I. INTRODUCTION

1. GENERAL

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. The building's exterior masonry elements include multi-wythe brick walls; terra-cotta claddings, water tables, and window surrounds; stone claddings, water tables, ceilings, and similar elements; marble columns and decorative panels; and granite cladding and paving at the entry. Small areas of stucco also occur near the building's upper reaches, in the back.

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 to perform a quick examination of the building's exterior masonry and windows and provide an overall summary for these elements. This investigation and summary report took place in late summer of 2006. This investigation revealed a large variety of significant problems plaguing the building's exterior masonry.

In 2010, PL:BECS was asked to perform a more detailed evaluation focused on the front portico, as the initial investigation revealed that this portico displayed truly severe symptoms of degradation and appeared to pose some of the most immediate risks to public safety. This effort produced a 12/31/10 report outlining the portico's problems and possible solutions. Although this report focused on the portico, it also addressed several of the building's other elements, such as its brick and stone-clad walls, as these directly affected the portico.

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

In addition to PL:BECS LLC, this evaluation involved the Architectural firm of Jensen Yorba Lott Inc., Structural Engineering firm of Swenson Say Fagét, Murray & Associates, P. C. Mechanical Engineers, Electrical Engineering firm of Haight & Associates, and Construction Cost-Estimating firm of HMS Inc.

Within this phase-3 effort, PL:BECS was primarily responsible for evaluating the building's exterior envelope elements, such as its masonry claddings and windows, and recommend appropriate corrective approaches for these, as well as for integrating these with needed structural corrections.

The firm of Swenson Say Fagét evaluated and developed appropriate solutions for the building's overall structure and its sub-elements.

As the work affecting the building's structure and its exterior masonry claddings would necessarily affect the building interiors, as well as various embedded mechanical and electrical systems, the Architectural firm of Jensen Yorba Lott developed the design for the resulting interior architectural work, and coordinated the work of the Mechanical, Electrical, and Cost-Estimating consultants.

Murray & Associates evaluated and outlined appropriate solutions for the various mechanical systems affected by the Structural/Masonry work.

Haight & Associates evaluated and outlined appropriate solutions for the various electrical systems affected by the Structural/Masonry work.

Dylan Johnson Architects assisted with preparing initial drawings of possible corrective approaches included in a start-up presentation.

Finally, HMS reviewed the entirety of the corrective work recommended by these consultants, and prepared rough cost estimates for three primary approaches outlined in this report.

2. SCOPE AND LIMITS OF REPORT

The purpose of this report is multifold, and includes an evaluation of the building's immediate structural and exterior envelope needs, development of plausible corrective approaches, and preparation of rough construction cost estimates for these corrective approaches. The ultimate purpose of this report is to serve as a basis for determining the specific corrective approach to be developed in detail.

To help determine the likely construction costs, this report includes drawings for many of the various possible corrective approaches. Although many of these may appear quite detailed, it is critical to note that these are intended primarily to allow rough cost estimates to be prepared for the various options, and do not necessarily represent the actual designs for the miscellaneous sub-elements, which are to be developed in subsequent phases.

3. INVESTIGATION METHOD

Each consulting firm performed its own investigation to arrive at the team's overall set of recommendations.

In brief, each firm reviewed the building's construction drawings of relevance to its discipline, and supplemented this with at least several days of field examination to confirm and document actual construction. The information gathered in this phase-3 evaluation was supplemented by each firm's prior familiarity with this building, which ranges up to several decades in the case of Jensen Yorba Lott.

Additional testing was performed as needed by the structural engineer, who tested the existing concrete for compressive strength, and PL:BECS, including random moisture testing in interior and exterior elements, cladding anchor detection, and absorption testing of various masonry elements.

4. ORGANIZATION OF REPORT

This report is divided into six major parts.

Part I is this **Introduction**.

Part II is a **Summary of Observations and Analysis**. It is organized by the building's various elements. This summarizes observations relevant to each system, provides an analysis of what the symptoms and design imply, and describes the projected future behavior of the specific element.

Part III, **General Discussion of Corrective Options**, provides a holistic review of the relative advantages and inherent limitations of each of the three primary approaches outlined in this report.

Part IV, Approach 1: Retrofit Existing Masonry & Structure, describes the first, "Retrofit" corrective approach, which can be summarized as an effort to save as much of the building's existing exterior masonry as is reasonably feasible, while also enhancing the structure's seismic safety. It also provides a very rough cost estimate for what this approach may cost. Generally feasible corrective measures are outlined for each building element within this approach.

Part V, Approach 2: New Masonry Veneer Over Concrete Walls, describes the technically optimal corrective approach, which also enhances the building's seismic safety while replacing the exterior wall claddings with a new masonry veneer over new and existing concrete back-up walls. It also provides a very rough cost estimate for what this approach may cost. Generally feasible corrective measures are outlined for each building element within this approach.

Part VI, Approach 3: New Masonry Veneer Over Concrete and Steel-Framed Walls, describes a less-costly, as well technically less optimal corrective approach, which also enhances seismic safety while replacing the exterior claddings with a new masonry veneer over new and existing concrete, as well as steel-framed back-up walls. It also provides a rough cost estimate for what this approach may cost. Generally feasible corrective measures are outlined for each building element within this approach.

Each Part is further subdivided into Sections, each of which addresses the various individual primary elements.

II. SUMMARY OF OBSERVATIONS AND ANALYSIS

1. GENERAL INTRODUCTION

This part is divided into eight Primary Sections, as follows:

1. General Introduction
2. Structure
3. Primary Exterior Enclosure Assemblies & Elements
4. Exterior Masonry Sub-Elements
5. Entry Portico
6. Interior Architectural Elements
7. Mechanical Systems
8. Electrical Systems

Each of the primary sections is further subdivided to address sub-components of these sections. For example, section 5, which addresses this report's "Entry Portico" focus, is further subdivided into six Subsections, as follows:

5.0 General
5.1 Support Base for Portico Entry and Stairs
5.2 Marble Columns
5.3 Stone Cladding on Exterior Building Wall
5.4 Portico Roof Structure
5.5 Stone Railing
5.6 Portico Roof, Drains, and Associated Flashings

Each of these primary subsections is yet further subdivided into four secondary subsections. For example, subsection 5.2, which addresses the Portico's Marble Columns, is subdivided as follows:

5.2.0 General
5.2.1 Summary of Observations
5.2.2 Analysis
5.2.3 Projected Future Behavior

The first such subsection merely describes the general element to which the section applies, and provides any other general background information.

The second subsection is a Summary of Observations pertaining to each element.

The third constitutes the Analysis, which provides an evaluation of the appropriateness of the observed construction, and explains the likely genesis of any observed problems with that element.

Finally, the fourth subsection describes the Projected Future Behavior of the affected element(s) if no corrective actions are taken.

2. STRUCTURE

2.0. General

This section of the report addresses issues related to the building's overall structural frame, without any consideration of specific structural details, etc.

2.1. Basic Structure of Building

2.1.0 General

This subsection pertains to the building's basic structural design in the most general terms.

2.1.1 Summary of Observations

Per the drawings, this building's basic structural frame consists of a grid-work of reinforced concrete columns supporting a series of reinforced concrete beams, which in turn support reinforced concrete slabs with integrally cast concrete joists.

Along the building's exterior walls, the concrete beams and columns are typically embedded within somewhat longer wall sections comprised primarily of brick masonry. The drawings also typically show 4" thick, non-structural terra-cotta along the interior faces of these exterior masonry walls, with plaster or other interior finish applied over this.

The concrete columns and beams are not well reinforced, limiting their capacity to resist lateral loads, such as would occur in seismic events. However, in various locations, these concrete columns are embedded within appreciably longer, non-structural masonry walls and interior partitions, possibly offering opportunities for retrofitting of shear walls.

As the structural elements are embedded within masonry, I could not personally verify that the actual structure aligns with the original design. However, all visible aspects are consistent with this original design, and the observable construction aligns quite well, though not perfectly, with the design. It thus appears probable that the building's actual structure mimics the design to a high degree.

Figure II-2.1(1) shows the building's SW corner at the 2nd floor level, which illustrates the typical plan section through the exterior walls.

