STRUCTURAL EVALUATION OF

FAIRMONT 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 Fairmont Elementary School in El Cerrito, 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. There are five permanent buildings: Main classrooms buildings (two), Multi-purpose Building, Kindergarten Building and Administration building. There are four portable buildings (see figure 1). All the permanent buildings are one story wood-framed buildings. There are covered walkways connecting the different units. There are two 1990 portables and two 1996 portables. The total square footage of the permanent structures is about 30,695 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 about 2.0 kilometers from the Hayward fault. All the buildings (permanent) have plywood shear walls, which have a response modification factor of 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:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.44x1.50x1.15)W}{5.5} = 0.345W$$

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. Fairmont School, Architectural Drawings by Donald L. Hardison Architects, Sheets A1 to A16 dated January 1957, Structural Drawings by Hall, Pregnoff & Matheu, Sheets S1 to S9 dated January 1957.
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 9th, 2001. 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

All the buildings are one story wood framed buildings with stucco finish on the exterior. The Multi-purpose building roof is about 3 years old and all other building roofs are about 5 years old. No new roofing work is required for this campus per the roofing report by Garland, Inc.. All the buildings in this campus have built-up roofing.

The classroom buildings labeled unit ‘A’ and ‘B’ (see figure 1), have continuos windows on the west exterior longitudinal walls (see figures 2, 7 & 8). The east exterior longitudinal walls of units ‘A’ and ‘B’ also have numerous window openings (see figure 6). There are skylights in the corridor of classroom units ‘A’ and ‘B’ (see figure 9). These skylights extend partially into the classrooms and can be seen from inside the classrooms. Some water leakage was noticed in the ceiling covering the skylight inside the classroom (see figure 3). Classroom and office rooms have plaster ceilings.

The multi-purpose room (unit ‘C’), has a low one story activities and service area on the west side with a covered walkway in front and on the south side. There are narrow and tall windows on the east side of this building (see figure 10). There is a covered walkway connecting the multi-purpose room and the kindergarten room with 4 inch diameter pipe column and wood framing.

There are covered walkways connecting different units. The covered walkway between the units ‘A’ and ‘B’ is disconnected at the unit ‘A’ side (see figure 11). All covered walkways are supported in pipe columns and have wood framing with straight sheathing, and all of them have plaster ceiling (see figure 12).

10.6 Review of Existing Drawings

The Main Classroom Buildings (Units A and B) has half an inch plywood roof supported on 2x4 intermediate joists and 3x12 main joists (at 4’ on center) spanning about 18 feet to 12” deep steel beams that spans approximately 26.5 feet in the north-south direction. The 3x12 joist runs on top of the steel beam and cantilevers 6’ beyond the longitudinal walls at either end and the roof does the same. The steel beams are supported by 6x6 wood posts that cover approximately a tributary area of 26.5 feet x 18 feet. There is a 12 feet wide corridor that runs in between the classrooms in both units ‘A” and ‘B’. There are four skylights above the corridor roof between classrooms in both units ‘A and ‘B’. There is 3x framing around the skylights and 2x12 blocking between the 3x framing. Footings for 6x6 wood post are 2’-8” square footing by 12” deep. Exterior walls of the classrooms have typically 2x6 studs at 16” on center with 3/8” plywood sheathing. Interior corridor walls between classrooms have 3/8” plywood sheathing for the entire length of the wall. Exterior wall footing is typically 14” wide by 12” deep except at locations where the steel beam frames into the wall studs, the footings are 2’-8” square by 12” deep. The floor slab is a 5” thick slab on grade for all the buildings.

The Kindergarten Building (room numbers 17 and 18) has half inch plywood roof and the framing is similar to the classroom buildings (Units A and B). There are only two 6x6 wood posts in the middle of the classrooms into which frame 12 inch deep steel beams. Exterior wall and foundation details are the same as classroom building.

