STRUCTURAL EVALUATION OF

MONTALVIN ELEMENTARY SCHOOL

WEST CONTRA COSTA UNIFIED SCHOOL DISTRICT (WCCUSD)

For

WLC Architects
Kaiser Building
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By

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10.1 Introduction

The purpose of this report is to perform a seismic assessment of the Montalvin Elementary School in San Pablo, CA. The structural assessment includes a site walk through and a limited study of available architectural and structural drawings. The purpose of the structural assessment is to identify decay or weakening of existing structural materials (when visible), to identify seismic deficiencies based on our experience with school buildings, and to identify eminent structural life-safety hazards.

The school campus has had a walk-through site evaluation and a limited study of available architectural and structural drawings. The general structural condition of the buildings and any seismic deficiencies that are apparent during our site visit and review of existing drawings are documented in this report. This report includes a qualitative evaluation and, therefore, numerical seismic analysis of buildings is not included.

The site visits did not include any removal of finishes. Therefore, identification of structural conditions hidden by architectural finishes or existing grade was not performed.

10.2 Description of School

The school is located in the city of San Pablo and was built in two stages. The original campus construction appears to have taken place in 1956. This consisted of two Classroom Buildings, an Administration Building, and a Multipurpose Building. The single story Classroom Buildings are constructed of steel framing with a metal deck roof and concrete shear walls. The wood framed administration building is also single story, as is the multipurpose building, which is concrete tilt-up construction with a wood framed roof. The second stage of construction occurred in 1965, and included additions to both of the previous Classroom Buildings and a new Library Building. Unlike the original construction, the classroom additions and Library Building were constructed with traditional wood-framing. The campus does not contain any portable buildings. The total square footage of the campus is about 37,947 square feet.

10.3 Site Seismicity

The site is a soil classification S_C in accordance with the 1998 California Building Code (CBC) and as per the consultants, Jensen Van Lieden Associates, Inc.

The classroom buildings have an educational occupancy (Group E, Division 1 and 2) and the multi-purpose building has an assembly occupancy (Group A, Division 2.1 or 3), both of which have an importance factor in the 1998 CBC of 1.15. The campus is located at a distance of less than 2 kilometers from the Hayward fault. The wood-framed buildings described above utilize plywood shear walls to resist lateral loads. Similarly the concrete buildings use concrete shear walls for seismic resistance. The response modification factors for these bearing wall systems are as follows: R=5.5 (plywood shear walls) and R=4.5 (concrete shear walls). The 1998 CBC utilizes a code level earthquake, which approximates an earthquake with a 10% chance of exceedance in a 50-year period or an earthquake having a 475-year recurrence period.

The seismic design coefficient in the 1998 CBC for the plywood shear wall buildings is:

$$V = \frac{2.5C_a IW}{R} = \frac{2.5(0.44x1.50x1.15)W}{5.5} = 0.314W$$

The seismic design coefficient in the 1998 CBC for the concrete shear wall buildings is:

$$V = \frac{2.5C_a IW}{R} = \frac{2.5(0.40x1.50x1.15)W}{4.5} = 0.383W$$

The site seismicity is used to provide a benchmark basis for the visual identification of deficient elements in the lateral force resisting systems of campus buildings.

10.4 List of Documents

1. Classroom Building Additions, Library Building: Jack Buchter – Architect – A.I.A. and Associates, Sheets 1 - 3, January 29, 1965; Eric O. Moorehead Structural Engineer, Sheets S-1 – S-3, March 3, 1965.
2. "Measure M" – WCCUSD Elementary School – UBC revised parameters by Jensen- Van Lienden Associates, Inc., Berkeley, California.
3. "Geological Hazard Study – Recently constructed portable buildings – 24 school sites for Richmond Unified School District," by Jensen-Van Lienden Associates, Inc. dated March 7, 1990.
4. "Measure M" roofing report by "the Garland Company Inc.", Orinda, California.