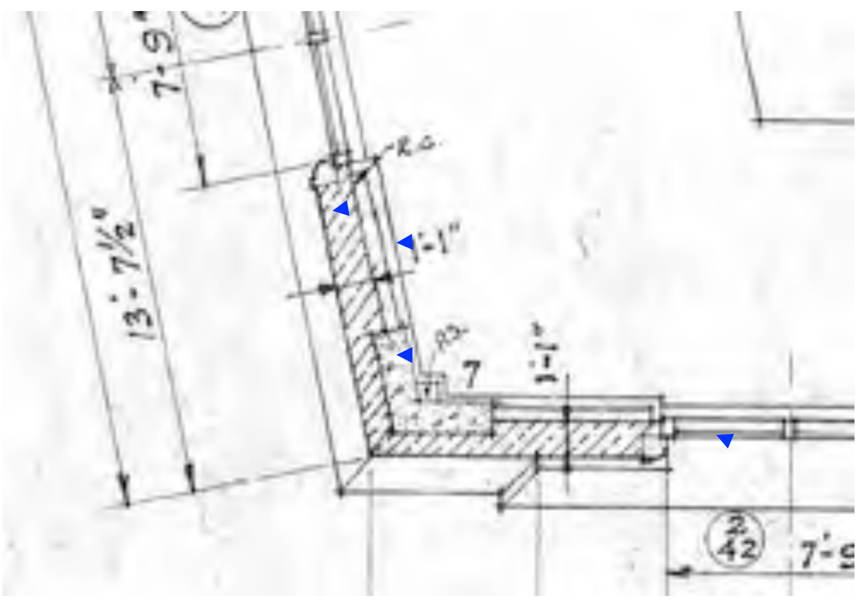

Figure II-2.1(1): Typical Exterior Wall Type, SW Corner, Level 2

A structural evaluation report by the engineering firm of Berger/Abam, dated 7/29/2002, titled “Seismic Assessment and Retrofit Concept Study”, concludes that many of the building’s primary structural elements, including its columns, beams, floor and roof diaphragms, and foundation pedestals, are structurally deficient and could experience significant damage in a seismic event. To address these deficiencies, the report recommends that concrete shear walls be added to the structure, along with the strengthening of the floor and roof diaphragms with composite and concrete overlays, addition of concrete drag struts, strengthening of the foundation pedestals, and removal of the interior tile/plaster partitions and finishes.

2.1.2 Analysis

As part of my earlier Phase 2 evaluation, I made no effort to analyze the building’s overall structural adequacy, as this fell outside that evaluation’s scope as well as my particular expertise.

However, the structural engineering firm of Swenson Say Fagét performed a structural analysis of the existing building, per ASCE 41-06 “Seismic Rehabilitation of Existing Buildings”, using Basic Safety Objective 1, as part of this Phase 3 evaluation, and this analysis confirmed that this building possesses excessive vulnerability to seismic damage.

2.1.3 Projected Future Behavior

Based on the previous Berger/Abam report, as well as on the detailed analysis by Swenson Say Fagét, the building’s basic structural design appears deficient with regard to plausible seismic forces. The building may be vulnerable to potentially severe damage in a plausible earthquake.

This concern is exacerbated by my field investigation, which revealed evidence of some previous seismically induced damage, which may have weakened some sub-elements of the building.

The combination of these conclusions would also appear to pose significant risk to life safety of the occupants and nearby pedestrians in the event of an earthquake.

2.2. Foundations

2.2.0 General

This subsection pertains to the building’s basic foundation system in general terms. See also section II-3.1: Lowest-Level Crawl Space for related information.

2.2.1 Summary of Observations

Three foundation plans exist for this building, but the most recent plan indicates that the foundation consists of a grid-work of many individual, mostly square footings of reinforced and un-reinforced concrete. This is true even along the building’s outer perimeter, and the only continuous footing occurs along the north wall of the west wing.

A cursory examination of accessible portions of the crawl space under the building revealed rather wet conditions, with a small but continuous stream running through this space. Consequently, the individual foundations displayed expected symptoms, including variable degrees of corrosive spalling and efflorescence, a powdery white crystalline substance that invariably indicates moisture passage through masonry materials.

Figures II-2.2(1-4) illustrate these observations.

Fig. II-2.2(1): Corrosive Concrete Spalling

Fig. II-2.2(2): Concrete Spalling

Fig. II-2.2(3): Spalling, Efflorescence

Fig. II-2.2(4): Efflorescence

2.2.2 Analysis

Issues germane to the foundations relate to structural adequacy and degradation.

With regard to structural adequacy, analysis of the original design by the structural engineering firm of Swenson Say Fagét revealed that the foundation system is generally adequate for resisting vertical gravity loads, but does not fully suffice to resist lateral loads, such as might occur during earthquakes.

The concrete spalling and efflorescence reflect degradation caused by moisture intrusion into the concrete. Some of the moisture enters the concrete from the damp atmosphere resulting from the running water within the crawl space. However, the specific pattern of the efflorescence on the concrete columns reveals that water also enters from the soils directly below the footings.

The corrosive spalling of the concrete results from corrosion of the embedded reinforcing. As steel corrodes, it experiences large volumetric expansion, thus popping concrete off the surface.

The white efflorescence consists of salts that had been extracted from the concrete by water migrating through it. This passing water first dissolves these salts, then leaves them behind upon evaporation from the surface. The white salt crystals become concentrated along the transition between wet and dry concrete, and this reveals that water migrates roughly 18" -24" upward from the soils.

The surface spalling located away from steel reinforcing can result from freezing expansion of embedded water as well as through concentrated recrystallization of salts. Both mechanisms appear plausible, even probable, in this case.

2.2.3 Projected Future Behavior

Future behavior of these foundations can also be viewed from structural and moisture-degradation perspectives.

With regard to structural concerns, the foundation system appears vulnerable to seismic damage, which can affect the entire structure above the foundations as well.

Left uncorrected, the present moisture degradation will continue. Continuation of steel corrosion, moisture migration, freezing, and salt recrystallization will cause ongoing spalling of the concrete.

2.3. Lowest-Level Concrete Floor Framing

2.3.0 General

This subsection pertains to the raised, concrete-framed floor directly above the crawl space.

2.3.1 Summary of Observations

This floor consists of a concrete slab integrally poured with concrete floor beams and joists.

Examination of this floor framing from the crawl space revealed widespread and fairly serious corrosive spalling, which appeared to affect most of the integrally cast joists, particularly near their midspans. The bottoms of these joists had in most locations spalled off, exposing corroding reinforcing steel.

Figures II-2.3(1-8) illustrate these observations.

Fig. II-2.3(1): Spalling @ Joist Midspan

Fig. II-2.3(2): Spalling @ Jst. Bottoms

Fig. II-2.3(3): Spalling @ Joist Midspan

Fig. II-2.3(4): Spalling @ Jst. Bottom

Fig. II-2.3(5): Spalling @ Joist Midspan   **Fig. II-2.3(6): Spalling @ Jst. Bottom**

Fig. II-2.3(7): Spalling @ Joist Midspan   **Fig. II-2.3(8): Spalling @ Jst. Bottoms**

2.3.2 Analysis

The concrete joist spalling reflects degradation caused by moisture intrusion. However, in contrast to the spalling affecting the foundations, the only moisture source reaching these joists consists of atmospheric humidity resulting from the wet crawl space.

The corrosive spalling of the concrete results from corrosion of the embedded reinforcing. As steel corrodes, it experiences large volumetric expansion, thus popping concrete off the surface.

2.3.3 Projected Future Behavior

Future behavior of these foundations can also be viewed from structural and moisture-degradation perspectives.

Left uncorrected, the present degradation will continue, causing ongoing spalling of the concrete. This will eventually compromise the structural integrity of the entire floor system.

2.4. Level 1 Concrete Floor Slab

2.4.0 General

This subsection pertains to the raised, concrete-framed floor directly above the ground floor level.

2.4.1 Summary of Observations

Nearly all of this floor slab is concealed from view from below by ceilings and from above by floor finishes. However, a small portion of it could be examined from the shop area in the west wing, where it is exposed to view from below.

This floor consists of a concrete slab integrally poured with concrete floor beams and joists.

Where it was visible, significant cracking was observed very near the building's outer corners, where typically fairly wide, often closely spaced cracks were located.

In addition, one continuous, completely straight crack was observed running a few feet south of the wall separating the boiler room from the shop. The crack parallels this wall, and runs across the entire width of the west wing.

Figures II-2.4(1-4) illustrate these observations.

Fig. II-2.4(1): Straight Crack in Floor Slab

Fig. II-2.4(2): Diagonal Cracks in Slab

Fig. II-2.4(3): Diagonal Crack in Floor Slab

Fig. II-2.4(4): Diagonal Cracks in Slab

2.4.2 Analysis

The straight crack across the west wing most likely occurs along a pour joint, where curing shrinkage would be expected to create such a crack. However, this crack is wider than one would expect from shrinkage alone, and it appears probable that it has been exacerbated by subsequent seismic displacement.

The diagonal cracks near the outer building corners cannot reflect curing shrinkage restraint, as these cracks are also typically far too wide, and often occur in closely spaced pairs. Shrinkage cracks would not occur closely spaced, as the initial crack would relieve any tensile stress, thus precluding the second crack from occurring. Due to their size, locations, and spacing, these cracks appear seismically induced.

These cracks may slightly weaken this floor slab, mildly increasing future seismic risk. The floor system in general appears structurally adequate.

2.4.3 Projected Future Behavior

These cracks may have some marginal detrimental effect on the building's performance in any future earthquakes.

2.5. Brick Chimney

2.5.0 General

This subsection pertains to the relatively tall brick chimney above the main roof, near the inside corner where the west wing joins the main portion of the building.

2.5.1 Summary of Observations

The drawings indicate that this chimney's structure consists of 2-wythe, 9" wide brick walls, which are lined with 4 ½" thick firebrick spaced 3" from the brick walls. The chimney is capped with two stone rings, each made of fairly large stone pieces, which appear to be secured to the chimney only with mortar bond.

