MAINTENANCE BUILDINGS

PIEDMONT UNIFIED SCHOOL DISTRICT

SEISMIC STRENGTHENING PROGRAM / MEASURE E BOND PROGRAM

INVESTIGATION AND ANALYSIS

FINAL REPORT

January 22, 2008

R. P. Gallagher Associates, Inc.
Structural Engineering

murakami Nelson
ARCHITECTURAL CORPORATION

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FOR MAINTENANCE BUILDINGS

View of Maintenance Buildings A, B, & C from Entry Driveway

View of Building A - Workshop

View of Building D - Trailer Office

R. P. Gallagher Associates, Inc.
Structural and Earthquake Engineering

murakami/Nelson
ARCHITECTURAL CORPORATION

EXECUTIVE SUMMARY
MAINTENANCE BUILDINGS
EVALUATION AND ANALYSIS

murakami/Nelson has been retained by the Piedmont Unified School District to evaluate buildings at the five school campuses and district corporation yard for seismic safety and related accessibility and fire & life safety deficiencies and to design corrections of those deficiencies as part of the Measure E Bond Program. As part of this global objective we have evaluated the three buildings at Piedmont Middle School for ADA/accessibility and Fire/Life-Safety. Each building, the Building A (Workshop), Building B (Storage), Building C (Large Trailer Office/Break Room/Toilet Room) and Building D (Small Trailer Office) have significant barriers to accessibility as well as life-safety deficiencies.

The project is divided into three phases - Evaluation and Analysis, Concept Design and Design/ Construction Document/Construction. This Evaluation and Analysis phase has identified deficiencies; later phases of the project will conceptualize and design corrections of those deficiencies.

To assist us in this effort we have assembled a consultant team comprised of R. P. Gallagher Associates for structural engineering, and Sandis for surveying. We have been assisted by Capital Program Management (CPM), the District's Program Manager; District staff and maintenance staff.

ACCESSIBILITY EVALUATION

The buildings were evaluated for accessibility conformance with the ADA and the related ADAAG regulations and the 2001 California Building Code. The evaluation process included review of applicable codes and site investigations to verify actual field conditions. The site was found to not be accessible and the buildings in general had major deficiencies.

Building A (Wood Workshop) – This building is significantly deficient. It lacks an accessible entrance and there are no accommodations within the facility.

Building B (Metal Storage) – Like Building A, there is no accessible entrance and shelving within is not accessible.

Building C (Large Trailer Office/Break Room/Toilet Room) – Both entrances to this trailer are not accessible, the office/storage space could be adaptable but is not currently compliant and the toilet room is not accessible.

Building D (Small Trailer Office) – This trailer is primarily for storage and does not necessarily need to be accessible.

FIRE & LIFE SAFETY EVALUATION

The buildings were evaluated for life safety in conformance with the 2001 California Building Code. In general the buildings are not in compliance with fire and life safety codes. The evaluation process included review of applicable codes and site investigations to verify field conditions.

Specific building fire and life safety deficiencies noted are as follows:

Building A (Wood Workshop) – The exit is not compliant and only minor fire and life safety deficiencies preside in this building although there are some OSHA concerns.

Building B (Metal Storage) – A clear exit path needs to be maintained and, although stored supplies and equipment was not analyzed, the building seems to only need minor changes.

Building C (Large Trailer Office/Break Room/Toilet Room) – None of the exits are compliant.

Building D (Small Trailer Office) – There is no code compliant exit.

Non-Structural Seismic Hazard Evaluation

RP Gallagher conducted a seismic evaluation for life safety performance levels as well as a non-structural hazards survey of the Maintenance Buildings. The evaluation criteria used was ASCE Standard 31 "Seismic Evaluation of Existing Buildings". This document is the generally recognized national standard for assessing the life safety risk of existing buildings, including non-structural hazards. The Tier 1 procedures of ASCE 31 which involve site review and completion of a checklist were used. The findings of the non-structural evaluation report are as follows:

The buildings were surveyed for seismic and nonstructural hazards and found to be severely deficient.

Building A (Wood Workshop) – This building is significantly deficient and would likely come off its foundation in a major earthquake. There are also many nonstructural hazards.

Building B (Metal Storage) – Although this building does not meet Tier 1 criteria, its life safety risk is relatively low. However the nonstructural hazards are severe.

Building C (Large Trailer Office/Break Room/Toilet Room) – This building could easily shift off it supports as it lacks foundation anchorage. There are also nonstructural risks.

Building D (Small Trailer Office) – This building, like Building C, could easily shift off it supports as it lacks foundation anchorage. There are also nonstructural risks.

Conclusions

- It is recommended that the buildings be upgraded to accommodate accessibility, fire life-safety and nonstructural hazards deficiencies. Although these issues could be mitigated, it may not be feasible.
- It is also recommended that the buildings be seismically strengthened to correct the structural deficiencies found. It is proposed that FEMA 356 criteria will be used for the initial strengthening design. This is the generally recognized criteria for strengthening existing buildings.
- Based on structural, accessibility and fire & life safety evaluations, we believe it is feasible to mitigate the deficiencies in the buildings while preserving their basic functional and architectural character. However, the overall feasibility of this project remains to be evaluated during the next, conceptual design phase of the work.
- There are numerous OSHA violations in each specialty workplace. Should the District decide to rehabilitate these maintenance buildings, a comprehensive check of OSHA compliance would be required.
- Although it is not required by the code, it is our recommendation that a full fire alarm and sprinkler system be installed due to the nature or objects stored in the facilities (such as the storage of flammable liquids).

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1. INTRODUCTION

A. Project Scope

In March of 2006, the City of Piedmont voters passed Measure E, a $56 million bond to address seismic safety in the Piedmont Unified School District (PUSD).

