Fire Station 51 Assessment Report

CHELAN COUNTY FIRE DISTRICT NO. 5

MANSON, WASHINGTON

December 14, 2010

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Chief Arnold Baker
Chelan County Fire District No. 5
250 W. Manson Blvd.
Manson, Washington 98831

Re: Station 51 Building Assessment

Dear Arnold,

It is with great pleasure that we present this report to you and your Commissioners and members of Chelan County Fire District No.5.

This report represents the first step of a multi-step process. Included in this report is the architectural and structural assessments which address the operational, functional and seismic characteristics of the existing station.

Please feel free to give us a call if you have any questions about the information and recommendations that we have included. We enjoyed working with you and your Commissioners and we look forward to proceeding with the next step.

Sincerely,
Rice Fergus Miller, PLLC

Howard Struve
Senior Associate

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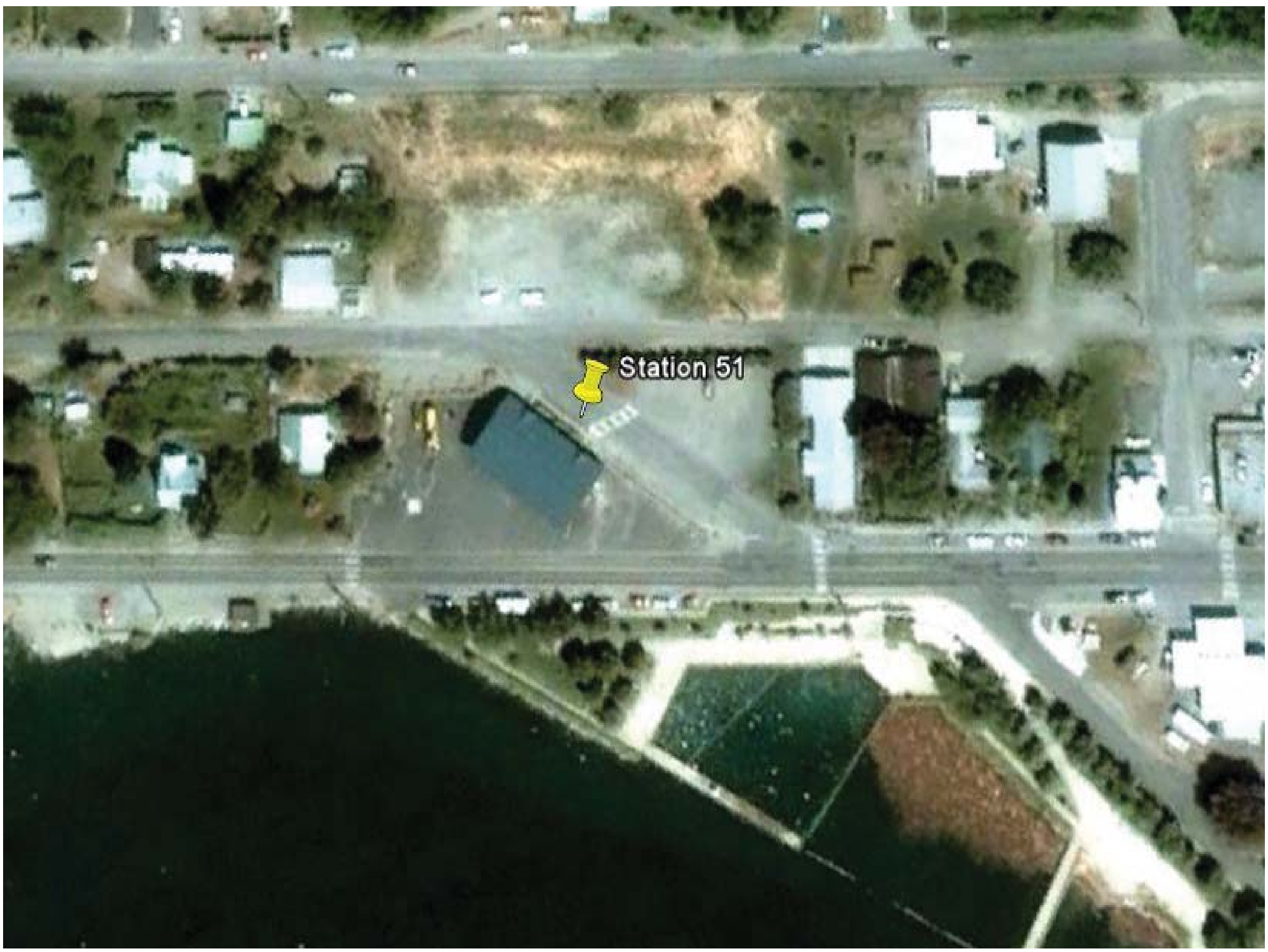
Fire Station 51
250 W. Manson Blvd.
Manson, Washington 98831

Year Built: Early 1970's
Size: 3,100 SF Ground Floor
Leased Property



STATION 51

A. Description, Age:

Station 51 utilizes 3,100 square feet of the ground floor of an office building leased by the fire district. The building is a two-story structure built in the early 1970's and is owned by the Lake Chelan Reclamation District. Recently the building owner has performed miscellaneous interior improvements to their upper floor area and constructed a sloped roof over the original flat roof. The flat roof remains in tack underneath the sloped roof creating a concealed space within the existing attic.

B. Departments/Functions:

- Station 51 serves as a response station for the Community of Manson: This station houses (1) active engine, (1) reserve engine, (1) brush truck and (1) aid unit.
- Station 51 serves as the headquarters/administration for Chelan County Fire District No. 5
- Meeting area: Public meetings and training meetings are held at this station.

C. Operational and Functional Issues:

1. Operational Limitations:

The fire district has identified the following staff and operational needs, which are not currently accommodated in the existing station.

- Standby power: The electrical system is not equipped for standby (emergency) power. This station has no means to remotely power the station in the event of a power outage.

- Sprinkler system/fire alarm system: This station is not equipped with a fire detection/sprinkler system. The fire district would like the building to be equipped with a fire alarm sprinkler system to protect personal and equipment.

- Apparatus Bay: Overall apparatus sizes have increase since this building was constructed in the 1970's. Therefore, the apparatus bays are undersized in depth, width and height compared today's fire station design standards. Staff access to emergency response apparatus is encumbered by columns supporting the ceiling structure, bunker gear storage behind the apparatus; clearance width from the emergency response apparatus to the physical building (walls, columns and overhead doors), between apparatus are undersized and do not meet the required dimension as noted in the Washington Administrative Code.