The chimney brick and stone caps are largely painted with an elastomeric coating, apparently to limit moisture intrusion into the brickwork, which is fairly degraded, with extensive erosion of outer brick faces and mortar, mortar cracking, etc. The coating is delaminating in various locations, indicating moisture intrusion behind it.

In addition, the chimney's junctures to the roof and parapets are not executed properly, in that the EPDM roof membrane and parapet flashings are sealed to the outer brick face, with no through-wall flashings to drain water out from behind the outer brick wythe.

Figures II-2.5(1-6) illustrate these observations.

Fig. II-2.5(1): General Chimney View **Fig. II-2.5(2): Chimney Location**

Fig. II-2.5(3): Coating Delamination **Fig. II-2.5(4): Coating & Brick Degr.**

Fig. II-2.5(5): Brick & Mortar Degradation **Fig. II-2.5(6): Improper Roof Junct.**

2.5.2 Analysis

Issues of pertinence to this chimney relate to structural considerations as well as to moisture infiltration.

Structural concerns relate to the chimney's overall stability as well as to securement of its stone cap elements. Based on the chimney's construction and height, it appears vulnerable to overturning failure in a seismic event. The absence of any mechanical securement of its heavy capstones to the primary chimney structure, combined with its degraded mortar, increase vulnerability of these capstones to seismic displacement. As the chimney occurs above one exit-way from the building, these issues represent a life-safety hazard to people existing the building in an earthquake.

From a water-infiltration perspective, the chimney suffers from ill-conceived masonry design, especially for Juneau's climate, though it represents typical construction of its time. The basic flaws are that it lacks any flashing caps to preclude water entry into the stone caps, and similarly lacks any flashings to drain water out from behind the brick along junctures where the roofing or parapets meet the chimney brick.

As masonry is inherently absorbent, the absence of flashing caps greatly exacerbates moisture intrusion into the stone and brickwork. As Juneau's climate includes roughly 220 rainy days each year, and low temperatures drop below freezing through five months annually, this can greatly accelerate degradation, lead to freeze-spalling, mortar erosion, and similar symptoms, which are in fact evident.

Along the chimney's base, its juncture to the roof membrane and parapets is improperly executed, as any water that permeates into and behind the outer brick drains downward into the roof assembly, posing a risk of interior leakage. The application of the elastomeric coating to the brickwork may in fact reflect an effort to limit interior moisture intrusion, although it may well exacerbate degradation by entrapping moisture. These junctures should have included continuous through-wall flashings above the roof membrane and flashing terminations to drain water harmlessly from behind the outer brick wythe and to preclude its drainage into construction elements below.

2.5.3 Projected Future Behavior

In its present configuration, this chimney appears vulnerable to seismic failure, posing a hazard to people exiting the building during earthquakes.

The degradation of the chimney's masonry will continue and will accelerate. Although frequent re-coating with elastomeric coating can temporarily retard the masonry degradation, I believe this may need to be done a near-annual basis to provide much benefit, and more importantly, if the coating is allowed to fail near the chimney tops, as was the case during my recent August 2012 visit, it can actually exacerbate degradation by entrapping moisture within lower portions of the brick, leading to freeze-spalling and mortar erosion in Juneau's wet and cold climate.

The improper, non-draining junctures of the chimney base with the roof and parapets will pose ongoing risk of interior moisture intrusion and associated damage.

2.6. Securement of Large Masonry Cladding Elements

2.6.0 General

This subsection pertains to the securement of the various stone cladding elements to the primary building structure and to each other in a general fashion. Such elements occur throughout the building's exterior cladding, and include the stone cladding along the building base, stone and terra-cotta water tables, terra-cotta wall panels, chimney caps, window sills, essentially all of the portico's sub-components, etc. These are also discussed in subsequent subsections in greater detail, and this subsection focuses on the "securement issues" applicable to all of these elements in general.

2.6.1 Summary of Observations

Examination of the drawings and past PL:BECS field investigations revealed that, in general, these large masonry elements are either not secured to the primary construction in any fashion other than with mortar bond alone, or where various steel anchors had been used, they appear widely spaced and minimal in many locations. Anchorage of some elements appears beefier, and specific quantitative analysis would be needed to evaluate adequacy. Such detailed evaluation falls outside this report's scope, whose primary purpose is to determine reasonable, large-scale costs of corrective options.

Large masonry elements which appear to lack any mechanical securement, other than mortar bond, include the chimney capstones, stone window sills, some portions of the stone railing atop the portico, the stone water table elements atop the portico, the stone portico ceiling elements, and probably some other elements. Similarly, the multi-wythe brick walls, which sit atop steel lintels and the concrete floor slabs and ledges, do not appear otherwise mechanically secured to the primary concrete structure. Further, my examination often revealed that the mortar bond securing these elements had degraded, and in some cases had become completely compromised. For example, I was able to freely, though with effort, move one very large stone cap atop the portico railing. Some of these elements had also become cracked, further compromising their securement. Figures II-2.6(1-6) depict a few of these un-secured elements.

Fig. II-2.6(1): Un-Secured Chimney Caps

Fig. II-2.6(2): Un-Secured Stone Sill

Fig. II-2.6(3): Un-Secured, Cracked St. Sill

Fig. II-2.6(4): Un-Scrd. Stone Railing

Fig. II-2.6(5): Un-Secured Stone Railing

Fig. II-2.6(6): Un-Scrd. Cracked Rlng.

The tall stone columns supporting the portico roof also appear un-secured to the stone roof beams, and the very large column sections are not attached to each other in any way, having only very small, short "cube-dowels" between sections, which act more to center the sections relative to each other than to secure them. Some of these columns also display rust staining, which may indicate corrosion of these dowels, while others have seemingly significant cracks. See Figures II-2.6(7 & 8).

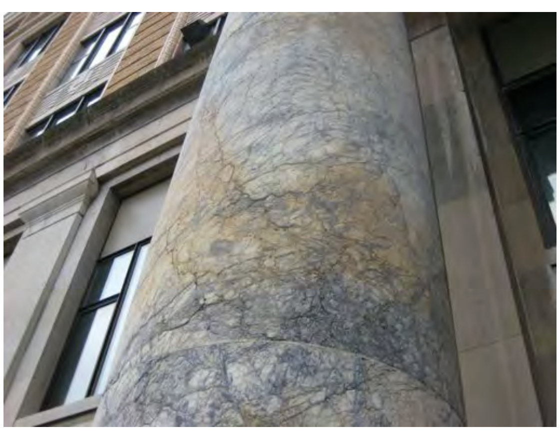

Fig. II-2.6(7): Un-Scrd., Rust-Stained Col.

Fig. II-2.6(8): Cracked Column

The large marble panels near the top of the south façade, directly above the portico, also do not appear to have any mechanical securement stipulated in the drawings, though some weak metal signals were detected in a few locations at some panels, indicating possible anchorage of some sort. Cracking observed at some panels may also indicate that these may be somewhat compromised. See Figures II-2.6(9 & 10).

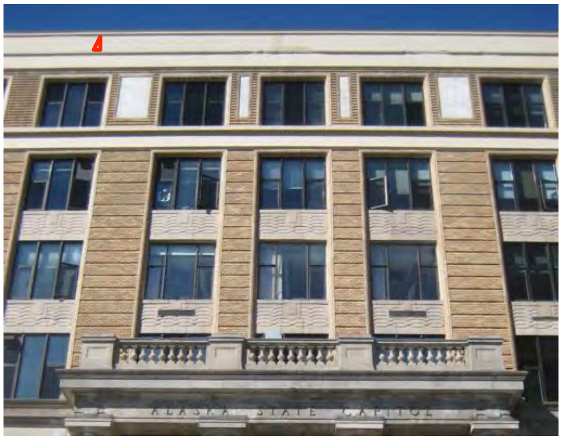

Fig. II-2.6(9): Un-Secured, Marble Panels

Fig. II-2.6(10): Possible Small Anchor

Some elements have a degree of mechanical securement, via steel dowels, straps, and similar methods, but such securement appears blatantly inadequate for holding these components in place under plausible seismic stresses. For example, the entire portico structure, which in totality weighs roughly 170 tons and consists of many individual stone elements, is secured to the primary structure with 7 or 8 small steel straps, each 2 ½" wide and ½" thick. These straps cannot resist lateral racking of the portico in the E-W direction, and the cracking pattern affecting the portico elements and the supporting stone cladding indicates that such racking had taken place. Further, though these straps, which are embedded within the portico ceiling, could not be examined, widespread staining on the portico ceiling indicates that these minimal straps have by now been largely compromised by corrosion. See Figures II-2.6(11-14).

Fig. II-2.6(11): Minimally Secured Portico

Fig. II-2.6(12): Water-Damaged Clg.

Fig. II-2.6(13): Cracked Portico Beams **Fig. II-2.6(14): Cracked Prtco. Beams**

Similarly, the large stone cladding pieces along the bottom two levels of the south façade are secured with a single 3/8" ø steel wire looped around the concrete columns and recessed into the stone about 2". In some cases, this yields a single point of marginal attachment for stones with a 13 SF face area, 20 CF volume, and over 3,000 lb. weight. The distribution of such anchors allows these stone pieces to rotate or buckle away from the building, and the cracking pattern in some of these elements under the portico indicates that such rotation had taken place, compromising these elements further. Also, though the drawings in a few locations call for "non-corroding" metal anchors, evidence of corroded anchors was observed in various locations. Figures II-2.6(15-18) illustrate these observations.