The Administration Building also has half an inch plywood roof with 3x12 joists (at 4’ on center) spanning about 15 feet and are supported by 12” steel beams running east west direction (approximately 20’ span), which in turn are supported by 6x6 wood posts in the interior and by the exterior 2x6 stud walls. Exterior wall and foundation details are same as classroom buildings. There are two smaller skylights in the administration building and has framing and blocking around it similar to classroom building. The 3x12 joists cantilevers 3’ to the north and so does the roof. On the south side, the roof cantilevers 7-1/2’ and has boxed framing with 4x12 joists at 4’ on center at top, which extends back towards the north (approximately 15’ back span) and frames into the 12” steel beams that runs in east-west direction. There are 2x4 joists at 16” on center at the bottom of boxed framing.

The Multi-purpose Building has half inch plywood roof supported by 2x4 intermediate joists and 3x12 main joists spanning in north south direction (approximately 17.5' span) into 21" deep steel bent beams (approximate span 48'). The steel beam frames into 8x8 wood posts at either end of the steel beam (see figure 13). The steel bent beam has full penetration welds at web and flanges with additional reinforcing ¼" fillet weld and with a 5/8" steel stiffener plate at the web joint. There is a low roof area in front of the multi purpose room on the south side approximately 88' long by 19' wide. This low roof has half inch plywood roof with 3x12 joists at 4' on center that frames into 2x stud walls which has 3/8" plywood sheathing. There is a 6' overhang of the low roof towards the west- side of the building.

The covered walkway framing has ½" plywood roof with 2x8 members at 16" on center (in longitudinal direction with 10'-6" span), supported on 6x8 members spanning 12' and are supported on 4" diameter pipe column at 10'-6" on center. Covered walkways adjacent to unit 'B' (in east-west direction) is not attached to the buildings. Pipe columns supporting the covered walkway is connected to an unreinforced 18" diameter by 4' long drilled pier with 4-1/2" diameter by 10" long anchor bolts with a 8" square base plate (5/8" thick). Seismic force in the transverse direction of covered walkways are resisted by the 4" diameter pipe columns through cantilever action as there are no lateral frame in transverse direction. The foundation system described above does not provide fixity at the base required for cantilever action and hence lateral bracing is required in transverse direction. Similarly, lateral bracing is required in longitudinal direction also for reasons described above.

The covered walkway connecting the administration building and classroom building 'A' has ½" plywood roof with 2x8 at 16" on center in transverse direction (12'span) that frames into 2x8 members at the perimeter (12'span), that are supported on 4" diameter pipe columns (4 total). These covered walkways are not attached to the main buildings (see figure 11). Above described framing is repeated for covered walkways connecting administration building and the kindergarten building and units 'A' and 'B, which are also not attached to the buildings.

The lateral system for classroom buildings units 'A' and 'B', kindergarten building and administration building consists of plywood diaphragms, which distribute the load to the plywood (3/8" thick typical) sheathed shear walls. The interior corridor walls of classroom buildings have 3/8" plywood on one side and provides most of the lateral resistance to seismic loads in north south direction. The exterior (longitudinal) shear walls of classroom buildings, in north south direction, have continuos window openings and as a result the length of the shear wall appears to be inadequate to resist lateral loads. There are three transverse shear walls with 3/8" plywood in the interior of each of the classrooms. This, together with the exterior transverse walls, provide the lateral resistance to the seismic forces in the east west direction.

The exterior longitudinal walls of administration building has excessive openings on south side and lot of window openings in the north side. The kindergarten building has excessive openings on both the east and west exterior walls. This indicates inadequate length of shear walls to resist lateral loads in both administration and kindergarten building.

The lateral system of multi purpose building consists of ½" plywood roof diaphragm, which distribute the loads to the exterior plywood sheathed shear walls (3/8" thick). The low roof on the west side of this building also has ½" plywood roof diaphragm and is attached to the longitudinal wall of the multipurpose building. There is a continuos 2x12 chord member at low roof level running in north south (longitudinal) direction and spanning between the 8x8 wood posts. This chord member transfers the lateral load in east west direction from the low roof diaphragm to the 8x8 wood posts, which in turn spans (about 18') between the multi purpose building roof and the slab on grade.

