STRUCTURAL EVALUATION OF

KENSINGTON 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 Kensington Elementary School in Kensington, CA. The structural assessment includes a site walk through. 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. The general structural condition of the buildings and any seismic deficiencies that are apparent during our site 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 Kensington and was built in t 1949. The permanent buildings are one story and are primarily constructed of light wood framing. Some of the walls were constructed of masonry. Eight portable buildings were added between 1969 and 1997 (figure 1). The total square footage of the permanent structures is approximately 35,793 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 cafetorium 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 kilometers from the Hayward fault. The classroom and cafeteria buildings are wood framed building with diagonally sheathed shear walls, and 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:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.40x1.5x1.15)W}{4.5} = 0.383W$$

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. Kensington Hilltop School, dated July 1, 1949, by Dragon Schmidts & Hardman Architects, Sheets 1-3, 3a, 10-14, 20-26 (poor quality reproductions).
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 November 8th, 2001 and March 6th, 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 school is one story with stucco exterior with brick wainscots. The front of the Administration building (figures 2, 5, & 6) is characterized by tall CMU pilasters, tall pipe columns and a minimum of shear walls. The Classrooms were characterized by clerestory windows (figure 4) on the west side and extensive glazing on the east face (figure 3) resulting in minimal lateral resistance in the longitudinal direction. The front wall adjacent to the multi-purpose room had extensive glazing with a 4 foot high brick wall (figure 6). In the absence of structural drawings it is not clear what is the mechanism for resisting out of plane loads.

The exterior corridor at the rear of the administration building has a brick finish on the columns and walls (figure 8).

The multi-purpose room is of wood construction with stucco finishes both exterior and interior and has big exterior windows on either side. Cracks were observed in the back wall of the multi-purpose room, above windows (figure 7).

Connecting the classrooms are covered walkways with plaster ceilings that are supported by 3” diameter pipe columns. The walkways are connected at both ends to the adjacent building and depend on their connection to the adjacent buildings for lateral resistance (figure 9).

10.6 Review of Existing Drawings

The Structural drawings for the buildings on this campus were poor copies and it was thus difficult to understand in detail how the building was built. Sheets 5 to 9 are missing and appear to include the roof framing plans.

While the drawings were not complete a number of insights could be made from the availible drawings.

The roof sheathing was 1x diagonal sheathing supported on 2x members at 16 to 24" oc. Roof trusses made up of 2x lumber were commonly used for much of the building. At the Cafetorium, the roof rafters spanned between roof trusses constructed of 8x timbers with steel rods for the verticals.

Typically the walls were constructed of 2x studs at 16" oc. It is clear from the drawings that some walls and columns were constructed of reinforced masonry and not the more typical wood wall with masonry veneer.

The covered walkways that run between the several wings are supported by exterior stud walls. They do not have their own independent lateral force resisting systems, and there is no seismic joint between them and the wings they connect.

There is a built-up roofing over the Main building and classrooms. This roof is about 14 years old and is scheduled to be restored. Before this roofing work is started consideration should be given to the need to reinforce the roof diaphragms. At the Cafetorium, the asphalt roof is only 2 years old and no repair work is contemplated.

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.	Lack of shear walls in the east longitudinal walls of the classrooms due to numerous window openings.
2.	Lack of shear walls in the west longitudinal classroom walls due to clerestory windows.
3.	Lack of sufficient lateral bracing of the front entrance of the Main Building.
4.	The brick wall, between front entrance and the Cafetorium, supporting windows may be unstable.
5.	Stucco cracks on the main building, may lead to rot and deterioration of the wall.
6.	Brick in the main building above the northwest exterior corridor openings and around columns may present a falling hazard.
7.	The covered walkways between the buildings may suffer damage and collapse as a result of being connected to more than one building. In addition the electrical conduit supported by these walkways may become damaged creating a potential life safety hazard.
8.	Decorative panels, between pipe columns of the exterior covered walkways, may prevent easy egress from under the covered walkway area.
9.	At the kindergarten classroom building overhang, the wood soffit shows signs of water damage.
10.	Portable buildings have had a history of falling off of their foundations in earthquakes. At least some of the portable buildings on this project were constructed in an era when minimal attention was paid to anchoring portable buildings.

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.	Fill in some existing classroom windows with new plywood shear walls and provide new collectors and holdowns as required.	1.1	3
2.	Add plywood shear walls at several classroom clerestory windows and provide new collectors and holdwons as required.	1.0	4
3.	Add new lateral bracing of the front entrance of the Main Building.	1.8	5
4.	Provide continuous columns from floor to roof at the tall windows adjacent to the Cafetorium Building.	1.8	6

5.	Fix the cracks in the stucco.	3.0	7
6.	Verify if it is brick wall or brick veneer and if it is veneer, remove brick veneer in the Main building corridor.	1.9	8
7.	Add new seismic joints at covered walkways along with necessary additional lateral and gravity supports. Where conduit crosses the seismic joints provide flexible connections.	1.9	9
8.	Remove selected decorative panels in front of classroom doors.	2.0	4
9.	At the kindergarten classroom building soffit, replace the damaged wood and paint to prevent further decay.	3.0	N/A
10.	Ensure that the portable buildings are adequately anchored to their footings.	2.0	N/A

10.10 Portable Units

In past earthquakes, the predominant damage displayed by portable buildings has been associated with the buildings moving off of their foundations and suffering damage as a result. The portables observed during our site visits tend to have the floor levels close to the ground, thus the damage resulting from buildings coming off of their foundation is expected to be minimal. The life safety risk of occupants would be posed from the potential of falling 3 feet to the existing grade levels during strong earthquake ground shaking. Falling hazards from tall cabinets or bookshelves could pose a greater life safety hazard than building movement. The foundation piers supporting the portable buildings tend to be short; thus the damage due to the supports punching up through the floor if the portable were to come off of its foundation is not expected to be excessive.

