STRUCTURAL EVALUATION OF

NYSTROM 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 Nystrom 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, which were apparent during our site visit, are documented in this report. 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

Nystrom Elementary School is located in the city of Richmond and was built in the years 1942, 1948, 1949 and 1953. The 1942 main classroom building is a two-story wood framed structure and has a hard board (transite) finish sheathing on the exterior (see Figures 2 & 3). There are three main buildings on this campus: main classroom building; multi-purpose room; kindergarten building. Thirteen older 1949 portable buildings at the rear of the yard are no longer in service. The 1948 kindergarten building is a one story building with covered walkways and window walls.

An old incinerator is located near the main building and is of unreinforced brick construction.

10.3 Site Seismicity

The site is located in The City of Richmond on Harbor Way South**.** The site is a soil classification S_D in accordance with the 1998 California Building Code (CBC) and as per the consultants, Jensen Van Lienden Associates, Inc.

The 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 <u>at a distance of 4.1 kilometers from the Hayward</u> fault. The buildings are wood framed buildings with shear walls, and have a response modification factor, R = 5.5. The 1998 CBC code 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. This earthquake is know as the *Code Level* earthquake or the 475 year earthquake.

The seismic design coefficient in the 1998 CBC is:

$$V = \frac{2.5C_a IW}{R} = \frac{2.5(0.44)(1.30)(1.15)W}{4.5} = 0.365W$$

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 Available Documents

1. School Building, USMC Houing Project, Architectural and Structural Drawings by Will G. Corlett and Arthur Anderson, dated December 5, 1942
2. Multi-use Building, An Addition to Nystrom School, by Barbachino, Ivanitsky, Watanabe Architects, and Thomas F. Chase Structural Engineer, April 1953
3. Kindergarten Bulding, by Dragon, Schmidts & Hardman Architects, December 1948
4. "Measure M" – WCCUSD Elementary School – UBC revised parameters by Jensen-Van Lienden Associates, Inc., Berkeley, California.
5. "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.
6. "Measure M" roofing report by "The Garland Company Inc.", Orinda, California.

10.5 Site Visit

DASSE visited the site on November 6th 2001 at about 11AM. The 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 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

Nystrom Elementary School is a two story wood framed building with a hard board finish on the exterior (see Figures 2 & 3). The roofing is in need of replacement. Leakage was found at the east end of the main classroom building and wood rot was noticed in that wall (Figure 4).

The roof diaphragm appears to be made of straight sheathing at the covered walkways (Figure 6) and diagonal sheathing above classrooms. The wall sheathing appears to be made of diagonal sheathing. Classrooms and corridors have plaster over wood lath ceilings. There are covered walkways in the school campus without adequate lateral bracing. Exterior longitudinal walls of the classrooms have numerous window openings.

10.6 Review of Existing Drawings

The two 1942 two-story classroom buildings have diagonal sheathing on the roof, floor and exterior walls. Interior corridor walls are considered partitions and do not appear to have diagonal sheathing for shear resistance. There was only one structural sheet "S5" which suggests that most of the structural sheets for this project are missing. It is therefore difficult to tell exactly which walls have diagonal sheathing for shear resistance and which walls do not.

The Multi-purpose building has a steel frame at the roof without moment connections. The lateral system is plywood walls in the longitudinal and transverse directions. However, the loads on these walls is greater than their capacities. Large windows reduce the longitudinal shear resistance of the building on both sides.

The Kindergarten Building employs typical window wall construction on the north side and clerestory window construction above a covered walkway on the south side (see Figures 7 & 8). The Kindergarten utilizes diagonal sheathing on the roof an exterior walls, however, there are not adequate amounts of walls for shear resistance.

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

The following structural deficiencies were noted during evaluation of this campus. 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.	Main classroom buildings do not have adequate shear resistance in either the longitudinal or transverse directions. Plywood sheathing should be added to interior corridor walls and transverse classroom walls.
2.	Exterior longitudinal walls of kindergarten building, classroom numbers 1A through 4A have numerous window openings, resulting in inadequate length of shear wall to resist seismic forces. This building has a window wall on the north side and clerestory windows on the south side.
3.	Upper story covered walkway at main building does not appear to have adequate lateral support or to be well connected to the buildings.
4.	Covered walkways are attached to the outside of the main classroom building and require better attachment to the building for lateral support.
5.	Siding decay was observed on the east wall of the main classroom building.
6.	Lack of shear resistance in Multi-purpose room walls.
7.	Old brick incinerator is a tall unreinforced masonry structure and poses a life-safety brick falling hazard.

