STRUCTURAL EVALUATION OF

GRANT 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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April 30, 2002

DASSE Design Project No. 01B300

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10.1 Introduction

The purpose of this report is to perform a seismic assessment of the Grant 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 1956. The original buildings are one-story wood structures with stucco and wood siding exterior finishes. There are eight permanent structures and 18 portable buildings. There are two 1985 portables, two 1989 portables, two 1996 portables, three 1997 portables, five 1998 portables, and four portables of unknown vintage. The total square footage of the permanent structures is about 36,771 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 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 2.4 kilometers from the Hayward fault. The main classroom building and multi-purpose building are wood structures with plywood shear walls in both directions, 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:

$$V = \frac{2.5CaIW}{R} = \frac{2.5(0.44x1.46x1.15)W}{5.5} = 0.336W$$

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. Grant Elementary School, dated January 19, 1955, by Donald L. Hardison Architect, Sheets A1-A20, and Hall Pregnoff & Matheu Structural Engineers, Sheets S1-S9.
2. Portable Classroom Building, dated June 9, 1953, by Donald L. Hardison Architect, Sheets A1-4, and Hall Pregnoff & Matheu Structural Engineers, Sheet 5.
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 October 25th, 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 school buildings are of one-story wood construction and were built in 1956. The exterior finishes are primarily wood siding with some stucco (Figures 2&3). Typically the interior ceilings are suspended acoustical ceilings (Figure 4).

There is water damage to the ceiling around one of the skylights in the classroom building corridor (Figure 8) which indicates that there is a failure of the roofing system and the likely existence of rot in the roof framing.

The covered walkways consist of 1x6 straight sheathing with wood beams and steel pipe columns. There is a need for lateral bracing since the covered walkway is not tied to the building (Figure 6).

There are a number of portable classrooms on the campus. Typically the base of the portable classrooms directly on the ground or on wood pads (Figures 10&11) which has resulted in decay of the wood in close contact with the ground (Figure 10). In many instances rigid electrical conduit was observed to run between portable classrooms (Figure 9) thus creating a potential life safety hazard during an earthquake when the buildings tend to move apart.

10.6 Review of Existing Drawings

The Administration, Multi-Purpose, and Classroom buildings built in 1956 have 3/8" plywood roof sheathing supported by joists at 16" oc. The joists are supported by either wood stud walls or steel beams and steel pipe columns. The floors are concrete slabs on grade and the foundation consists of continuous strip footings that support the walls and columns.

The lateral forces of the 1956 buildings consist of a plywood roof diaphragm that transfers the lateral forces to the plywood shear walls, which in turn, transfer the lateral forces to a concrete slab on grade. In the classroom building the longitudinal shear walls are located on each side of the corridor and transverse walls consist of the end walls and the walls between the classrooms.

There is a reinforced brick incinerator chimney near the middle of the classroom building.

The covered walkway at the front consists of 2x T&G straight sheathing supported by 6x beams and steel pipe columns. There does not appear to be a substantial system to resist lateral forces.

The roof of the portable classroom buildings, as defined on the 6-9-53 drawings, has diagonal 2x6 T&G sheathing supported by 4x joists at 4'-0" oc. At the overhangs the 2x sheathing is orientated perpendicular to the joists. The roof joists are supported by the side wood walls and by wood posts at the end walls. The floor framing consists of 3/8" plywood over 2x8 T&G sheathing which spans about 6 feet to 6x12 wood beams which in turn are supported by isolated spread footings.

The lateral resistance of the portable classroom buildings is provided by the side walls and the rod bracing between top of the posts in the end walls. Positive anchorage has been provided between the portable building and its foundation.

The temporary classroom buildings were originally approved by Division of Architecture in 1945. The roofs consists of diagonal sheathing supported by 2x joists at 24" o.c. which span to the exterior walls. The lateral wall bracing consists of 1x6 diagonal let in bracing. The structure s are anchored to continuous footings that transfer the lateral forces to the ground.

For temporary classrooms 23-26 the roof is about 24 years old and thus should be re-roofed. All other roofs are only about 3 years old and thus no roofing 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.	Covered walkways have a lack of lateral bracing.
2.	Water damage to ceiling adjacent skylight in classroom corridor.
3.	Incinerator chimney is not braced at the roof. This could lead to damage in an earthquake.
4.	Kindergarten Building lacks sufficient seismic capacity in the longitudinal direction.
5.	Electrical rigid conduit runs between roofs of portable classrooms thus creating a potential life safety hazard when buildings move during an earthquake.
6.	The portable classrooms rest directly on the ground or on wood pads that rest on the ground. This has resulted in rot in the wood in contact with the ground.

