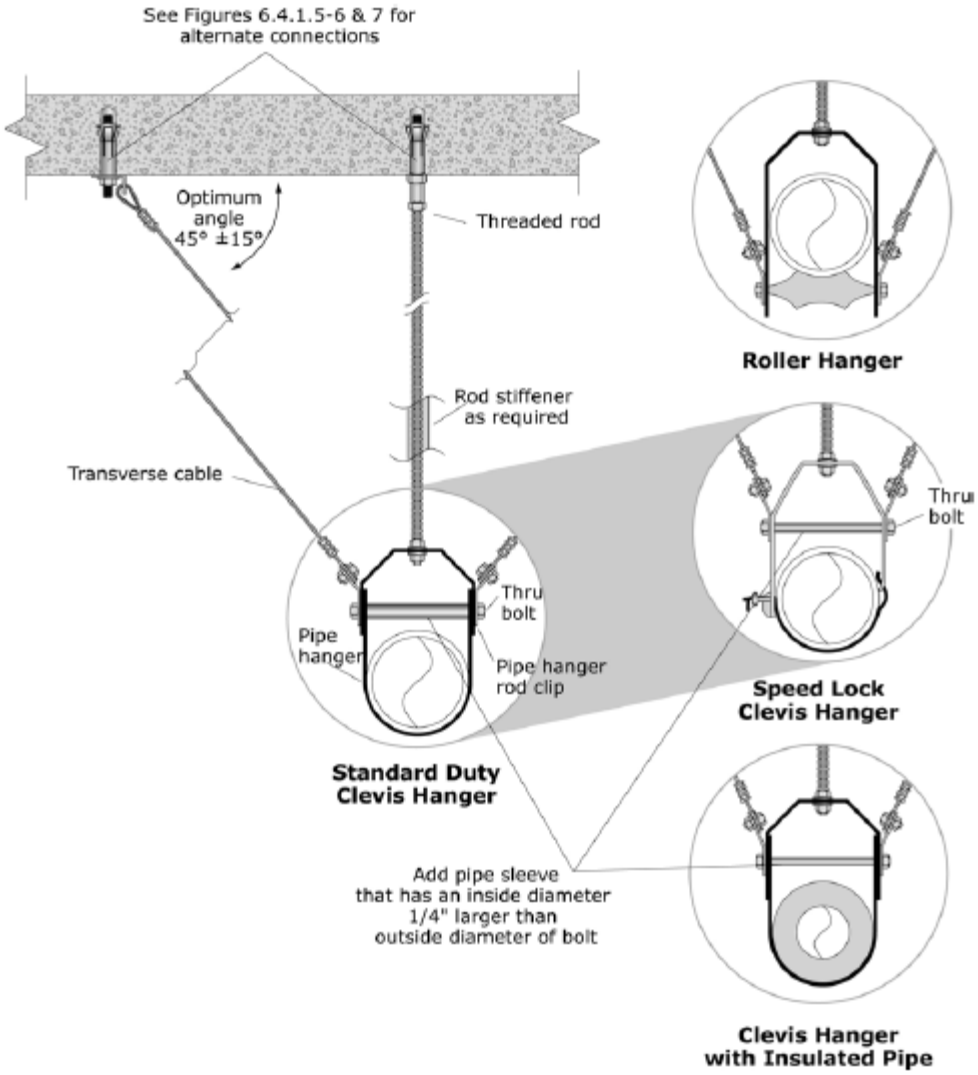


Figure G.36: Cable Bracing – Single Pipe Transverse

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

Electrical and Communications

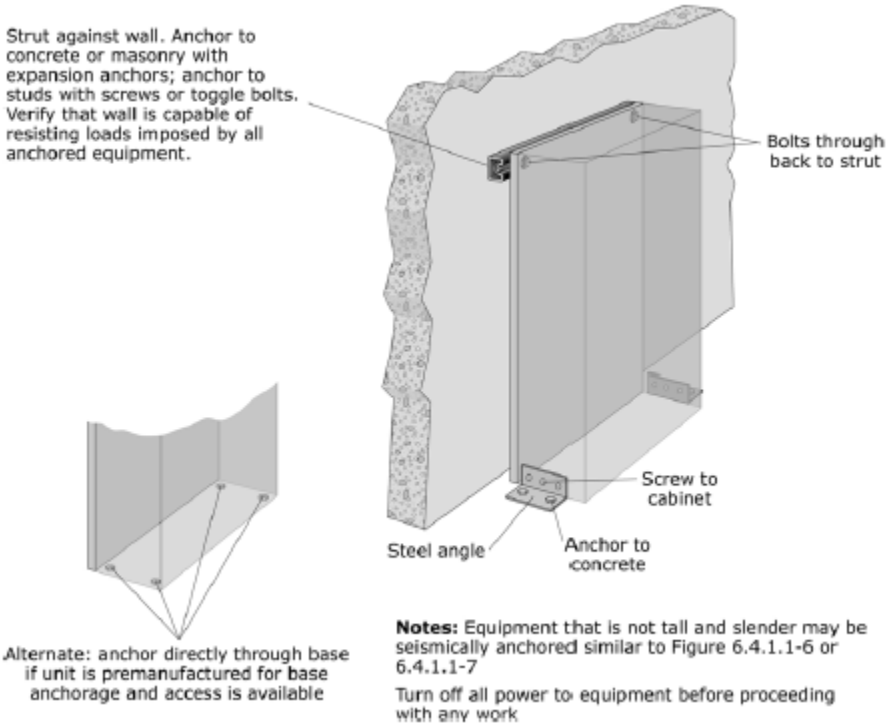


