STRUCTURAL
SOLUTIONS
INC

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PROVIDENCE, UT
84332
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21st January, 2020

Box Elder School District
% Corey Thompson
960 South Main
Brigham City, UT
84302

RE: **Grouse Creek School Building – Seismic Evaluation** for the existing original portion of the school building located in Grouse Creek, UT.

Corey:

As per your request, we have conducted a schematic seismic evaluation of the older original portion of the Grouse Creek School in Grouse Creek, UT. As part of our evaluation we conducted two separate site visits to visually inspect, measure, and document the existing portions of the structure under consideration. The following is a report of our evaluation and findings.

Existing Structure:

The existing school building can be divided into 3 distinct areas:

1. **Original School Building** (classrooms & kitchen area) - This portion of the building is a single level, is located on the east end of the building complex, and is constructed of a wood, stick-framed roof, with stick framed ceiling joists (see attached photos). The roof sheathing appears to be 1x wood planking that was sheathed over with Oriented Strand Board (OSB) sheathing in the recent past. The exterior walls, which are also the roof and main floor systems' bearing walls, and two of the main interior walls, are all 12" to 16" thick unreinforced stone walls, which extend down to grade to create stone foundation walls and stone footings. The main floor framing system appears to be 2x wood joists with wood plank decking. We understand this portion of the building was constructed circa 1900. This is the sole area under consideration in this report. See attached "**Existing Building Layout Plan**" sheet.

2. **Gymnasium Area –** This is the west-most portion of the building complex. We understand this area was constructed some time in the 1980s. No construction drawings of this area were available for review. This is a single level area, with a concrete slab on grade floor. The roof appears to be wood construction, and is supported along the perimeter with masonry walls. We assume these walls are grouted and reinforced, which would have been the standard during the time of

construction. This area was not reviewed, as it is not within the scope of services we were asked to perform. See attached "**Existing Building Layout Plan**" sheet.

3. **Breezeway Area** – This area is located near the middle of the building complex. This is a narrow area that connects the older, original, east portion of the building complex, to the newer Gymnasium portion. We understand this area was constructed at some time in the 1980s, at the same time as the construction of the Gymnasium Area. No construction drawings of this area were available for review. This is a single level area, with a concrete slab on grade floor. The roof appears to be wood construction, and is supported along the perimeter with masonry walls. We assume these walls are grouted and reinforced, which would have been the standard during the time of construction. This area was not reviewed, as it is not within the scope of services we were asked to perform. See attached "**Existing Building Layout Plan**" sheet.

Seismic Evaluation:

The purpose of our investigation was to identify and attempt to quantify the current seismic risk to the existing Original School Building on the east end of the structure, as this area is clearly more seismically deficient that the newer Gymnasium are Breezeway areas. To assist us in this process, we have utilized the ***FEMA P-154 Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook – Third Edition.*** This guide offers a screening scheme for buildings, and is based on the local geographic potential seismic accelerations developed by the USGS, which are also used in the current International Building Code.

The process of the FEMA P-154 handbook begins with determining the Region of Seismicity based on county maps within the guide (see attached **Figure 1**), or based on site-specific values determined by the USGS using the site's longitude and latitude (see attached **Figures 2 & 3**). **Figure 1** indicates Box Elder County is considered a "Very High" Region of Seismicity. However, this appears due to the potential high seismic accelerations in Brigham City, near the mountains. The site-specific accelerations in Grouse Creek are lower, with Ss = 0.424g and S1 = 0.1395g (see attached **Figure 2**). Thus, the Region of Seismicity for Grouse Creek would be considered "Moderate" (see attached **Figure 3**), and not "Very High".

The next step in the FEMA P-154 screening process is to conduct on-site *Level 1* and *Level 2* visual evaluations for the MODERATE Seismicity level. See attached **Figure 4** and **Figure 5** for these evaluations. Per **Figures 4 and 5**, the ***<u>Final Level 2 Score = 0.5</u>***. Per attached **Figure 6** (excerpt from the FEMA P-154 Handbook), a score below 2.0 indicates the structure is likely inadequate for the Maximum Considered Earthquake (MCE) for the specific site. The calculated score of 0.5 can be expressed numerically as $1 \times 10^{0.5}$ as the potential for collapse if the MCE was to occur. Therefore, as score of 2.0 would indicate a $1 \times 10^{2.0}$ chance, or 1 in 100 chance of collapse. **<u>A score of 0.5 translates into a 1 in 3.16 chance of collapse, which is clearly excessive.</u>**

<u>Findings</u>*:*

Based on our evaluation, the current east portion of the school building under consideration (Classroom and Kitchen Areas) is highly likely to partially or totally collapse if the MCE earthquake for this geographic area occurs. This portion of the building has bearing walls and shear walls constructed of Unreinforced Masonry or Stone (URM), which are known to perform extremely poorly when subjected to seismic loading. Their lack of ductility and heavy weight combine to create increased seismic risk, and high potential for loss of life.

This building, in particular, has several glaring deficiencies that may cause the performance of the building to be even worse than anticipated, when subjected to seismic loading. Those deficiencies are:

- The mortar in the stone is deteriorating in several locations.
- The existing roof structure is in poor condition (see attached photos).
- Several openings in the exterior of the building have been infilled with unreinforced Concrete Masonry Units (CMU).
- The existing footings and foundation walls are unreinforced stone, and are deteriorating and settling in some locations.
- The existing roof and floor structures are not positively anchored to the unreinforced stone walls, which increases the likelihood of wall collapse, resulting in roof collapse. See attached Details 1 & 2.
- There is a large, unreinforced stone gabled end wall over the main entry, with a cantilevered wood canopy. The gabled end wall and canopy are not adequately braced or reinforced to prevent failure or collapse. Such collapse could fall on persons trying to exit the building during and after a seismic event.

In our opinion, there are three options for how to address the building's seismic risk going forward. They are:

Option 1 – No change to the existing structure or its current use. Continue to use the building as it has been used in the past, with no structural upgrades to increase safety during and after a seismic event. If no seismic event occurs, the building will likely continue to function as it has in the past, but will continue to slowly deteriorate. However, there are some damaged and inadequate roof structural elements that should be mitigated as soon as possible to prevent potential roof collapse due to snow or wind loads (see attached photos). **We do not recommend this option.**

Option 2 – Seismically Retrofit the existing building. This would likely involve adding several inches of reinforced gunite (sprayed concrete) to the interior face of the existing unreinforced stone exterior bearing walls. Then the existing stone walls would be anchored to the reinforced gunite with hooked, epoxied, reinforcing steel anchors spaced at 16” to 24” on center in each direction. These epoxy anchors would require screen tubes. In addition, the existing roof structure should be replaced with a modern wood truss system. Then the new roof structural system and existing main floor system should be positively anchored to the unreinforced stone/gunite walls both in plane and out-of-plane. New concrete footings and foundation walls should also be incorporated into the retrofit. See attached **”Schematic Retrofit Plan”** and referenced Details 3 & 4. This plan and details are schematic only. This option would increase seismic load resisting capacity of the portion of the building under consideration to an acceptable level, and could be done in such a manner to preserve most of the historic value of the building. However, such work is extremely costly and difficult. In addition, it would essentially require a complete remodel of the existing interior of the building. ***We would recommend this option, but it is likely cost prohibitive, and the historic value of the existing structure appears questionable due to the additions and infilled openings.***

Option 3 – Demolish the seismically deficient east portion of the existing building and rebuild a new building with modern materials, construction methods, and code requirements, while leaving the existing Gymnasium Area intact. Or mobile classrooms and kitchen buildings could also be used in place of the demolished portion, and located as required at the site. ***We recommend this option as it is the most cost effective.***

Limitations:

It should also be noted that our investigation is based solely on information obtained from visual review of the existing construction, information provided by representatives of Box Elder School District, and professional judgement and knowledge. All analysis performed, findings, and recommendations were schematic in nature, therefore we make no guarantees or warranties related to the future performance of the building or any retrofit measures that are implemented.