10.5 Site Visit

DASSE visited the site on October 24th, 2001 and March 8th, 2002. The main purpose of the site visit was to evaluate the physical condition of the structure and in particular focus on the lateral force resisting elements of the building. The following items were evaluated during the site visit:

1. Type and Material of Construction
2. Type of Sheathing at Roof, Floor, and Walls
3. Type of Finishes
4. Type of Roof
5. Covered Walkways
6. Presence of Clerestory Windows
7. Presence of Window Walls or High Windows in exterior and interior walls
8. Visible cracks in superstructure, slab on grade and foundation

The multipurpose building is a single story structure with transverse beams spanning the 45'-0" width of the building. The concrete walls indicate that the building was constructed by the tilt-up method, and it is anticipated that the roof is wood-framed, although this cannot be verified visually due to the acoustical tile ceiling. It is also expected that the anchorage of these concrete walls to the wood roof diaphragm is inadequate and poses a life safety hazard. A large settlement cracked in the slab on grade was observed running across the width of the building, and foundation cracks were apparent at the building's exterior (see figure 3), which should be investigated by geotechnical engineer. On the west side of the building, the kitchen area has a lower roof diaphragm, where the out of plane anchorage of the concrete walls should also be addressed.

Because the ceiling has been removed from the single story classroom buildings, the steel roof beams are observed spanning the longitudinal length of the classrooms and supporting a metal deck roof that spans in the transverse direction of the building (see figure 4). The steel beams are supported throughout the structure by intermediate concrete walls between the classrooms. The outside longitudinal walls at the classrooms are metal deck walls (exposed to the exterior) with stiffeners spaced at 6'-0" on center between windows, and the corridor walls are concrete. While the steel beams act at struts to support the transverse walls under out of plane loading, the corridor walls do not appear to have adequate anchorage. This deficiency in out of plane wall anchorage constitutes a life safety hazard. Each classroom also has a skylight filled with wood framing. The additions to the classroom buildings are traditional wood-framed structures (see figure 5). Hard conduits were observed running across the transition between the original classroom building and its addition without provision for the differential displacement of the two structures. This also represents a life safety concern.

The administration building, which dates back to the original campus construction, appears to be of a hybrid of steel/wood framing. Wood planks span 6'-0" to steel beams spanning in the transverse direction of the building. While the building has significant solid walls on three sides, the long window wall at the building's front has minimal strength to resist seismic forces, resulting in a life safety hazard. Built along with the classroom additions, the library building is also a traditional wood-framed building with wood joists spanning between wood stud bearing walls. Lastly, the campus contains some miscellaneous covered walkways, which are supported by multiple buildings. This condition, including the hard conduits that occur at the covered walkway structures, represents a life safety hazard due to the inability of the system to withstand the potential differential movements of the adjacent buildings. It should also be noted that while waterproofing issues are beyond the scope of this evaluation, the users of the campus have expressed concern over water leakage in both the multipurpose and classroom buildings.

10.6 Review of Existing Drawings

Construction drawings for the multipurpose building are not available for review at this time (see figure 3). The existing roof of the multipurpose building was not evaluated in the "Measure M" roofing report provided by the Garland Company Inc.

Construction drawings for the original classroom buildings are not available for review at this time (see figures 4, 6, 7, and 9). The existing roofs of the classroom buildings were not evaluated in the "Measure M" roofing report provided by the Garland Company Inc.

