SUMMARY EVALUATION, CORRECTIVE OPTIONS, AND ESTIMATED CORRECTIVE COSTS

PERTAINING TO THE

ALASKA STATE CAPITOL

Juneau, AK.

PREPARED FOR

Legislative Affairs Agency

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APPLICABILITY

Each building displays unique behavior characteristics, reflecting numerous complex interactions between its particular structural systems, cladding elements, orientation and exposure to elements, and various other factors. Appropriate design recommendations must take these factors into account to minimize the danger of unsatisfactory performance.

This report provides general guidance for the Alaska Capitol building in Juneau. Extrapolation from the suggestions contained herein to other projects is not recommended, and may result in inadequate performance in some cases and needless expense in others. No warranty is provided that these recommendations can be successfully applied to other buildings. Any use of any information in this report for any purpose is strictly at the user's risk, and PAUL LUKES: Building Envelope Consulting Services LLC accepts no liability for any consequences arising from such use.

EXECUTIVE SUMMARY

1. GENERAL INTRODUCTION

The Alaska State Capitol Building is a concrete-frame structure built in 1930. Its exterior skin consists of a multitude of masonry elements, extruded aluminum and steel sash windows, and EPDM and built-up asphaltic roofs. Due primarily to a combination of some ill-advised initial design approaches and material selections, as well as the effects of 80 years of Juneau's climate, many of the building's exterior elements have begun to display signs of leakage, degradation, and stress.

PAUL LUKES: Building Envelope Consulting Services, (PL:BECS), was initially retained in 2006 to perform a quick examination of the building's exterior masonry and windows and provide an overall summary for these elements. This investigation revealed a large variety of significant problems plaguing the building's exterior masonry, and the front portico appeared particularly worrisome.

In 2010, PL:BECS was asked to perform a more detailed evaluation focused on the front portico. This produced a portico-focused report dated 12/31/10.

In 2012, PL:BECS was asked to assemble a team of specialized consultants to perform a multidisciplinary evaluation of the entire structure, help determine recommended solutions, and provide very rough cost estimates for seemingly viable options. This report represents the culmination of this 3rd phase of this building's evaluation.

2. OVERVIEW OF PROBLEMS & CORRECTIVE RECOMMENDATIONS

This building's design appears to fall within the technically-typical range for its time, and is thus not "deficient" in the "legal" sense of being outside then-current industry standards. However, a number of vulnerabilities are inherent to the design. Combined with the building's 80+ years spent in Juneau's very masonry-challenging climate, these vulnerabilities have begun to manifest, in places fairly seriously, in degradation of much of the building's exterior masonry. In addition, the building was not designed to current seismic standards, and poses significant safety hazards and risk of earthquake damage.

This section outlines these concerns and related corrective recommendations under individual headings for clarity. While such subdivision helps clarify many issues, it can also obscure the highly intertwined nature of these problems. The reader should mentally re-integrate these individual issues into a holistic understanding of the building.

This report outlines three different primary corrective approaches, which can be summarized as "**Option 1: Restoration Approach**", which attempts to save as much of the existing exterior masonry as is feasible; "**Option 2: New Masonry Veneer Over Concrete Walls**", which proposes to reconstruct the exterior cladding with a new but similar-looking masonry veneer placed over new concrete shear walls; and "**Option 3: New Masonry Veneer Over Concrete and Steel-Framed Walls**", which is very similar to Option 2, and also replaces the entire exterior cladding system, but provides both concrete and steel-framed back-up walls. Option 3 was evaluated only because it initially appeared to represent a possibly less costly approach. However, the cost estimate revealed this to be the most costly option. In view of this, Option 3 is not recommended, as it represents a technically lesser approach for higher cost.