Figure G.37: Electrical Control Panels, Motor Controls Centers, or Switchgear.

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

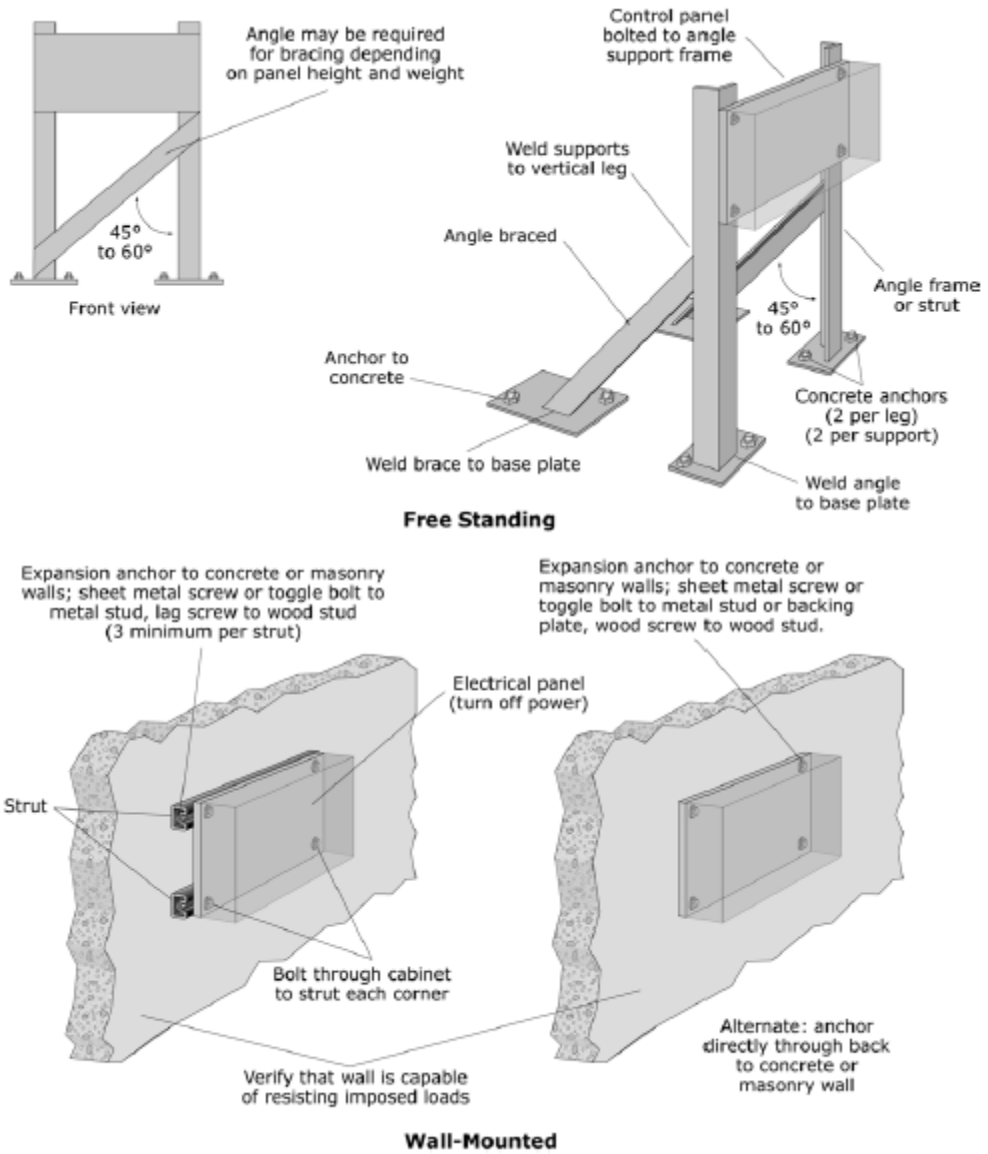


Figure G.38: Free-standing and Wall-mounted Electrical Control Panels, Motor Controls Centers, or Switchgear