If you have any additional questions, please let me know.

Respectfully Submitted,

PROFESSIONAL STRUCTURAL ENGINEER
No. 318774-2203
JOSHUA CLARK MAUGHAN
STATE OF UTAH

Joshua C. Maughan S.E.

1-22-2020

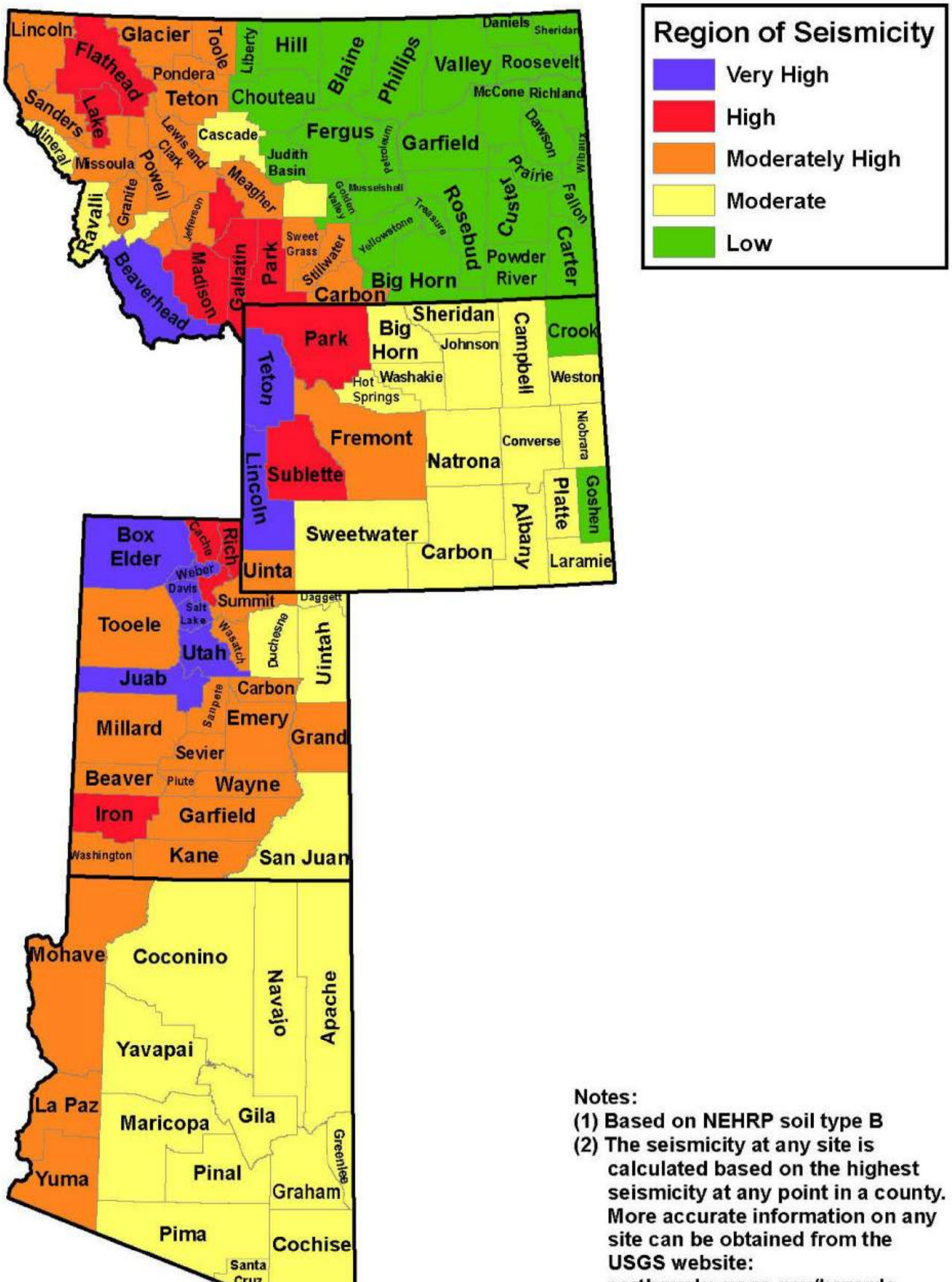


Figure A-3 Seismicity regions in Arizona, Montana, Utah, and Wyoming.

Figure 1

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 22 JAN 2020, 9:58AM

ASCE Seismic Base Shear

File = C:\Users\Public\STRUCT~1\2020JO~1\2020-0~2\2020-002 DWA Grouse Creek School .
Software copyright ENERCALC, INC. 1983-2019, Build:12.19.11.30 .

Lic. # : KW-06009480 **Structural Solutions Inc**

DESCRIPTION: Grouse Creek Seismic Accelerations

Grouse Creek Seismic Accelerations

Risk Category

Calculations per ASCE 7-16

Risk Category of Building or Other Structure : "III" : Buildings and other structures that represent a substantial hazard to human life in the event of a failure. *ASCE 7-16, Page 4, Table 1.5-1*

Seismic Importance Factor = 1.25 *ASCE 7-16, Page 5, Table 1.5-2*

Ss & S1

ASCE 7-16 11.4.2

Max. Ground Motions, 5% Damping :

S_S = 0.4241 g, 0.2 sec response
S_1 = 0.1395 g, 1.0 sec response

Latitude = 41.308 deg North
Longitude = 113.564 deg West
Location : Grouse Creek, UT 84313

Site Class, Site Coeff. and Design Category

Site Classification "D" : Shear Wave Velocity 600 to 1,200 ft/sec		= D	*ASCE 7-16 Table 20.3-1*
Site Coefficients Fa & Fv	Fa	= 1.46	*ASCE 7-16 Table 11.4-1 & 11.4-2*
(using straight-line interpolation from table values)	Fv	= 2.24	
Maximum Considered Earthquake Acceleration	S_{MS} = Fa * Ss	= 0.619	*ASCE 7-16 Eq. 11.4-1*
	S_{M1} = Fv * S1	= 0.313	*ASCE 7-16 Eq. 11.4-2*
Design Spectral Acceleration	S_{DS} = S_{MS} * 2/3	= 0.413	*ASCE 7-16 Eq. 11.4-3*
	S_{D1} = S_{M1} * 2/3	= 0.209	*ASCE 7-16 Eq. 11.4-4*
Seismic Design Category		= D	*ASCE 7-16 Table 11.6-1 & -2*

Resisting System

ASCE 7-16 Table 12.2-1

Basic Seismic Force Resisting System . . . **Bearing Wall Systems**
11.Ordinary plain masonry shear walls

Response Modification Coefficient " R " = 1.50
System Overstrength Factor " Wo " = 2.50
Deflection Amplification Factor " Cd " = 1.25

NOTE! See ASCE 7-16 for all applicable footnotes.

Building height Limits :

Category "A & B" Limit:	No Limit
Category "C" Limit:	Not Permitted
Category "D" Limit:	Not Permitted
Category "E" Limit:	Not Permitted
Category "F" Limit:	Not Permitted

Lateral Force Procedure

ASCE 7-16 Section 12.8.2

Equivalent Lateral Force Procedure

The "Equivalent Lateral Force Procedure" is being used according to the provisions of ASCE 7-16 12.8

Determine Building Period

Use ASCE 12.8-7

Structure Type for Building Period Calculation : All Other Structural Systems

" Ct " value = 0.020
" x " value = 0.75
" hn " : Height from base to highest level = 18.0 ft

" Ta " Approximate fundemental period using Eq. 12.8-7 : Ta = Ct * (hn ^ x) = 0.175 sec
"TL" : Long-period transition period per ASCE 7-16 Maps 22-14 -> 22-17 8.000 sec

Building Period " Ta " Calculated from Approximate Method selected = 0.175 sec

" Cs " Response Coefficient

ASCE 7-16 Section 12.8.1.1

S_{DS} : Short Period Design Spectral Response	= 0.413		From Eq. 12.8-2, Preliminary Cs	= 0.344
" R " : Response Modification Factor	= 1.50		From Eq. 12.8-3 & 12.8-4 , Cs need not exceed	= 0.994
" I " : Seismic Importance Factor	= 1.25		From Eq. 12.8-5 & 12.8-6, Cs not be less than	= 0.023

Cs : Seismic Response Coefficient = = **0.3442**

Seismic Base Shear

ASCE 7-16 Section 12.8.1

Cs = 0.3442 from 12.8.1.1

W (see Sum Wi below) = 0.00 k

Seismic Base Shear V = Cs * W = 0.00 k

Figure 2

Appendix A
Maps Showing Seismicity Regions

This appendix provides seismicity region designations of Low, Moderate, Moderately High, High, and Very High for all counties in the United States, based on an assumed Soil Type B throughout the county. The seismicity designation is based on the site-specific values of seismic hazard at a point in the county considering risk-targeted Maximum Considered Earthquake (MCE_R) ground motions. The determination is based on criteria set in Table 2-2 and repeated here as Table A-1. The designation at any county is based on the highest seismicity expected at any location in the county. A more accurate determination of the seismicity of a specific site can be made using the site-specific procedure described in Chapter 2.