PL:BECS strongly recommends the Option 2 approach as technically optimal, safer, and far longer-lived than Option 1. In view of this option's relatively small cost premium compared to Option 1, and its many significant advantages, as outlined in in Part III, PL:BECS considers this the only viable approach. As Option 1 cannot correct the most fundamental design vulnerabilities of the existing building, it poses inherent limitations, and will require notably higher operating costs related to ongoing maintenance of the masonry and appreciably higher energy costs. Further, it is seismically a less safe approach. In brief, the required masonry maintenance inherent in the Option 1 approach relates to the already seriously damaged brickwork and its specific configuration. Further damage to the brickwork can be slowed down, but cannot be stopped, and the brickwork's many ledges will inherently increase moisture absorption and consequent damage. However, these limitations should not obscure the fact that even this Option 1 approach will greatly enhance both the overall building's as well as the entry portico's seismic safety, reduce interior infiltration, and restore and slow-down further degradation of the many exterior masonry elements. Please see Part III for a more detailed discussion of corrective approach considerations.

With these “Corrective Approach” clarifications made, let me outline issues and recommendations for the building’s major elements. With regard to the **Building’s Basic Structure**, a 2002 evaluation by Berger/Abam concluded that the structure is lacking in capacity of the primary concrete frame to resist lateral loads, making the building vulnerable to serious seismic damage. This same conclusion was confirmed by Swenson Say Fagét as part of this phase-3 evaluation. Additional structural concerns include inadequate and damaged foundations; somewhat damaged concrete floor systems; a seismically-vulnerable masonry chimney; inadequate securement of most exterior masonry elements; and un-braced interior hollow clay tile partitions and mechanical equipment. In addition, much of the portico’s structure is fairly seriously damaged, and was never adequate to begin with. Combined, these pose safety hazards for occupants as well as risk of costly damage in case of earthquake. The building already manifests signs of past seismic damage, particularly at the portico. Please refer to sections II-2 and II-5 for a more detailed summary of the building’s structural concerns.

This report outlines three different approaches, and Recommended Corrective Actions for the structural concerns vary to between them. However, all include addition of reinforced concrete shear walls to enhance seismic capacity of the entire building, epoxy injection and other repairs to damaged concrete elements, lowering of the masonry chimney, securement of exterior masonry elements, and bracing of interior masonry partitions and equipment. Please refer to sections IV-2 & IV-5, V-2 & V-5, and VI-2 & VI-5 for a more detailed description of recommended corrective actions for the three primary approaches.

The building’s **Primary Exterior Enclosure Assemblies & Elements** include 13 different components, precluding an overall quick summary. In skeletal form, problems affecting these include widespread spalling and reinforcing corrosion affecting the foundations and lowest level floor level near the very wet crawl space under the building; cracking and some leakage via on-grade floor slabs; probable leakage via sub-grade foundation walls; effective moisture destruction of the building’s stone-clad exterior wall base; inadequate securement, anchor corrosion, and weathering damage to the stone-clad south wall bottom; widespread weathering damage, inadequate securement, lintel corrosion, and interior leakage affecting the brick-clad walls; cracking and weathering damage at the terra-cotta clad wall panels; ill-suited, leaky, and in places deflected windows; and ill-suited roof assemblies and some leaky roof-related conditions. All of the masonry elements also share the large-scale flaw of a complete absence of flashings and drainage provisions to limit water-infiltration and damage to the masonry. Please see section II-3 for a more detailed summary of the issues affecting the Primary Exterior Assemblies.

Recommended Corrective Actions for these Primary Enclosure Elements within the Option 1 approach include addition of a drainage system in the lowest-level crawl space; epoxy injection of cracked floor slabs and sub-grade walls; reconstruction of the destroyed stone base; restoration of the stone-clad south wall; re-anchoring and restoration of the brick-clad walls; reconstruction of the terra-cotta wall panels; re-cladding of two small metal-clad wall areas; replacement of all windows; and some perimeter detailing of the primary roofs. Please see section IV-3 for a more detailed summary of the Option 1 corrective recommendations for the Primary Exterior Assemblies.