To assist the District in managing the seismic program, the PUSD has engaged Capital Program Management, Inc. (CPM), to oversee program planning and implementation. The School Board has formed a Steering Committee to oversee the management of all bond projects and serve as a communications hub; a Technical Advisory Committee to advise the Steering Committee and about the technical aspects of the project and a Citizens Oversight Committee to ensure that funds are appropriately and prudently spent. Additionally, an extensive public engagement effort has been set up to both educate the community about the progress of the project and to elicit comments and feedback.

murakami/Nelson was selected to evaluate the school buildings, develop design solutions, prepare construction documents and oversee construction of the projects. Assisting us in this effort is R. P. Gallagher Associates. The work effort was to assess all of PUSD buildings. This report summarizes the investigative efforts of the design team to understand the existing conditions of the Maintenance Buildings at the PUSD's corporation yard. The corporation yard houses four structures – a wood-framed Workshop (Building A), a pre-fabricated metal building (Building B), and two office trailers (Buildings C & D). *murakami*/Nelson has reviewed the four buildings and identified accessibility and life safety deficiencies. R. P. Gallagher has completed a Tier 1 non-structural hazards analysis of these buildings. This report documents our findings.

The contents of this report are based on field investigations conducted by *murakami*/Nelson and R.P. Gallagher Associates, conversations with Maintenance staff, and an existing conditions topographic survey by Sandis. No documents were available from the Division of the State Architect (DSA) or the Piedmont Unified School District.

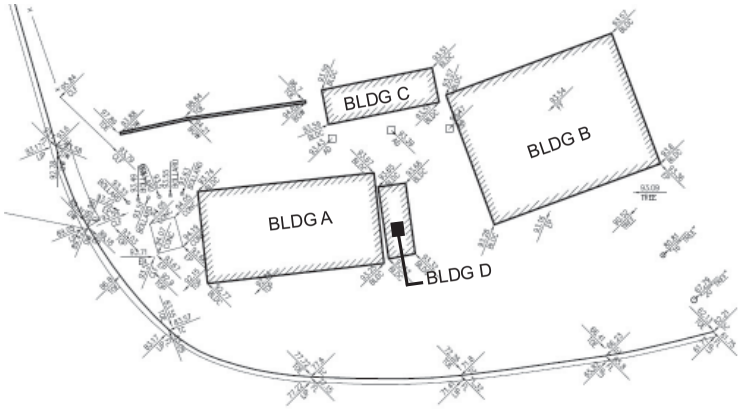
B. Application of California Building Code

Since there are often code interpretations with use of the California Building Code, the School District engaged DSA in a discussion about the PUSD Voluntary Seismic Upgrade Program. In May 2006 DSA representatives attended a special meeting of the School Board to discuss the District's program and how individual projects would involve compliance with fire, life safety and accessibility requirements of the California Building Code. *murakami*/Nelson continued that discussion with a follow on meeting with DSA on February 9, 2007. At that meeting DSA indicated a willingness to work with the District on the extent of compliance with the current California Building Code. Such determinations would be made on a case by case basis and relate to the specifics of each project.

In addition to the California Building Code, the Education Code has bearing with regards to the Corporation Yard buildings. The Education Code does not consider the buildings of the Corporation Yard as a "school building". The requirement for upgrading school buildings do not apply to the Corporation Yard building. The PUSD may choose the level of voluntary seismic upgrade it wishes. However, the PUSD must maintain life safe facilities, which includes the Corporation Yard buildings. In addition, there are statues related to the American's with Disabilities Act that pose substantial legal consequences to the PUSD if not addressed.

C. Future Considerations

During the next Concept Design phase of the project, programmatic, maintenance and sustainability issues will be considered where those issues can be solved as an integral part of the Bond project. Where those issues are not integrally linked to the seismic work, then the District may decide to use Modernization or other funding sources to solve those problems. In addition, there are numerous OSHA violations. Should the PUSD decide to rehabilitate the buildings, a comprehensive check of OSHA requirements would be needed.



Site Plan of Maintenance Building

D. Building Descriptions

The Corporation Yard is cut into the hillside, east of the Witter Field House. The Yard is bound-in by the hillside to the east, the road to the north and the drop-off of the hillside on the south and west sides. The Corporation Yard has four structures that are used by the Maintenance Department as shops and offices. The staff indicated that the Corporation Yard was inadequate in size and function. There was inadequate room to store equipment and supplies, with some materials having to be left exposed to weather. The driveway did not provide any turnaround space and requires vehicles to back out to the road way.

The four Corporation Yard buildings are:

Building A. **The Workshop**, a 1,320 s.f. wood framed structure. It is believed that the structure was moved to it current location. The Workshop is used for a wide variety of maintenance related services and repairs. The building houses woodworking tools and equipment, lumber, painting supplies and equipment, plumbing supplies, etc. The space is very congested, with every nook and cranny filled.

View of Building A - Workshop

Congested isles & workspace in workshop

Building B. **The Pre-fab Metal Storage Building** was apparently donated to the PUSD. This building serves as the main maintenance department storage space. Two mezzanines were built to create addition storage. Like the Workshop, this building is brimming with supplies, small parts, piping, conduit, equipment, etc. In the evening the two maintenance trucks are garaged in this building for security. One truck is parking on a platform trailer, due to the lack of space.

Building B - Mezzanines created for additional storage is full of supplies

Building C. **The large Trailer Office/Breakroom/Toilet Room** houses maintenance staff office space, lunchroom and a toilet room. The toilet room has one water closet, one urinal, a shower (that appears to serve as an emergency shower), one lavatory, and three metal lockers.

Building D. **The small Trailer Office** is use primarily for storage.

Building C - Large Trailer Office

Building D - Small Trailler Office

2. ADA /ACCESSIBILITY.

A. Background:

The Workshop and Pre-Fab Metal Storage Buildings are classified as S-1 occupancy. The two trailer offices are classified as B occupancy. Both types of facilities in California are required by federal and state law to provide equal access for employees and visitors. At the Federal level the empowering legislation is the Americans with Disabilities Act or ADA. Under that law ADAAG regulations were written to describe the accessibility requirements for the entire country. The ADAAG regulations are enforced by civil action. At the State level accessibility is governed by the California Building Code. In the case of public school buildings the California Building Code is enforced by the Division of the State Architect or DSA.