Table A-1 Seismicity Region Determination from MCE_R Spectral Acceleration Response (from ASCE/SEI 41-13)

Seismicity Region	Spectral Acceleration Response, S_S (short-period, or 0.2 seconds)	Spectral Acceleration Response, S_1 (long-period, or 1.0 second)
Low	less than 0.250g	less than 0.100g
Moderate	greater than or equal to 0.250g but less than 0.500g	greater than or equal to 0.100g but less than 0.200g
Moderately High	greater than or equal to 0.500g but less than 1.000g	greater than or equal to 0.200g but less than 0.400g
High	greater than or equal to 1.000g but less than 1.500g	greater than or equal to 0.400g but less than 0.600g
Very High	greater than or equal to 1.500g	greater than or equal to 0.600g

Notes: g = acceleration of gravity in horizontal direction

Ss & S1 - Use Moderate

The maps have been developed by the U.S. Geological Survey. Figure A-1 provides a map of the seismicity regions in the entire United States. The following maps in Figure A-2 through Figure A-11 present seismicity regions in different geographical regions of the United States and its territories.

Figure 3

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA P-154 Data Collection Form

Level 1
MODERATE Seismicity

PHOTOGRAPH

SKETCH

Address: Grouse Creek, UT
Zip:
Other Identifiers:
Building Name: Grouse Creek School
Use:
Latitude: **Longitude:**
S_S: 0.4241g **S_1:** 0.1395g
Screener(s): Josh M. & Dillon F. **Date/Time:** 1/9/20

No. Stories: Above Grade: 1 Below Grade: - **Year Built:** 1900 ☒ EST
Total Floor Area (sq. ft.): 5000 **Code Year:** none
Additions: ☐ None ☒ Yes, Year(s) Built: 1950s & 1980s

Occupancy: Assembly, Commercial, Emer. Services, ☐ Historic, ☐ Shelter, Industrial, Office, School, ☐ Government, Utility, Warehouse, Residential, # Units:

Soil Type: ☐ A Hard Rock ☐ B Avg Rock ☐ C Dense Soil ☒ D Stiff Soil ☐ E Soft Soil ☐ F Poor Soil DNK *If DNK, assume Type D.*

Geologic Hazards: Liquefaction: Yes/No/DNK Landslide: Yes/No/DNK Surf. Rupt.: Yes/No/DNK

Adjacency: ☐ Pounding ☐ Falling Hazards from Taller Adjacent Building

Irregularities: ☐ Vertical (type/severity)
☒ Plan (type) Reentrant corners - minor

Exterior Falling Hazards: ☐ Unbraced Chimneys ☒ Heavy Cladding or Heavy Veneer ☐ Parapets ☐ Appendages ☐ Other: Canopy @ gabled entry

COMMENTS:

☐ Additional sketches or comments on separate page

BASIC SCORE, MODIFIERS, AND FINAL LEVEL 1 SCORE, S_{L1}

FEMA BUILDING TYPE	Do Not Know	W1	W1A	W2	S1 (MRF)	S2 (BR)	S3 (LM)	S4 (RC SW)	S5 (URM INF)	C1 (MRF)	C2 (SW)	C3 (URM INF)	PC1 (TU)	PC2	RM1 (FD)	RM2 (RD)	URM	MH
Basic Score		**5.1**	**4.5**	**3.8**	**2.7**	**2.6**	**3.5**	**2.5**	**2.7**	**2.1**	**2.5**	**2.0**	**2.1**	**1.9**	**2.1**	**2.1**	**1.7**	**2.9**
Severe Vertical Irregularity, V_{L1}		-1.4	-1.4	-1.4	-1.2	-1.2	-1.4	-1.1	-1.2	-1.1	-1.2	-1.0	-1.1	-1.0	-1.1	-1.1	-1.0	NA
Moderate Vertical Irregularity, V_{L1}		-0.9	-0.9	-0.9	-0.8	-0.7	-0.9	-0.7	-0.7	-0.7	-0.7	-0.6	-0.7	-0.6	-0.7	-0.7	-0.6	NA
Plan Irregularity, P_{L1}		-1.4	-1.3	-1.2	-1.0	-0.9	-1.2	-0.9	-0.9	-0.8	-1.0	-0.8	-0.9	-0.8	-0.8	-0.8	-0.7	NA
Pre-Code		-0.3	-0.5	-0.6	-0.3	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.3	-0.2	-0.2	-0.2	-0.2	-0.1	-0.5
Post-Benchmark		1.4	2.0	2.5	1.5	1.5	0.8	2.1	NA	2.0	2.3	NA	2.1	2.5	2.3	2.3	NA	1.2
Soil Type A or B		0.7	1.2	1.8	1.1	1.4	0.6	1.5	1.6	1.1	1.5	1.3	1.6	1.3	1.4	1.4	1.3	1.6
Soil Type E (1-3 stories)		-1.2	-1.3	-1.4	-0.9	-0.9	-1.0	-0.9	-0.9	-0.7	-1.0	-0.7	-0.8	-0.7	-0.8	-0.8	-0.6	-0.9
Soil Type E (> 3 stories)		-1.8	-1.6	-1.3	-0.9	-0.9	NA	-0.9	-1.0	-0.8	-1.0	-0.8	NA	-0.7	-0.7	-0.8	-0.6	NA
Minimum Score, S_{MIN}		*1.6*	*1.2*	*0.9*	*0.6*	*0.6*	*0.8*	*0.6*	*0.6*	*0.3*	*0.3*	*0.3*	*0.3*	*0.2*	*0.3*	*0.3*	*0.2*	*1.5*

FINAL LEVEL 1 SCORE, $S_{L1} \geq S_{MIN}$: 0.9

EXTENT OF REVIEW

Exterior: ☐ Partial ☒ All Sides ☐ Aerial
Interior: ☐ None ☐ Visible ☒ Entered
Drawings Reviewed: ☐ Yes ☒ No
Soil Type Source: Assumed
Geologic Hazards Source:
Contact Person:

LEVEL 2 SCREENING PERFORMED?

☒ Yes, Final Level 2 Score, S_{L2} 0.5 ☐ No
Nonstructural hazards? ☒ Yes ☐ No

OTHER HAZARDS

Are There Hazards That Trigger A Detailed Structural Evaluation?

☐ Pounding potential (unless S_{L2} > cut-off, if known)
☐ Falling hazards from taller adjacent building
☐ Geologic hazards or Soil Type F
☒ Significant damage/deterioration to the structural system

ACTION REQUIRED

Detailed Structural Evaluation Required?

