STRUCTURAL EVALUATION OF

OLINDA ELEMENTARY SCHOOL

WEST CONTRA COSTA UNIFIED SCHOOL DISTRICT (WCCUSD)

For

WLC Architects
Kaiser Building
1300 Potrero Avenue
Richmond, CA 94804

By

DASSE Design, Inc.
33 New Montgomery Street #850
San Francisco, CA 94105
(415) 243-8400

April 30, 2002

DASSE Design Project No. 01B300

TABLE OF CONTENTS

List of Figures

10.1 Introduction

The purpose of this report is to perform a seismic assessment of the Olinda 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 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 was built in 1957. The original building is a one-story wood- and steel- framed structure (main building). The multi-purpose building is a wood structure that was constructed in 1989 (see figure 1). There is one 1960 portable, two 1965 portables, one 1988 portable, two 1989 portables, two 1995 portables, four 1997 portables, and one portable whose construction date is not known. The total square footage of the permanent structures is about 18,409 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 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 about 3.6 kilometers from the Hayward fault. The main building has plywood shear walls, which have a response modification factor R=5.5. The multi-purpose building is a wood framed building with plywood shear walls, and has a response modification factor R = 5.5. 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:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.40x1.34x1.15)W}{5.5} = 0.280W$$

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. Olinda School; John Hudpette (name partially illegible), Architect; sheets 2-10; Moorehead, Structural Engineer; sheets S1-SS5; February 8, 1957.
2. Multi-Purpose Building; Barbachano and Associates, Inc., Architects; sheets A0-A9; Shapiro, Okino, Hom, and Associates; sheets S1-S5; March 2, 1988.
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 7th, 2001 and March 8th, 2002. The main purpose of the site visits 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 main building is an L-shaped building with classrooms on both sides of a central longitudinal corridor (see figure 1). The exterior finish is stucco. The main portion of the building, which houses the classrooms, has windows along the exterior longitudinal walls (see figures 3 and 5). The transverse walls between classrooms do not have any openings. There are long sections of shear wall along the central corridor (see figure 9). At the administration and computer room wing, there are windows with a vertically slotted sunshade along most of the west wall (see figures 2 and 8). The east wall of the computer room has clerestory windows above an exterior covered walkway (see figures 6 and 8). The roof is supported by open-web steel joists spaced at about 5 ft o.c. that rest on 4x8 posts (see figure 10). The ceiling has acoustical tiles attached directly to the underside of the roof. There are skylights in the corridor spaced every 10 feet (see figure 9) and there are long sections of skylight that penetrate the roof diaphragm on both sides of the corridor at the classrooms. The presence of these skylights significantly decreases the ability of the diaphragm to transfer forces to the corridor walls. This is of particular concern because the corridor walls are the main lateral force resisting elements in the east-west direction. At the east end of the corridor, there are restrooms that have a low roof (see figure 4). This low roof is connected into the side of the adjacent transverse wall, most likely by a ledger connection. There is also a discontinuity in roof height at the corridor that divides the classroom wing of the main building from the area that houses the computer room, offices, and kindergarten (see figure 6).

The multi-purpose building is a roughly square wood-framed building with stucco finish. The roof has sheet metal roofing. In the central part of the building, the roof slopes in the east-west direction to a central ridge. At the north and south sides, the roof slopes up in the perpendicular direction from the exterior to a short pony wall (see figures 11 and 12). The exterior walls have windows only above the door openings, leaving reasonable lengths of shear wall at all four sides of the building. The interior of the building has a suspended T-bar ceiling. There is some minor cracking of the exterior slab adjacent to the building.

The front face of the 1960 portables has excessive openings in the shear wall (see figure 15). Also, there is electrical conduit running between the portable units near the roof level (see figure 16).

