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March 4, 2010

Robert Patton, Commander
Veterans of Foreign Wars
Bill Motto Post 5888
846 Front Street
Santa Cruz, California 95060

Re: Santa Cruz Veterans Memorial Building

Dear Commander Patton,

This letter is to provide my observations and opinions on the condition of, and structural issues surrounding, the Santa Cruz Veterans Memorial Building that was suddenly closed by the County on January 21, 2010, due to County of Santa Cruz concerns over its structural safety. This letter is based on my site visit, my review of the January 21 letter by County staff, the January 18 letter by William Fisher Architecture, and the January 18 letter by the Streeter Group.

I am a California State licensed civil engineer and a 24-year member of the VFW Post 5888. I have 25 years experience across the United States specializing in investigation of existing buildings, including issues related to seismic loads, wind loads, overloads, fire, aging, historic preservation, repair design, and retrofit design.

On January 27, I visited the Santa Cruz Veterans Memorial Building at the request of VFW Post 5888, of which I am a member. I was escorted by Anthony Loero of Santa Cruz County General Services Department, William Fisher of William Fisher Architecture, Inc., and Hugh Zike of Streeter Group, Inc. These gentlemen graciously showed me around the building, pointed out the areas of concern and described their approach to the structural issues. Our inspection included the attic space over the auditorium, the roof, the auditorium, and the exterior walls on both sides and the rear of the building. I briefly looked at the original 1930s-era building drawings Mr. Fisher had with him. We did not inspect the basement or the front portion of the building as it was represented to me that these areas do not exhibit any visible damage conditions.

Other than removing a few pieces of loose concrete from exterior pilasters, I did not remove finishes to expose underlying conditions or perform destructive or non-destructive tests. I have not performed a mathematical analysis of the building. Other than as mentioned above I have not had the opportunity to review existing drawings or other documents related to the building. I base my opinions on 25 years' experience investigating and designing repairs to—and mitigations of—existing structures of all types, including many building of similar vintage and condition to the Veterans Building. The above caveats notwithstanding, I spent sufficient time at the building to form a firm and clear opinion as to its condition.

OBSERVATIONS

Building Description: All the building exterior walls and columns are steel-reinforced concrete, and it is likely that certain of the interior partitions are also. The floor, ceiling, and roof framing throughout the building are wood with heavy timber roof trusses and major beams. The building was constructed in the early

1930s except for the concrete stage structure at the back of the auditorium. Mr. Fisher believes the stage may have been added in the 1950s, but had not at the time of my visit found documentation to confirm it. The stage addition is about 15 feet deep. The original back wall of the auditorium was solid concrete, or nearly so, but about half the wall width has been removed to create the proscenium arch for the stage. The original concrete wall is intact above the proscenium arch, and is functionally now a deep beam, perhaps 8 feet tall. The nature of the reinforcement within this unintended beam is not known. The new back wall of the stage was erected over four short concrete columns. The nature of the stage's horizontal framing could not be determined during our visual survey. The auditorium sits over an equal-sized banquet room known as the bunker that is partially below grade. The side walls of the auditorium/bunker are concrete with windows. The four timber floor beams and four roof trusses that span the auditorium bear on four reinforced-concrete pilasters built into each side wall.

Roof Trusses: From our cursory inspection of the attic spaces, the heavy timber roof trusses and secondary lumber framing appear sound, with no indications of sag, decay, member splits, misalignment, or overloading damage. At least two of the trusses have steel brackets connecting the truss bearing points to the pilasters and side walls that appear to be retrofitted. We speculated that this work was installed at the time that trapeze anchors were installed on the trusses for the use by a community group in the auditorium. Messrs. Fisher and Zike had not identified any damage in the attic areas of the building.

County Observed Damage: As the letters from William Fisher Architecture and Streeter Group indicated, they have identified loose pieces of concrete on some of the eight pilasters along the north and south walls of the auditorium; loose concrete on some of the short columns under the back (west) wall of the stage; and corrosion to steel reinforcement under the loose concrete. They indicated that they had not found any other damage in the building that caused them concern, nor did I observe any other damage.

Spalling Concrete: I, too, observed loose concrete and corroded steel. Known as spalling, such loose concrete is not damage from overloading, or damage from seismic events, or poor quality concrete, or inadequate design, or poor construction. Instead, it is a deterioration process related simply to the age of the building and deferred maintenance.

The exposed concrete material itself appears to be in good condition; and it appears hard an properly colored, and the cracks split some of the aggregate, indicating that the cement paste and aggregate are sound.