  The existing ceiling structure is approximately 11 feet high above the existing floor. This limits the type of apparatus that the fire district is able to deploy out of this station.

  The existing overhead door dimensions are 10 feet wide by 10 feet high. National trends in modern fire station design favor 14' wide by 14' high doors. Smaller door sizes increase the potential for physical damage to the building, apparatus and life safety to building occupants. The low ceiling and structural system of this building restricts the ability to increase the overhead door size.

  It was observed that the existing concrete floors are not adequately sloped to drain water dripping from the apparatus into the existing floor drains. As a result there is standing water in several places underneath and alongside the apparatus. This condition presents a safety issue to staff as they mount and dismount the emergency response vehicles.

The fire district has identified the need for a 5th bay for storage of a hazardous material unit. The existing apparatus bay is undersized to accommodate any additional apparatus.

- Storage Limitations: Due to the lack of dedicated storage space for firefighting/rescue equipment, bunker gear, and supplies, these items are stored in the apparatus bays. This constricts the travel path width to emergency response apparatus.

  The record files and office supplies are stored in an existing stair well which serve the upper floor. The building owner closed the stairway access to the upper floor while renovating their upper floor office area. The existing stair still remains. Therefore this space is not suitable for use of any kind and presents a safety hazard to staff.

- Decontamination Area: There is no separate decontamination room for cleaning “dirty” equipment. Currently, contaminated items are stored in a receptacle in the apparatus bay near emergency response vehicles and bunker gear. The best management practice would be to provide a separate room off the apparatus bay for cleaning and drying of equipment prior to storage elsewhere in the station and/or on emergency response vehicles. This helps to reduce the spread of infectious viruses, etc.

- Bunker Gear: The bunker gear is stored in the apparatus bay exposed to diesel and gas exhaust fumes from the apparatus, natural and artificial light, and minimal air circulation. The best management practice would be to store bunker gear in a dedicated room. A dedicated room serves to limit the amount of natural and artificial light, and provide good ventilation for drying. This serves to protect the fabric of the bunker gear from pre-mature deterioration.

  Contaminated bunker gear is cleaned off site.

- The public entrance leads directly into the apparatus bay and hallway to the administrative office. This poses a security concern to occupants in the fire station.

- The existing station has no lobby area at the main entrance to perform blood pressure checks, etc.

- Administrative area: The fire district has identified a need for (1) fire chief's office with a conference area for 6 to 8 individuals, (1) administrative office and (1) training chief's office. The existing station lacks adequate space to provide the addition of an administrative office or training office within the station.

- Sleep Rooms: The fire district has identified a need to provide sleep rooms for volunteer residents. There are no sleep rooms within the existing station. The existing station lacks adequate space to provide the addition of sleep rooms.

- Laundry Room: There is no laundry room within the existing station. The existing building lacks adequate space to provide a laundry room. Currently, without sleep rooms within the station, there is no need for a laundry room. However, the addition of sleep rooms will trigger the need for a designated laundry area for resident volunteers.

- Fitness Room: There is no fitness area within the existing station. The existing building lacks adequate space to provide a fitness room. The best management practice would be to provide a separate area for equipment with good ventilation to encourage physical fitness.

- Apparatus approach: During our assessment, we witnessed several vehicles using the apparatus apron area for a vehicle "turn around" area. This poses a potential risk to fire fighter and public safety.

- Property: Since the building and property are leased by the fire district there are no opportunities to further expand the fire station.

2. Code and WAC Limitations:

   - Unisex Restroom: Does not meet current ADA requirements.

   - Apparatus Bay clearance around apparatus: Washington Administrative Code requires a minimum of 3 feet of clearance around the apparatus.

   - Apparatus Bay floor: Washington Administrative Code requires that floors shall be free of water and tripping hazards.

- Environmental & Life Safety: There is no floor to ceiling wall that separates the existing apparatus bays from the meeting area and rear portion of the building. As a result, odors and fumes created by the apparatus parked within are noticeable throughout the fire station (ground floor only). The station is equipped with a diesel exhaust fan that is manually operated when apparatus deploy and return to the station.

  Chief Baker indicated occasionally there is a sewer odor when the apparatus bay diesel exhaust fans are turned on to exhaust apparatus exhaust fumes. This odor may be caused by the catch basins installed in the apparatus bays which may not have p-traps to help contain the odor from the community sewer pump located in front of the building.

  The apparatus bay is often referred to as the “dirty” area while the office portion being the “clean” area. It would be best management practice to separate the two areas from direct communication thus creating two separate areas that are monitored and environmentally controlled, respectively.

3. Facility Improvements/Maintenance Issues:

- Exterior Siding: It appears that the existing paint system has failed in numerous places. It was observed that the sealant joints have failed which may contribute to further deterioration and water infiltration into the existing wall cavity. We recommended hiring a weatherization consultant to determine the cause for this deterioration and provide recommendations to properly repair/replace the exterior building system.

- Water infiltration: It was observed that the restroom floor has no finishes over the existing concrete floor. It was discovered that the existing floor tile, at the time of construction, contained asbestos. The asbestos floor tile was removed as a preventive measure. In addition, during the walk-through it was noted that the existing restroom has had rain water infiltration issues in the past at the east wall. This east wall is a retaining wall for the ground floor of the building. It is our understanding that water infiltration occurs in the restroom during rain events.

  It is our recommendation to hire a weatherization consultant to determine the cause of the water infiltration and provide recommendations to properly repair the exterior building