The wood-framed additions to the classroom buildings are separate structures with a 1½" seismic separation from the original structure (see figures 5, 6, 8, and 9). Given the stiffness of these two shear wall structures this separation is expected to be adequate to prevent pounding of the two buildings, but the prevention of this pounding action should a primary design consideration in the implementation of the rehabilitation measures recommended below. At the classroom additions the roofs are framed with typical 2x14 joists spaced at 16" on center, sheathed with 1/2" plywood, and supported by 2x6 stud bearing walls. Substantial lengths of plywood (3/8") shear walls resist seismic loads at each side except the window walls at the north and south ends of the additions (figures 6 and 8). While shorter shear panels do exist at these walls it is likely that more of the wall will need to be sheathed in order to provide adequate resistance to seismic loads. Double top plates with nailed splice connections provide continuity for the transfer of chord and collector forces, but the strength of these splices is minimal and likely to be inadequate to resists the required seismic forces at the north and south window walls. These buildings are founded on reinforced concrete strip footings of a typical 1'-2" width. For the resistance of uplift forces, foundation tie downs have been provided only at the short shear walls. A positive connection may be necessary at the other wall locations as well. The life safety hazards identified at the classroom building additions include the inadequate shear wall and collector splice strength at the window walls, and a lack of uplift connection at the shear wall locations. The existing roofs of the classroom building additions were not evaluated in the "Measure M" roofing report provided by the Garland Company Inc.

Construction drawings for the administration building are not available for review at this time (see figure 2). The existing roof of the administration building was not evaluated in the "Measure M" roofing report provided by the Garland Company Inc.

Similar to the classroom additions, the library building is a wood-framed structure with 2x12 joists at 24" on center supported by 2x6 stud bearing walls (see figure 2). The roof is sheathed with 1/2" plywood with a maximum 49'-0" diaphragm span. Plywood (3/8") shear walls are provided to resist seismic forces. Significant lengths of shear wall occur in the transverse direction and at the west wall, but due to a long window wall the shorter length of shear wall at the east side of the building is likely to be inadequate. Continuity for the transfer of chord and collector forces is provided by double top plates with nailed splices, but the strength of these splices is minimal and likely to be inadequate to resists the required seismic forces at the longitudinal walls. Reinforced concrete strip footings make up the foundation system of the building. While tie down connections are provided at some of the existing shear wall locations, this type of positive connection to the foundation is likely to be needed at the other shear wall locations as well. The life safety hazards identified at the library building include the inadequate shear wall and collector splice strength at the longitudinal walls, and a lack of uplift connection at the shear wall locations. The existing roof of the library building was not evaluated in the "Measure M" roofing report provided by the Garland Company Inc.

Construction drawings for the miscellaneous covered walkways are not available for review at this time.

10.7 Basis of Evaluation

The document FEMA 310, Federal Emergency Management Agency, *"Handbook for the Seismic Evaluation of Buildings – A Prestandard,"* 1998, is the basis of our seismic evaluation methods, although no numerical structural analyses were performed. The seismic performance levels that the FEMA 310 document seeks to achieve are lower than the current Building Code. However, it attempts to identify potential for building collapse, partial collapses, or building element life safety falling hazards when buildings are subjected to major earthquake ground motion.

10.8 List of Deficiencies

Building deficiencies listed below have corresponding recommendations identified and listed in Section 10.9, which follow the same order as the itemized list of deficiencies identified below. The severity of the deficiency is identified by a *"structural deficiency hazard priority"* system based on a scale between 1.0 and 3.9, which is described in Section 10.11. These priority ratings are listed in section 10.9. Priority ratings between 1.0 to 1.9 could be the causes for building collapses, partial building collapses, or life-safety hazards, if the corresponding buildings are subjected to major earthquake ground motions, which are possible at these sites. It is strongly recommended that these life safety hazards are mitigated by implementing the recommendations listed below.

Item	Building Structural Deficiencies
1.	Multipurpose Building: Strength of anchorage connection of concrete walls to the roof diaphragm is likely to be inadequate to transfer the required out-of-plane seismic forces.
2.	Classroom Buildings: Strength of anchorage connection of longitudinal concrete walls to the roof diaphragm is likely to be inadequate to transfer the required out-of-plane seismic forces.
3.	Classroom Building Additions: Strength of wood shear walls at the window walls is likely to be inadequate to resist shear forces.
4.	Classroom Building Additions: Strength of collector/chord elements is likely to be inadequate to resist prescribed forces at the window walls.
5.	Classroom Building Additions: Positive connection of shear walls to foundation is lacking at some shear walls.
6.	Administration Building: Strength of wood shear wall at the front window wall is likely to be inadequate to resist shear forces.
7.	Library Building: Strength of wood shear walls at the east window wall are likely to be inadequate to resist shear forces.
8.	Library Building: Strength of collector/chord elements is likely to be inadequate to resist prescribed forces at the longitudinal walls.
9.	Library Building: Positive connection of shear walls to foundation is lacking at some shear walls.
10.	Covered Walkways: Structure is tied to multiple adjacent buildings with no provision to accommodate differential movement.
11.	Classroom Buildings/Covered Walkway: Electrical conduits are connected to adjacent buildings with no provision to accommodate differential movement.