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
1.	Add plywood shear walls to main classroom buildings at the corridor walls and the transverse classroom walls. Provide new collectors & hold downs as required.	1.5
2.	Add plywood shear walls to kindergarten building. Provide new collectors & hold downs as required.	1.2
3.	Add lateral bracing to upper story walkway	1.5
4.	Add connections to covered walkway	1.9
5.	Repair east wall siding and flashing.	1.5
6.	Add plywood shear walls or steel braced frames to Multi-purpose room. Strengthen shear transfer between steel beams and shear walls.	1.8
7.	Demolish brick incinerator.	1.5

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 Prioritizations

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 4 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.

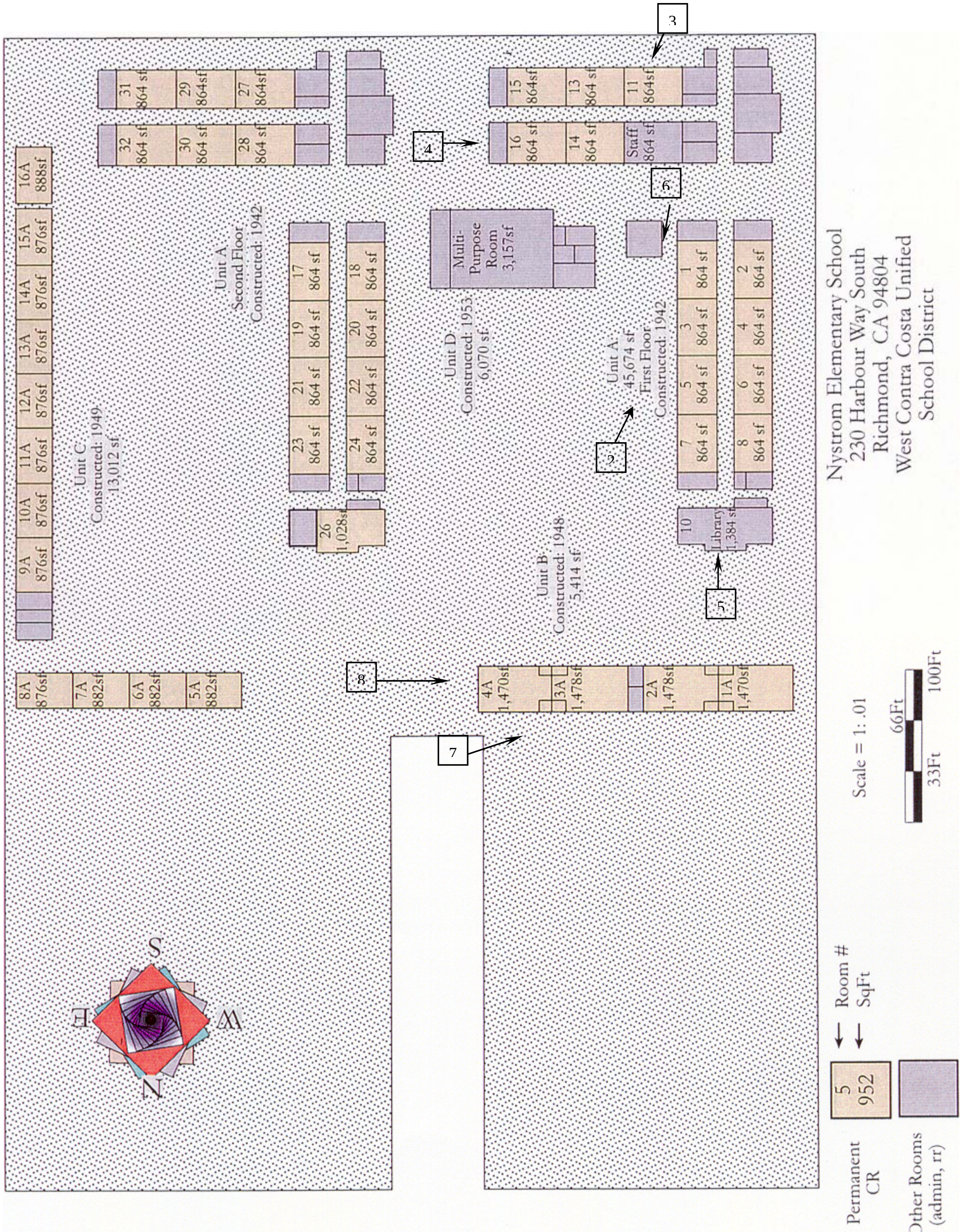

Figure 1: School Layout Plan

Figure 2: View from Rear School Yard

Figure 3: South Elevation of Main Classroom Building (window wall)

Figure 4: East Elevation of Main Classroom Building (siding decay)

Figure 5 North of Main Classroom Building

Figure 6: Covered Walkways at Main Classroom Building

Figure 7: North Elevation of Kindergarten (Window Wall)

Figure 8: East Elevation of Kindergarten (shows South Elevation clerestory)