Fig. II-2.6(15): Minimal Anchor Location **Fig. II-2.6(16): Cracked Stone Cldng.**

Fig. II-2.6(17): Corroding Anchor **Fig. II-2.6(18): Cracked Stone Cldng.**

Securement of a few elements is more difficult to judge without specific analysis. For example, many of the terra-cotta elements, such as the upper water table, the spandrel panels between windows, and the window bay surrounds, as well as possibly the stone water table at level 2, appear to contain somewhat beefier securement via steel anchors. However, given the building's length of exposure to the wet Juneau climate, it appears probable that corrosion has begun to compromise these anchors, and some of the cracking observed in these elements coincides with locations of embedded steel, and resembles cracking one would expect of corrosive steel expansion. Figures II-2.6(19-22) illustrate these observations.

Fig. II-2.6(19): Stone Water Table

Fig. II-2.6(20): Cracks Near Anchor

Fig. II-2.6(21): Crack Near Embedded Steel

Fig. II-2.6(22): Crack Near Anchor

2.6.2 Analysis

In very broad terms, the building appears lacking with respect to the securement of many large masonry elements to the structure and to each other. Many elements rely entirely on mortar bond, and in various locations, such mortar bond is largely or entirely compromised. Even those elements that have some sort of embedded steel anchorage appear inadequately secured, and this has been further impaired by corrosion and past seismic damage.

While this consideration does not threaten the integrity of the building as a whole, it poses appreciable risk to pedestrians below in case of an earthquake, as many such large pieces could fall off the building.

2.6.3 Projected Future Behavior

The securement of these elements will continue to degrade with ongoing loss of mortar bond and corrosion of steel anchors, posing increasing risk to pedestrians below.

2.7. Interior Hollow Clay Tile Walls

2.7.0 General

This subsection pertains to the interior partition walls comprised of hollow clay tile, referred to in the drawings as terra-cotta walls.

2.7.1 Summary of Observations

Many interior partition walls consist of 4" or 6" hollow clay tile, with plaster or other finishes applied over these. In many locations, these heavy partition walls do not extend to the underside of the concrete floor slabs or beams above them, and stop above the ceilings, with no connections to the upper floor slabs. Figure II-2.7(1) shows a typical example of this condition.

Fig. II-2.7(1): Un-Secured, Un-Braced Tops of Hollow Clay Tile Walls

In a few locations, such as around the stair and elevator shafts, these partitions extend full height, but are not adequately secured.

2.7.2 Analysis

These partition walls are quite heavy, and as their tops are not secured or braced in any way, they pose a risk of collapsing in earthquakes. This risk is particularly significant near the stairs and elevators, where they could block egress in case of seismic collapse.

2.7.3 Projected Future Behavior

In their current configuration, these walls will remain vulnerable to seismic collapse, posing a hazard to occupants, particularly near stairs and elevators.

2.8. Large Mechanical Equipment

2.8.0 General

This subsection pertains to various pieces of large mechanical equipment, such as the boiler, within the building.

2.8.1 Summary of Observations

The building contains various large mechanical equipment units, such as the boiler, ductwork, piping, and similar elements that are not secured or braced in any fashion. Figures II-2.8(1 & 2) depict a couple of examples.

Fig. II-2.8(1): Un-Braced Piping & Ducts **Fig. II-2.8(2): Un-Secured Boiler**

2.8.2 Analysis

These equipment elements are quite heavy, and as they are not secured or braced, they pose a risk of overturning or falling in earthquakes. This poses some risk to any people nearby, but further, it greatly exacerbates risk of damage to the equipment, which is typically much costlier to repair, compared to the cost of preventive bracing.

2.8.3 Projected Future Behavior

In their current configuration, these elements will remain vulnerable to seismic overturning or falling, posing a hazard to occupants.

3. PRIMARY EXTERIOR ENCLOSURE ASSEMBLIES & ELEMENTS

3.0. General

This section of the report addresses issues related to the building's primary exterior elements, such as wall assemblies, ground-level floor slabs, windows, roofs, and similar major components, without any consideration of specific details, etc.

3.1. Lowest-Level Crawl Space

3.1.0 General

This subsection pertains to the crawl space located under the building's main body and under the southerly portions of both north-extending wings, in general terms.

3.1.1 Summary of Observations

A crawl space of variable height occurs below the building's main body and southerly portions of both wings. Exposed sloping soil forms the crawl space floor, and the underside of the concrete-framed ground floor level comprises its ceiling. As also outlined in subsections II-2.2.1 and II-2.2.2, very wet conditions prevail, and even a small but continuous stream runs through this space. Perceived humidity was also palpably high. Consequently, many visible concrete elements, such as the foundations and ground floor level concrete floor joists, displayed corrosive spalling and efflorescence, both absolute indicators of water's passage through concrete or other masonry. Corrosive spalling appeared to be affecting most floor joists. See Figures II-3.1(1-8).

Fig. II-3.1(1): Fndtn. Spalling, Wet Soil

Fig. II-3.1(2): Sloping, Wet Soil

Fig. II-3.1(3): Fndtn. Spalling, Effloresc.

Fig. II-3.1(4): Fndtn. Efflorescence

Fig. II-3.1(5): Spalling @ Joist Midspan

Fig. II-3.1(6): Spalling @ Jst. Bottoms

Fig. II-3.1(7): Spalling @ Joist Midspan

Fig. II-3.1(8): Spalling @ Jst. Bottoms

3.1.2 Analysis

The exposed, water-saturated soils, which must characterize this crawl space year-round, are having a very visible, cumulative, and detrimental effect on the integrity of all exposed concrete within the space, especially where steel-reinforced. The corrosive spalling and efflorescence represent the smoking-gun evidence for this. Water is being absorbed directly from soil into the foundations, but atmospheric moisture alone is causing the concrete floor joists to spall.

3.1.3 Projected Future Behavior

Left uncorrected, the present degradation of the concrete and its steel reinforcing will continue, causing ongoing corrosion and spalling. This will eventually compromise the structural integrity of the entire floor system.

3.2. Concrete On-Grade Floor Slabs

3.2.0 General

This subsection pertains to the on-grade concrete floor slabs that occur at the base of the northern portions of both north-extending wings.

3.2.1 Summary of Observations

These floor slabs were examined only in the west wing. Random moisture readings at the shop area revealed elevated moisture levels within this slab, and occupant-staff reported occasional leakage via a crack in the slab and along the slab-floor juncture, both near the west wing's NW corner. No leakage was reported at the east-wing floor slab during a brief visit to this restricted-access space. Water and staining were visible along the floor crack and the floor-wall juncture where occasional leakage was reported. See Figures II-3.2(1 & 2).

Fig. II-3.2(1): Wet Concrete Along Fl. Crack

Fig. II-3.2(2): Stained Floor Near Wall

It is unclear whether any sub-slab drainage and waterproofing measures had been installed under these floors, as there are three different foundation plans. Though the most recent plan on sheet 400-B, dated 12/3/29 is assumed to represent the built condition, it is plausible that the perimeter sub-slab drainage system shown on sheet 400-A, dated 11/6/29, had been installed, as this reveals that soil moisture was a known concern. Similarly, the original foundation plan on sheet 400, dated 2/2/29, reveals a high level of soil-moisture awareness during the design, as portions of the original floor slab, such as under the boiler room, are shown consisting of a 3" thick "rat-slab", covered with "3-ply membrane waterproofing", and finally capped with a 5" thick topping slab. Section A-A on sheet 400-C, dated 12/3/29, shows that this waterproofed sandwich-slab does not extend under the shop area, which was originally designed for coal storage, and that this portion consists of a 5" thick on-grade slab, with no waterproofing.

3.2.2 Analysis

It is evident that very wet soil lies beneath these floors. The drawings reveal that this moisture was a well-known design consideration, so while the multitude of conflicting foundation drawings raises some confusion, it is likely that the floor under the boiler room had been built as a waterproofed sandwich slab, that a simple perimeter sub-slab drainage system had been installed, and that the shop floor consists only of a floor slab with no waterproofing. This is also consistent with the observation that infiltration via the floor appears limited only to this shop area.

3.2.3 Projected Future Behavior

With regard to the floors alone, as a minimum, recurring infiltration via floor cracks and along floor-wall junctures will continue to be a nuisance. It would become problematic if any moisture-sensitive floor finishes, such as floor coatings, linoleum, vinyl tile, etc., were to be placed directly over these. Corrosive spalling may begin popping off the floor surface along reinforcing lines.

3.3. Concrete Sub-Grade Walls

3.3.0 General

This subsection pertains to several sub-grade concrete walls that occur primarily at the base of the northern portions of both north-extending wings.