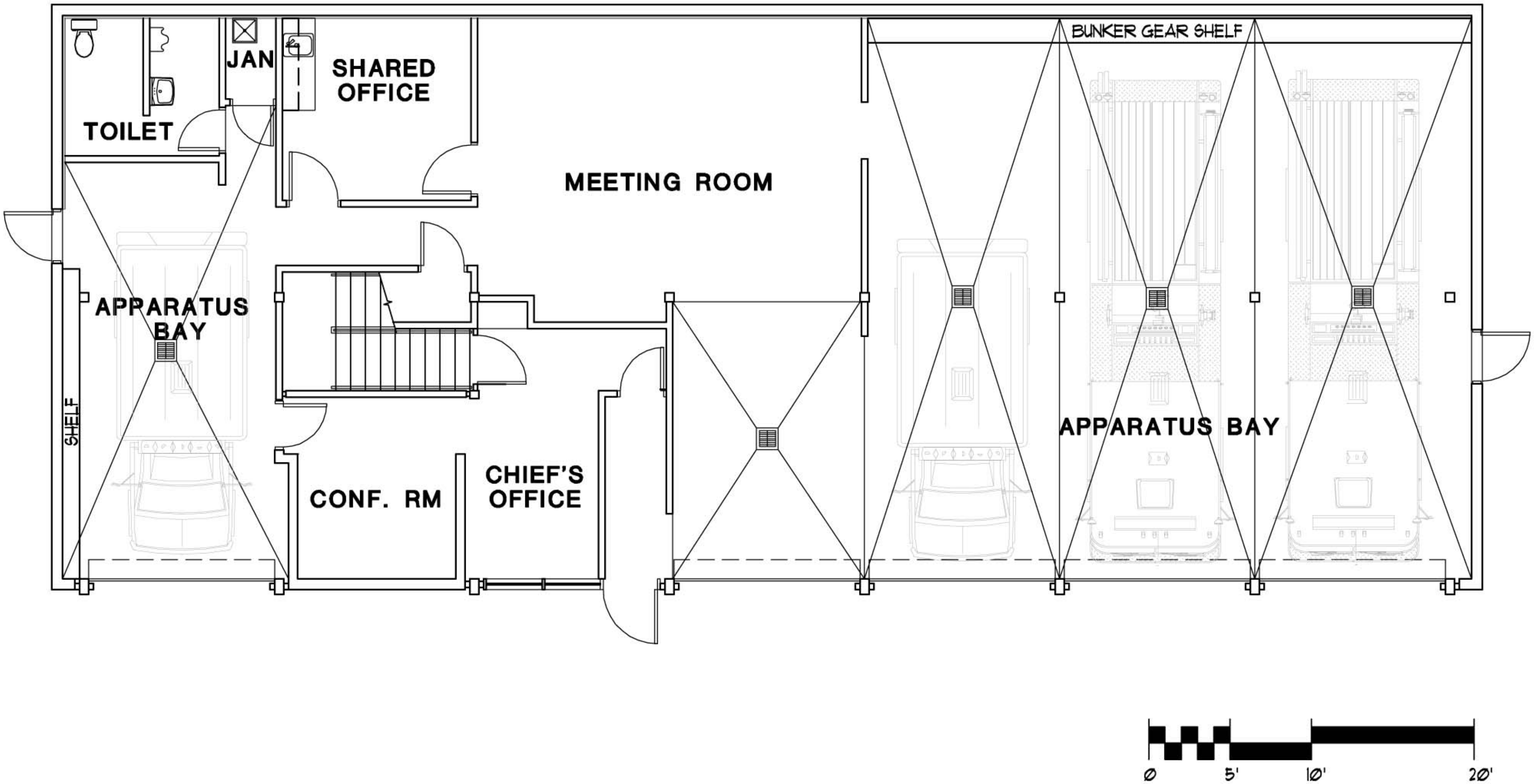
drainage system. In addition, we further recommend testing the existing interior gypsum wallboard for structural integrity and possible presence of mold.

- Galvanized piping: The building domestic water system is constructed of galvanized pipe throughout the building. Chief Baker noted that the water was very rusty in appearance when not in used over a weekend, as an example. This is most likely caused by galvanized pipes eroding. It is our recommendation to hire a consultant to examine and provide a recommendation for replacing the existing building domestic water system pipe within the building.

- Apparatus Bay floors: The existing concrete floor appears to have no floor coating installed over the concrete to protect the concrete from fluid leaks/odors to promote ease of cleaning apparatus fluids and contain fluids from penetrating the existing concrete floor and off gassing within the station.

D. Recommendations:

1. Building Improvements:
    a. Given the age, size, and serviceability of the building, plus the fact if is leased by the fire district; it is the recommendation of this report to replace the existing fire station. While it is technically feasible to make seismic improvements, replace the domestic water system piping, and add fire detection and sprinkler systems; the existing station still has significant operational limitations as addressed in “Operation and Functional issues”. Many of these operation issues cannot be corrected or improved without expansion of the facility which is inhibited with the lease agreement.



JAN
SHARED OFFICE
TOILET
MEETING ROOM
BUNKER GEAR SHELF
APPARATUS BAY
SHELF
CONF. RM
CHIEF'S OFFICE
APPARATUS BAY
0
5'
10'
20'

Chelan County Fire District No. 5 Station 51 Seismic Evaluation

Chelan County Fire District No. 5

December 2010

Prepared for:
Rice Fergus Miller Architecture & Planning

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12.6.10

Reid Middleton is responsible for the seismic evaluation contained within this report.

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File No. 262010.036

Existing Fire Station Seismic Evaluation Criteria

An ASCE 31 Tier 1 seismic evaluation was performed for Chelan County Fire District 5 Station 51. The evaluation reviewed the expected seismic performance of the building to identify potential structural deficiencies that may affect the building's performance during an earthquake.

The seismic evaluations do not consider compliance with the seismic requirements of the current building code for new construction. Buildings designed prior to the current building code often include structural configurations and connection detailing that have historically contributed to poor seismic performance in structures, based on post-earthquake evaluations of damaged buildings. Additionally, recent research and studies of regional seismicity have shown that the expected seismic ground motions are higher than was expected in the past. The combination of higher ground motions, configurations, and poor connection detailing may result in buildings that were built to the requirements of older versions of the building code having deficiencies noted in a seismic evaluation. Buildings designed to older building code standards are evaluated using evaluation and design guidelines specifically developed for existing structures by the Federal Emergency Management Agency (FEMA) and the American Society of Civil Engineers (ASCE).

The structural findings and recommendations presented in this report are based on visual observations of the buildings and a review of the record drawings provided by Chelan County Fire District 5. The available record documents do not contain all of the information necessary to confirm the structural configuration of some portions of the buildings, which is typical for older structures.

Reid Middleton participated in a walk-through of Station 51 and performed limited visual observations of existing conditions. Neither destructive nor non-destructive testing was performed to confirm or supplement information shown in the record drawings.

The seismic evaluation of Station 51 is based on performance-based earthquake engineering guidelines presented in ASCE 31-03 *Seismic Evaluation of Existing Buildings* (American Society of Civil Engineers, 2002). The ASCE 31 Tier 1 evaluations were completed using the Immediate Occupancy (IO) performance objective. Buildings that meet the IO performance objective will have similar seismic performance to new buildings that are designed as essential facilities. A general background of performance-based earthquake engineering (PBEE) and an overview of seismic rehabilitation objectives, building performance levels, and the seismic evaluation and rehabilitation procedures are included in this section.

