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To:	Robbie Lyng
Company Name:	**ALAMEDA UNIFIED SCHOOL DISTRICT**
From:	Chris Warner
Date:	February 7, 2012
Regarding:	Historic Alameda High School
Project:	11130.20

SUMMARY

ZFA has completed a structural evaluation of the East (current AUSD administration offices) and West (vacant library) Wings, and the Science Building (adult school) of the Historic Alameda High School (HAHS). This review has identified building deficiencies that have the potential to lead to collapse of these buildings during a large earthquake.

These three buildings were built around 1924 along with the Patton Gym and the Auditorium. Shortly after completion, the state of California passed the Field Act in 1933, following the Long Beach earthquake. During that earthquake approximately 70 schools were destroyed and 120 schools were severely damaged. This Act required that school buildings receive approval through the State of California in order for the students to use the buildings, along with more stringent design and construction requirements. To bring HAHS into compliance with the Field Act, a set of retrofit drawings was produced which consisted of structural plans for all of the buildings in 1935. It included extensive retrofit of the concrete shearwalls and structural connections. However, only the gym and approximately 80% of the Auditorium was completed. Subsequent laws mandated that by 1976, school districts throughout the state must remove students from existing buildings which were not Field Act compliant. This prompted the Alameda Unified School District to build the West Wing in 1957 and new classroom and administration building on campus in 1975. In 1995, the Auditorium retrofit construction was completed and seismic joints were created on each side of the auditorium lobby but the proposed retrofit of the other three buildings was again removed from the project. This project was certified by DSA in 1998. As a result of this work, the Patton Gym and the Auditorium, including the lobby, can be considered to conform to the Field Act and are approved for student use. Finally, in 2005, retrofit designs were started but not completed for the vacant library, keeping only the exterior walls, with an entirely new vertical and lateral system inside. Overall, mostly non-structural modifications have occurred to these buildings while in use. While the language in Measure C, the bond passed in 2004,

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included seismic retrofit of the East and West wings, this project was ultimately unfunded. Essentially, these buildings remain structurally unchanged from their original construction.

ZFA used the recently created DSA procedure 08-03 evaluation form for analysis of these three buildings. This procedure was developed by DSA for the evaluation of the most vulnerable school buildings to assist the districts with a pathway to claim Proposition 1D funding. ZFA was one of two consultants hired by the Division of State Architect to assist in the development of this document. The purpose of the review was to capture critical structural deficiencies in buildings which have the potential to cause collapse of the structure during a large seismic event. The review of HAHS indicates there are several deficiencies that are common to all three buildings. These deficiencies are:

- Inadequate wall anchorage
- Unblocked diaphragm spans
- Inadequate reinforcing steel in some concrete walls
- Wall opening ratios are deficient
- Concrete column bar splices are deficient
- Unknown shear transfer from the diaphragms to the wall.

Multiple engineering reports over several decades have outlined these same significant structural deficiencies in the buildings. Multistory concrete buildings with wood roofs and floors are among the most vulnerable to earthquakes. We consider the lack of adequate wall anchorage to be the most critical deficiency. The lack of proper anchorage from heavy concrete walls to light wood diaphragms has led to collapse of buildings during large seismic events. During the Northridge Earthquake, buildings designed under the code in place experienced wall to floor anchorage failures. Actual motions recorded in buildings with flexible diaphragms show that the ground acceleration may be increased by a factor of 3 on the anchors. The original and current anchors are spaced approximately 7 ½ feet on center and do not have positive attachment to the floor or roof framing. In fact, the original retrofit drawings in 1938 had required a significant structural modification of the concrete wall to floor/roof anchors. Unfortunately, this appears to not have been completed in the buildings in question. The remediation of this deficiency has been a part of every seismic retrofit proposed for these structures. Several cities in California have passed ordinances requiring upgrading of this deficiency if other significant construction or modification occurs to the building. The other deficiencies noted have the potential to cause collapse and would trigger potential structural retrofits but we feel they are not as critical as the anchor deficiency.