☐ Yes, unknown FEMA building type or other building
☒ Yes, score less than cut-off
☐ Yes, other hazards present
☐ No

Detailed Nonstructural Evaluation Recommended? *(check one)*

☐ Yes, nonstructural hazards identified that should be evaluated
☒ No, nonstructural hazards exist that may require mitigation, but a detailed evaluation is not necessary
☐ No, no nonstructural hazards identified ☐ DNK

Where information cannot be verified, screener shall note the following: EST = Estimated or unreliable data OR DNK = Do Not Know

Legend: MRF = Moment-resisting frame; BR = Braced frame; RC = Reinforced concrete; SW = Shear wall; URM INF = Unreinforced masonry infill; TU = Tilt up; MH = Manufactured Housing; LM = Light metal; FD = Flexible diaphragm; RD = Rigid diaphragm

Figure 4

Rapid Visual Screening of Buildings for Potential Seismic Hazards
FEMA P-154 Data Collection Form

Level 2 (Optional)
MODERATE Seismicity

Optional Level 2 data collection to be performed by a civil or structural engineering professional, architect, or graduate student with background in seismic evaluation or design of buildings.

Bldg Name: Grouse Creek School	**Final Level 1 Score:**	S_{L1} = 0.9		*(do not consider S_{MIN})*
Screener: Josh M. & Dillon F.	**Level 1 Irregularity Modifiers:**	*Vertical Irregularity, V_{L1} =* 0.0		*Plan Irregularity, P_{L1} =* 0.7
Date/Time: 1/9/20	**ADJUSTED BASELINE SCORE:**	$S' = (S_{L1} - V_{L1} - P_{L1})$ = 1.6		

STRUCTURAL MODIFIERS TO ADD TO ADJUSTED BASELINE SCORE

Topic	**Statement** *(If statement is true, circle the "Yes" modifier; otherwise cross out the modifier.)*		**Yes**	**Subtotals**
Vertical Irregularity, V_{L2}	Sloping Site	W1 building: There is at least a full story grade change from one side of the building to the other.	-1.4	
		Non-W1 building: There is at least a full story grade change from one side of the building to the other.	-0.4	
	Weak and/or Soft Story *(circle one maximum)*	W1 building cripple wall: An unbraced cripple wall is visible in the crawl space.	-0.7	
		W1 house over garage: Underneath an occupied story, there is a garage opening without a steel moment frame, and there is less than 8' of wall on the same line (for multiple occupied floors above, use 16' of wall minimum).	-1.4	
		W1A building open front: There are openings at the ground story (such as for parking) over at least 50% of the length of the building.	-1.4	
		Non-W1 building: Length of lateral system at any story is less than 50% of that at story above or height of any story is more than 2.0 times the height of the story above.	-1.1	
		Non-W1 building: Length of lateral system at any story is between 50% and 75% of that at story above or height of any story is between 1.3 and 2.0 times the height of the story above.	-0.6	
	Setback	Vertical elements of the lateral system at an upper story are outboard of those at the story below causing the diaphragm to cantilever at the offset.	-1.2	
		Vertical elements of the lateral system at upper stories are inboard of those at lower stories.	-0.6	
		There is an in-plane offset of the lateral elements that is greater than the length of the elements.	-0.4	
	Short Column/ Pier	C1,C2,C3,PC1,PC2,RM1,RM2: At least 20% of columns (or piers) along a column line in the lateral system have height/depth ratios less than 50% of the nominal height/depth ratio at that level.	-0.5	
		C1,C2,C3,PC1,PC2,RM1,RM2: The column depth (or pier width) is less than one half of the depth of the spandrel, or there are infill walls or adjacent floors that shorten the column.	-0.5	
	Split Level	There is a split level at one of the floor levels or at the roof.	-0.6	
	Other Irregularity	There is another observable severe vertical irregularity that obviously affects the building's seismic performance.	-1.2	V_{L2} = -0.0
		There is another observable moderate vertical irregularity that may affect the building's seismic performance.	-0.6	*(Cap at -1.4)*
Plan Irregularity, P_{L2}	Torsional irregularity: Lateral system does not appear relatively well distributed in plan in either or both directions. *(Do not include the W1A open front irregularity listed above.)*		-1.0	
	Non-parallel system: There are one or more major vertical elements of the lateral system that are not orthogonal to each other.		-0.5	
	Reentrant corner: Both projections from an interior corner exceed 25% of the overall plan dimension in that direction.		-0.5	
	Diaphragm opening: There is an opening in the diaphragm with a width over 50% of the total diaphragm width at that level.		-0.3	
	C1, C2 building out-of-plane offset: The exterior beams do not align with the columns in plan.		-0.4	P_{L2} = -1.0
	Other irregularity: There is another observable plan irregularity that obviously affects the building's seismic performance.		-1.0	*(Cap at -1.4)*
Redundancy	The building has at least two bays of lateral elements on each side of the building in each direction.		+0.4	
Pounding	Building is separated from an adjacent structure by less than 0.25% of the height of the shorter of the building and adjacent structure and:	The floors do not align vertically within 2 feet. *(Cap total pounding modifiers at -1.4)*	-1.2	
		One building is 2 or more stories taller than the other.	-1.2	
		The building is at the end of the block.	-0.6	
S2 Building	"K" bracing geometry is visible.		-1.2	
C1 Building	Flat plate serves as the beam in the moment frame.		-0.5	
PC1/RM1 Bldg	There are roof-to-wall ties that are visible or known from drawings that do not rely on cross-grain bending. *(Do not combine with post-benchmark or retrofit modifier.)*		+0.4	
PC1/RM1 Bldg	The building has closely spaced, full height interior walls (rather than an interior space with few walls such as in a warehouse).		+0.4	
URM	Gable walls are present.		-0.5	
MH	There is a supplemental seismic bracing system provided between the carriage and the ground.		+1.2	
Retrofit	Comprehensive seismic retrofit is visible or known from drawings.		+1.4	M = -0.1

FINAL LEVEL 2 SCORE, $S_{L2} = (S' + V_{L2} + P_{L2} + M) \geq S_{MIN}$: 0.5 (*Transfer to Level 1 form*)

There is observable damage or deterioration or another condition that negatively affects the building's seismic performance: ☒ Yes ☐ No

If yes, describe the condition in the comment box below and indicate on the Level 1 form that detailed evaluation is required independent of the building's score.

OBSERVABLE NONSTRUCTURAL HAZARDS

Location	**Statement** *(Check "Yes" or "No")*	**Yes**	**No**	**Comment**
Exterior	There is an unbraced unreinforced masonry parapet or unbraced unreinforced masonry chimney.	▲		
	There is heavy cladding or heavy veneer.	▲		
	There is a heavy canopy over exit doors or pedestrian walkways that appears inadequately supported.	▲		
	There is an unreinforced masonry appendage over exit doors or pedestrian walkways.	▲		
	There is a sign posted on the building that indicates hazardous materials are present.		▲	
	There is a taller adjacent building with an unanchored URM wall or unbraced URM parapet or chimney.		▲	
	Other observed exterior nonstructural falling hazard:		▲	
Interior	There are hollow clay tile or brick partitions at any stair or exit corridor.	▲		
	Other observed interior nonstructural falling hazard:		▲	

Estimated Nonstructural Seismic Performance (*Check appropriate box and transfer to Level 1 form conclusions*)

- ☐ Potential nonstructural hazards with significant threat to occupant life safety → Detailed Nonstructural Evaluation recommended
- ☒ Nonstructural hazards identified with significant threat to occupant life safety → But no Detailed Nonstructural Evaluation required
- ☐ Low or no nonstructural hazard threat to occupant life safety → No Detailed Nonstructural Evaluation required

Comments: Exterior mortar and stone is in poor condition and is deteriorating.

Figure 5

damage or collapse can be accompanied by loss of life and serious injury. In a great earthquake, deaths could number in the thousands.