Background

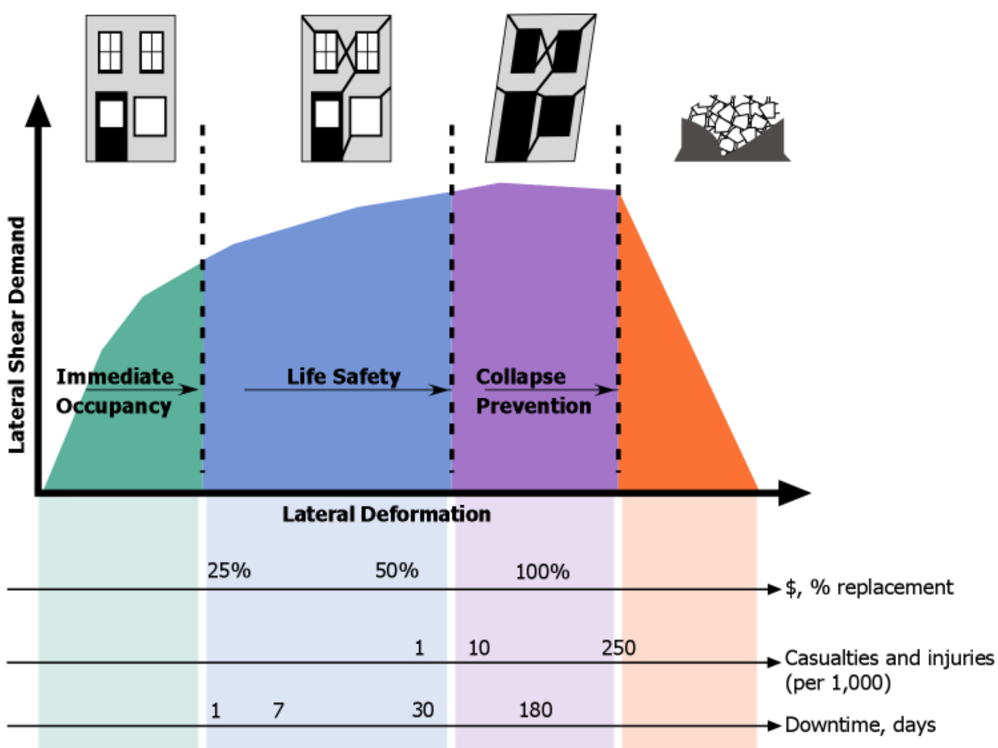
Seismic analysis and design of buildings has traditionally focused on one performance level – reducing the risk of life loss in the design earthquake. The concept of designing essential facilities needed immediately after an earthquake evolved after hospitals and other critical facilities were damaged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

In 1991, a comprehensive program was started 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 FEMA 310 *Handbook for the Seismic Evaluation of Buildings – A Prestandard (1998)* and FEMA 273 *NEHRP Guidelines for the Seismic Rehabilitation of Buildings (1997).* ASCE 31-02 and FEMA 356 superseded these documents. The new PBEE documents reflect advancements in technology and incorporate case studies and lessons learned from recent earthquakes.

ASCE 31-03 and ASCE 41-06 provide criteria by which existing buildings can be seismically evaluated and rehabilitated to attain a wide range of different performance levels when subjected to earthquakes of varying severity. Relationships are established between structural response and performance-oriented descriptions, such as Operational, Immediate Occupancy, Life Safety, and Collapse Prevention. As illustrated in the figure below, each building performance description or objective is related directly to its expected post-earthquake damage state. Each damage state has readily identifiable consequences, which include:

- Cost – economic feasibility of restoring the facility to pre-earthquake condition.
- Public Safety – number of critical injuries and casualties to building occupants.
- Downtime – length of time the building is removed from service to make repairs.

Efforts by the Applied Technology Council (ATC), the Pacific Earthquake Engineering Research Center (PEER), FEMA, and others are underway to quantify these estimated losses to allow stakeholders to make more informed decisions.



Estimated Performance-Related Consequences (Moehle, 2003).

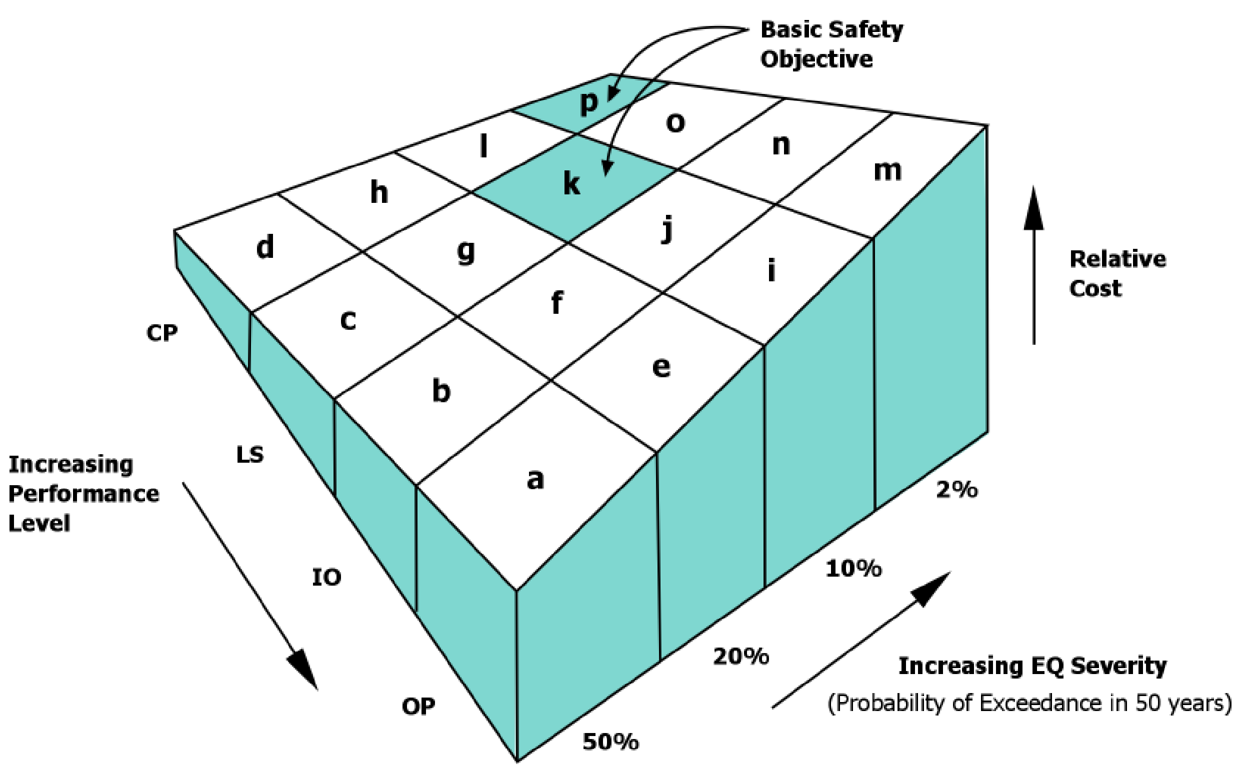
Rehabilitation Objectives

The seismic rehabilitation objective expresses the desired building behavior during an earthquake of projected severity, a design-level event. The objective consists of one or more goals, each with a target building performance level and a corresponding earthquake hazard level. The four defined levels of building performance are Operational (OP), Immediate Occupancy (IO), Life Safety (LS), and Collapse Prevention (CP). Common probabilistic earthquake hazard levels and their corresponding mean return periods are:

Probabilistic Earthquake Hazard Levels and Return Period.