The USGS (United States Geological Survey) has recently released a seismic activity forecast called the Uniform California Earthquake Rupture Forecast (UCERF). Per the information released in this forecast there is a 63% probability of a magnitude 6.7 or greater earthquake in the bay area in the next 30 years

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and more specifically, a 31% probability on the Hayward Fault. The USGS considers a moderate earthquake to be from magnitude 5.0 to 6.0, a large earthquake to be 6.0 to 7.0, and a major earthquake to be 7.0 to 8.0. For further reference, the Loma Prieta earthquake that struck the Santa Cruz Mountains in 1989 was magnitude 6.9. Although over 50 miles to the north, the ground acceleration in Alameda was approximately 0.2g (measured as a percentage of gravity) which according to the Mercalli scale causes strong perceived shaking with light potential for structural damage. We have attached two figures at the end of this memo produced by the Association of Bay Area Governments (ABAG) produced from their report "On Shaky Ground". Figure 1 models the ground shaking that Alameda likely felt during the Loma Prieta quake and is consistent with the statement above. Figure 2 shows that the expected level of shaking during a magnitude 6.9 quake on the Hayward Fault. As you can see, the site will likely experience significant shaking much greater than with the Loma Prieta earthquake. It is likely that these buildings have not experienced strong ground shaking capable of significant structural damage during their existence.

The Structural Engineers Association of California Existing Building Committee has provided some guidance on appropriate terminology when discussing existing buildings. The seismic forces generated by an earthquake are considered rare events and are unlikely to happen in any short term time frame. A building could be termed "dangerous" if it has a significant potential of collapse under loads that could occur during a relatively short time frame. This would include the normal loads of the buildings' self-weight, the normal occupancy loads, or typical wind forces. This does not include damage caused by a seismic event. Using these definitions, we would not classify these buildings as "dangerous". However, we do feel that these buildings are potentially hazardous due the deficiencies identified in the reports.

A first step to retrofit would be a temporary abatement of the hazardous conditions by providing barricades around these three buildings to protect students and school staff from harm if one of the buildings did collapse during a seismic event. This barricade would consist of steel driven members with substantial chain link fencing installed around the buildings. This would be placed beyond the potential fall zone of the concrete walls. Additionally, we would propose some minimum level of anchorage to tie the walls to the floor and roofs along some portions of the buildings. Along with this approach some form of temporary structures would need to be constructed to withstand falling debris as students used the exits on the east and west side of the Auditorium. It is our understanding that as part of the DSA approval of the Auditorium, there was confirmation that if the East or West Wing fell onto the Auditorium, it would support this additional loading without causing a failure.

We believe that a timely comprehensive retrofit of these buildings is necessary based on their age and construction type. This retrofit would mostly likely take the form of added concrete shearwalls and/or braced frames, new wall to floor/roof anchorages, and a strengthening of the floor and roof diaphragms.

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Based on these buildings' history of structural reports, numerous proposed retrofits and the noted deficiencies, we believe the district should make the seismic retrofit of these buildings a high priority. If you have any questions or concerns please contact myself or Robin Wendler at 707-526-0992.

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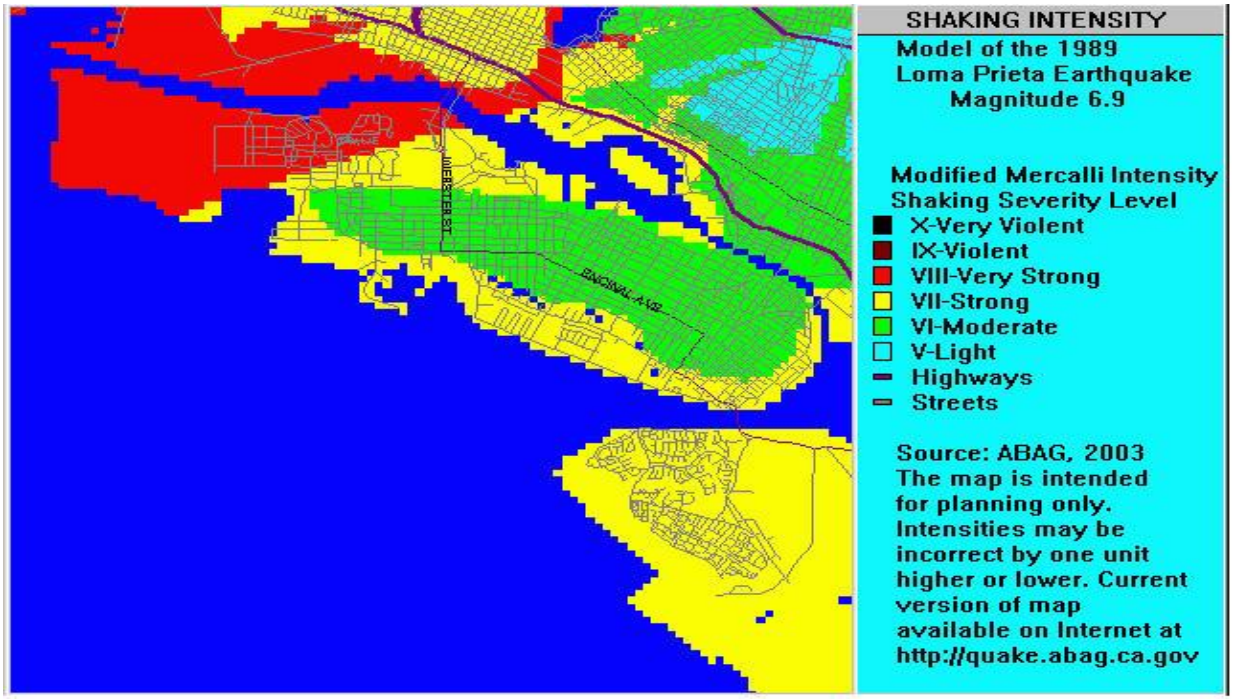

