STRUCTURAL EVALUATION OF

MIRA VISTA ELEMENTARY SCHOOL

WEST CONTRA COSTA UNIFIED SCHOOL DISTRICT (WCCUSD)

For

WLC Architects
Kaiser Building
1300 Potrero Avenue
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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 Mira Vista Elementary School in Richmond, 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 and quantitative evaluation of the buildings. A limited lateral (seismic) numerical analysis was performed to identify deficient lateral elements which could pose life safety hazards.

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 Richmond and the original campus was built in 1949. An addition of additional classroom wings was added in 1955. The construction is a mix of wood steel and masonry construction. The wood roof is typically supported on steel frames while the exterior walls are constructed of concrete block. The total square footage of the permanent structures is about 48,671 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 main classroom building has an educational occupancy (Group E, Division 1 and 2 buildings) and the Multi-Purpose building has an assembly occupancy (Group A, Division 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 2.0 kilometers from the Hayward fault. The classroom and multi-purpose buildings support the vertical loads with a combination of steel columns, masonry walls, and wood walls. The lateral forces are resisted by a combination of masonry and plywood shear walls, and steel braced frames, and thus have a response modification factor R = 4.5. 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 is:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.40x1.50x1.15)W}{4.5} = 0.384W$$

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. The calculated base shear was used to perform a limited lateral analysis of the school buildings as described in section 10.7.

10.4 List of Documents

1. Mira Vista Elementary School, dated August 5, 1949, by Miller & Warnecke Architects, Sheets A1-A21, and Hall & Pregnoff Structural Engineer, Sheets S1-S13
2. Mira Vista Elementary School, dated January 26, 1966, by John Carl Warnecke and Associates Architects, various sheets, and Wildman & Morris, Structural, Sheets S1, S1R, S3, S6-S13s dated
3. "Measure M" – WCCUSD Elementary School – UBC revised parameters by Jensen-Van Lienden Associates, Inc., Berkeley, California.
4. "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.
5. "Measure M" roofing report by "The Garland Company Inc.", Orinda, California.

10.5 Site Visit

DASSE visited the site on November 8th, 2001 and March 7th, 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. 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 buildings are one story with steel posts and beams and a combination of masonry and wood walls. There are continuous skylights in the roof along the north side of the classroom buildings, which raises concerns about the completeness of the diaphragm. In addition the back walls of the classrooms have few if any shear walls.

The roof framing consists of wood joists spanning to steel frames supported on steel pipe columns. The exterior concrete masonry walls of the buildings are offset from the pipe columns.

Much of the full height CMU walls showed signs that holes had been drilled into the cells and later filled with grout (Figure 15). We noted that a number of the CMU walls showed signs of small vertical cracks (Figure 16).

At a number of locations there are trellis and roof overhangs that are not protected by roofing or flashing (Figures 14 & 15). There is some signs that these exposed wood members are subject to decay because of this condition.

The Multi-Purpose building roof has steel wide flange bents spanning the 50' plus span which are supported on steel wide flange columns. Diagonal sheathing was observed at the roof of the Multi-Purpose Building. The Multi-Purpose has an acoustic tile ceiling CMU walls.

At both exterior walls there are high windows limiting the available length of shear wall. At the back wall of the Multi-Purpose there are some slight cracks.

The front canopy walkway needs bracing because of the minimal lateral resistance provided by the 3" diameter pipe columns. The covered walkways connect the buildings without any provision for building movement and as a result are likely to be damaged in an earthquake. In addition the electrical conduits and pipes that run along these covered walkways are likely to break as a result of the differential movement (Figure 17).

10.6 Review of Existing Drawings

The drawing review was performed on the drawings for the original 1949 buildings. We were not provided with any drawings for the 1955 addition. The 1966 set of drawings was a revision to the 1949 drawings. Due to the lack of construction drawings signed off by the Division of the State Architect for the 1955 addition the school district should verify that this work was done with proper permits.

The classroom roof construction consists of diagonal sheathing supported on 2x wood joists at 24" oc. In turn, the roof joists are supported by steel beams and pipe columns, which are supported, by spread footings. The floors of all of the classroom buildings consist of concrete slabs on grade.