Each community or RVS Authority needs to engage in some consideration of these costs and benefits of seismic safety, and decide what value of S is an appropriate "cut-off" for their situation. The final decision involves many non-technical factors, such as determining the acceptable level of risk for the community, and is not straightforward. A study quantifying the risk inherent in modern building codes, conducted by the National Bureau of Standards (NBS, 1980), observed: "In selecting the target reliability it was decided, after carefully examining the resulting reliability indices for the many design situations, that a $\beta_0 = 3$ is a representative average value for many frequently used structural elements when they are subjected to gravity loading, while $\beta_0 = 2.5$ and $\beta_0 = 1.75$ are representative values for loads that include wind and earthquake, respectively." Note that β_0, as used in the National Bureau of Standards study, is approximately equivalent to $S - 1$ as used herein.

More recently, FEMA P-695, *Quantification of Building Seismic Performance Factors* (FEMA, 2009b), which established consistent and rational building system performance and response parameters for the linear design methods traditionally used in current building codes, concluded that it is acceptable that: "The probability of collapse due to MCE ground motions applied to a population of [buildings of the same type] is limited to 10%, on average." The 10% figure is an upper bound. After accounting for how conservative it is, that is, how the average real new building behaves rather than the upper limit, and accounting for the fraction of the building area that collapses, one can estimate that new buildings might realistically have an average $S = 2.5$. (See FEMA P-155 Chapter 8 for more details on this estimate.) Assuming that existing buildings can reasonably have a somewhat lower value of S than new buildings, the authors of the present work suggest that the acceptable probability of collapse in existing buildings is again roughly equivalent to a value of S of about 2.0.

Thus, an S value of about 2.0 is a reasonable preliminary value to use within the context of RVS to differentiate adequate buildings from those potentially inadequate and requiring detailed review. This is the value that has traditionally been used by RVS programs in the past. Use of a higher cut-off S value implies greater desired safety but increased community-wide costs for evaluations and rehabilitation; use of a lower value of S equates to increased seismic risk and lower short-term community-wide costs for evaluations and rehabilitation (prior to an earthquake).

Figure 6

Photo 1 – East Elevation

Photo 2 – South Elevation

Photo 3 – North Elevation

Photo 4 – Existing roof framing over classroom area.   Note erratic, inadequate support and bracing.

Photo 5 - Existing roof framing over classroom area. Note buckled and bowed bracing member.

Photo 6 - Existing roof framing over classroom area.   Note erratic, inadequate support and bracing.

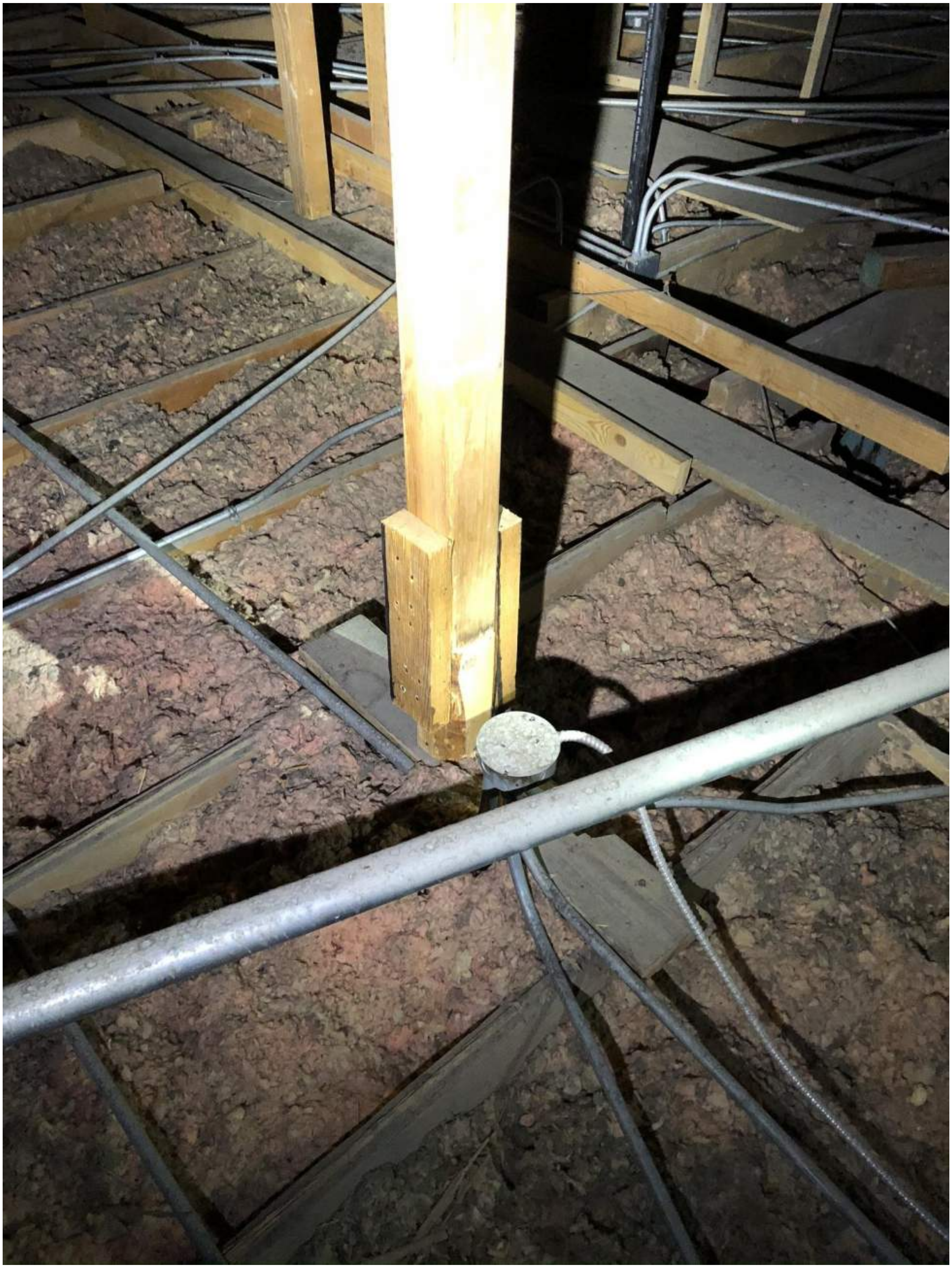


Photo 7 - Existing roof framing over classroom area. Scabbed together, unstable support brace.

Photo 8 - View of inside face of gabled end wall above east entry. This is the condition at the base of the roof valley. Inadequate brace and support.

Photo 9 - View of inside face of gabled end wall above east entry. This shows how the wood canopy is anchored.

Photo 9 – View of roof to wall connection along north and south exterior walls. No in-plane shear connection or out-of-plane anchorage to the stone wall below.

Photo 10 – View of roof to wall connection along east and west exterior walls.   No in-plane shear connection or out-of-plane anchorage to the stone wall below.

Photo 11 – View of existing anchor bolts along top of stone exterior walls. Bolt locations are erratic. Not nuts or washers are present on the anchor bolts.

Photo 12 – View of wood and steel rod attic truss for ceiling joist support.   This truss is clearly inadequate for its intended use.

Photo 13 – View of foundation along the south wall.   Settlement and cracking are present.

