STRUCTURAL EVALUATION OF

TARA HILLS 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

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10.1 Introduction

The purpose of this report is to perform a seismic assessment of the Tara Hills 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 was built in 1958. The original buildings are two one-story classroom buildings, a one-story kindergarten / library building, and a one-story multi-purpose building. These buildings are all connected by enclosed corridors. There are also three portables, one built in 1997, one in 1998, and one with the construction date unknown. The total square footage of the permanent structures is about 38,023 square feet.

10.3 Site Seismicity

The site is located in The City of San Pablo**.** 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 classroom and kindergarten / library buildings have 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 3.4 kilometers from the Hayward fault. The buildings are supported laterally by plywood sheathed shear walls, which have 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:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.44x1.36x1.15)W}{5.5} = 0.313W$$

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. Tara Hills School; Jack Buchter, Architect; sheets 1-5; Smith and Moorehead Structural Engineering; sheets S1-S4; January 22, 1958 (classrooms 1-8 only).
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 6th, 2001 and March 7th, 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. Following items were evaluated during the site visit:

1. Type and Material of Construction
2. Type of Sheathing at Roof, Floor, 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 four permanent buildings are all one-story wood-framed structures with stucco finish (see figures 2 through 12). The roofs are not exposed and the roof overhangs have plaster soffits. The classroom and kindergarten / library buildings are all of similar construction. In these buildings, there are classrooms on both sides of a central corridor. The exterior longitudinal walls have windows along most of the length (see figure 8) and the interior corridor walls appear to have shear wall panels (see figure 14). For lateral forces, the roof diaphragm is cantilevered out from these walls to the exterior of the building. In the transverse direction, there appear to be shear walls between the classrooms and the end walls have significant lengths of shear wall. There is some deterioration of an exposed roof beam at the kindergarten building.

The multi-purpose building (see figures 4 through 6) has a high, open main area and a shorter ancillary area at the northwest side. The roof of the main area appears to be supported by lumber framing over glu-lam beams that span across the width of the building. There are some minor cracks in one of these glu-lam beams that appear to be due to checking. The roof above the main and ancillary areas is continuous. The only major wall openings in the building are on the northwest face at the ancillary area.

There are enclosed corridors linking the buildings together. Except at the kindergarten / library building, these corridors have roofs that are continuously framed with the roofs of the adjoining buildings (see figure 8). Some localized tearing of the roof diaphragm can be expected at the intersection of the corridor and building roofs. At the kindergarten / library building, the corridor roof frames into the end wall of the building (see figure 9). The corridors generally have windows along their entire length on both sides, although the corridor to the multi-purpose building has wood siding on the rear face (see figure 6). There is conduit running over the corridor roofs between buildings.

10.6 Review of Existing Drawings

The majority of the original construction drawings were unavailable for review and there are minor portions of the available drawings that are not legible. Although it appears from visual inspection that the four main buildings were designed in a similar manner, this review is only applicable to the building containing classrooms 1 to 8.

The classroom building roof is has ½” plywood sheathing over 2x10 joists spaced at 24” o.c. There are four main wall lines in the building’s longitudinal direction – the exterior walls, which have numerous windows, and the interior corridor walls. The 2x10 roof joists span between these wall lines and 7”x22¾” glu-lam beams that run longitudinally over the classrooms. The glu-lam beams span 30 feet between 3½” diameter pipe columns that are hidden within the transverse shear walls. The ceiling is framed with 2x4 members spaced at 24” o.c. that are hung from the roof joists above. The corridor longitudinal walls and the transverse walls are sheathed with 3/8” plywood nailed with 8d at 6” o.c. There are steel angle holdowns at the ends of the shear wall panels along the corridor. The top plate splices at the stud walls have 16-16d nails each side of the splice and, because the shear walls are evenly distributed, appear to be adequate. There are collector elements present where the shear wall elements do not align with each other. The 2x6 stud walls have 3x redwood sills and rest on 14” wide x 21” deep strip footings.

The existing built-up roofing on all the buildings is about 1 year 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.	The classroom buildings and the kindergarten / library building have large window walls at the exterior longitudinal walls. Therefore, the buildings must be supported laterally by the shear walls along the interior corridor. These shear walls and their connection to the diaphragm may be slightly overstressed.
2.	At the end wall of the classroom building near the office, all of the window openings are at one end of the wall. This results in high collector forces, and the existing collector elements and connections may be overstressed.
3.	At the multi-purpose building, the transverse shear wall at the re-entrant corner (the end of the ancillary area) may be overstressed due to its short length and long tributary area. The collector on that line may be inadequate.
4.	There is a discontinuity in the roof of the southeast classroom building near classrooms #12 and #15. The collectors at the discontinuity may be overstressed.
5.	The connecting corridors are attached to multiple buildings and may be damaged as the buildings move independently. At the corridor roof intersection with the classroom building and multi-purpose building roofs, some local tearing may be expected. At the corridor interface with the kindergarten / library building, the corridor roof frames into the side of a wall. At this location there could be a partial collapse of the corridor roof.
6.	There is some deterioration at an exposed roof beam at the kindergarten 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.	Add new nailing at existing shear wall panels. Strengthen existing collectors and add new holdowns as required.	1.5	6-9, 11, 14
2.	Provide new continuous strap at roof and new clip angles for	1.5	3