The State of California is in the process of getting the California Building Code certified by the Department of Justice as meeting ADAAG. Until that occurs architects must comply with both the ADAAG and the California Building Code. *murakami*/Nelson has used both documents in evaluating the Maintenance Buildings.

The California Building Code requires that whenever more than $120,000 (*adjusted for inflation each year*) worth of work other than for maintenance or replacement of finishes is done in any three year period for an existing building, that access compliance work be included as part of that project. Section 1134B of the California Building Code requires that alteration work within an existing building comply with the current Code and that additional access work, as stipulated in the Code, be done beyond the area of the alteration.

Because seismic upgrade projects often affect areas throughout a school the State Attorney General has issued an interpretation (DSA Document 96-01) that access work triggered by a seismic strengthening project need only provide an accessible primary entrance, sanitary facilities, signs, telephone (if provided), drinking fountain and an accessible path of travel to those facilities, but not a accessible path of travel to the area of all the alterations as Section 1134B.2 of the Building Code requires. Use of this interpretation by DSA on the Piedmont Seismic project remains to be resolved.

In any event, the voluntary seismic strengthening work the District is planning will trigger substantial compliance with the access requirements of Section 1134. Furthermore, if State modernization funds are used for the projects, then all the requirements of Section 1134 would be triggered.

B. Summary & Analysis

In general, there have been no accommodations made in the Corporation Yard for accessibility.

C. Site

The Corporation Yard is bound by steep hillside to the east, south, and west sides. The access roadway is to its north. The primary access to the Corporation Yard is the access road into a one-lane driveway. The access road and the driveway at the entry gate are very steep. There is no compliant access to the Corporation Yard. There is no visitor parking in the Corporation Yard. There are parking spaces for the school across the road, but none designated as accessible. There is no accessible path of travel into the Corporation Yard as the driveway is too steep and there are no sidewalks on the access road. The driveway in the Corporation Yard is asphalt paving and appears to be in good repair, except in localize areas near Building B.

Path of travel to the primary entry of each building is non-compliant. The entry door to Buildings A, C, & D are above grade. No ramp is provided for wheelchair access. In addition, the stairs are non-compliant. There is no accessibility signage.

Entry into corporation yard

View of steep hillside at corporation yard

D. Buildings

Building A - Workshop

The Workshop is approximately two feet above the paved driveway. Wood stairs provide access in the workshop. There is only one entry, a pair of three foot doors that swing outward. There is no landing at the top of the stairs and no handrails as required by the California Building Code. The primary entry is not accessible.

Within the Workshop, there are no accommodations for accessibility. Aisle spaces are not 36-inches clear in all area, no work bench at accessible height, etc. The keying office is not accessible, lacking door clearance, lever hardware, signage, etc.

If seismic upgrades identified in the structural section of this report are implemented, substantial accessibility upgrades to the Workshop would be required. The entry upgrade would potentially affect the functional use of the driveway

Building B – Pre-fab Metal Storage Building

The Storage Building has only one entry, a pair of 5'-4" barn-type, sliding doors. By code, the doors are acceptable as an exit (if proper signage is provided, see fire/life safety section of this report), however, the doors are not accessible.

The interior of the building is used for storage, disheveled, with no clear accessible aisle spaces or path of travel. A major re-organization of the space would be required to accommodate a wheel-chair bound employee. In the structural section of this report, Building B was identified as not meeting the Tier 1 criteria and has numerous non-structural hazards. Mitigating the structural issues would trigger upgrades for accessibility. Accessibility upgrades would include accessible primary entry, signage, and path of travel within the building.

Building A - Workshop has non-compliant entry

Building B doors are not accessible

Bldg D - Stairs to small trailer office are non-compliant

Building C – Large Trailer Office/Breakroom/Toilet Room

This trailer was formerly a construction job trailer that the maintenance adopted and converted for their use. The trailer is set on pedestals and the floor line is 34-inches above the driveway. There are two non-compliant entry doors. One door leads into the office space. The second door leads into the toilet room. The stairs to the office is a free-standing unit inherited with the trailer and is not an accessible stair or landing. The stairs to the toilet room are wood with no handrails. This stair is non-compliant by code and not accessible.

The office / storage space is congested. The space is not current accessible, but could be adaptable. The Toilet room is not accessible and would require a major renovation to bring it into compliance with accessibility requirement.

Bldg C - Stairs to toilet room are non-compliant

Bldg C - Stairs to office/ breakroom are non-compliant

Non-compliant water closet

Non-compliant urinal stall & lavatory

Non-compliant lockers

Non-compliant emergency shower

Building C - Toilet Room

Building D – Small Trailer Office

This trailer is primarily for storage. PUSD would not necessarily have to provide accessibility to this trailer. DSA has not required storage room to be made accessible, if for the use of maintenance staff only.

3. FIRE/LIFE-SAFETY

A. Background:

As with accessibility, fire and life-safety is governed by the California Building Code and is enforced by the Division of the State Architect (DSA). Unlike the accessibility regulations the fire and life-safety regulations are spread throughout the Code; however, most of the pertinent regulations are in Chapters 5 and 10. There is no overarching life safety regulation like ADAAG for fire and life safety. Life Safety is not an area where the School District, the design professional or DSA would compromise; however, there will be areas of negotiation about what is acceptable given the fact that the existing buildings may be constructed differently from what would be built today under current codes. Nonetheless, a primary objective of the project, in addition to seismic safety and accessibility will be to increase fire and life-safety at the schools, which could include its maintenance facilities. However, since the maintenance facilities are not considered a "school building" per the Education Code, they are not subject to the same stringent requirements. PUSD does have to maintain its facilities to be life safe. In addition, the buildings should not pose a fire hazard that could spread to adjacent school building. Due to the extensive number of trees and underbrush surrounding the maintenance buildings, this is a possibility.