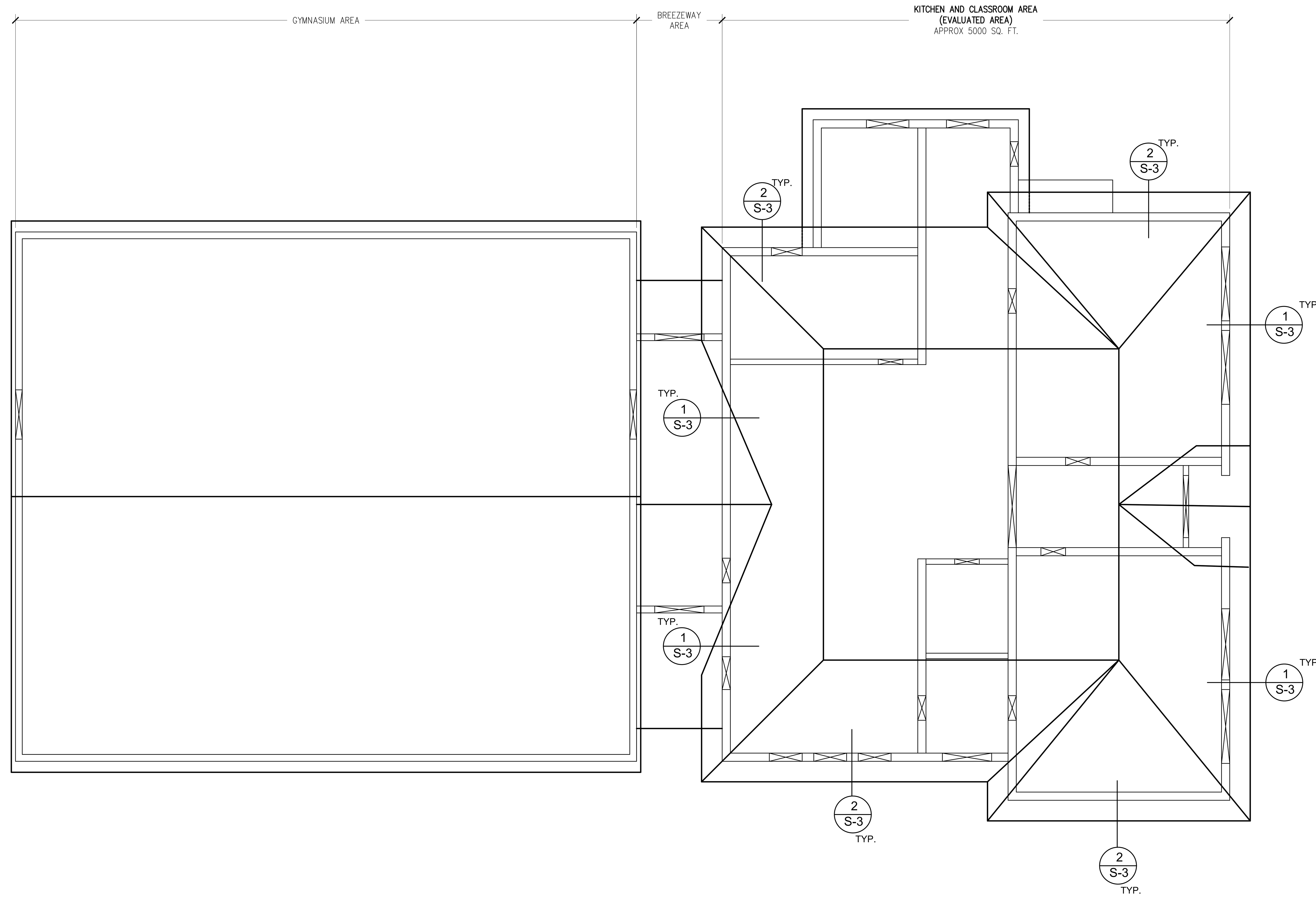
Photo 14 – Another view of the foundation along the south wall.   Plastered stone.

Photo 15 – View of infilled opening in south exterior wall.   Note the wood header below the window, which is deteriorating.

Photo 16 – View of stone and deteriorating mortar along the north exterior wall.

Photo 17 – View of infilled opening in west exterior wall at the Breezeway.

Photo 18 – View of the northwest corner of the kitchen area, near the breezeway. Note mortar deterioration and cracking.



EXISTING BUILDING LAYOUT PLAN

SCALE: 1/8"

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84332
435.787.2789

JANUARY 21, 2020

GROUSE CREEK

SCHOOL RETROFIT

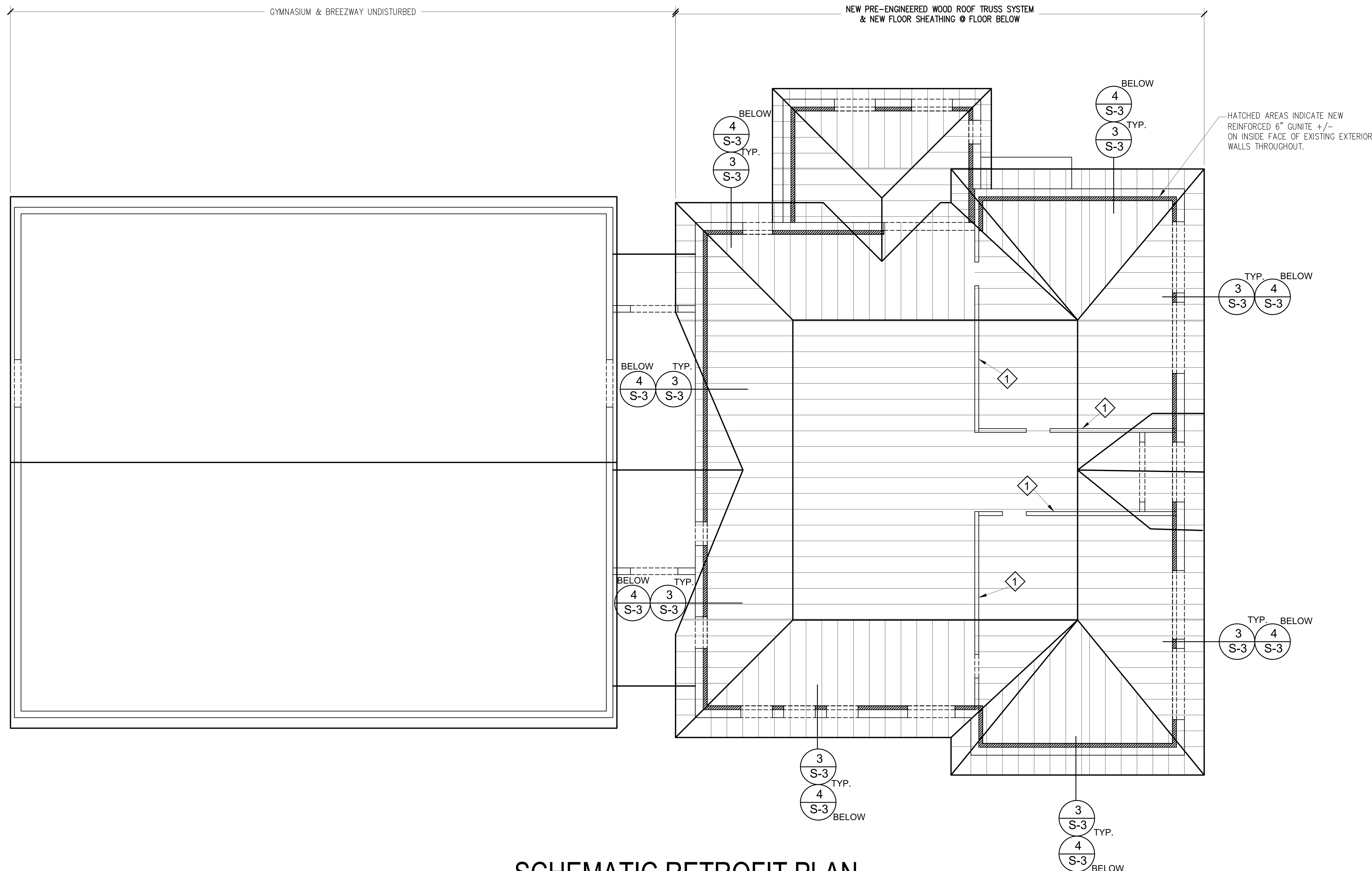
GROUSE CREEK, UT

REVISIONS

REV #	DATE	COMMENTS
1		
2		
3		
4		

EXISTING BUILDING LAYOUT PLAN

S-1



SCHEMATIC RETROFIT PLAN

SCALE: 1/8"

KEY NOTES:

1. DEMOLISH EXISTING MASONRY INTERIOR WALLS. REPLACE WALLS WITH 2X6 WOOD FRAMED BEARING WALLS. ADD NEW FOOTING AND FOUNDATION WALL OR WOOD CRIPPLE WALL IN CRAWLSPACE.

