STRUCTURAL EVALUATION OF

FORD ELEMENTARY SCHOOL

WEST CONTRA COSTA UNIFIED SCHOOL DISTRICT (WCCUSD)

For

WLC Architects
Kaiser Building
1300 Potrero Avenue
Richmond, CA 94804

By

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10.1 Introduction

The purpose of this report is to perform a seismic assessment of the Ford 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 was built in 1949. The permanent buildings are a one-story wood frame classroom building and a one-story wood multi-purpose building. In addition there are thirteen portable buildings (see Figure 1). There are two 1954 portables, three 1955 portables, one 1989 portable, four 1996 portables, two 1997 portables, and two portables of unknown age. The total square footage of the permanent structures is about 24,752 square feet.

10.3 Site Seismicity

The site is a soil classification S_D 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 permanent buildings are of wood frame construction and have wood shear walls. The diagonally sheathed wood shear walls 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:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.44x1.5x1.15)W}{4.5} = 0.422W$$

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. J. O. Ford Elementary School, dated April 22, 1949, by Charles F. Strothoff, Architect, and W. Adrian, L Graham & W. Hayes Associated, Structural, Sheets S1-S10.
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 23rd, 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. 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 permanent school buildings are one story wood construction with stucco finish (figures 2,3 & 4). The main building has a lot of windows along the front as well as clerestory windows along the back wall (figures 3 & 6).

It was reported that some ceilings had water stains both in the Main building as well as the Multi-Purpose room..

The covered walkway connecting the several buildings will likely suffer damage as a result ot the differential movement of the buildings in an earthquake. Damage to the stucco was observed at the interface of the covered walkway and the building.

At the covered walkway in front of the Multi-Purpose Room decayed lumber was removed thus weakening the member. As a result the beam should be replaced.

At the covered walkway to the West of Classroom number 2 and at the overhang to the east of Classroom number 23 beams and joist are not protected by roofing and thus show signs of decay. The decayed members should be repaired and the beams and joists should be protected from direct exposure to the rain.

While the buildings appeared to be in reasonable condition a good paint job is needed.

There are several old portables that rest directly on the without attachment to the ground (figure 7). Electrical conduit was observed to run between portables such that it could be damaged in an earthquake.

10.6 Review of Existing Drawings

The vertical gravity loads for all buildings on the campus are supported by 1x sheathing that spans 16” to 2x wood joists which are in turn either supported by steel beams or wood walls.

The floor consists of a concrete slab-on-grade. The loads from the roof structure are transmitted to the soil by concrete spread footings.

The lateral loads are transferred to shear walls by diagonally sheathed roof diaphragms. The shear walls consist of wood stud walls with 1x diagonal wood sheathing. Tiedowns are typically provided at the end of shear walls.

The covered walkway in front of the Multi-Purpose Room is constructed of 2x8 T&G boards spanning between steel frames consisting of 10” wide flanges supported on pipe columns.

There is a reinforced brick screen wall adjacent to the kindergarten play area and a full height reinforced brick wall at the front of the kindergarten classroom.

It was reported that the roof age is about 6 years and that no roof work is needed.

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.	At the Main building wall facing the street, there is a lack of adequate shear walls in the longitudinal direction as a result of the large number of windows.
2.	At the Main building wall at the entrance to the classrooms, there is a lack of shear wall resistance in the longitudinal direction doe to the clerestory windows.
3.	Covered walkways connecting buildings are likely to experience damage as a result of differential movement of the buildings.
4.	Electrical conduit runs between portable buildings and is at risk of being damaged in an earthquake and is a life safety hazard.
5.	Wood rot in the roof framing is likely given the reports of water stains in ceilings.
6.	The shear wall at the East wall of classrooms 21 & 23 is overstressed.
7.	Roof diaphragm of the Multi-Purpose Room is overstressed.
8.	The shear walls of the Multi-Purpose Room are overstressed.
9.	The shear walls of the Toilet Building are overstressed.
10.	Some portable buildings appear to have no anchorage to the ground.
11.	At the covered walkway in front of the Multi-Purpose Room decayed lumber was removed thus weakening the member.
12.	At the covered walkway to the West of Classroom #2 and the overhang to the East of Classroom #23 beams and joist are not protected by roofing and thus show 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.	Add supplemental plywood shear walls to the main building wall facing the street by filling is some windows. Provide new collectors and holdowns as required.	1.5	2, 3, 5
2.	Add additional plywood shear walls to the wall at the entrance to the typical classrooms by filling is some windows. Provide new collectors and holdowns as required.	1.5	6
3.	At the covered walkways connecting the buildings, provide new beams and columns close to the building so that damage will not lead to collapse of the walkway.	1.9	4
4.	Relocate electrical conduit or install flexible connection when conduit passes between adjacent buildings above ground level.	1.9	N/A
5.	Investigate extent of potential wood rod as a result of roof leaks. Repair roof and any wood rot.	3.0	N/A
6.	Reinforce the East wall of Classrooms 21& 23 or fill in some of the existing windows. Provide new collectors and holdowns as required.	1.9	9
7.	Add plywood sheathing over existing Multi-Purpose Building roof sheathing.	1.9	N/A
8.	Reinforce the shear walls around the Multi-Purpose room.	1.9	4
9.	Reinforce shear walls around the Toilet Building.	1.9	10, 11
10.	Anchor portable buildings to the ground.	2.0	7,8
11.	Replace the beam that had decay removed.	1.2	12
12.	Repair decayed members and provide protection.	2.1	13,14

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, 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.