B. Summary & Analysis

The buildings in the Corporation Yard all fall within the Type V-no hour construction type. The materials of construction are compliant with that allowed by the California Building Code (CBC). The buildings comply with the number of required exits. In Building B, a sign needs to be posted that the exit doors must remain unlocked when the building is occupied.

C. Site

There is one driveway that comes off the access road. It is not marked "Fire Lane". We will be meeting with the Piedmont Fire Department to review the Corporation Yard for fire department access, as well as any other concerns of the Fire Department.

D. Buildings

Building A – Workshop Building

This building has a local fire alarm alert system. A fire extinguisher is available. The staff has tried to maintain clear aisle space and exiting appears adequate, though not from an accessibility standpoint. There is a tremendous amount of supplies, parts, equipment, and tools stored or setup in the Workshop. Though not a direct fire and life safety issue, over-crowd combustible storage can be a contributing factor for a fire. In addition, there could be some OSHA concern with regards to volatile fume and sawdust inhalation.

The exit is not compliant. Code requires that a landing be provide on both sides of the exit door. The exterior side does not have a landing. In addition, no handrails have been provided at the stairs.

Building B – Pre-fab Metal Storage Building

This building has no fire alarm system or smoke detection system. By code, none are required. However, visual observation of the Storage Building suggest that a major re-organization of the storage be implemented to ensure that a clear exit path is maintained and that non-structural falling hazards (as summarized in the structural section of this report) are eliminated.

Stored supplies, equipment, and tools were not analyzed and not in the scope of this fire/life safety review. PUSD should monitor the facility to ensure no combustibles such as fuel or gasoline, are stored in the building. Chemical storage such as pesticides, cleaner, etc. should be in proper containers and stored in a safe manner.

Main driveway into corporation yard

Building B - Congested storage spills over into exit path

Building C – Large Trailer Office, Breakroom / Toilet

This building has no fire alarm system or smoke detection system. By code, none are required. A local self-contained smoke detector was observed.

The exit from the toilet room is not compliant. Code requires that a landing be provide on both sides of the exit door. The exterior side does not have a landing. In addition, no handrails have been provided at the stairs. The exit from the Office/Breakroom is not compliant. The landing is 8-inches below the floor line. By code, one inch is allowed, by accessibility standards, ½-inch is the maximum level change.

Building D – Small Trailer Office

This building has no fire alarm system or smoke detection system. By code, none are required. The trailer does not appear to pose significant life safety issues.

The exit is not compliant. Code requires that a landing be provide on both sides of the exit door. The exterior side does not have a landing. In addition, no handrails have been provided at the stairs.

Seismic Evaluation of the Piedmont Unified School District Corporation Yard Structures

Prepared for
murakami/Nelson Architects, Inc.
Oakland, CA

December 19, 2007

Prepared by
R. P. Gallagher Associates, Inc.
Structural Engineers
Oakland, CA

Executive Summary

The Piedmont USD Corporation Yard has four structures: a 1,320 sf wood frame building, a 1,980 sf prefab metal building; a large 10' x 32' trailer; and a small 8' x 20' trailer. These are used by the District's maintenance department as shops and offices.

An ASCE 31 Tier 1 evaluation of each structure was performed. Nonstructural items were also surveyed using the Tier 1 nonstructural procedures. ASCE 31 "Seismic Evaluation of Existing Buildings", published in 2003, is the generally recognized national standard for assessing the life safety risk of existing buildings.

The following is a summary of the study findings.

(1) Wood frame building – does not meet the Tier 1 criteria. This structure will very likely shift off its supports in a large earthquake and fall to the ground.

(2) Prefab metal building – does not meet some of the Tier 1 criteria, however, it is unlikely that this building would collapse. It does have some serious nonstructural hazards within it (see discussion below). The building also has two mezzanines that do not meet code requirements for structural safety.

(3) Trailers – the two trailers will very likely fall off their supports and portions of them will fall to the ground. The life safety risk in these is believed small.

(4) Nonstructural items – there are a great number of nonstructural falling hazards in the prefab metal building, including unsecured contents, unanchored racks and storage shelves, and structurally questionable mezzanines. There are also a number of falling hazards, and possible falling hazards, in the wood frame building, and some in the two trailers.

(5) Continued operations – following a large earthquake on the Hayward fault, it is very likely that the damage to the structures and their contents will be so extensive that continued operation of the District's corporation yard will be greatly impaired, if entirely not prevented.

While some of the structures at the corporation yard may be near the end of their useful life, and have serious seismic deficiencies, it is possible to fix these. They can be upgraded to present day seismic standards using ASCE 41 "Seismic Rehabilitation of Existing Buildings". Additionally, new and/or anchored shelving and storage racks will be required to meet ASCE 31, and new mezzanines will be required to comply with basic building code structural safety requirements.

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1. Introduction

This report summarizes the seismic evaluation of the structures at the Piedmont Unified School District's Corporation Yard. The yard is located adjacent the Piedmont High School and Piedmont Middle School campuses. The purpose of the study was to assess the vulnerability of the structures for life safety risk in a major earthquake. The yard consists of four structures: a 1,320 sf wood frame building, a 1,980 sf prefabricated metal building, a large trailer, and a small trailer. The trailers appear to be mobile construction offices and are now used as offices by the maintenance staff.

Construction of the buildings was not done under the jurisdiction of the California Division of State Architect (DSA). In fact, there are no drawings or other documentation of the construction.

The evaluations summarized in this report represent an assessment of the structures using the latest seismic evaluation methodology. The study consisted of an ASCE 31 Tier 1 evaluation. A Tier 1 evaluation involves an inspection of the structure, review of drawings (if available), completion of checklists, and limited calculations.

The work presented in this report also includes a Tier 1 survey of nonstructural hazards. The purpose of this was to identity potential falling and other hazards that may be triggered by an earthquake. The nonstructural survey included a survey of each of the four structures.

The report is organized as follows. The criteria used in the evaluations are described in Section 2. A description of the two buildings and the results of their evaluations are presented in Section 3. The two trailers are discussed in Section 4. Nonstructural hazards are discussed in Section 5. Section 6 provides a summary and recommendations.