3.3.1 Summary of Observations

The exterior portions of these sub-grade walls could not be examined, and the drawings raised some confusion concerning what type of waterproofing may have been incorporated. For example, the sections on sheet 400 call for “Applied Surface Waterproofing” on interior faces of some walls. On the other hand, section A-A on sheet 400-C calls for “Waterproofing and Brick Protection” on the exterior face of a sub-grade wall. Further, section E-E on sheet 400-E shows “3-Ply Waterproofing” applied to the exterior wall face. To add to the confusion, the sub-grade space below the east wing had been excavated after the building’s original construction, and as I do not have any drawings for this later work, I cannot determine what type of waterproofing may have been applied in that location.

A brief examination of accessible interior wall portions at the west wing revealed some floor staining near this wing’s NW corner, and occupant-staff reported occasional water accumulation along this floor-wall juncture. No other locations of leakage were observed below the west wing.

In contrast, the newer sub-grade walls below the east wing displayed various leak symptoms, at least from the past. However, I was informed that no current leakage affects this east-wing basement, adding more to confusion. Leak symptoms at this wing include staining, plaster damage, and streaks running down the walls. Figures 3.3(1-8) illustrate these observations.

Fig. II-3.3(1): Fl. Stain, NW Corner, W. Wing

Fig. II-3.3(2): Plaster Dam., E. Wing

Fig. II-3.3(3): Streaks Bel. Duct, E. Wing

Fig. II-3.3(4): Streaks, E. Wing

Fig. II-3.3(5): Streaks, Plstr. Dam., E. Wing   Fig. II-3.3(6): Plaster Dam., E. Wing

Fig. II-3.3(7): Stains Below Wall, E. Wing   Fig. II-3.3(8): Plaster Dam., E. Wing

3.3.2 Analysis

The apparent drawing contradictions raise confusion about whether waterproofing had been used on these walls. Further, the observed symptoms below the east wing seem to contradict reports that no leakage affects this space. However, for the purpose of this report, which is to develop corrective cost estimates, I believe some reasonable conclusions can be made.

The west wing basement is part of the original building design, and the drawings reveal high awareness of this site's wet conditions. Further, only one leak was reported in this wing, along a floor-wall juncture. Based on these observations, it appears most probable that 3-ply asphaltic waterproofing had been applied to the exterior faces of this wing's sub-grade walls. The one leak in this space most likely enters via a floor-wall or footing-wall cold-joints.

In contrast, the east wing basement had been excavated after the building was in place. Although no leakage was reported in this space, the relatively ample leak symptoms imply otherwise. In view of this, it appears most prudent to assume that leakage is affecting these walls, most likely via shrinkage cracks, cold-joints, and possibly rock-pockets.

3.3.3 Projected Future Behavior

Left uncorrected, the one leak reported in the west wing's basement will continue to be a recurring nuisance, but will have limited effect.

It appears probable that some leakage is occurring at the east wing, despite reports to the contrary. If so, this will continue to damage interior plaster, stain walls, etc. Over the long term, this could begin affecting the walls' integrity through reinforcing corrosion.

3.4. Stone-Clad Exterior Wall Base

3.4.0 General

This subsection pertains to the lowest-level stone base along the building's south elevation. This stone base extends from grade up to a projecting stone water table, which separates it from the stone cladding above.

3.4.1 Summary of Observations

This stone base probably consists of limestone, though it also resembles sandstone, and the distinction was not investigated, as it has little effect. Either type is poorly suited to the essentially permanently wet conditions along the building base, and the stone, especially along the very bottom, has effectively been destroyed. An entirely secondary consideration concerning this base is that the securement of the stone to the structure is minimal. See Figures II-3.4(1-8).

Fig. II-3.4(1): Spalled Stone Base

Fig. II-3.4(2): Spalled Stone Base

Fig. II-3.4(3): Spalled Stone Base

Fig. II-3.4(4): Spalled Stone Base

Fig. II-3.4(5): Spalled Stone Base

Fig. II-3.4(6): Spalled Stone Base

Fig. II-3.4(7): Spalled Stone Base

Fig. II-3.4(8): Spalled Stone Base

3.4.2 Analysis

This stone base, particularly along the grade, has effectively been destroyed, largely through moisture absorption from the ground, followed by freeze-spalling. Sedimentary stone in general is poorly suited to such wet, often freezing conditions.

The steel wire anchors securing this base to the building are minimal to begin with, and it is highly probable that these have been further compromised by corrosion.

While the stone's appearance could temporarily be restored with restoration mortars, this would not last very long, and the same symptoms would continue to manifest.

3.4.3 Projected Future Behavior

Left uncorrected, the current spalling will continue, and will eventually destroy the entire base portion.

Similarly, continued corrosion of the anchors will also compromise these anchors, leading to instability of this stone base.

3.5. Stone-Clad Exterior Walls Along Bottom 2 Levels

3.5.0 General

This subsection pertains to the stone-clad walls directly above the stone base addressed in subsection II-3.4. The stone cladding extends from this base upward to a projecting stone water table above the first floor windows, and clads most of the building's south elevation. While this base is contiguous with and similar to the stone cladding below the portico, the portico-related cladding is addressed separately in subsection II-5.3.

3.5.1 Summary of Observations

Observations related to these stone-clad walls can be divided into at least three categories pertaining to their general design, the condition of its cladding, and the walls' and cladding's anchorage to the primary structure.

The primary factor relating to the design of these walls is the fact that they completely lack any flashings or other means to limit water intrusion and to drain any water back out the cladding at appropriate locations. This general observation pertains to all masonry-clad walls on this building.

With regard to its general condition, this cladding displays scattered erosion, cracking, mortar delamination, and similar symptoms. See Figures II-3.5(1-6).

Fig. II-3.5(1): Stone Cladding Erosion

Fig. II-3.5(2): Stone Cladding Erosion

Fig. II-3.5(3): Spalled-Off Stone Capital

Fig. II-3.5(4): Stone Cldng. Spalling

Fig. II-3.5(5): Surface Cracking of Stone **Fig. II-3.5(6): Stone Cracking**

A related interesting observation is that all ground-level stone sills within this cladding are cracked at one side, and all sills located west of the central entry are cracked at their west ends, while all sills located east of the entry are cracked at their east ends. See Figures II-3.5(7-10).

Fig. II-3.5(7): W. Sill Cracked @ W. End **Fig. II-3.5(8): E. Sill Cracked @ E. End**

Fig. II-3.5(9): W. Sill Cracked @ W. End **Fig. II-3.5(10): E. Sill Crckd. @ E. End**

The stone cladding's securement to the structure is also addressed in a general fashion in subsection II-2.6. In brief, at least two observations can be made with regard to the stone cladding's securement. First, the drawings indicate that the securement is achieved with a single 3/8" ø steel wire drilled 2" into each of the largest stones. In some cases, this yields a single point of marginal attachment for stones with a 13 SF face area, 20 CF volume, and over 3,000 lb. weight. Second, though the drawings in a few locations call for "non-corroding" metal anchors, evidence of corroded anchors was observed. See Figures II-3.5(11 & 12).

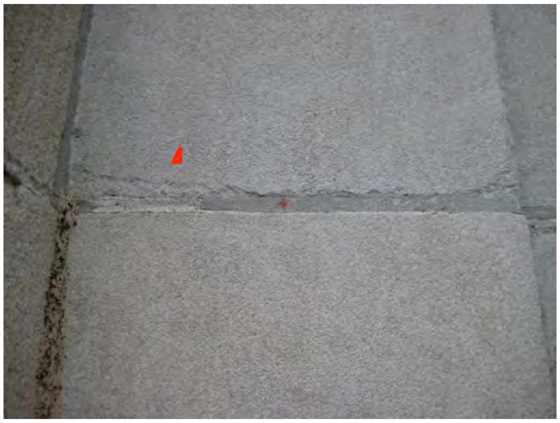

Fig. II-3.5(11): Location of Wire Anchor

Fig. II-3.5(12): Corroded Wire Anchor

3.5.2 Analysis

Let me address the three primary factors individually, including general design, the stone cladding's condition, and the walls' and cladding's anchorage to the primary structure.

With regard to the general design, the absence of flashings to limit water intrusion and drain it back out of the cladding exacerbates moisture intrusion and interior leak risk, and accelerates degradation of the stone cladding and its metal anchors.

This leads to the second issue concerning the cladding's condition. The stone is moderately degraded, and displays scattered erosion, cracking, mortar delamination, etc. Though less visible, it also appears very likely that the metal anchorage has also been at least partly degraded by corrosion. The cracking of the stone sills appears to reflect seismic damage, and it further exacerbates moisture intrusion and anchor corrosion.

The anchorage of the stone cladding to the structure was insufficient to begin with, and this inadequacy has been further exacerbated by anchor corrosion. Many of the stone elements weigh several thousand pounds each, and anchorage failure would cause these, and the supported brick above, to fall off the building.

While this consideration does not threaten the integrity of the building as a whole, it poses appreciable risk to pedestrians below in case of an earthquake, especially near the south entry, and could injure people exiting the building, or could block the exit-way, in earthquakes.

3.5.3 Projected Future Behavior

The degradation of the existing cladding will accelerate, and pieces of stone may fall off from time to time. Risk of interior leakage, especially below window sills and above the lower window heads will also persist. Risk of seismic displacement will also persist, and will increase with continued anchor corrosion.