The lateral forces are distributed to the shear walls by means of the diagonally sheathed roof diaphragms. When portions of the buildings were reconstructed in 1966 after a fire some of diagonal sheathing for the Administration Building were replaced by ½" plywood. The diaphragm forces are transferred to the foundation by means of either perimeter reinforced concrete masonry walls or interior plywood sheathed walls. Holdowns were installed at the ends of the plywood shear walls. At the continuous skylights in the classroom buildings diagonal rod bracing was installed behind the glazing in several bays to compensate for the lack of roof sheathing. At the rear wall of the classroom buildings little to no shear walls were provided.

The concrete masonry used (both 8" and 16" thick walls) was specified to have reinforcement in both directions and is solidly grouted. The CMU walls were positively tied to either the steel framing or to the roof joists.

The Multi-Purpose Building is similar to the other construction with the addition of a transverse steel braced frame at the front of the stage. In the longitudinal direction steel braced frames were added on each side of the Multi-Purpose Building.

The covered walkways that connect the buildings are interconnected and thus will likely be damaged in an earthquake. Thus consideration should be given to adding seismic movement joints between the buildings and providing additional seismic bracing of the covered walkways.

The roof age is reported as 8 years and no roof work is believed necessary.

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 qualitative seismic evaluation methods. The seismic performance levels that the FEMA 310 document seeks to achieve are lower than the current Building Code. However, it attempts to identify the potential for building collapse, partial collapses, or building element life safety falling hazards when buildings are subjected to major earthquake ground motion.

The California Building Code (CBC 1998) is the basis of our quantitative seismic evaluation methods. Base shears identified in section 10.3 were used to perform a limited lateral seismic analysis of the school buildings. The scope of the analysis was not to validate every member and detail, but to focus on those elements of the structure determined to be critical and which could pose life safety hazards. Member *strength* values are based on the document FEMA 356, Federal Emergency Management Agency, *"Prestandard and Commentary for the Seismic Rehabilitation of Buildings"* 2000.

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.	Covered walkways are connected at each end to buildings creating possibility that when buildings move independently the walkway may tear away and collapse.
2.	At the overhangs and covered walkways the exposed steel is showing some signs of rust.

3.	At the front covered walkway between the Multi-Purpose Bldg. and the Kindergarten Classrooms there appears to be a lack of lateral bracing.
4.	There is some slight cracking of the rear wall of the Multi-Purpose Building
5.	The connections of the braced frames on the north and south sides of the Multi-Purpose Building are overstressed.
6.	The connections of the braced frame at the front of the Multi-Purpose room stage are overstressed.
7.	The water stains on the acoustical ceiling tiles in the Classrooms may indicate roof leaks.
8.	The rod bracing used to transfer the roof shears across the clerestory windows in the classrooms are slightly overstressed.
9.	Exposed roof joists and covered walkway members that are not protected from the elements show some signs of decay

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 supplemental support adjacent to each building so that damage will not lead to collapse of the walkway. Reroute conduits and piping so that it is not supported by covered walkways.	1.9	3
2.	Remove the rust and paint the steel that is rusting.	3.0	4
3.	Add new moment connections or knee bracing, at walkway columns.	1.9	5
4.	Grout and seal the cracks in the Multi-Purpose rear walls	3.0	6
5.	Reinforce the connections of the braced frames on the North and South walls.	1.9	N/A
6.	Reinforce the connections of the braced frames at the front of the stage in the Multi-Purpose room.	1.9	N/A
7.	Inspect the roof, repair roofing and wood rot as required.	3.0	7
8.	Add additional bays of rod bracing at clerestory windows.	1.9	N/A
9.	Repair exposed roof and covered walkway members with decay and protect members from further exposure to rain	2.5	14,15

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, FEMA 310 requirements and limited lateral (seismic) calculations, 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 and limited quantitative 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 buildings 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(s), 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 5 and we recommend that seismic retrofit work be performed in Phase II.

10.12 Limitations and Disclaimer

This report includes a qualitative (visual) evaluation and a limited quantitative seismic evaluation of each school building. Obvious gravity or seismic deficiencies that are identified visually during site visits or on available drawings are identified and documented in this report. Elements of the structure determined to be critical and which could pose life safety hazards are identified and documented during limited quantitative seismic evaluation of the buildings.