2. Evaluation Criteria

Building Structural Systems

The buildings and trailers were evaluated using the criteria of ASCE Standard 31-03 "Seismic Evaluation of Existing Buildings" (Ref. 1). This is the state-of-the-art criteria for the seismic evaluation of existing buildings. It is used to establish whether there is a significant life safety risk.

The structures were given a Tier 1 evaluation. This involved a building inspection by a structural engineer, completion of the Tier 1 checklist, and limited calculations using the ASCE 31 "quick check" procedures.

Nonstructural Components

Nonstructural elements and equipment were also investigated. These were evaluated in a site survey by a structural engineer using the Tier 1 procedures of ASCE 31, supplement by additional guidance developed by DSA and other state agencies (Ref. 2).

Earthquake Ground Motions

Earthquake ground motions for the site were obtained from the seismic ground shaking maps found on the CD-ROM Seismic Design Parameters (Ref. 3). These ground shaking maps were developed by the U.S. Geological Survey under the National Earthquake Hazards Reduction Program (NEHRP). Ground motions at the site were determined for the Maximum Considered Earthquake (MCE). This represents an earthquake with only 2-percent chance of being exceeded in 50 years (i.e., an earthquake with a 2,500 year return period). At this location, the MCE has a peak ground acceleration of 0.77g; however, only 2/3 of this level of motion (0.51g) is required to be used in the evaluations done under ASCE 31. Site class D (default class) was used.

The yard is located approximately 1 mile west of the Hayward fault. This is a large fault and believed capable of a magnitude 7.0 or larger earthquake. This would produce very strong shaking at the site.

3. Buildings

There are two buildings at the yard (Figure 1). Both are reported to have been relocated to the site from other places. One is a 1,320 sf wood frame structure, and the other is a 1,980 sf prefabricated metal building. These are used as shops and offices.

Wood Frame Building

This is a one-story structure (Figure 2) that is approximately 26' x 50' in plan. The roof is supported by light wood trusses spaced at 2'-8" and has 1X8 straight sheathing. Walls are wood frame construction with board and batten wood siding. Other than a small office in the N/E corner, there are no interior walls. Several of the walls have a number of large openings, evidently put in at various times, that significantly weaken them. In general, the walls can not be considered real structural shear walls (i.e., walls sheathed with diagonal sheathing or plywood) although they do have some capacity to act as shear walls.

The building supported is on individual precast concrete footings spaced about 4 feet apart longitudinally (Figure 3). These are about 1 foot high and essentially not structurally connected to the floor framing. There are no concrete strip footings, sill plates or cripple walls.

No drawings for the building are available, and a survey by a structural engineer from our office was conducted. The general condition of the exterior of the building is poor. The paint is badly weathered, and there is rot on a number of rafter ends. Many of the exterior walls have had large openings made for windows. Some have subsequently been covered over.

An ASCE 31 Tier 1 evaluation was preformed, and the building was found to not meet the life safety criteria. The biggest and most significant problem is lack of foundation anchorage. When a magnitude 6.0 or larger event occurs on the Hayward fault, there is a very high likelihood that the building will fall off its supports (see Figure 4 for an example of a structure that has shifted off of its foundations). If this happens, it will not be useable and may not be repairable.

The walls of the building have wood siding with many openings. These were checked using the ASCE 31 quick check procedures. Because of the nonstructural nature of the siding, an allowable shear capacity of 100 plf was used. Maximum demand to capacity ratios (D/C) were 2.0 and 1.1 for the longitudinal (N/S) and transverse (E/W) walls.

Prefab Metal Building

The metal building is one-story structure (Figures 5 and 6) that is 39' x 50' in plan. It has a light gage metal roof and walls. Lateral forces are resisted by three moment frames in the N/S direction and by 1/2-inch diameter rod x-bracing (on the north and south walls) in the E/W direction. The building frame rests on a slab on grade with possible spread footings beneath the columns.

Considering its age (estimated to be 30 to 40 years old, possibly older), it is in relatively good condition. No drawings for the structure were available, and a structural engineer from our office examined the building to collect the information needed for the Tier 1 evaluation. There are two bays of horizontal rod x-bracing in the roof. On one bay, one leg of the rod x-bracing is missing.

The building was evaluated and found not meet the Tier 1 criteria. There are several noncompliant items. These include nonconforming moment-connections in the moment frames and the missing roof bracing. The vertical rod x-bracing in the walls does not meet criteria. It has a demand to ratio capacity (D/C) of 1.2.

There are two mezzanines in the prefab building. These do not meet building code structural requirements. They are discussed further in Section 5 under nonstructural hazards.

Prefab metal buildings have had an excellent earthquake performance record, particularly in avoiding collapse. We believe it unlikely that the building would collapse in an earthquake. The more significant risk to the maintenance staff in the building comes from nonstructural hazards (see discussion in Section 5) and possible structural failure of the ad hoc mezzanine construction.

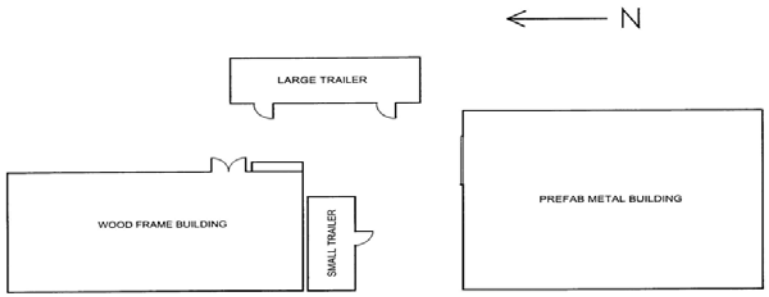


Figure 1 – Corporation yard site plan showing the approximate layout of buildings.

Figure 2 – Wood frame building. This is showing deterioration on its the exterior. The ends of many roof rafters are rotten and the paint is peeling off the siding in many places.

Figure 3 – The wood frame building is supported on one foot high precast concrete piers. These do not provide resistance to lateral forces.