3.6. Brick-Clad Exterior Public Façade Walls, All Levels

3.6.0 General

This subsection pertains to the brick-clad exterior walls at all floor levels and at all of the building's "public" façades, including its south, east, and west elevations, and the north elevations of its east and west wings. Although the specific brick bond patterns vary between locations and floor levels, these walls are all fundamentally similar. Elements integral to these walls, such as steel lintels above the windows, are also addressed here.

3.6.1 Summary of Observations

Observations related to these brick-clad walls can be divided into two broad categories, one pertaining to their general design and the resultant condition of its cladding, and the second relating to the walls' and cladding's anchorage to the primary structure.

General design considerations can be divided into several sub-categories. First, the composition of these walls varies appreciably between where these occur over the concrete columns and between the columns. Where these occur over the concrete columns, which represents the majority of locations, the brick walls consist of double-wythe brick placed outward of the concrete columns. Between columns, such as above and below some windows as well as adjacent to some windows, the brick walls contain 3 brick wythes. In all cases, the brick wythes contain interlocking header or rowlock courses, wherein the brick is turned 90 degrees to span across two adjacent wythes to secure them together. Figures II-3.6(1 & 2) depict this header coursing.

Fig. II-3.6(1): Recessed Header Coursing

Fig. II-3.6(2): Recessed Hdr. Course

Further, none of these brick walls incorporate any flashings or weep holes to help drain any water back out of the brickwork. Consequently, expected symptoms of infiltration are scattered around the building, such as interior plaster damage near windows, elevated moisture levels within the stone cladding below these brick walls, extreme infiltration into the portico roof structure and stone cladding below, etc. Absence of flashings above steel lintels that support the brick above some windows has also contributed to variable degrees of lintel corrosion, even at some sheltered locations. Figures II-3.6(3-10) illustrate some examples of observed symptoms.

Fig. II-3.6(3): Interior Plaster Damage

Fig. II-3.6(4): Interior Plaster Damage

Fig. II-3.6(5): Portico Ceiling Damage

Fig. II-3.6(6): Portico Ceiling Damage

Fig. II-3.6(7): High Moisture in Stone Bel.

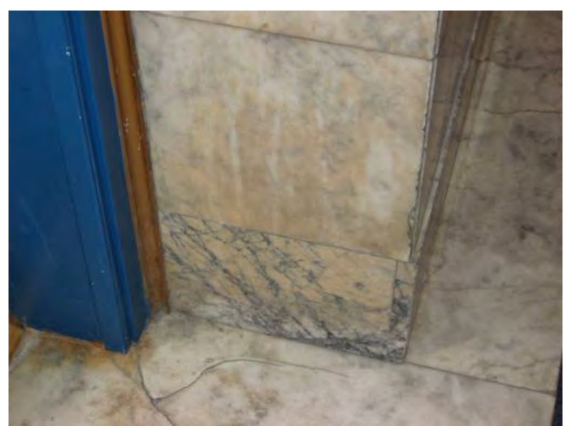

Fig. II-3.6(8): Corrosion Staining

Fig. II-3.6(9): Lintel Corrosion

Fig. II-3.6(10): Lintel Corrosion

Although the specific bond pattern varies between different levels, all of the visible brickwork is similar in that it is characterized by typically recessed header courses and deeply raked mortar joints. Both of these factors increase the brickwork's weather-exposed surface area, and create many water-catching ledges throughout the exterior brick surface. This design approach, though adding visual interest, greatly increases moisture intrusion and associated degradation of the brick and mortar, and widespread spalling and surface erosion affects the brickwork, especially at highly exposed locations. Figures II-3.6(11-18) illustrate some of these observations.

Fig. II-3.6(11): Brick Spalling

Fig. II-3.6(12): Brick Spalling

Fig. II-3.6(13): Brick Spalling

Fig. II-3.6(14): Brick Spalling

Fig. II-3.6(15): Brick Surface Erosion

Fig. II-3.6(16): Brick Surface Erosion

Fig. II-3.6(17): Brick Surface Erosion

Fig. II-3.6(18): Brick Surface Erosion

In addition to widespread spalling, the brickwork also displays scattered cracks through both the brickwork and mortar. Figures II-3.6(19-24) illustrate some of these observations.

Fig. II-3.6(19): Brick & Mortar Crack

Fig. II-3.6(20): Brick & Mortar Crack

Fig. II-3.6(21): Brick & Mortar Crack

Fig. II-3.6(22): Brick & Mortar Crack

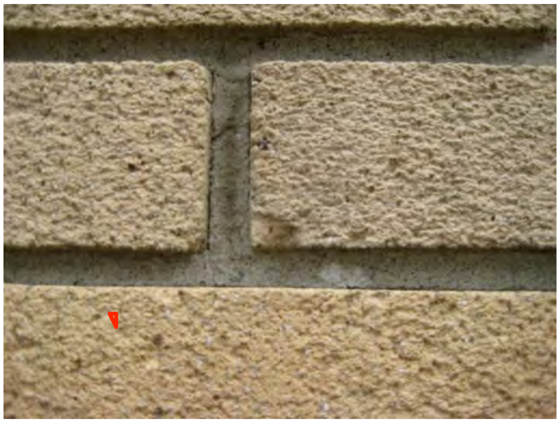

Fig. II-3.6(23): Mortar Cracks & Delam.

Fig. II-3.6(24): Mrtr. Crck. & Delamin.

The mortar condition varies greatly between locations, with some areas displaying largely sound, well-bonded mortar, while eroded, cracked, and delaminated mortar typifies other locations. Figures II-3.6(25 & 26) illustrate this variation.

Fig. II-3.6(25): Well-Bonded Mortar

Fig. II-3.6(26): Mrtr. Crck. & Delamin.

Several observations can be made regarding the anchorage of the brick wythes together, and of the brick walls to the structure. The brick wythes are well interconnected via the many header courses. On the other hand, the brick walls themselves appear to rely primarily on mortar bond to the floor slabs that support them. It is not clear whether the brick walls are connected to the concrete columns that occur inward of many such walls.

3.6.2 Analysis

Let me begin the analysis by addressing the easier primary consideration, relating to anchorage of these brick walls.

In brief, adjacent wythes of brick are mutually well-secured to each other via the interlocking header or rowlock courses. However, the brick walls connect to the floor slabs and concrete column edges only via mortar bond. My examination of the drawings did not reveal any specific connections between the double-wythe brick walls and the concrete columns, but if any had been installed, they would typically consist of metal straps, which by now would be compromised by corrosion, especially near tops of weather-exposed walls. Although much of the brickwork is likely to remain in-place due to its interlock with concrete perimeter beams, significant spalling and localized failures are probable in case of earthquakes, particularly near the level 2 water table and near windows. As with the stone-clad walls, this does not threaten the integrity of the building as a whole, but poses appreciable risk to pedestrians below in case of an earthquake.

The issue of the cladding's design and its resultant condition is more complex and requires more explanation. A confluence of technically flawed, though for its time typical, design and Juneau's conditions has caused greatly accelerated degradation of the masonry, including its brickwork. Put another way, the building's general design is not particularly well suited to Juneau's climate.

To illustrate this, it is important to note that what kills masonry is freezing of absorbed water and persistent one-directional moisture migration through it. Freezing of embedded moisture causes spalling of the masonry's outer face, as the expanding ice rips the surface apart. One-directional moisture migration through masonry dissolves its integral salts and carries them inward, leaving these to recrystallize near the inner masonry surfaces as the water evaporates. This crystallization has much the same effect as freezing water, and typically causes the innermost masonry surface to pulverize. Fairly extensive spalling affects the exposed brickwork, and the inner-face pulverization was also observed and reported, so both phenomena affect these walls.

Juneau's climate greatly accelerates both effects. Its 220 days of annual rain, combined with a 5-month period when sub-freezing temperatures occur, are a deadly combination, providing both the water and the freezing ice. In addition, fairly frequent strong winds appear to accelerate surface erosion.

The cladding's design further exacerbates degradation. The many ledges and deeply recessed raked mortar joints greatly increase the weather-exposed surface of the masonry, thus causing it to both absorb much more water and reach lower temperatures on cold nights. The recessed header and rowlock courses, though needed for interlocking adjacent wythes, also serve as ledges which help water enter more deeply into the walls, especially via the many head joints. This increases risk of interior leakage, and also complicates flashing retrofit work. The absence of drainage flashings at appropriate locations, most notably above the portico roof, among many others, allows water to drain into lower walls below, causing widespread damage.

The use of light-colored brick, which is often an indicator of lower-strength, more absorbent brick, as explained in greater detail in the 12/31/10 PL:BECS portico report, section IV-4.4.2, page 146, may also have contributed to the fairly widespread spalling and surface erosion.

The improper initial design of the projecting cornice near the roof level, which led to severe infiltration and efflorescence directly below it, and to the cornice's subsequent removal, further contributed to the damage affecting the brickwork by significantly increasing the frequency of wetting of the walls below, as explained in greater detail in section II-4.5.

Though I have only observed comparable levels of surface erosion on similarly-aged brick which had been actively sandblasted for cleaning, my recent observation that the serious erosion does not appear to affect more sheltered exposures could indicate that in this case, Mother Nature alone may have caused this. The marble columns, for example, also display serious erosion on their SW, SE, and NE faces, while their NW exposures retain much of their original polish, implying that severe weather hits this building from the southeast.