Holdown anchors have been called out on the drawings at the four corners of administration and multi purpose buildings only. Holdown anchor consists of angle 7x4x5/8" with two ¾" diameter through bolts into the vertical studs and one single ¾" diameter rod (24" long) attached to the angle flange and embedded into the foundation.

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 avoid 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 classroom buildings units 'A' and 'B', the west and the north portion of exterior longitudinal walls have excessive window openings resulting in inadequate length of shear wall. Therefore, the shear walls along the interior corridors carry the majority of the seismic force and may be overstressed.
2.	Covered walkway running west to east and connecting classroom building unit 'A' and multi purpose building lacks bracing in longitudinal direction and transverse directions to resist seismic forces.
3.	The exterior longitudinal walls of administration building has numerous window

	openings in north and south walls, resulting in inadequate length of shear walls.
4.	The exterior longitudinal walls of kindergarten building has excessive window openings in east and west walls resulting in inadequate length of shear walls.

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.	In fill some windows at exterior with new plywood shear wall. Provide new collector elements and holdowns as required.	1.9	2, 7 & 8
2.	Provide lateral bracing in the longitudinal direction to resist lateral loads.	1.9	4
3.	In-fill some window openings with new plywood shear wall. Provide collector elements and holdowns as required.	1.5	N/A
4.	In-fill some window openings with new plywood shear wall. Provide collector elements and holdowns as required	1.5	5

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 5 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.