Recommended Corrective Actions for these Primary Enclosure Elements within the Option 2 approach are in many respects similar to Option 1, and include addition of a drainage system in the lowest-level crawl space; epoxy injection of cracked floor slabs and sub-grade walls; reconstruction of the destroyed stone base; reconstruction of the stone-clad south wall; reconstruction of the brick-clad walls; reconstruction of the terra-cotta wall panels; re-cladding of two small metal-clad wall areas; replacement of all windows; and some perimeter detailing of the primary roofs. Please see section V-3 for a more detailed summary of the Option 2 corrective recommendations for the Primary Exterior Assemblies.

Recommended Corrective Actions for these Primary Enclosure Elements within the Option 3 approach are in most regards identical to Option 2, and include addition of a drainage system in the lowest-level crawl space; epoxy injection of cracked floor slabs and sub-grade walls; reconstruction of the destroyed stone base; reconstruction of the stone-clad south wall; reconstruction of the brick-clad walls; reconstruction of the terra-cotta wall panels; re-cladding of two small metal-clad wall areas; replacement of all windows; and some perimeter detailing of the primary roofs. The primary difference between Options 2 and 3 is that Option 3 includes steel-framed back-up walls as well as concrete ones inward of the exterior cladding, while Option 2 includes only concrete back-up walls. Please see section VI-3 for a more detailed summary of the Option 3 corrective recommendations for the Primary Exterior Assemblies.

The building's **Exterior Masonry Sub-Elements** include seven different components. In skeletal form, problems affecting these include inadequate securement and weathering damage affecting the level 2 stone water table; cracking, spalling, and other damage affecting the terra-cotta window bay surrounds; serious weathering damage to the level 5 terra-cotta water table; inadequate securement and weathering damage to the level 5 exterior marble panels; also seriously degraded, hazardous upper cornice-parapet band; inadequate securement and variable weathering and seismic damage to the stone window sills; and variable corrosion of steel window-head lintels. Please see section II-4 for a more detailed summary of the issues affecting the Exterior Masonry Sub-Elements.

Recommended Corrective Actions for these Exterior Masonry Sub-Elements within the Option 1 approach include re-anchoring, restoration, and flashing of the level 2 water table; replacement of the terra-cotta window bay surrounds; reconstruction of the level 5 terra-cotta water table; re-anchoring of the level 5 marble panels; reconstruction of the roof-level cornice-parapet band; re-anchoring, restoration, and flashing of the stone window sills; and replacement and flashing of accessible window-head lintels. Please see section IV-4 for a more detailed summary of the Option 1 corrective recommendations for the Exterior Masonry Sub-Elements.

Recommended Corrective Actions for these Exterior Masonry Sub-Elements within the Option 2 approach include reconstruction and flashing of the level 2 water table; replacement of the terra-cotta window bay surrounds; reconstruction of the level 5 terra-cotta water table; re-anchoring of the level 5 marble panels; reconstruction of the roof-level cornice-parapet band; replacement and flashing of the stone window sills; and replacement and flashing of all window-head lintels. Please see section V-4 for a more detailed summary of the Option 2 corrective recommendations for the Exterior Masonry Sub-Elements.

Recommended Corrective Actions for these Exterior Masonry Sub-Elements within the Option 3 approach are essentially identical to Option 2, and include all of the same work. Please see section VI-4 for a more detailed summary of the Option 3 corrective recommendations for the Exterior Masonry Sub-Elements.

The building's **Entry Portico** includes six different components. In skeletal form, problems affecting these include displacement and some cracking in the stone support base; absence of inter-connections, inadequate securement, and damage and degradation affecting the marble columns; inadequate securement, anchor corrosion, absence of flashings, and serious seismic damage affecting the load-bearing stone cladding under the portico roof; nearly absent and compromised securement and serious seismic and water damage to the portico roof structure; lack of securement, absence of flashings, and weathering damage affecting the portico railing; and improper integration with abutting walls and complete failure of the portico roof membrane. Please see section II-5 for a more detailed summary of the issues affecting the Entry Portico.