Earthquake Hazard Level	Probability of Exceedance in 50 Years	Mean Return Period (Years)
50%/50-year	50 percent	72
20%/50-year	20 percent	225
BSE-1 (10%/50-year)	10 percent	474
BSE-2 (2%/50-year)	2 percent	2,475

For each building, a decision must be made as to the acceptable behavior for different levels of seismic hazard, balanced with the cost of rehabilitating the structure to obtain that behavior. The figure below presents the schematic relationship between different rehabilitation objectives and probable program cost.



Surface Matrix of Rehabilitation Objectives (FEMA, 1997).

The "baseline" performance level for a standard building is referred to as the Basic Safety Objective (BSO). The BSO is defined as providing Collapse Prevention performance at the 2%/50-year event and Life Safety performance at the 10 percent probability of exceedance in a 50 year event (10%/50). Higher (enhanced) or lower (limited) objectives may be selected based on the essential nature of the facility, the expected remaining life of the building, and the associated cost and feasibility. The rehabilitation objective selected as a basis for design will determine the benefit to be obtained in terms of improved safety, reduction in property damage, and interruption of use in the event of future earthquakes.

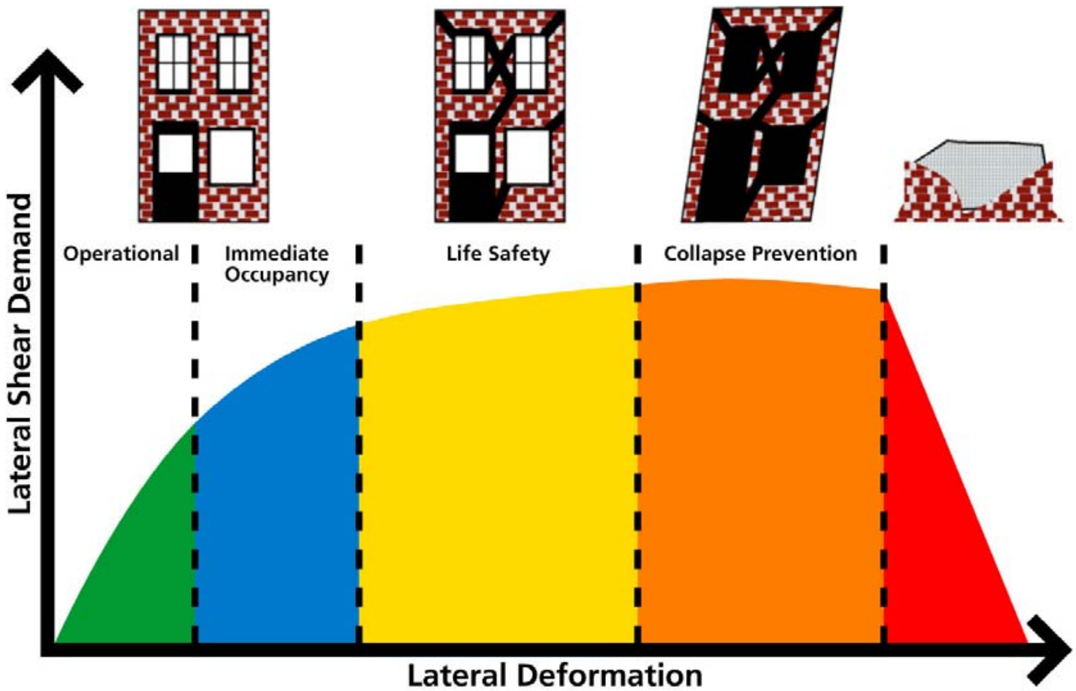
Due to the essential nature of Station 51, the enhanced objective of Immediate Occupancy (IO) was selected as the target performance objective.

Building Performance Levels

The terminology used for target building performance levels is intended to represent goals of design. The target levels are discrete damage states selected from among the infinite spectrum of possible damage states that a building could experience during an earthquake.

Since the actual ground motion is seldom comparable to that used for design, the selected damage state may only determine relative performance during most events. 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.

Building performance is a combination of the performance of both structural and nonstructural components. Structural performance is related to the amount of lateral deformation or drift of the structure and the capacity or ability of the structure to deform. In the ASCE 31-03 and ASCE 41-06 documents, it is intended that structures meeting Life-Safety performance will be able to experience at least 33 percent greater lateral deformation before failure of primary elements. This equates to a safety factor of 1.33 against collapse. In the design of new buildings, somewhat better performance is expected, since structures are designed with an approximate 1.5 margin against collapse.



Building Performance Levels.

Mitigation of nonstructural seismic hazards is a complex issue that is addressed independently in the evaluation and rehabilitation guidelines. 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 and can also be costly to repair or replace post earthquake. Due to these complexities and the required coordination with other disciplines (i.e., architect, mechanical engineer, electrical engineer, hazardous materials engineer, etc.), nonstructural seismic performance has not been addressed in this initial evaluation. The owner, with assistance from the design team, will select a nonstructural performance level during the rehabilitation design process that considers the cost-benefit of such mitigation.

The table below summarizes the approximate levels of structural and nonstructural damage that may be expected of buildings rehabilitated to the defined levels.

Damage Control and Building Performance Levels (FEMA, 2000).

	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.
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.	Substantial. 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.

Seismic Evaluation Procedure

ASCE 31-03 provides a three-tiered evaluation procedure using performance-based criteria. The process for seismic evaluation is depicted in the flowchart below. 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 is provided below.