Figure 4 – This Watsonville house shifted off its foundation and fell to the ground during the 1989 Loma Pieta earthquake.

Figure 5 – Prefab metal building. This structure was relocated to the site from another location and is in relatively good condition for its age.

Figure 6– Inside view of the prefab metal building showing a moment frame and rod bracing.

4. Trailers

There are two trailers in the yard, a large trailer and a small trailer. These are used as offices. The trailers appear to be former mobile construction offices that have been converted to their present use.

Large Trailer

The large trailer (Figure 7) is 10' x 32' in plan. It consists of two "rooms", an office and a restroom. Its floor level is about 2 feet above the ground. It is vertically supported on several small, slender individual precast concrete footings. These are about 18 inches tall and provide only vertical support. The trailer lacks foundation anchorage.

The large trailer does not meet the Tier 1 criteria because it lacks foundation anchorage. Trailers and mobile homes without anchorage frequently fall off their supports in earthquakes (see Figure 8). While the life safety risk is generally small, immediate use of the trailer afterwards is prevented and repairs are generally required.

Small Trailer

The small trailer (Figure 9) is 8' x 20' in plan. It is vertically supported by several steel jacks (Figure 10). Similar to the large trailer, it does not have foundation anchorage and is vulnerable to falling off its support in an earthquake. It also does not meet the Tier 1 criteria.

Discussion of Results

Both trailers are very vulnerable to falling off their supports in an earthquake. This deficiency can be fixed by installing bracing to secure the trailer to the ground. Because of their age (estimated to be more than 25 years), the devices manufactured today may not be adaptable to them, but it is possible to build custom hardware to secure them. The California Department of Housing and Community Development maintains standards for seismic bracing of mobile homes, and these can be used as a design basis.

Figure 7 – Large trailer.

Figure 8 – An example of a trailer (mobile home) that has fallen off its supports.

Figure 9 – Small trailer.

Figure 10 - Typical steel jack support for the small trailer. This type of support does not provide lateral resistance and frequently fails in earthquakes.

5. Nonstructural Hazard Survey

Survey Methodology

This section describes the survey conducted for nonstructural hazards and presents the results. The purpose of the survey was to identify potential falling and other hazards.

Nonstructural components consist of things that are brought into a building after it has been constructed (e.g., furnishings, bookshelves, and building contents) as well as items that were installed when the building was built (e.g., mechanical and electrical equipment and fixtures, ceilings, and partitions). These can become hazards when they break, fall, slide or overturn. When this happens they can cause injury, block exits, and create secondary hazards such as chemical spills, gas leaks and postearthquake fires.

A nonstructural hazard survey of the four corporation yard structures was conducted using ASCE 31 Tier 1 procedures. The Basic and Intermediate Nonstructural Component Checklists were used. The survey involved a room-by-room inspection of all buildings by a structural engineer experienced in seismic design. The survey was conducted on June 28 and July 3, 2007.

Table 1 summarizes results for the wood frame building. Table 2 summarizes results for the prefab metal building, and Table 3 summarizes results for the two trailers. There is so much material in the prefab metal building, that Table 2 lists only the more obvious and significant concerns. The tables identify the items examined, the estimated vulnerability of the item, and observations about each. The survey was entirely visual, and no drawings were reviewed or calculations prepared. The levels of vulnerability used are defined as follows:

Vulnerability	Characteristics
High (H)	Noncompliant under ASCE 31 Tier 1 procedures. Possesses little or no seismic resistance; item may break, fall, slide or overturn during strong shaking. High probability of damage under strong shaking. May cause injury to persons in vicinity.
Moderate (M)	Possesses some seismic resistance, but not as much as an item rated low.
Low (L)	Compliant under ASCE 31 Tier 1 procedures. Possesses good seismic resistance, should resist moderate shaking without damage. Low probability of damage under strong shaking. Unlikely to cause injury to persons in vicinity.

Building Contents

In addition to the survey results given in Tables 1, 2 and 3, it should be noted that there are many unrestrained contents. These include such things as stored materials and parts on shelves. While these are a threat to fall to the floor and may result in economic loss, they are generally not considered serious life-safety hazards unless they are heavy or overhead.

The prefab metal building, in particular, will be “trashed” after a large earthquake on the Hayward fault. There are many unrestrained items that will fall off shelves and other “supports” (see Figures 11 and 12 for examples).

The large trailer has a stack of heavy wood flat files stacked near the door area. These may be a serious falling hazard to personnel in the trailer.

Racks, Storage Shelving and Cabinets

All racks, shelving and tall cabinets appear to be unanchored (the bases of many of these can not be seen because of the clutter). Those over 4 feet tall with height to depth ratios of 3.0 or greater are considered a hazard to overturn (Refs. 1 and 2).

Natural Gas

The buildings and trailers have no natural gas supply. Consequently, there is no risk of postearthquake fire from natural gas leaks.

Mezzanines in the Prefab Metal Building

Several interior structural modifications have been made to gain storage space. A small ad hoc mezzanine has been constructed in the S/E corner (see Figures 13 and 14). Another mezzanine has been created on the west side of the building by placing wood floor joists and plywood over steel shelving (Figures 15 and 16). These have not been engineered and do not meet code requirements. Their structural safety is doubtful, and they do not meet ASCE 31 requirements.

Materials stored on the mezzanines are unrestrained and can fall off during an earthquake, creating a falling hazard.

Table 1 – Nonstructural Survey Results for the Wood Frame Building

Item	Vulnerability	Comments
1. Fluoresent light fixtures	L-H	Some chain-hung and others fastened to bottom chords of trusses.
2. Exterior windows	Unknown	Assorted glazing.
3. Materials stored overhead	H	Some material is stored in trusses or in wood frames secured from trusses. This material is unrestrained and could shift, becoming a falling hazard.
4. Shelving for lumber	M-H	Relatively large weight of wood stored on shelves.
5. Band saw	H	Unanchored
6. Drill press	H	Unanchored
7. Shelves on work bench	H	Unsecured
8. Metal storage cabinet	H	Unsecured
9. Windows in office area	H	Ordinary glass.
10. Metal shelving	L	Two racks against wall, secured to wall.