	shear transfer to the wall		
3.	Add new plywood sheathing. Strengthen existing collectors and add new holdowns as required.	1.5	5
4.	Provide new blocking and straps at roof	1.9	7, 11, 12
5.	At the typical intersecting roof condition, the potential tearing does not present a significant threat to life safety and does not need to be modified. At the corridor to kindergarten / library building interface, add new posts and beams to provide a secondary means of support for the roof and prevent partial collapse.	1.2	2, 4, 6, 8, 9
6.	Replace the damaged wood and re-paint.	1.9	15

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 4 and we recommend that seismic retrofit work be performed in Phase II.

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

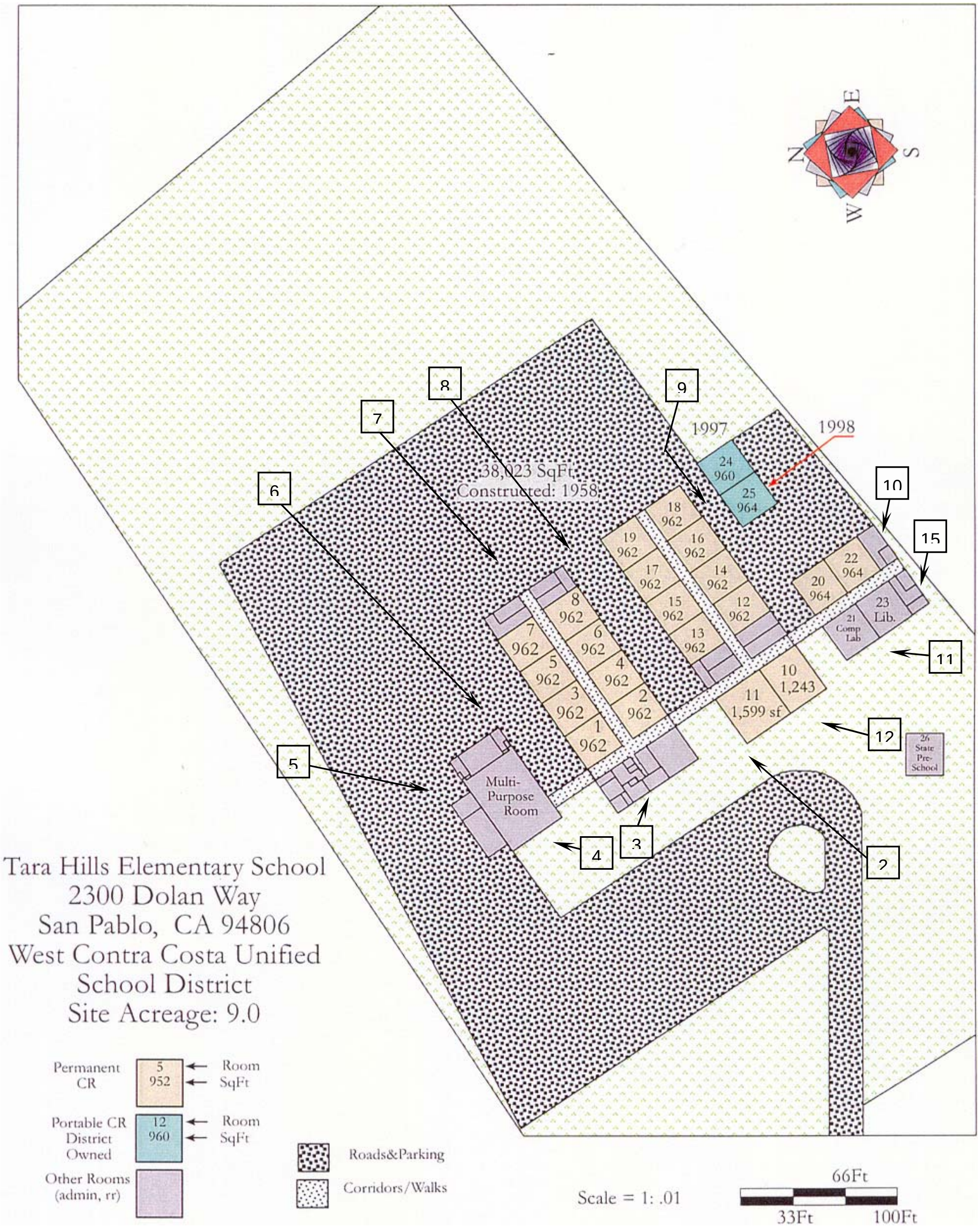

Figure 1: School Layout Plan

Figure 2: Main Entrance

Figure 3: West Corner of Administration Area

Figure 4: Front of Multi-Purpose Building

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