Recommended Corrective Actions for the Entry Portico are essentially identical in all three options, and include reinforcing and re-anchoring, restoration, and flashing of the marble columns; replacement of the stone wall cladding with color-matched pre-cast concrete; complete replacement of the entire portico roof structure above the column capitals; complete replacement and flashing of the portico railing; and replacement and re-flashing of the portico roof. Please see sections IV-5, V-5, and VI-5, for more detailed summaries of the Option 1, 2, and 3 corrective recommendations for the Entry Portico.

There are no particular concerns with regard to the building's interior **Architectural Elements**, and **Mechanical** and **Electrical Systems**. However, along the inner faces of the exterior walls, these will necessarily be affected by the needed structural and masonry work.

Recommended Corrective Actions for the Architectural, Mechanical, and Electrical Elements largely aim to relocate and modify existing systems where needed to accommodate the structural and masonry work, and to reinstall interior finishes matching existing ones. Some modifications to the mechanical systems will be made generally per a previous upgrade design which had not yet been executed.

3. SUMMARY OF CORRECTIVE COSTS

This report outlines three different primary corrective approaches, described in detail in parts IV, V, and VI. Each of these is subdivided into three construction phases, which would be executed over the course of three consecutive summers for logistical and feasibility reasons.

Before delving into the actual cost estimates, a few clarifications should be made.

The first of these is that Phase 1 of each option consists of the reconstruction of the entry portico, and the work of this phase is essentially identical in all three options. Consequently, the costs of Phase 1 for all three options are also the same.

Second, Phase 2 of each option consists of corrective work affecting the building's primary south façade. As Option 1 involves primarily restoration of the existing masonry, this approach inherently involves a greater degree of uncertainty in determining the costs of this work, as it can not be fully known ahead of time what fraction of the existing brickwork will require replacement, for example. To account for this, a somewhat higher contingency was assumed in the Phase 2 work for Option 1 than for Options 2 or 3, which both assume removal of all existing exterior masonry, allowing for a greater degree of certainty.

Third, Phase 3 of each option consists of corrective work affecting the remaining east, west, north, and courtyard sides of the building. As with Phase 2, the Option 1 approach inherently involves a greater degree of uncertainty in determining costs, and to account for this, a somewhat higher contingency was assumed in the Phase 3 work for Option 1 than for Options 2 or 3.

It should further be noted that this preliminary evaluation obviously did not attempt to design in detail every aspect of each option, but rather attempted to define each approach to a schematic level, sufficient to allow only very rough construction cost estimates to be prepared. The primary intent of this evaluation was to help determine the relative construction costs of each of the three approaches. For this reason, the costs of each phase of each option are rounded to the nearest $ 100,000, and realistically, even this level of precision implies a higher degree of certainty than can be justified by the schematically-defined work scope descriptions. The reader is encouraged to round these estimates to the nearest $ 1,000,000.

Finally, it should also be clarified that these estimates relate only to the projected construction costs, and that in any case and with any approach, appreciable additional costs should be anticipated to cover temporary relocation of occupants, design and engineering fees, possible soil studies, and other, non-construction related expenses.

With these clarifications made, let me dive into the cost estimates.

In brief, the estimated construction cost of all three phases of the **Option 1: Restoration Approach**, described in Part IV, is $18.1 million. This breaks down to $ 1.1 million for Phase 1, $ 4.8 million for Phase 2, and $ 12.2 million for Phase 3.

The estimated construction cost of all three phases of the **Option 2: New Masonry Veneer Over Concrete Walls** approach, described in Part V, is $ 21.9 million. This breaks down to $ 1.1 million for Phase 1, $ 6.7 million for Phase 2, and $ 14.1 million for Phase 3.

The estimated construction cost of all three phases of the **Option 3: New Masonry Veneer Over Concrete and Steel-Framed Walls** approach, described in Part VI, is $ 22.5 million. This breaks down to $ 1.1 million for Phase 1, $ 6.9 million for Phase 2, and $ 14.5 million for Phase 3.