10.12 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 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.

10.13 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.

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

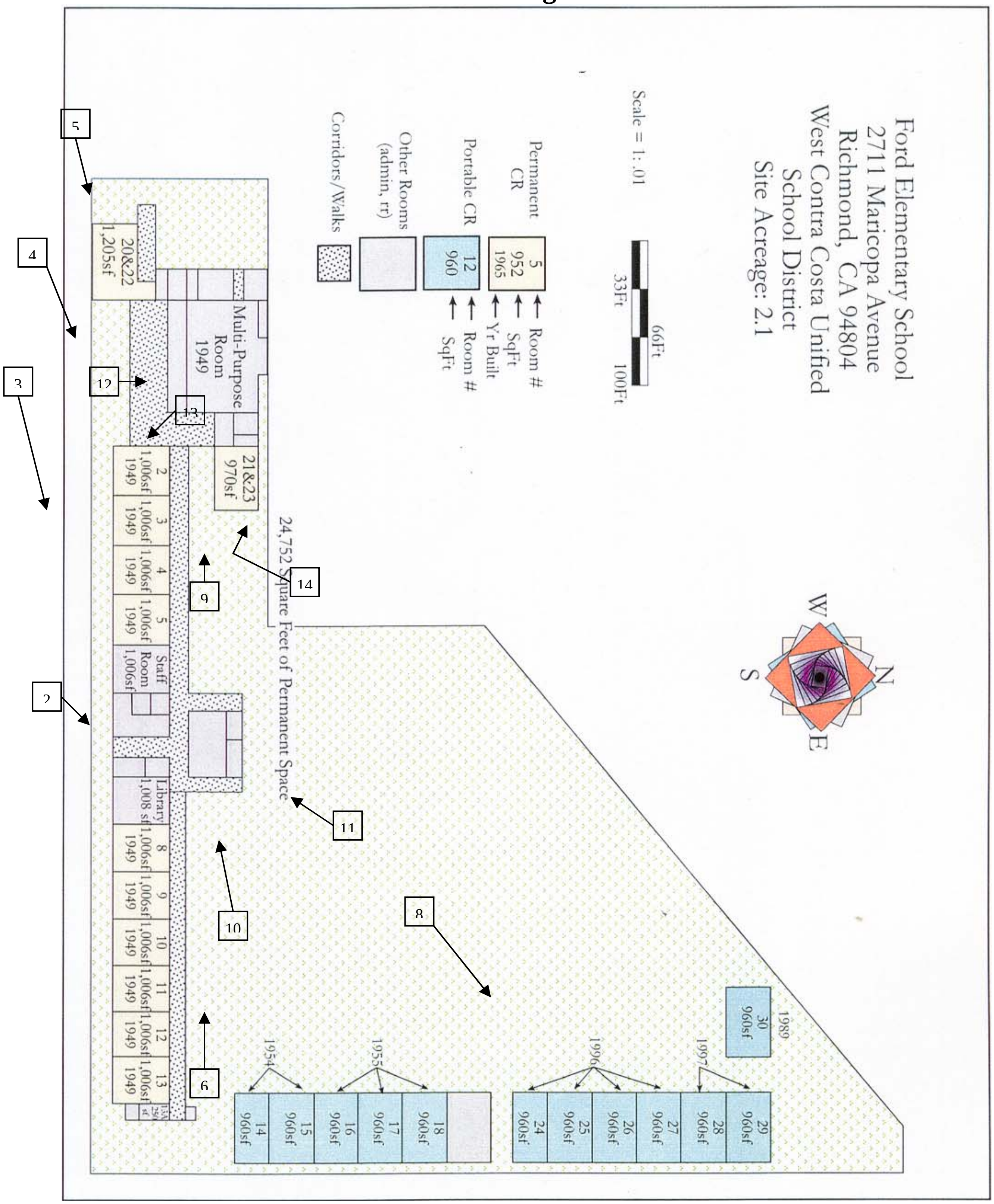

Figure 1: School Layout Plan

Figure 2: Front Entrance

Figure 3: Front of Classroom Building

Figure 4: Multi-Purpose Building

Figure 5: Classroom Building at Corner

Figure 6: Rear of Classroom Building

Figure 7: Foundation of Portable Classroom.

Figure 8: Portable Classroom Buildings

Figure 9: East Wall of Classrooms 21 &23

Figure 10: Toilet Building

Figure 11: Toilet Building

Figure 12: Repaired Beam

Figure 13: Covered Walkway

Figure 14: Roof Overhang