10.9 Recommendations

Items listed below follow the same order as the itemized list of deficiencies identified in section 10.8 above.

Item	Recommended Remediation	Priority	Figure Number
1.	Provide new out-of-plane anchorage connection and continuity ties in roof diaphragm.	1.0	N/A
2.	Provide new out-of-plane anchorage connection and continuity ties in roof diaphragm.	1.0	N/A
3.	Remove some windows and replace with new stud framing and plywood sheathing.	1.1	6
4.	Provide new strapping at inadequate locations.	1.5	N/A
5.	Provide new holdown anchors into existing foundation at lacking locations.	1.5	N/A
6.	Remove some windows and replace with new stud framing and plywood sheathing. Provide holddown anchors and collectors as required.	1.1	2
7.	Remove some windows and replace with new stud framing and plywood sheathing.	1.1	N/A
8.	Provide new strapping at inadequate locations.	1.5	N/A
9.	Provide new holdown anchors into existing foundation at lacking locations.	1.5	N/A
10.	Provide new beams and columns to support the covered walkway framing near each adjacent building.	1.9	N/A
11.	Provide new flexible electrical conduits in covered walkway and between adjacent buildings.	1.9	N/A

10.10 Structural Deficiency Prioritization

This report hazard rating system is based on a scale of 1.0 to 3.9 with 1.0 being the most severe and 3.9 being the least severe. Based on FEMA 310 requirements, building elements have been prioritized with a low rating of 1.0 to 1.9 if the elements of the building's seismic force resisting systems are woefully inadequate. Priority 1.0 to 1.9 elements could be the causes for building collapses, partial building collapses, or life-safety falling hazards if the buildings were subjected to major earthquake ground motion.

If elements of the building's seismic force resisting system seem to be inadequate based on visual observations and based on FEMA 310 requirements, but DASSE believes that these element deficiencies will not cause life-safety hazards, these building elements have been prioritized between a rating low of 2.0 to 3.9. These elements could experience and / or cause severe building damage if the buildings were subjected to major earthquake ground motion. The degree of structural damage experienced by buildings could cause them not to be fit for occupancy following a major seismic event or even not repairable.

The following criteria was used for establishing campus-phasing priority:

First, the individual element deficiencies which were identified during site visit and review of existing drawings were prioritized with a rating between 1.0 to 3.9 and as described in this section.

The next step was to arrive at a structural deficiency rating between 1 and 10, with a rating of 1 representing a school campus in which the building's seismic force resisting systems are woefully inadequate.

Based on the school district's budgetary constraints and scheduling requirements, each school campus was given a phasing number between one and three. Phase I represents a school campus with severe seismic deficiencies, Phase II represents a school campus with significant seismic deficiencies and Phase III represents a school campus with fewer seismic deficiencies.

10.11 Conclusions

1. Given the vintage of the building(s), some elements of the construction will not meet the provisions of the current building code. However, in our opinion, based on the qualitative evaluations, the building(s) will not pose serious life safety hazards if the seismic deficiencies identified in section 10.8 are corrected in accordance with the recommendations presented in section 10.9.

2. Any proposed expansion and renovation of the building should include the recommended seismic strengthening presented in section 10.9. Expansion and renovation schemes that include removal of any portion of the lateral force resisting system will require additional seismic strengthening at those locations. It is reasonable to assume that where new construction connects to the existing building, local seismic strengthening work in addition to that described above will be required. All new construction should be supported on new footings.