10.6 Review of Existing Drawings

Although construction drawings of the main building were available for review, they were almost completely illegible. Only very basic information regarding the main building could be garnered from them. The roof and shear walls are sheathed with ¾" and 3/8' plywood, respectively. There are concrete strip footings (about 12" wide) under all of the exterior and major interior bearing walls. Because there are no drawings available for the administration and computer room addition to the building, there is no information about that area's structural system or about how the two portions of the building are connected to each other. The existing roofing is about 10 years old and needs to be restored.

The multi-purpose building has a plywood sheathed roof supported by 2x10 joists at 16" o.c. that span about 15' between 6x12 beams and the exterior stud walls. The 6x12 beams span about 16'-6" between 6x6 posts. These posts rest on 10¾"x27" glu-lam beams at the ceiling level, which span 60' between posts at the exterior of the building. The 2x10 ceiling framing, spaced at 48" o.c., is also supported by the glu-lam beams. Both the roof and ceiling plywood sheathing is fully blocked, and the pony wall at the vertical discontinuity in the roof has structural plywood sheathing. Blocking and strapping have been provided at the ceiling level to create sub-diaphragms to resist out-of-plane wall loads. The glu-lam beams are supported on built-up columns made of seven 2x6 members bolted together. These rest on 2'-6" square spread footings. The interior and exterior walls are supported on 12 wide strip footings. It appears that the connections are generally well-detailed and adequate collectors have been provided. The existing sheet metal roofing at the multi-purpose building is about 10 years old and appears to be in good condition.

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.	At the main building central corridor, the nailing of the plywood shear walls is unknown and the walls may be overstressed.
2.	The west face of the computer room wing of the main building has excessive window openings, resulting in a lack of adequate length of shear wall.
3.	The east face of the computer room wing of the main building has clerestory windows, resulting in a lack of adequate length of shear wall.
4.	The main building has a re-entrant corner where the computer room wing meets the rest of the building. There is no information about the connection between portions of the building at this location, but the roof collectors, if present, may be overstressed.
5.	There are skylight openings in the roof diaphragm on either side of the central corridor. The roof diaphragm may be inadequate to transfer shear forces to the corridor walls.
6.	The connection of the low roof at the restrooms to the adjacent wall may be a ledger connection that is susceptible to damage leading to partial collapse of the structure.
7.	The front wall of the 1960's portables have excessive window openings, resulting in a lack of shear wall.
8.	There is conduit running between the portable units near the roof level. As the buildings move independently, the conduit may get damaged and is a life-safety hazard.
9.	There is minor cracking in the slab outside of the multi-purpose building.

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.	Verify existing shear wall nailing and add new wall nailing as required.	1.7	9
2.	Infill some windows with plywood shear wall. Strengthen existing collectors and add new holdowns as required.	1.3	2, 8
3.	Infill some windows with plywood shear wall. Strengthen existing collectors and add new holdowns as required.	1.3	6-8
4.	Verify presence of collectors at re-entrant corner. Strengthen existing collectors as required.	1.6	6
5.	Infill some skylights with new plywood. Add additional nailing and straps at roof diaphragm	1.1	N/A
6.	Verify details of existing connection. Provide strapping from the low roof diaphragm to the wall studs if required.	1.5	4, 5
7.	Infill some windows with new plywood shear wall. Strengthen existing collectors and add new holdowns as required.	1.3	15
8.	Provide flexible connection in conduit at building separation.	1.9	16
9.	Repair the cracked slab.	3.9	14