Figure 1- Shaking Intensity Modeled After the Loma Prieta Earthquake

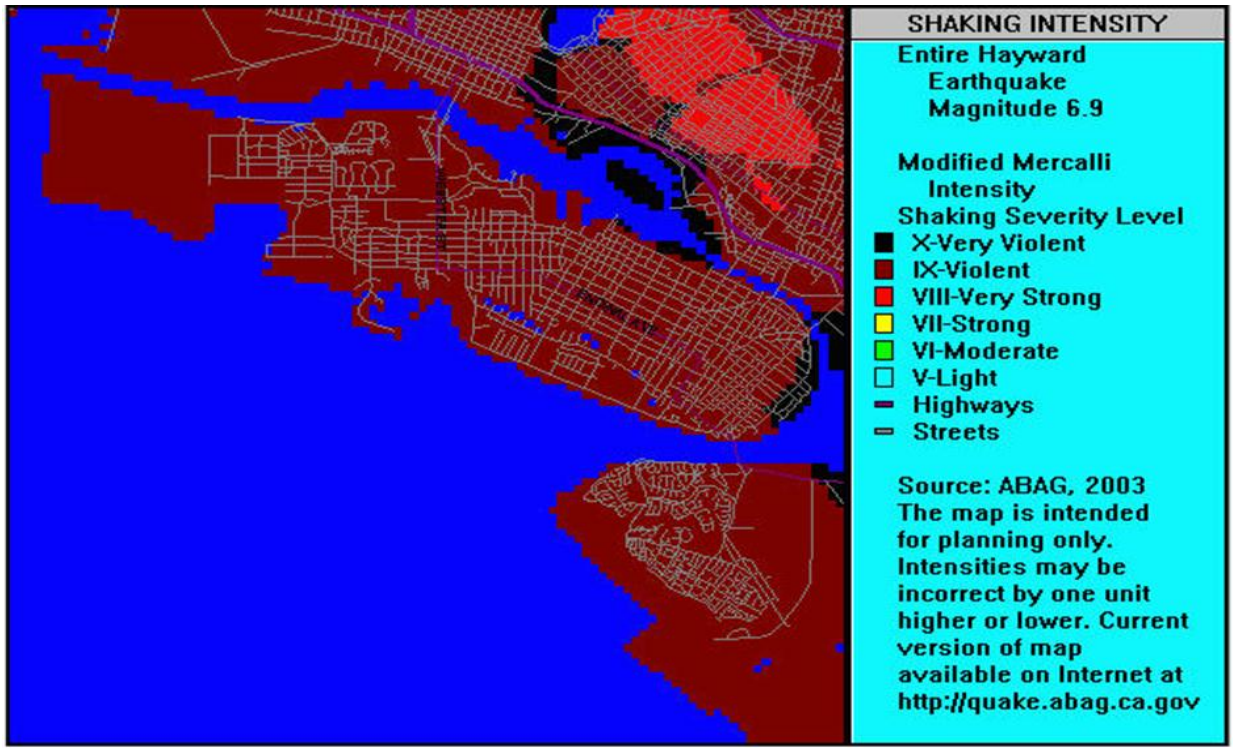

Figure 2- Shaking Intensity Forecast Based on 6.9 Earthquake on the Hayward Fault