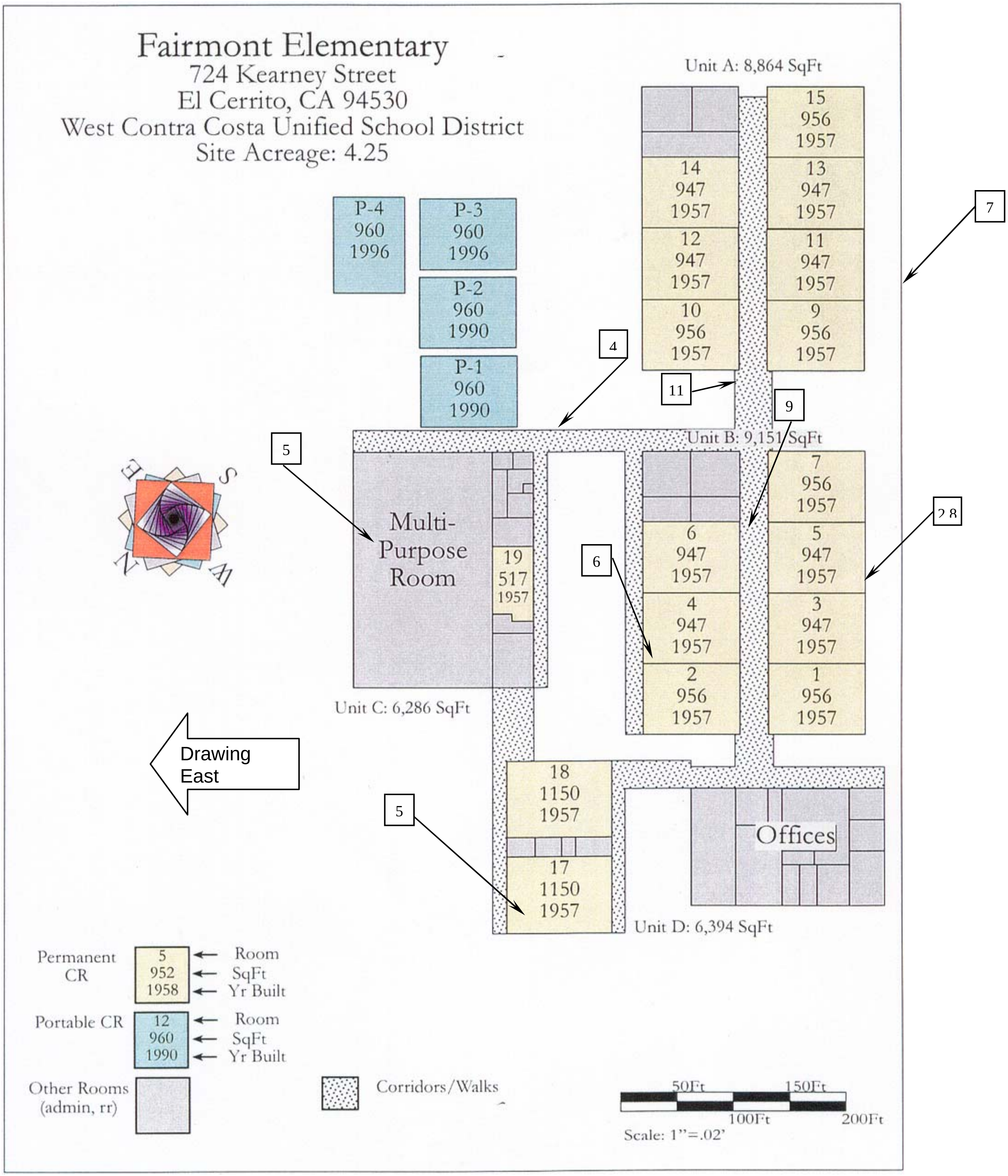

Figure 1: School Layout Plan

Figure 2: Front Entrance

Figure 3: Skylight inside classroom with water leakage

Figure 4: Covered Walkway (Not attached to the classroom building on left)

Figure 5: East wall of Kindergarten Building

Figure 6: East wall of Classroom building (unit ‘B’)

Figure 7: Exterior Longitudinal (west) wall (unit ‘A’)

Figure 8: Exterior Longitudinal (west) wall (unit 'B')