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 lateral bracing to the existing covered walkways.	1.9	6,7
2.	Repair the roofing and replace any damaged wood in the roof.	1.9	8
3.	Brace incinerator chimney at roof of classroom building or remove incinerator.	2.0	N/A
4.	At the Kindergarten Building, add additional length of shear walls in the longitudinal direction. Provide holdowns and collectors as required.	1.5	N/A
5.	Re-route electrical conduit or install flexible connections to enable the portable classrooms to move without damaging the conduit.	1.9	9
6.	Repair the wood members of the portable classrooms that have rot and support the structure on a raised concrete foundation.	1.9	10

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 3 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

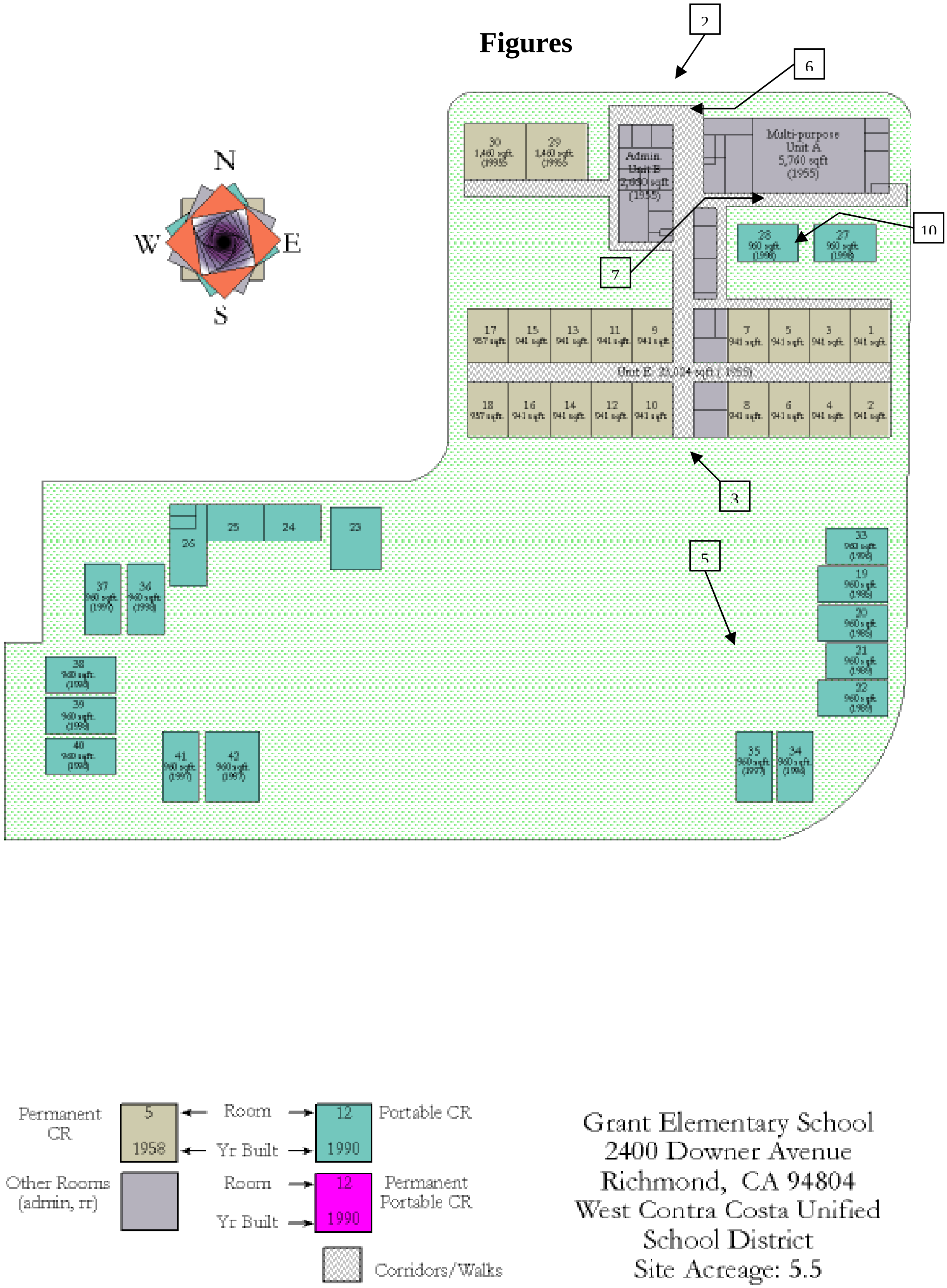

Figure 1: School Layout Plan

Figure 2: Main Entrance

Figure 3: Classroom Building

Figure 4: Classroom Corridor

Figure 5: Portable Buildings

Figure 6: Covered Walkway

Figure 7: Covered walkway

Figure 8: Water Damage at Skylight Over Classroom Corridor.

Figure 9: Conduits Between Portable Buildings.

Figure 10: Decay at Base of Portable Building.

Figure 11: Anchorage of Portable Buildings