3. Overall, this school campus has a seismic priority of 2, and we recommend that seismic retrofit work be performed in Phase I.

10.12 Limitations and Disclaimer

This report includes a qualitative (visual) level of evaluation of each school building. Numerical seismic analyses of buildings are not included in this scope of work. The identification of structural element code deficiencies based on gravity and seismic analysis demand to capacity evaluations are therefore not included. Obvious gravity or seismic deficiencies that are identified visually during site visits or on available drawings are identified and documented in this report.

Users of this report must accept the fact that deficiencies may exist in the structure that were not observed in this evaluation. Our services have consisted of providing professional opinions, conclusions, and recommendations based on generally accepted structural engineering principles and practices.

Figures

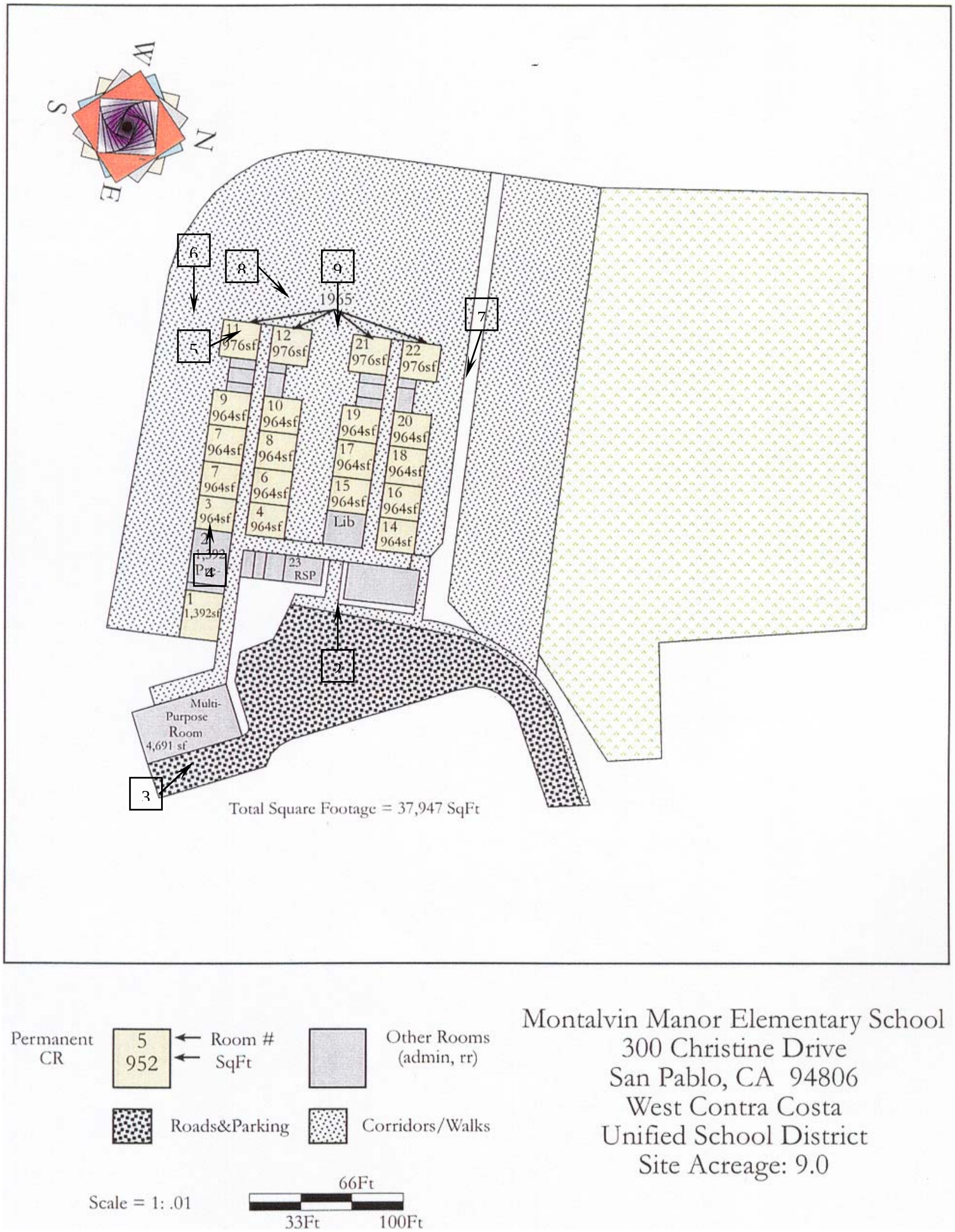

Figure 1: School Layout Plan

Figure 2: Main Entrance

Figure 3: Multipurpose Building, east face

Figure 4: Classroom Building, interior of classroom

Figure 5: Classroom Building Addition, interior of classroom

Figure 6: Classroom Building, south face

Figure 7: Classroom Building, north face

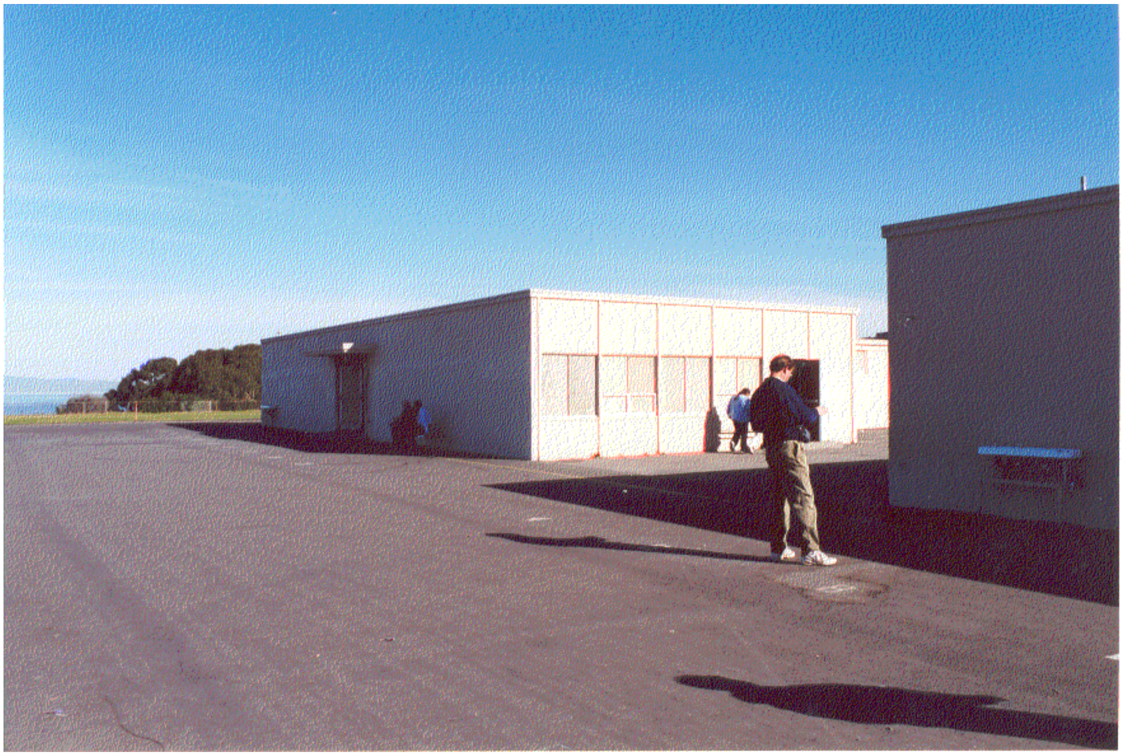

Figure 8: Classroom Building Addition, west face

Figure 9: Classroom Building, between buildings