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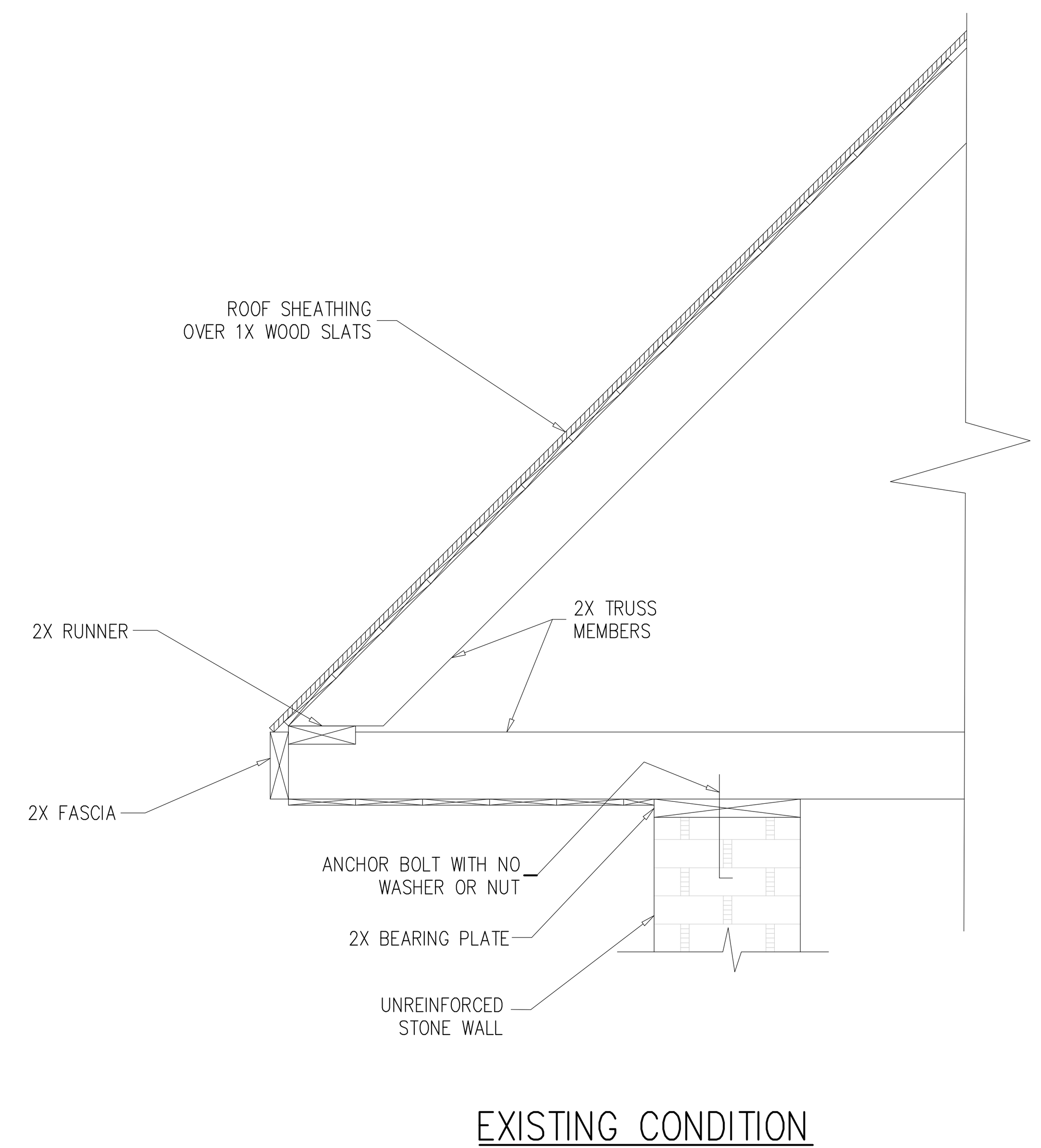
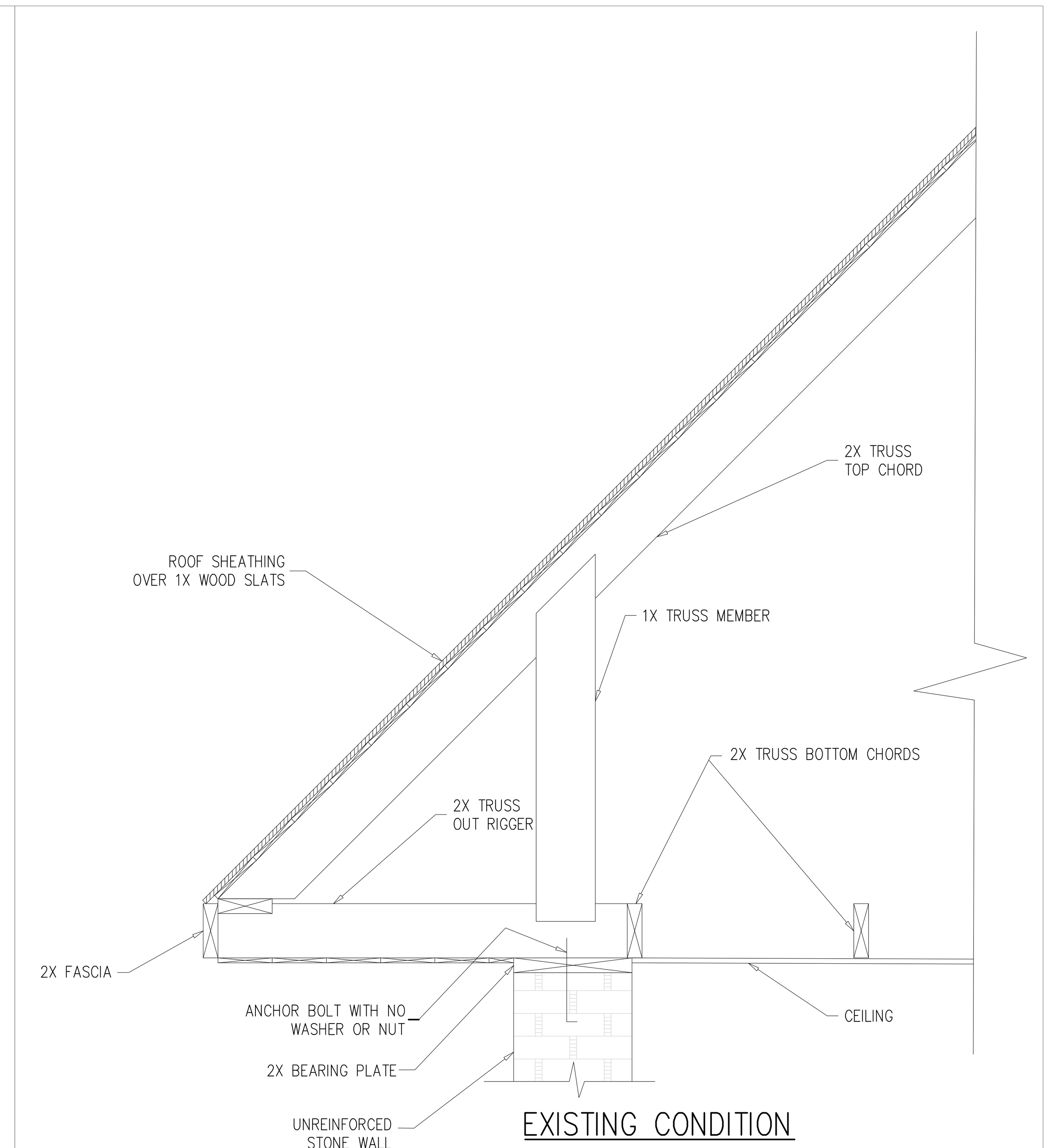
SCHEMATIC RETROFIT PLAN