Because of their light frame wood construction and the fact that they were constructed to be transported, the portable classrooms are not in general expected to be life safety collapse hazards. In some cases the portables rest directly on the ground and though not anchored to the ground or a foundation system could only slide a small amount. In these instances the building could slide horizontally, but we do not expect excessive damage or life safety hazards posed by structural collapse of roofs.

The regulatory status of portables is not always clear given that portables constructed prior to 1982 will likely have not been reviewed by DSA and thus will likely not comply with the state regulations for school buildings. Portables constructed after about 1982 should have been permitted by DSA. The permits are either issued as temporary structures to be used for not more than 24 months or as permanent structures.

10.11 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.

10.12 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.

10.13 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.

DASSE's review of portable buildings has been limited to identifying clearly visible seismic deficiencies observed during our site visit and these have been documented in the report. Portable buildings pose several issues with regard to assessing their life safety hazards. First, drawings are often not available and when they are, it is not easy to associate specific drawings with specific portable buildings. Second, portable buildings are small one story wood or metal frame buildings and have demonstrated fairly safe performance in past earthquakes. Third, there is a likelihood that portable buildings (especially those constructed prior to 1982) are not in compliance with state regulations, either because they were not permitted or because the permit was for temporary occupancy and has expired.

Figures

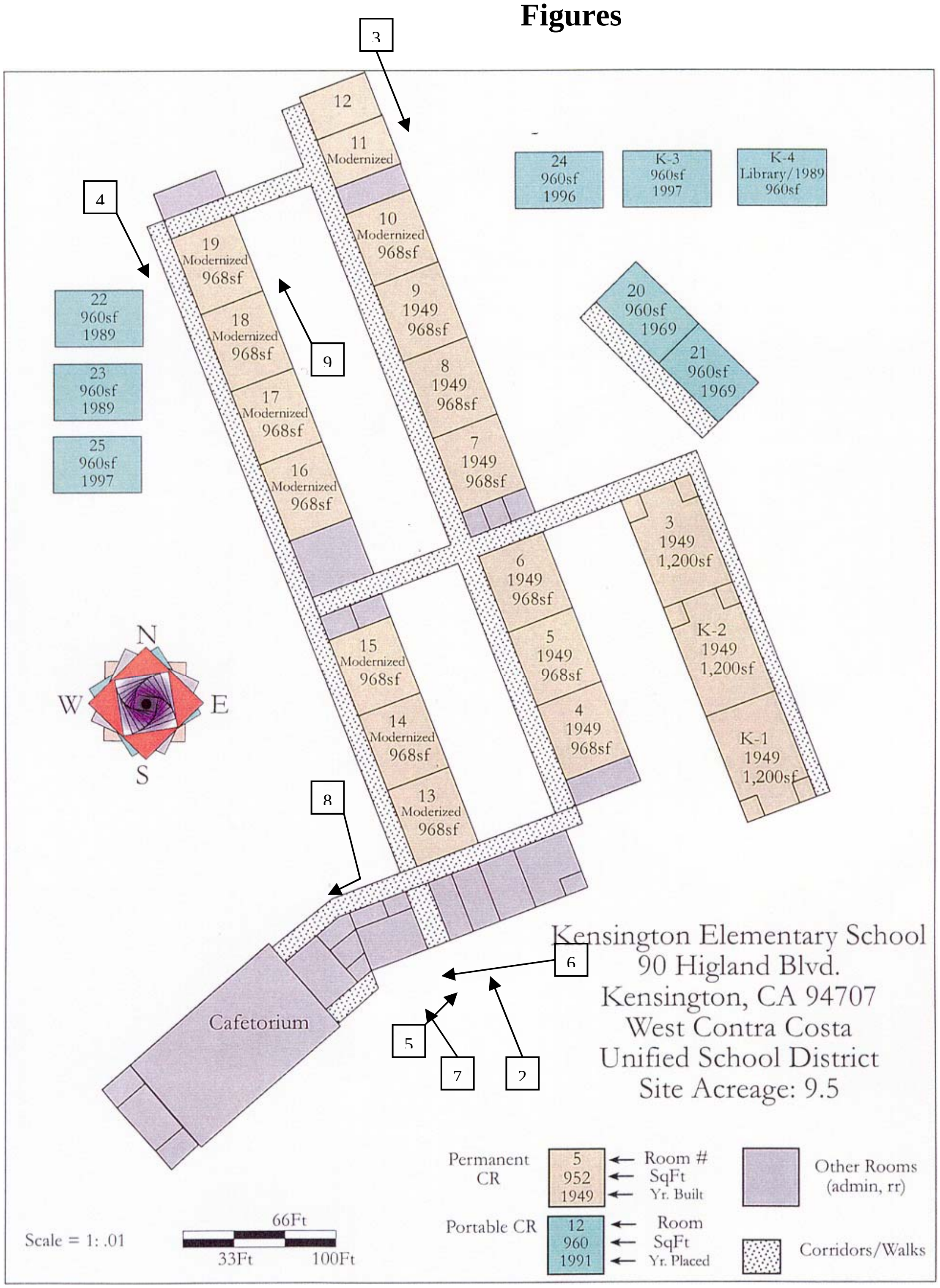

Figure 1: School Layout Plan

Figure 2: Front Entrance

Figure 3: Classrooms East longitudinal Walls

Figure 4: Classrooms with Clearstory Windows, West Longitudinal Walls

Figure 5: Main Building Front Entrance.

Figure 6: Main Building Front Entrance

Figure 7: Main Building – Plaster Cracks

Figure 8: Main Building Northwest Exterior Corridor

Figure 9: Covered Walkway Between Buildings