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

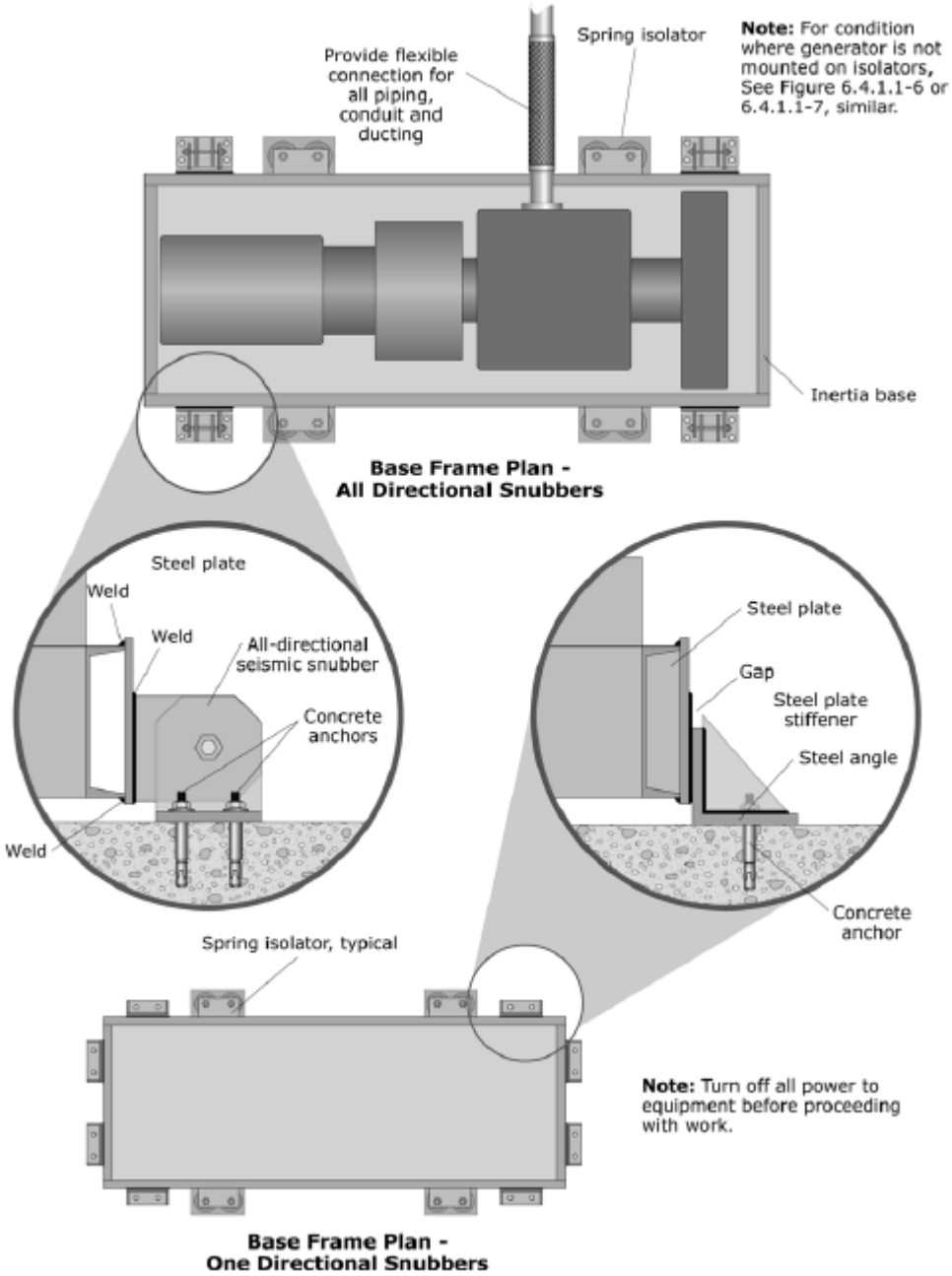


Figure G.39: Emergency Generator

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

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