3.6.3 Projected Future Behavior

The projected behavior of these walls is already described in greater detail in section IV-4.4.3, page 148 of the 12/31/10 PL:BECS Portico report.

In brief, absence of adequate securement of these brick walls to the structure increases seismic risk to pedestrians below.

Infiltration into the brickwork will also continue, leading to recurring interior leakage and plaster damage, progressive corrosion of embedded lintels and other steel anchors, continued degradation of the brick and other masonry below it, progressively worsening degradation and destabilization of the entry portico, and related symptoms. Infiltration into the brickwork can be reduced through a combination of measures, but due to the existing, multi-wythe brick construction, infiltration cannot be reliably fully stopped with the existing configuration.

Unfortunately, the specific configuration of the brickwork, combined with the already advanced erosion of the outermost brick faces, will lead to ongoing spalling, which can be slowed down, but cannot be effectively stopped, by treating with consolidating agents.

3.7. Terra-Cotta-Clad Exterior Walls at Levels 2-4

3.7.0 General

This subsection pertains to the terra-cotta exterior wall panels that occur between windows at floor levels 2-4.

3.7.1 Summary of Observations

Each of these terra-cotta spandrel panels consists of six individual terra-cotta pieces, which are secured to the back-up brick walls with steel anchors. The apparent condition of these elements varies appreciably between different locations. Many appear to still be in reasonably good condition, with minor surface spalling.

However, the design of these elements lacks any drainage provisions, as is typical of all masonry elements on this building, and as was typical of masonry in general during this building's construction. Consequently the bottoms of many panels in weather-exposed locations are degrading, with spalling and efflorescence evident.

In addition, various panels display both vertical and horizontal cracking, which often coincides with locations of embedded steel, and can be an early indication of corrosion of embedded steel.

Above the entry portico, several of these panels have sloping mortar-wash sills, which are degrading seriously. Several panels in the same general location also have some grille penetrations with moss growth. Figures II-3.7(1-12) illustrate examples of these observations.

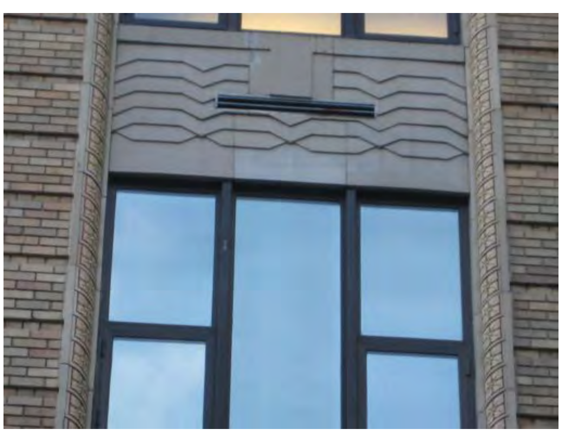

Fig. II-3.7(1): Moderate Degr. of T-C Panel **Fig. II-3.7(2): Mod. Degr. of T-C Panel**

Fig. II-3.7(3): Minor Degr. of T-C Panel

Fig. II-3.7(4): Serious Spalling @ Bot.

Fig. II-3.7(5): Serious Degr. of T-C Pnl. Bot.

Fig. II-3.7(6): Serious Spalling @ Bot.

Fig. II-3.7(7): Vertical Cracking in T-C Pnl.

Fig. II-3.7(8): Horiz. Crack in T-C Pnl.

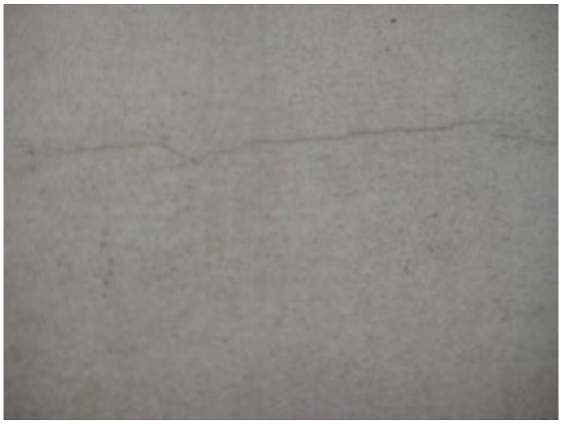

Fig. II-3.7(9): Horiz. Cracking in T-C Panel

Fig. II-3.7(10): Sill Degradation

Fig. II-3.7(11): Sill Degradation

Fig. II-3.7(12): Grille Penetration

3.7.2 Analysis

These terra-cotta panels repeat the same basic errors common to all of this building's masonry. Namely, they lack flashing caps over upward-facing surfaces, and they do not accommodate drainage from behind the panel bottoms. Based on the initial cracking visible at some panels, it also appears probable that embedded steel anchors and reinforcing consist of standard steel, and have begun to corrode.

The absence of flashing caps significantly increases infiltration into these panels, and the fairly advanced degradation along the bottoms of some panels confirms this. The panel-bottom damage is appreciably accelerated by the absence of drainage provisions. Removal of the roof cornice in the past further increased exposure.

3.7.3 Projected Future Behavior

The damage to a majority of the panels is still pretty limited and largely visual at this stage. Many of these could probably last up to 40 years before beginning to display truly worrisome symptoms, such as recurring dropping of small chunks onto the ground below. On the other hand, a more limited number of panels already show more advanced degradation along their bottom edges, and these are already shedding small flakes, require temporary maintenance now and will need replacement within about two decades.

Probable corrosion of embedded steel anchorage may increase susceptibility to seismic damage.

3.8. North Courtyard Walls, Brick-Clad

3.8.0 General

This subsection pertains to the brick-clad exterior walls wrapping the north courtyard, but excluding the stairwell walls, which intervene between the two areas described in this section.

3.8.1 Summary of Observations

While the public-facing exterior walls of this building are relatively ornate, these courtyard walls are plain and utilitarian in character. Though different in appearance, the basic construction of these walls is basically the same as of the more public walls addressed in section II-3.6, and many of the same observations apply. These can again be divided into structurally-related concerns and general design and resultant condition.

These walls are also multi-wythe brick walls, with up to 3-wythe thickness. In contrast to the “public” walls, these courtyard walls only have a single wythe of brick outward of most of the embedded concrete columns. These walls also have interlocking header courses, though these do not generally align with corresponding courses in the immediately abutting “public” walls, displaying almost wanton disregard for the aesthetic care revealed in the brickwork of the public walls.

Structural securement issues relevant to these walls are basically the same as at the public brickwork. Namely, interlocking header coursing ties parallel wythes together very effectively, but the overall wall assembly relies on mortar bond alone to secure the walls to the supporting floor slabs, and if anchors exist between the brick and columns, many would by now be compromised by corrosion.

With regard to “design and weathering” considerations, these walls are also similar to the more public ones. For example, they also lack flashings or weep holes to drain water out of the brickwork, or above steel window-head lintels, which display variable, and in a few locations moderately-advanced, corrosion.

In contrast to the deeply raked mortar joints in the more public brickwork, the mortar at these walls appears mostly flush-struck, with its outer surface very near the brick face, but not visibly tooled, though surface erosion could have removed tooling indications.

Though we were unable to reach the north-facing walls, examination of the east and west-facing ones proved educational. Namely, the east-facing wall displays significant degradation, such as surface spalling, surface erosion, mortar stress, lintel corrosion, etc. Visible window-head lintel corrosion at this wall affects all of the openings in the upper two levels, and a few near the wall base. In contrast, the west-facing wall is in visibly better condition, with much more limited surface erosion and little spalling, and apparent lintel corrosion occurs only below an entry door.

The east-facing wall also displays cracking in the brick as well as in one pre-cast concrete window sill. Further, it appears that the steel window-head lintel above an upper-level window has sagged, causing a long and significant delamination crack in the brick header above.

Figures II-3.8(1-14) illustrate these observations.

Fig. II-3.8(1): Utility-Grade Design

Fig. II-3.8(2): Spalling, E-Facing Wall

Fig. II-3.8(3): Spalling, E-Facing Wall

Fig. II-3.8(4): Erosion, E-Facing Wall

Fig. II-3.8(5): Better Cond., W-Facing Wall

Fig. II-3.8(6): Absorption Test, E. Wl.

Fig. II-3.8(7): Lintel Corr., E-Wall, Bottom

Fig. II-3.8(8): Lintel Corrosion, E.

Fig. II-3.8(9): Lintel Corr., E-Wall, Top

Fig. II-3.8(10): Lintel Corrosion, E.

Fig. II-3.8(11): Sagging Head., E-Wall, Top

Fig. II-3.8(12): Crack Abv. Sag. Hd.

Fig. II-3.8(13): Sagging Head., E-Wall, Top **Fig. II-3.8(14): Crack @ E. Wall, Top**

3.8.2 Analysis

Though these courtyard walls differ substantially in appearance from their more public counterparts, much the same analysis applies to both, with the one major exception being that these courtyard walls lack the recessed header courses and mortar joints, thus presenting less surface area to the weather. As the analysis for both wall types is quite similar, please refer to subsection II-3.6.2 for a more detailed description, which is repeated here only skeletally.