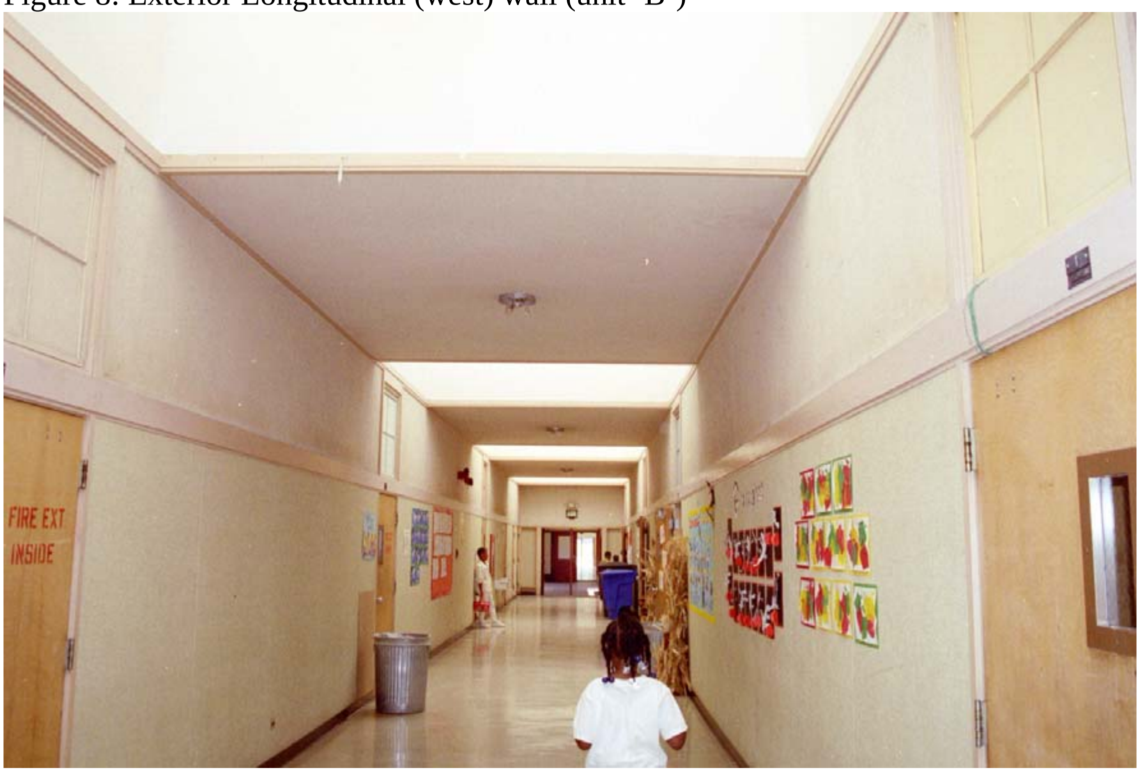

Figure 9: Interior Corridor showing Skylights

Figure 10: East wall of Multi Purpose Building

Figure 11: Covered Walkway between units 'B' and 'A' (seismic gap at the left)

Figure 12: Covered Walkway between units ‘B’ and ‘A’ with plaster ceiling

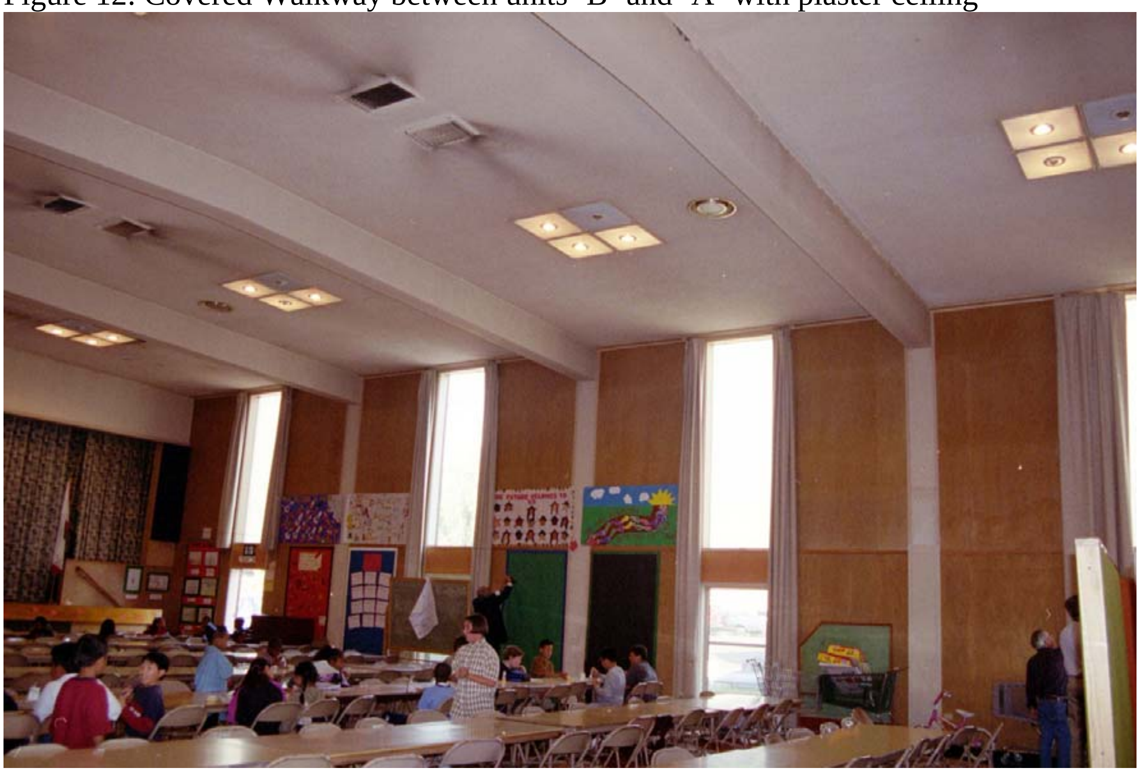

Figure 13: Interior of Multi Purpose Building