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

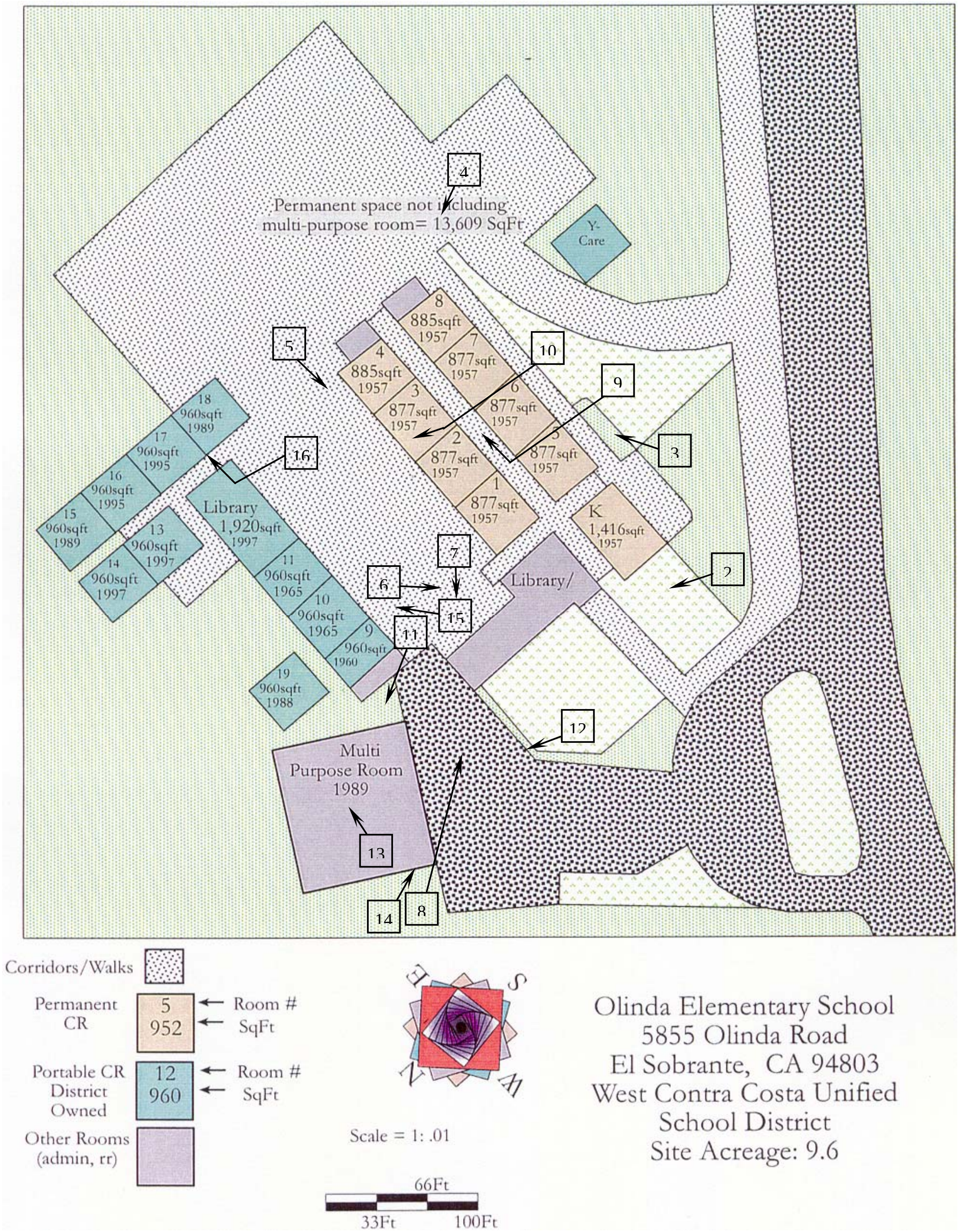

Figure 1: School Layout Plan

Figure 2: West Face of Main Building

Figure 3: South Face of Main Building

Figure 4: Southeast Corner of Main Building

Figure 5: North Face of Main Building

Figure 6: Re-entrant Corner at Main Building

Figure 7: East Face of Computer Room Wing of Main Building

Figure 8: Northwest Corner of Main Building

Figure 9: Central Longitudinal Corridor of Main Building

Figure 10: Typical Classroom Interior at Main Building

Figure 11: South Corner of Multi-Purpose Building

Figure 12: South Face of Multi-Purpose Building

Figure 13: Interior of Multi-Purpose Building

Figure 14: Cracks in Exterior Slab at Main Building

Figure 15: Front of 1960's Portables

Figure 16: Conduit Running between Portable Units