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

Figures

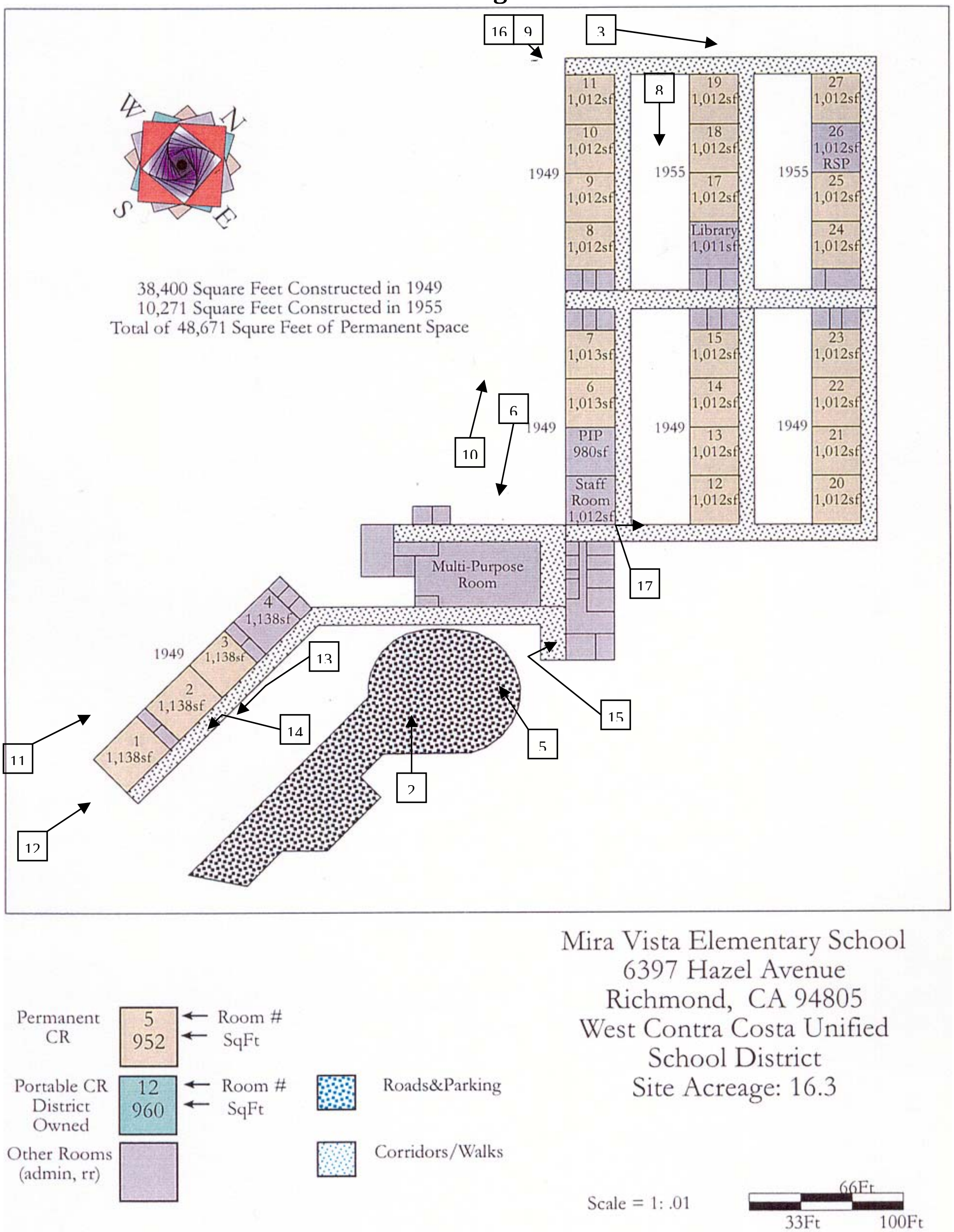

Figure 1: School Layout Plan

Figure 2: School Entrance

Figure 3: Covered Walkways Between Buildings

Figure 4: Rusting Steel at Overhangs

Figure 5: Covered Walkway at Front

Figure 6: Rear Wall of Multi-Purpose Building

Figure 7: Water Stains on Classroom Ceilings

Figure 8: Rear Wall of Classroom Building

Figure 9: West View Classroom Buildings

Figure 10: Lower Level Classroom Building

Figure 11: Rear Wall of Kindergarten Classrooms

Figure 12: South View of Kindergarten Classrooms

Figure 13: Front of Kindergarten Classrooms

Figure 14: Trellis Overhang

Figure 15: Holes in CMU Walls

Figure 16: Vertical Cracks in CMU Walls

Figure 17: Pipes and Conduit at Covered Walkways