S-2



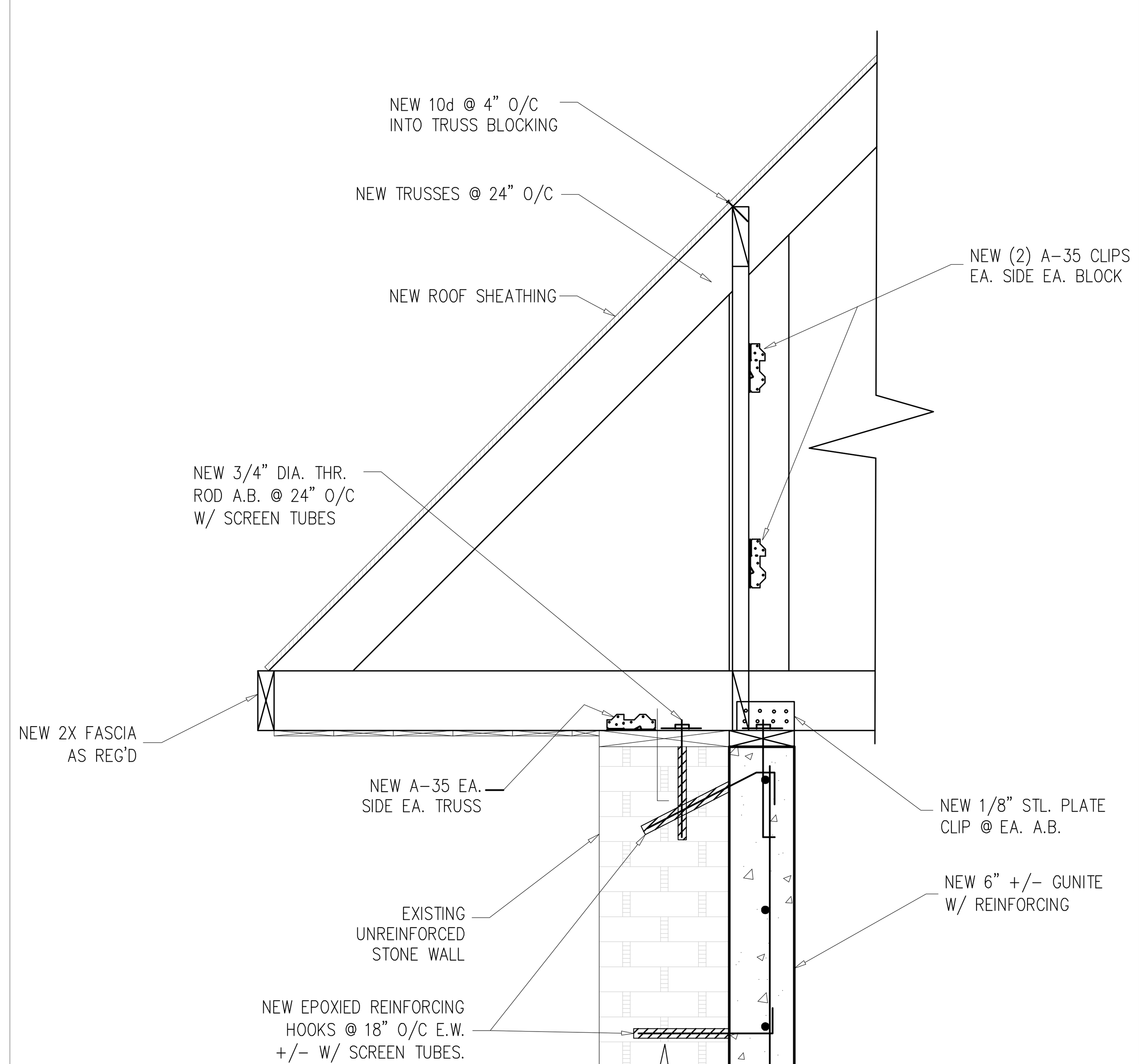
EXISTING CONDITION

DETAIL	1
SCALE: 1"=1'-0" REF:	



EXISTING CONDITION

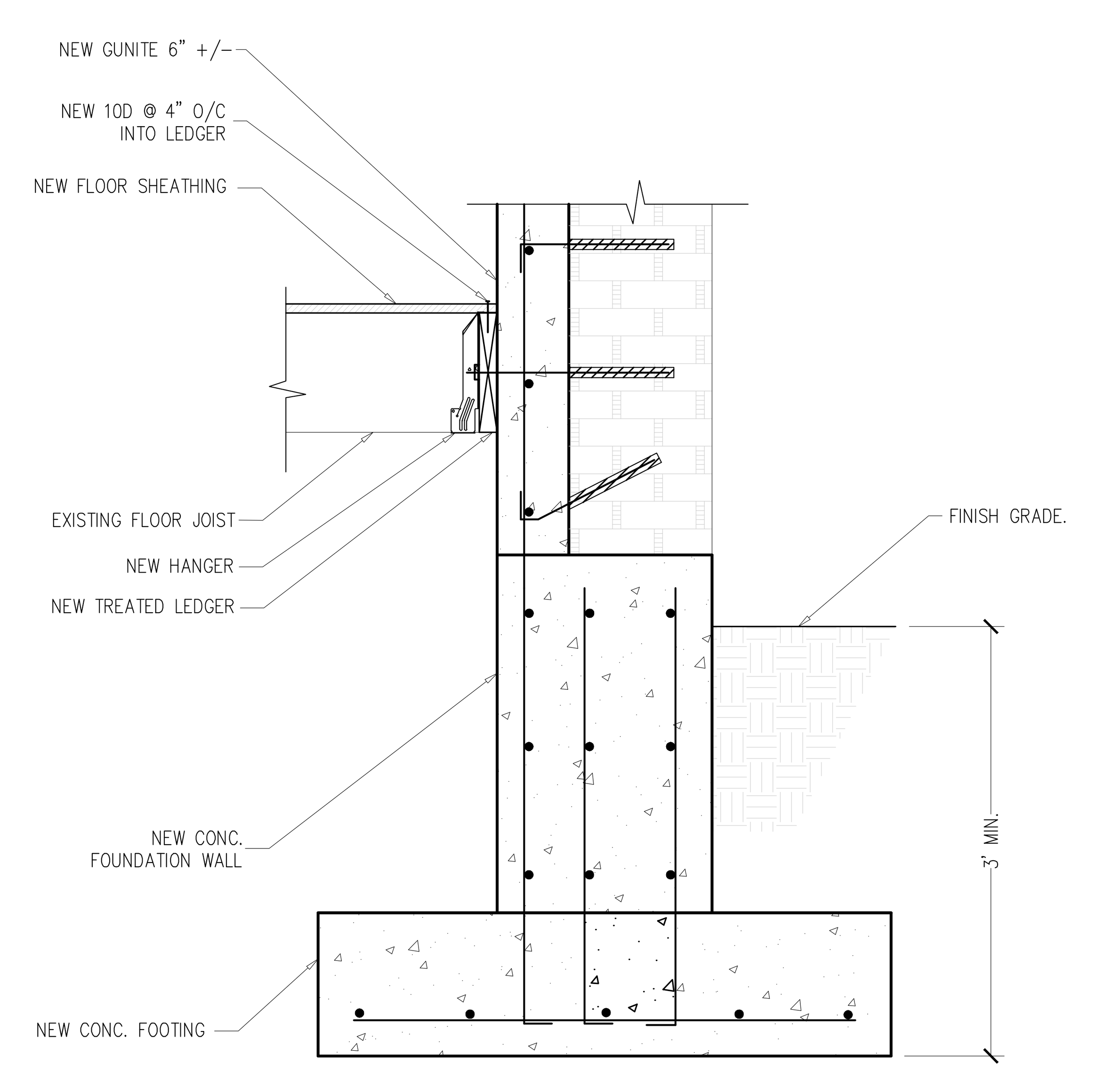
DETAIL	2
SCALE: 1"=1'-0" REF:	



RETROFITTED CONDITION

DETAIL	3
SCALE: 1"=1'-0" REF:	

NOTE: INSTALL FOUNDATION IN ALTERNATING 6' SECTIONS



RETROFITTED CONDITION

DETAIL	4
SCALE: 1"=1'-0" REF:	

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DETAILS

S-3