Stirrups: Also in the pilasters, we observed some exposed horizontal steel stirrups that wrap around the vertical steel. These stirrups are open loops spaced about 24 inches apart in the areas we could see, and are typically 1/4-inch diameter smooth "pencil rods." One of these exposed rods has corroded through. I assume in his letter Mr. Streeter was referring to this rod that had "deteriorated completely in some locations."

Historic Building Code: Since the Santa Cruz Veterans Memorial Building is on the National Register of Historic Places, it is regulated by the 2007 California Historic Building Code, Part 8 of Title 24 (CHBC), for purposes of "preservation, restoration, rehabilitation…or reconstruction…" The intent of the CHBC is to "facilitate the preservation and continuing use of qualified historical buildings…" [my emphasis] Among other things, this code controls the terms under which this building can be declared hazardous. The CHBC defines terms pertinent to this discussion, as follows:

- "Life Safety Hazard: See Distinct Hazard"
- "Distinct Hazard: Any clear and evident condition that exists as an immediate danger to the safety of the occupants or public right of way. Conditions that do no meet the requirements of current regular codes and ordinances *do not*, of themselves, constitute a distinct hazard." [italics in original]

- "Imminent Threat: Any condition within or affecting a qualified historical building or property which, in the opinion of the authority having jurisdiction, would qualify a building or property as dangerous to the extent that the life, health, property or safety of the public, its occupants or those performing necessary repair, stabilization or shoring work are in immediate peril due to conditions affecting the building or property. Potential hazards to persons using, or improvements within, the right-of-way may not be construed to be "imminent threats" solely for that reason if the hazard can be mitigated by shoring, stabilization, barricades, or temporary fences."

In addition, Section 8-102.5 Unsafe buildings or Properties states, "When a qualified historical building…is determined to be unsafe as defined in the regular code, the requirements of the CHBC are applicable to the work necessary to correct the unsafe conditions. Work to remediate the buildings…need only address the correction of the unsafe conditions, and it shall not be required to bring the entire qualified historical building…into compliance with regular code."

For vertical loads, the CHBC structural section requires that, "The capacity of the structure to resist gravity loads shall be evaluated and the structure strengthened as necessary. The evaluation shall include all parts of the load path. Where no distress is evident, and a complete load path is present, the structure may be assumed adequate by having withstood the test of time…"

For seismic loads, the CHBC requires that the structure's ability to resist wind and seismic loads be evaluated, and that unsafe conditions in the lateral-load-resisting system be corrected to meet certain minimum strengths.

DISCUSSION

Spalling Mechanism: New concrete is extremely alkaline, and where concrete surrounds the reinforcing steel, the steel will be protected from corrosion. However, as reinforced concrete buildings age, there are gradual changes to the chemistry of the cement paste that have no effect on the concrete material strength but do reduce its alkalinity—eventually to the point that it no longer protects the steel. If oxygen and moisture are present, steel can then begin to corrode. When steel corrodes, the rust products swell to about six times the volume of the original steel. Concrete is strong in compression, but it is very weak in tension; so the internal tension forces from corrosion swelling soon overcome the concrete's tensile strength and cause it to crack (spall). This deterioration process accelerates after the concrete has cracked because it provides a channel for even more water and oxygen to reach the steel.

Eventually, chunks of concrete can be dislodged and fall from the building, exposing the underlying corroded steel. While this is a disturbing sight—and the public must be protected from falling debris—spalling is not, in itself, an indication that the building has become unsafe. It requires very little corrosion on the surface of steel reinforcement to blow off the overlying concrete. Typically the remaining cross-sectional area—and load-bearing capacity—of large bars is not significantly compromised simply because they have corroded enough to crack the concrete cover. My observation of the exposed vertical steel bars in the pilasters and columns at the Veterans Building is consistent with my past experience in that regard: the bars have destroyed the concrete cover in a few areas, but the bars themselves do not appear to have lost significant cross-sectional area. The very limited quantity of the obvious damage supports that contention. That is, by the time some of the bars have corroded enough to become compromised, the extent of the corrosion is normally exhibited over large areas, not just small corner spalls such as those present on the Veterans Building.

Additionally, when the strength of a reinforced column or beam is analyzed by engineers, the concrete cover to the outboard side of the reinforcement is neglected in the tension region. Thus, for the critical tension case,

the cover does not count structurally. The function of the concrete cover is to protect the steel from the weather, which is a serviceability issue, not a structural one.

The four columns and beams supporting the back wall of the stage are in the same condition as the pilasters: they have superficial spalling of the concrete cover due to corrosion of the underlying steel. Despite Mr. Fisher's assertion, there is no reason to replace any of the columns or beams.