TIER 1 – Screening Phase

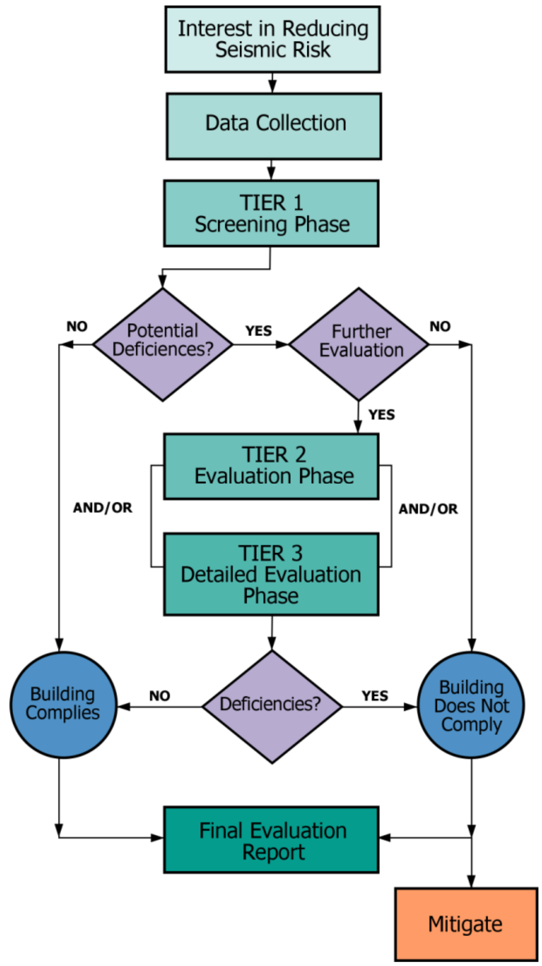
- Checklists of evaluation statements to quickly identify potential deficiencies
- Requires field investigation and/or review of record drawings
- Analysis limited to "Quick Checks" of global elements
- May proceed to Tier 2, Tier 3, or rehabilitation design if deficiencies are identified

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 FEMA 356 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

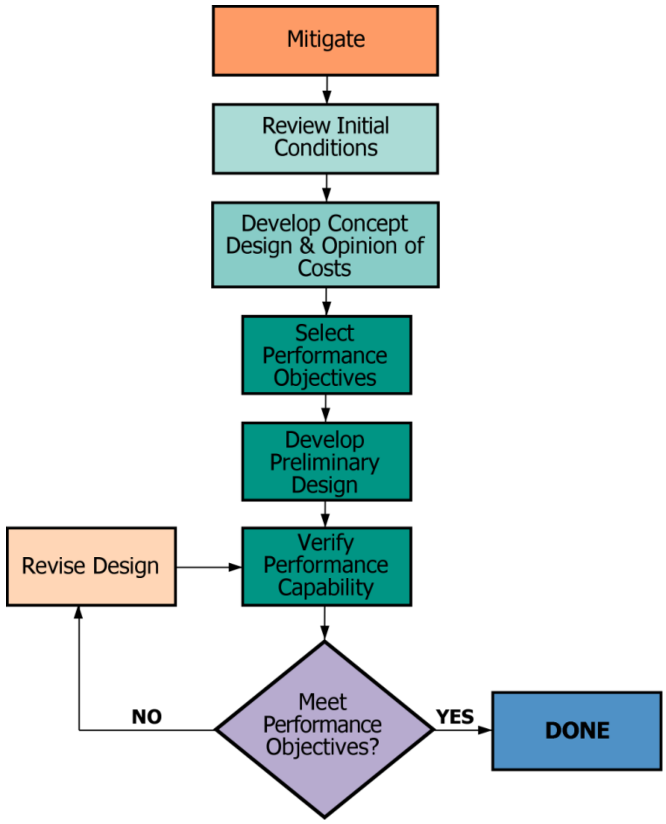


Flow Chart and Description of ASCE 31 Seismic Evaluation Procedure.

The Tier 3 detailed evaluation references and utilizes rehabilitation design criteria, such as ASCE 41-06. Since ASCE 31-03 is an evaluation standard, it is written to accept greater levels of damage within each performance level than permitted by retrofit design standards. This is consistent with the historic practice of evaluating existing buildings for slightly lower criteria than those used for design. ASCE 31-03 quantifies this difference by using a 0.75 reduction factor on demands when performing a Tier 3 evaluation. This essentially lowers the reliability of achieving the selected performance level from about 90 percent to 60 percent. This practice generally minimizes the need to rehabilitate structures with relatively modest deficiencies relative to the desired performance level.

Seismic Rehabilitation 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 rehabilitation 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 rehabilitation design is illustrated in the flow diagram below.



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.

Fire Station 51

Structural Site Observations

A site visit of Station 51 was conducted as part of this seismic evaluation. During the site visit, minor cracking was observed in the masonry walls and the wood framing observed in the mechanical mezzanine and roof appears to be in good condition. No obvious signs of distress or decay were observed in other primary structural members.

Structural System

Structural System Description of Fire Station 51.

Structural System	Description
High Roof	The new roof is constructed of 2x4 wood trusses that span the entire transverse direction of the building. The wood trusses support and un-blocked plywood roof diaphragm.
Original Roof	The original roof of the structure is still in place and is constructed of TJL wood trusses that span the entire transverse dimension of the building. The wood trusses support a blocked plywood diaphragm.
Second Floor	The second floor is constructed of an unblocked plywood floor that is supported by 2X10 wood floor framing. The 2X10 floor framing is supported by glued laminated beams that are supported by glued laminated wood posts.
Foundations	The foundation system for the building is constructed of concrete spread footing, concrete strip footings and a concrete basement wall. A 6" slab on grade is located on the ground floor of the building.
Lateral System	The roof of the building is laterally supported by perimeter wood shear walls in the longitudinal direction and masonry shear walls in the transverse direction. The second floor of the building is laterally supported by masonry shear walls and the concrete basement wall in the longitudinal direction and masonry shear walls in the transverse direction.
Vault	The vault area is constructed of masonry walls on all four sides with a concrete floor slab on the second floor and a concrete lid that is located below the building's roof.