Table 2 - Nonstructural Survey Results for the Prefab Metal Building

Item	Vulnerability	Comments
1. Fluorescent light fixtures	L-M	Some chain-hung and some secured to purlins. Some may swing and impact the structure or contents.
2. Incandescent light fixtures	Unknown	Four large fixtures hung from purlins, possibly low (L) risk but this is uncertain.
3. Speedaire compressor	H	Not anchored to floor, can slide.
4. Storage racks	M-H	Mostly back to back 111" H x 22" D, H/D=5.0. These racks also provide vertical support for the west mezzanine.
5. Metal storage cabinets	H	Unrestrained
6. Small storage rack	H	Unrestrained 5-foot high rack containing containers of flammable materials.
7. Industrial storage rack	H	Tall steel storage rack that is not anchored to the floor.

Table 3 - Nonstructural Survey Results for the Trailers

Item	Vulnerability	Comments
Large Trailer		
1. Fluorescent light fixtures	L	Ceiling-mounted.
2. Refrigerator	M	Unrestrained, can slide.
3. Windows	M-H	Appear to be ordinarily glass.
4. Wood flat files	H	Unrestrained stack of six wood flat files. These are next to the door, and they can shift and/or overturn, blocking the exit. This is potentially a very serious life safety hazard.
5. File cabinet	H	One 4-drawer unit without drawer locks. This can tip over.
6. Locker	H	Unrestrained unit in restroom.
Small Trailer		
1. Fluorescent lights	L	Ceiling-mounted.
2. File cabinet	M	One 5-drawer unit with drawer locks.
3. File cabinet	H	One 5-drawer unit without drawer locks.
4. Metal storage cabinet	H	Unrestrained unit, 72" H x 36" W x 18" D, H/D=4.0.

Figure 11 – Boxes are stored on a ladder placed horizontally. These constitute a falling hazard, and the storage arrangement does not meet ASCE 31 requirements.

Figure 12 – The contents of these metal storage shelves can topple. Additionally, some shelves in the building are not anchored to the floor and can slide or tip over.

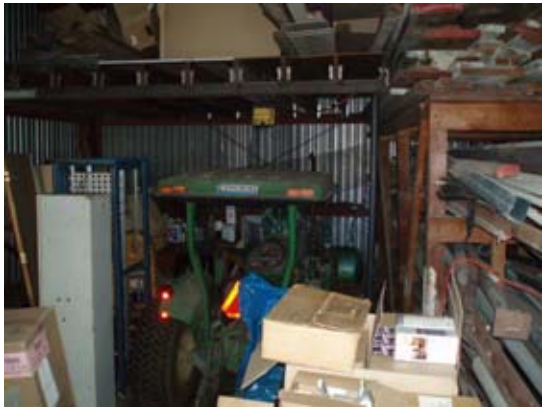


Figure 13 – An ad hoc mezzanine was installed in S/E corner of the prefab building. Materials on it are unrestrained and can fall off.

Figure 14 – One end of the joists supporting the S/E mezzanine are vertically supported by a light-gage girt. Girts are designed to resist horizontal wind loads and not substantial vertical dead loads. This arrangement does not meet building code structural requirements.

Figure 15 – The west mezzanine is partially supported on the tops of steel shelving.

Figure 16 – Wood posts supporting the west mezzanine are not structurally connected at their tops. This arrangement does not meet code structural requirements.

6. Summary and Recommendations

Summary

Two buildings and two trailers at the PUSD Corporation Yard were given ASCE 31 Tier 1 seismic evaluations for the life safety performance level. Nonstructural hazards were also examined using the Tier 1 nonstructural procedures of ASCE 31. Findings are summarized below.

(1) Wood frame building – this does not meet the Tier 1 criteria and would very likely fall off its supports in a large earthquake. If this happened, it would not be useable.

(2) Prefab metal building – this does not meet the Tier 1 criteria but the life safety risk is believed to be low. This structure is unlikely to collapse. There are significant nonstructural hazards within this building (see discussion below).

(3) Trailers – both trailers lack foundation anchorage and are vulnerable to falling off their supports. While the life safety risk is believed small, the trailers would probably not be available for use after an earthquake.

(4) Nonstructural hazards – there are many nonstructural hazards present, particularly in the prefab metal building. These consist primarily of unsecured contents and unanchored storage racks and shelves. Two mezzanines used for storage have questionable structural supports and do not comply with building code structural requitements. There is no gas service to the yard, and risk of postearthquake fire is believed to be low.

(5) Continued operations – it is very doubtful that the corporation yard facility would be useable after a large earthquake on the Hayward fault. Both trailers and the wood frame building would likely be off their foundations. The interior of the prefab metal building would have massive spillage and toppling of contents, stored parts, supplies, etc.

Recommendations

The corporation yard appears to be nearing the end of its useful life, and replacement may be an option because it is also seismically very vulnerable. However, if the District elects to mitigate the seismic deficiencies found, we recommend the following:

(1) The wood frame building should be strengthened to the Life Safety performance level of ASCE 41 “Seismic Rehabilitation of Buildings” (Ref. 4). This is the accepted standard for the seismic rehabilitation of existing buildings and has been accepted by DSA in the past (when previously designated as FEMA 356). The document represents the next step in an evaluation and rehabilitation process that starts with an ASCE 31 evaluation.

(2) An ASCE 31 Tier 2 evaluation of the prefab metal building should be done, followed by possible strengthening of this structure.

(3) The nonstructural hazards should be abated. Racks and shelving needed to be code compliant and seismically anchored or braced to prevent overturning. Heavy contents should be stored low. Ladders must not be used as shelves.

(4) The two mezzanines within the prefab building need to be either removed or replaced with code-compliant structures.

Finally, it should be noted that the above recommendations will need to be considered in conjunction with ADA, fire and safety, and OSHA considerations. These were not studied or considered in the work summarized in this report. These evaluations are being conducted by the architect for the project.