It should be noted that if the concrete has is not cracked, there can be little corrosion of the underlying steel. Thus, in the areas of the building that are away from the existing spalls and are not cracked, the steel is likely to be in good condition.

Stirrups: Obviously, a small-diameter steel rod will corrode through much more quickly than a large-diameter one. However, to say that the complete corrosion of a small rod on a column is a significant structural matter is a significant overstatement. While modern ductile reinforced concrete design in seismic zones requires columns to have careful detailing and closely-spaced continuous-spiral stirrups, the need for such detailing was not understood when this building was designed. At that time, the sole purpose of an occasional loop of pencil rod was to hold the vertical steel in alignment within the forms until the concrete could be placed. Once the concrete was cured, the pencil rods were not expected to have any function whatsoever; and, in fact, because of their wide spacing, small diameter, discontinuity, and inability to provide confinement for the concrete, they contribute nothing to the serviceability, strength, or ductility of an in-service column. Thus, if one or a few of these rods are corroded through, it will have no influence whatsoever on the behavior of the column during the cyclic loads imposed by an earthquake.

Building Code Requirements: Mr. Streeter described "significant cracking" and "significant risk of injury or death...should a seismic event occur, " but he did not call for the building to be closed. Mr. Fisher called the pilaster damage "extremely significant," described "extreme danger" for the public if an earthquake occurs, and called for the auditorium to be closed. While neither Mr. Fisher nor Mr. Streeter used any of the three CHBC hazard terms listed above in their letters, they clearly intended to raise the alarm as to the seismic capacity of the building, but they did not identify an "imminent threat…due to conditions affecting the building." That is, they did not indicate that they thought the building could collapse under its own weight or normal live loads. As described above, it is my opinion that, while there is minor spalling at the pilasters, this does not constitute distress due to loading, nor does it affect gravity load-carrying capacity.

As for the seismic capacity, it is clear from its age, its design, and its condition that the building does not meet current code requirements for seismic capacity. For any building professional to suggest that it be investigated and upgraded is simply prudence. But, as defined by the CHBC, "distinct hazard" cannot exist merely because the building does not meet current regular codes. Similarly, "imminent threat" cannot exist if the hazard "can be mitigated by…stabilization [or] barricades."

Unoccupied Building Costs: As a practical matter, the County should keep in mind that uninhabited buildings often experience accelerated deterioration through a variety of mechanisms. Undetected leaks, vandalism, maintenance neglect, stagnant plumbing, rusted mechanical systems, condensation and mildew in unheated spaces, varmints, and other insults can result in much higher costs when the time comes to reoccupy a facility.

CONCLUSIONS

Instead of characterizing the observed damage to the steel and spalling concrete as "extremely significant," as Mr. Fisher did in his letter, I would characterize it as insignificant structurally, but a significant maintenance

issue that could—if left unrepaired—become significant structurally in years to come. Similarly, instead of indicating that the "deterioration observed presents a significant risk of injury or death to the occupants of the auditorium should a seismic event occur," as Mr. Streeter did in his letter, I would characterized the observed deterioration as an indication that the County should immediately move to protect the public from falling concrete by preventing people from leaning against the pilasters—which has already been accomplished by the judicious application of yellow tape. The observed deterioration itself in no other way presents significant risk. The building likely has seismic deficiencies; but these deficiencies are completely unrelated to the spalling, and the County should not conflate the two issues.

For existing vertical loads on the structure, it is my opinion that the observed damage to the concrete pilasters, walls, and columns is not significant, and in no way justifies closure of the building. In addition, the California Historic Building Code forbids its closure because neither a distinct hazard nor an imminent threat exist.

For potential seismic loads on the structure, I concur that the building capacity should be carefully evaluated. Given the archaic nature of the existing construction, some level of seismic upgrade will likely be warranted, but is not mandated by any code requirements. However, the mere existence of seismic-response deficiencies does not constitute a distinct hazard or an imminent threat as defined by the CHBC, because these deficiencies represent only potential hazards. While it may be necessary to empty the building during the construction of a seismic retrofit, it is my opinion that there is no justification for its closure based on the current condition of the building, nor will it be necessary to close the building during the evaluation or retrofit design phases.

Lastly, due diligence requires the County to let a contract on a non-emergency basis to repair the spalling concrete as part of a maintenance program—an easy, effective, and essentially permanent repair if properly conceived and installed. Again, this can be accomplished without closing the building.

I hope this letter has helped to clarify for you the condition of the Veterans' Building, and assists you in getting it reopened immediately.

Sincerely,

Paul Cox, C.E. 45152