Seismic Evaluation Findings

Seismic Deficiencies

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

Identified Seismic Deficiencies for Fire Station 51

Deficiency	Description
Load Path	The new roof does not have blocking located between the under side of the roof sheathing and supporting member, this creates a gap in the lateral load path of the structure.
Walls Connections Through Floors	The available drawings do not have any information on wall hold downs for the wood framing on the second floor. Based on the vintage of the building it is unlikely that hold downs were incorporated into the original design, hold downs provide resistance for wood shear wall overturning.
Plan Irregularity	The second floor of the building has an irregular in shape. Plan irregularities have traditionally resulted in poor seismic performance due to stress concentrations at the irregularity if not properly detailed.
Roof Chord Continuity	The chord elements are not continuous at the new roof.
Hold-down Anchors	The available drawings do not have any information on wall hold downs for the wood framing on the second floor. Based on the vintage of the building it is unlikely that hold downs were incorporated into the original design, hold downs provide resistance for wood shear wall overturning.
Unblocked Diaphragm	The plywood panel edges of the 2nd floor and new roof diaphragm are un-blocked, the span of these diaphragms between shear walls exceeds the allowable span limit.
Wall Anchorage	The exterior masonry walls do not have connections that tie them into the floor and roof diaphragms. These anchorage elements are critical for resolving out of plane wall loads during an earthquake. With out these elements it is possible that the wall may separate from the building during an earthquake possibly resulting in a collapse of the wall.
Wood Ledger	Lateral wall ties are not present between wall panels and the diaphragms to cross-grain bending in the wood ledger.
Transfer to Shear Walls	There is not a positive connection between masonry shear walls and the new roof diaphragm; because of this the lateral loads from the new roof may not transfer into the masonry shear walls.
Cross Ties	The new roof does not have continuous cross ties between diaphragm chords.
Soft Story	A soft story condition was created by the removal of the masonry wall to create the apparatus bay opening. While the opening was planned in the original design, this discontinuity results in a soft story condition.
Weak Story	A weak story condition was created by the removal of the masonry wall to create the apparatus bay opening. While the opening was planned in the original design, the removal of this wall results the lateral capacity of the second floor being weaker than the story above.

Deficiency	Description
Vertical Discontinuity	A vertical discontinuity in the lateral load path was created when the masonry wall pier was removed to create the apparatus bay. While this was in the original design, the masonry wall will collect load from the roof resulting in seismic overturning forces on the wall, the existing framing may not be able to support these loads.

Structural Conclusions

Fire Station 51 does not to meet the Immediate Occupancy performance objective. Based on this evaluation, some damage to the building may occur during a design-level earthquake. The primary concern for the structure is that the exterior masonry walls are not adequately tied into the buildings roof and floor diaphragms, because of this the exterior masonry walls may separate from the structure during an earthquake resulting in a partial collapse of the structure. Additionally, the building has plan irregularities, a vertical irregularity, weak story and soft story conditions. Historically these conditions have resulted in pour seismic performance for structures, and increased damage has been observed. While the seismic hazard of the area is generally thought to be moderate, there is the possibility for strong earthquakes to occur. In 1872, an estimate 6.8 magnitude earthquake, known as the North Cascade Earthquake, caused massive landslides and fishers to occur in the Chelan area. This earthquake is one of the largest seismic events to have occurred in Washington State, an earthquake of similar magnitude could be expected to cause significant damage to Station 51.

For additional information on the building performance objective and on the evaluation criteria see the section titled *Existing Building Evaluation Criteria.*

Basic Structural Checklist for Building Type W2: Wood Frames, Commercial And Industrial

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

Building System

C	NC	N/A	EVALUATION STATEMENT	COMMENT
	X		LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)	No positive interconnection between masonry shear walls to new roof to transfer roof diaphragm to shear walls.
		X	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)	
	X		WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life-Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)	No shear walls along north side at second floor.
	X		SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life-Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)	CMU wall along north side is not continued up to roof.
	X		GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)	No shear walls along north side at second floor.
X			VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	
X			MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)	
X			DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members, and none of the metal connection hardware shall be deteriorated, broken, or loose. (Tier 2: Sec. 4.3.3.1)	

	X		WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS: There shall be no more than 15 percent of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.3.3.2)	Available existing drawings do not have any information on structural panel fasteners.

Lateral Force Resisting System

C	NC	N/A	EVALUATION STATEMENT	COMMENT
X			REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)	
X			SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure in Section 3.5.3.3, shall be less than the following values for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.7.1) Structural panel sheathing: 1000 plf Diagonal sheathing: 700 plf Straight sheathing: 100 plf All other conditions: 100 plf	
		X	STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings shall not rely on exterior stucco walls as the primary lateral-force-resisting system. (Tier 2: Sec. 4.4.2.7.2)	
		X	GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard shall not be used as shear walls on buildings over one story in height with the exception of the uppermost level of a multi-story building. (Tier 2: Sec. 4.4.2.7.3)	
X			NARRROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 for Life Safety and 1.5-to-1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of moderate and high seismicity. Narrow wood shear walls with an aspect ratio greater than 2-to-1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of low seismicity. (Tier 2: Sec. 4.4.2.7.4)	
	X		WALLS CONNECTED THROUGH FLOORS: Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor. (Tier 2: Sec. 4.4.2.7.5)	Wall hold-downs are not shown in available drawings.
X			HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story due to a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1-to-1 for Life Safety and 1-to-2 for Immediate Occupancy. (Tier 2: Sec. 4.4.2.7.6)	
		X	CRIPPLE WALLS: Cripple walls below the first-floor-level shear walls shall be braced to the foundation with wood structural panels. (Tier 2: Sec. 4.4.2.7.7)	

	X		OPENINGS: Walls with openings greater than 80 percent of the length shall be braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or shall be supported by adjacent construction through positive ties capable of transferring the lateral forces. (Tier 2: Sec. 4.4.2.7.8)	No details shown on available existing drawings.

Connections

C	NC	N/A	EVALUATION STATEMENT	COMMENT
X			WOOD POSTS: There shall be a positive connection of wood posts to the foundation. (Tier 2: Sec. 4.6.3.3)	
X			WOOD SILLS: All wood sills shall be bolted to the foundation. (Tier 2: Sec. 4.6.3.4)	
X			GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	

Supplemental Structural Checklist for Building Type W2: Wood Frames, Commercial And Industrial

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral Force Resisting System

C	NC	N/A	EVALUATION STATEMENT	COMMENT
	X		HOLD-DOWN ANCHORS: All shear walls shall have hold-down anchors constructed per acceptable construction practices, attached to the end studs. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.7.9)	Available existing drawings do not have any information on shear wall hold downs.

Diaphragms

C	NC	N/A	EVALUATION STATEMENT	COMMENT
X			DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. (Tier 2: Sec. 4.5.1.1)	
	X		ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation. (Tier 2: Sec. 4.5.1.3)	
	X		PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	The shape of second floor is irregular.
	X		DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragms openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)	No information available on the available existing drawings.
		X	STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2-to-1 for Life Safety and 1-to-1 for Immediate Occupancy in the direction being considered. (Tier 2: Sec. 4.5.2.1)	
X			SPANS: All wood diaphragms with spans greater than 24 feet for Life Safety and 12 feet for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing. Wood commercial and industrial buildings may have rod-braced systems. (Tier 2: Sec. 4.5.2.2)	
	X		UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms shall have horizontal spans less than 40 feet for Life Safety and 30 feet for Immediate Occupancy and shall have aspect ratios less than or equal to 4-to-1 for Life Safety and 3-to-1 for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	Unblocked second floor and new roof have spans exceeding 30ft.
		X	OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 4.5.7.1)	

Supplemental Structural Checklist for Building Type W2: Wood Frames, Commercial And Industrial

Connections

C	NC	N/A	EVALUATION STATEMENT	COMMENT
X			WOOD SILL BOLTS: Sill bolts shall be spaced at 6 feet or less for Life Safety and 4 feet or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete. (Tier 2: Sec. 4.6.3.9)	.