7. References

1. ASCE/SEI Standard 31-03, "Seismic Evaluation of Existing Buildings," Structural Engineering Institute, American Society of Civil Engineers, 2003.

2. "Guide and Checklist for Nonstructural Earthquake Hazards in California Schools," a Project of the California Governor's Office of Emergency Services, Division of State Architect, Seismic Safety Commission, and Department of Education, January 2003.

3. "Seismic Design Parameters," prepared by U.S. Geological Survey, Federal Emergency Management Agency, and Building Seismic Safety Council, Version 3.10, February 2001 (CD-ROM).

4. ASCE/SEI Standard 41-06, "Seismic Rehabilitation of Existing Buildings", Structural Engineering Institute, American Society of Civil Engineers, 2006.

APPENDIX A: BUILDING CODE ANALYSIS

Calculation of Building Area and Occupant Load

Building	sq. footage	Occ. Load Factor	Occupant Load
Building A:	1,320 sf	100	14
Building B:	1,980 sf	500	4
Building C:	320 sf	100	4
Building D:	160 sf	300	1
Total Area:	3,780 sf		

Chapter 3: Use or Occupancy

Main Occupancy Group: S-2 Storage

Accessory Occupancy Groups:

Administrative B Office

✓ No occupancy separation required between **S-1** and **B** Occupancy. (Table 3-B) CBC 302.1. Exception 2.2: "Administrative and Clerical offices & similar rooms which do not exceed 25 percent of the floor area of the major use."

Chapter 5: Building Limitations

Building A, B, C, and D:

Allowable Floor Area

	Allowance	Running Total
-Construction Type V no-hr:	8,000 sf	8,000 sf

(Allowable floor area without allowable area increases complies)

✓ Total actual floor area for all four structures: 3,780 sf

Allowable Height

✓ 40 feet, 2 stories (Type V -no hr) (Table 5-B)

Wall and Opening Protection (Table 5-A)

✓ Walls: Not permitted less than 5 ft.
✓ Walls: One-hour less than 20 ft.
✓ Walls: NR elsewhere
✓ Openings: Protected less than 10 ft., not permitted less than 5 ft.

Chapter 9: Fire Protection Systems

✓ Sprinklers not required for Group B and S-2 Occupancy.

Chapter 10: Means of Egress

Exits Required:

☒ Based on occupant load, one exit is required for Buildings A, B, C, and D. Building B does not have a compliant exit door as appropriate sign requiring the door to remain unlocked.

✓ Maximum travel distance to exit in non-sprinklered hallway is 150' (section 1007.3.3).

Stairs and Landings:

☒ Every stair shall have a landing area on each side of the door. Every stair shall have handrails on each side of the stairs. Building A, C, and D are deficient.

✓ Stair width shall not be less than 44". (Section 1007.3.6).

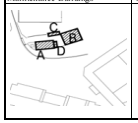
PIEDMONT SEISMIC SAFETY PROGRAM

PIEDMONT UNIFIED SCHOOL DISTRICT

PROJECT STATUS

MARCH 31, 2008

murakami/Nelson Architectural Corp.
Job No.: 0629 - PUSD Seismic

School / Site	Abbreviation	Building Designation	Building Name	Seismic Tier 1	Revised Seismic Tier 1	Letter From Ford & Flessner on Seismic Performance*	ATI Report (Accessibility / Seismic Performance)	Included in Scope Of Work (for m/N)	Qualitative Seismic Assessment by R.P. Gallagher	Quantitative Seismic Assessment by Peer Reviewer	Benchmark Building	Seismic Tier 2	Seismic Non-Structural Hazard Report	ADA / Access Evaluation	Life Safety Evaluation	Materials Testing Spring 2007	Materials Testing Summer 2007	Materials Testing Fall 2007	Materials Testing Winter 2007	Destructive Testing Spring 2007	Destructive Testing Summer 2007	Destructive Testing Fall 2007	Destructive Testing Winter 2007	Slope Stability Analysis - Site Specific Spectra	Peer Review at Investigation and Analysis	Peer Review Non Structural	Peer Review at Concept Design	Peer Review at Schematic Design	Peer Review at Design Development	Peer Review at 100% Construction Documents	Existing Hazardous Materials Reports at m/N possession	Hazardous Materials Report by Hazard Management Services, Inc.	Topographical Survey	Title Report	Boundary Survey	Existing Geotechnical Reports	Existing Structural Calculations at m/N possession	Existing Specifications at m/N possession	Measured Drawings - Architectural	Measured Drawings - Structural	DSA Drawing in m/N Possession	DSA Drawing Date	DSA Number for Drawings	Drawings	Architect	Concept Plan	Cost Estimate (1)	Refined Concept Plan / Vision	Cost Estimate (2)	Comments
Maintenance Buildings	MB																																															
		A	Wood Workshop	●				●	●			×	●	●	●	×				×				●	●	●	●	○	○	○	○	●	×	×	×	×	×	●	×	×	-	-	None	Unknown	●	●	×	×	
		B	Metal Storage	●				●	●			×	●	●	●	×				×				●	●	●	●	○	○	○	○	●	×	×	×	×	×	●	×	×	-	-	None	Unknown	●	●	×	×	
		C	Large Trailer Office, Break Rm. &	●				●	●			×	●	●	●	×				×				●	●	●	●	○	○	○	○	●	×	×	×	×	×	●	×	×	-	-	None	None	●	●	×	×	
		D	Small Trailer Office	●				●	●			×	●	●	●	×				×				●	●	●	●	○	○	○	○	●	×	×	×	×	×	●	×	×	-	-	None	None	●	●	×	×	

LEGEND

- ○ NEEDED/IN PROGRESS
- ● YES / OK / COMPLETE
- ○ DO NOT HAVE
- ● NON CONCLUSIVE
- × NOT NECESSARY
- ○ Pending Authorization
- ● NO

Shaded Area Indicates Tier 2 Seismic Analysis.