Basic Structural Checklist For Building Type RM1: Reinforced Masonry Bearing Walls With Flexible Diaphragms

This Basic Structural Checklist shall be completed where required by Table 3-2.

Each of the evaluation statements on this checklist shall be marked Compliant (C), Non-compliant (NC), or Not Applicable (N/A) for a Tier 1 evaluation. Compliant statements identify issues that are acceptable according to the criteria of this standard, while non-compliant statements identify issues that require further investigation. Certain statements may not apply to the buildings being evaluated. For non-compliant evaluation statements, the design professional may choose to conduct further investigation using the corresponding Tier 2 Evaluation procedure; corresponding section numbers are in parentheses following each evaluation statement.

Building System

C	NC	N/A	EVALUATION STATEMENT	COMMENT
	X		LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. (Tier 2: Sec. 4.3.1.1)	No positive interconnection between new roof diaphragm and shear walls to transfer diaphragm shear to masonry shear walls.
X			ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4 percent of the height of the shorter building for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.1.2)	
		X	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. (Tier 2: Sec. 4.3.1.3)	
	X		WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80 percent of the strength in an adjacent story, above or below, for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.1)	No shear walls along north side at second floor.
	X		SOFT STORY: The stiffness of the lateral-force-resisting system in any story shall not be less than 70 percent of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80 percent of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.3.2.2)	CMU wall along north side is not continued up to roof.
	X		GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30 percent in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. (Tier 2: Sec. 4.3.2.3)	No shear walls along north side at second floor.
X			VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. (Tier 2: Sec. 4.3.2.4)	
X			MASS: There shall be no change in effective mass more than 50 percent from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses, and mezzanines need not be considered. (Tier 2: Sec. 4.3.2.5)	

X			DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any wood member and none of the metal connection hardware shall be deteriorated, broken, or loose. (Tier 2: Sec. 4.3.3.1)	
X			MASONRY UNITS: There shall be no visible deterioration of masonry units. (Tier 2: Sec. 4.3.3.7)	
X			MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar. (Tier 2: Sec. 4.3.3.8)	
X			REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8 inch for Life Safety and 1/16 inch for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. (Tier 2: Sec. 4.3.3.10)	

Lateral Force Resisting System

C	NC	N/A	EVALUATION STATEMENT	COMMENT
X			REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.1.1)	
X			SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. (Tier 2: Sec. 4.4.2.4.1)	
X			REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy, with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48 inches for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. (Tier 2: Sec. 4.4.2.4.2)	

Connections

C	NC	N/A	EVALUATION STATEMENT	COMMENT
	X		WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check procedure of Section 3.5.3.7. (Tier 2: Sec. 4.6.1.1)	Connections are not present.
	X		WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers. (Tier 2: Sec. 4.6.1.2)	Lateral wall ties are not present.

Basic Structural Checklist For Building Type RM1: Reinforced Masonry Bearing Walls With Flexible Diaphragms

	X		TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. (Tier 2: Sec. 4.6.2.1)	No positive interconnection between masonry shear walls and the new roof to transfer roof diaphragm shear to shear walls.
X			FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety, and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. (Tier 2: Sec. 4.6.3.5)	
X			GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. (Tier 2: Sec. 4.6.4.1)	

Supplemental Structural Checklist For Building Type RM1: Reinforced Masonry Bearing Wall With Flexible Diaphragms

This Supplemental Structural Checklist shall be completed where required by Table 3-2. The Basic Structural Checklist shall be completed prior to completing this Supplemental Structural Checklist.

Lateral Force Resisting System

C	NC	N/A	EVALUATION STATEMENT	COMMENT
	X		REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcement on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.4.2.4.3)	Available drawings for existing building do show the reinforcing detail around the openings.
X			PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level Only. (Tier 2: Sec. 4.4.2.4.4)	

Diaphragms

C	NC	N/A	EVALUATION STATEMENT	COMMENT
	X		CROSS TIES: There shall be continuous cross ties between diaphragm chords. (Tier 2: Sec. 4.5.1.2)	
X			OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25 percent of the wall length for Life Safety and 15 percent of the wall length for Immediate Occupancy. (Tier 2: Sec. 4.5.1.4)	
X			OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 feet long for Life Safety and 4 feet long for Immediate Occupancy. (Tier 2: 4.5.1.6)	
	X		PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.7)	The shape of second floor is irregular.
		X	DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50 percent of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. (Tier 2: Sec. 4.5.1.8)	
		X	STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios of less than 2-to-1 for Life Safety and 1-to-1 for Immediate Occupancy in the direction being considered. (Tier 2: Sec. 4.5.2.1)	
X			SPANS: All wood diaphragms with spans greater than 24 feet for Life Safety and 12 feet for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing. (Tier 2: Sec. 4.5.2.2)	

Supplemental Structural Checklist For Building Type RM1: Reinforced Masonry Bearing Wall With Flexible Diaphragms

	X		UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms shall have horizontal spans less than 40 feet for Life Safety and 25 feet for Immediate Occupancy and shall have aspect ratios less than or equal to 4-to-1 for Life Safety and 3-to-1 for Immediate Occupancy. (Tier 2: Sec. 4.5.2.3)	No blockings are present at the new roof and second floor spans exceed 25ft limit.
		X	NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans less than 40 feet and shall have and shall have span/depth rations less than 4-to-1. This statement shall apply to Immediate occupancy Performance Level only. (Tier 2: Sec. 4.5.3.1)	
X			OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Tier 2: Sec. 4.5.7.1)	

Connections

C	NC	N/A	EVALUATION STATEMENT	COMMENT
X			STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative moment between the wall and the diaphragm to no greater than 1/8 inch prior to engagement of the anchors. (Tier 2: Sec. 4.6.1.4)	

South Apparatus Bay

Bunker Gear Storage At Rear Of South Apparatus Bay

Meeting Area Open To South Apparatus Bay

Meeting Area & Hallway Open To North Apparatus Bay