With regard to securement, adjacent brick wythes are secured to each other via interlocking header courses, but the walls connect to the floor slabs and concrete column edges only via mortar bond. It is not clear whether the brick walls are secured to the columns, but even if they were, the anchors are probably compromised by corrosion, especially at the east-facing wall. Although much of the brickwork is likely to remain in-place, significant localized failures are probable in case of earthquakes, particularly near windows. While this does not threaten the integrity of the entire building, it poses appreciable risk to pedestrians in an earthquake.

Issues related to the cladding's design and its resultant condition are essentially identical to those affecting the more public walls, though the significantly different weather-exposure of these walls has resulted in correspondingly noticeable differences in condition.

The absence of drainage flashings at appropriate locations allows water to drain into lower walls below, exacerbating damage and interior leak risk. Interlocking header courses, though structurally needed, also increase risk of deep water penetration into the walls.

The use of light-colored, probably lower-strength, more absorbent brick, may also have contributed to spalling and surface erosion.

Though these design issues apply to all of the courtyard walls, differences in exposure have produced widely differing results, and the east-facing wall displays much greater degradation, including surface erosion, spalling, lintel corrosion, etc. than its west-facing counterpart.

3.8.3 Projected Future Behavior

In brief, absence of adequate securement of these brick walls to the structure increases seismic risk to pedestrians below.

Infiltration into the brickwork will continue, causing recurring interior leakage, progressive lintel corrosion, continued brickwork degradation, etc. Infiltration into the brickwork can be reduced through a combination of measures, but due to the existing construction, infiltration, and associated brick spalling, cannot be reliably fully stopped with the existing configuration.

These considerations apply much more to the east-facing wall than to the west-facing one, and probably also to the north wall, and degradation will continue to be most rapid at the east wall.

3.9. North Stairwell Walls, Brick & Stucco-Clad

3.9.0 General

This subsection pertains to the brick-clad exterior walls wrapping the stairwell tower in the north courtyard.

3.9.1 Summary of Observations

With regard to their construction, these walls are effectively identical to the other courtyard walls, differing primarily in being taller, protruding a floor level above the roof line, with this upper portion over-clad with directly adhered stucco. The east and west stairwell walls consist of triple-wythe brickwork, while the north wall consists almost entirely of concrete columns wrapped with a single brick wythe. The south wall, which occurs only above the roof, consists of double-wythe brick coated with stucco. The upper stucco band, as well as the entire height of the east-facing wall, is painted with an elastomeric coating. Figures II-3.9(1 & 2) illustrate these observations.

Fig. II-3.9(1): Stairwell's North Wall

Fig. II-3.9(2): Stairwell's North Wall

The east-facing wall suffers significant brick spalling, though partly concealed by the elastomeric coating, which has clearly been applied to address infiltration. The coating has not proved successful in fully precluding moisture entry, and spalling continues, with brick chunks in places hanging by only the coating. The north and west-facing walls are in notably better condition. See Figures II-3.9(3-5).

Indications of ongoing infiltration are also evident at the south-facing wall, whose innermost face manifests the surface pulverization, brick flaking, and white salt deposition characteristic of deep infiltration, as already explained in greater detail in subsection II-3.6.2. See Figures II-3.9(6-8).

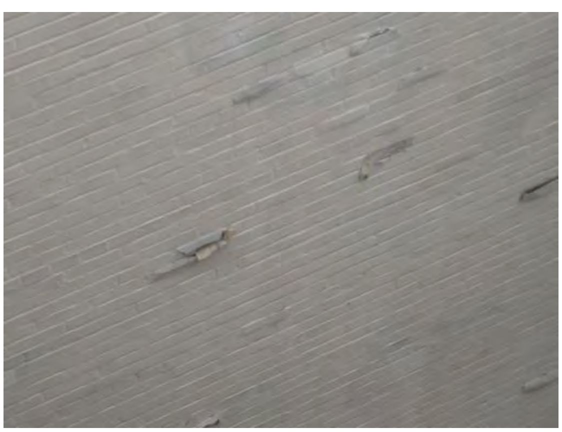

Fig. II-3.9(3): Post-Coating Spallng., East

Fig. II-3.9(4): East Wall Spalling

Fig. II-3.9(5): Post-Coating Spallng., East

Fig. II-3.9(6): Flaking @ Int., S. Wall

Fig. II-3.9(7): Flaking @ Interior, S. Wall

Fig. II-3.9(8): Flaking @ Int., S. Wall

The upper stucco band appears directly adhered to the brick. In places, it bulges outward, and some coating blisters indicate moisture intrusion behind the coating. The stucco's bottom merges into the brick face below, and the elastomeric coating spans across the juncture, precluding any opportunity for drainage. Similarly, the stucco joins the abutting parapets and roof in a non-draining fashion, wherein any water behind the stucco would drain into the roof assembly. See Figures II-3.9(9-12).

Fig. II-3.9(9): Stucco Bulging, W. Wall

Fig. II-3.9(10): Coating Over Junct.

 

Fig. II-3.9(11): Non-Dr. Stucco-Roof Junct. **Fig. II-3.9(12): Blistered Coating**

Brief review of the drawings did not reveal any anchorage of the brick to the concrete columns, and same observations apply to these walls as elsewhere relative to anchorage.

These walls also lack flashings or weep holes to drain water out of the brickwork, or above window-head lintels, which however appear to be in good condition, reflecting their more forgiving northerly exposure.

3.9.2 Analysis

In most respects, the analysis for the courtyard walls, described in subsection II-3.8.2, applies equally well to the stairwell walls, with a few additions.

With regard to securement, the north-facing wall, which in many locations consists of a single wythe of brick over concrete columns, may pose some risk of falling brick in case of earthquakes.

Issues related to the design and resultant condition of these walls are essentially identical to those affecting the courtyard walls.

For example, absence of flashings exacerbates damage and interior leak risk. This is particularly true along the base of the upper stucco band, which drains directly into the brick below, causing accelerated brick spalling, primarily on the east-facing wall.

Similarly, improper, non-draining junctures of the stucco cladding to the parapets and roof along the south side pose inherent risk of interior leakage and damage to the roof.

As with the courtyard walls, differences in exposure have produced widely differing results, and the east-facing wall displays much worse spalling, than any of the other exposed brick walls.

3.9.3 Projected Future Behavior

Questionable securement of the brick, especially at the north stairwell wall may pose seismic risk to pedestrians below.

Infiltration into the brickwork will also continue, which will particularly affect the more weather-exposed west and south walls, causing continued brickwork degradation, and posing risk of recurring interior leakage. Infiltration into the brickwork can be reduced through a combination of measures, but due to the existing construction, infiltration, and associated brick spalling, cannot be reliably fully stopped with the existing configuration.

3.10. Brick Chimney

3.10.0 General

This subsection pertains to the relatively tall brick chimney above the main roof, near the inside corner where the west wing joins the main portion of the building. As the “structural” and “weather-integrity” issues affecting this chimney are intricately related and inseparable, all observations and considerations related to this chimney are addressed holistically in section II-2.5. The sole purpose of section II-3.10 is to refer the reader to section II-2.5 for both “structural” and “weathering” information.

3.11. North Courtyard Walls, Metal-Clad

3.11.0 General

This subsection pertains to two small wall portions on the building’s north side, one to each side of the stair tower, at floor level 2. These walls were not part of the building’s original construction.

3.11.1 Summary of Observations

These two newer, small walls are reported to consist of standard light-gage steel framing, with steel studs, gypsum exterior sheathing, probably building paper, an exterior metal cladding, and windows and doors. Examination with binoculars did not reveal any drainage provisions along the metal cladding’s base. The cladding is lightly warped. Figures II-3.11(1 & 2) show the eastern wall.

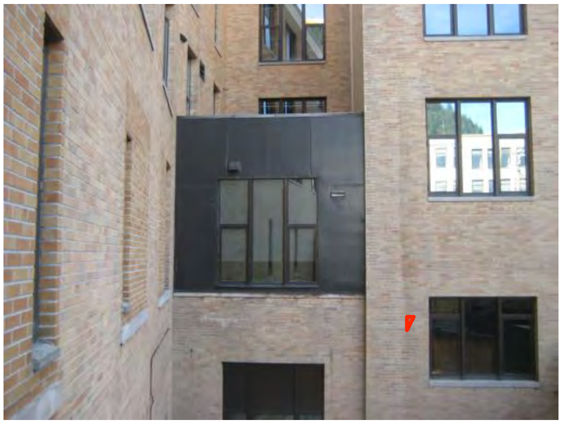

Fig. II-3.11(1): N-Facing, Metal-Clad Wall

Fig. II-3.11(2): Metal Cladding

3.11.2 Analysis

No structural considerations apply to these lightweight walls.

Absence of cladding drainage provisions, if confirmed, would exacerbate risk of interior leakage and water damage to the lower portions of these walls. This concern is appreciably minimized by the sheltered orientation of both walls.

3.11.3 Projected Future Behavior

In general, these walls are of minor concern, pose no structural issues, and could at worst experience limited infiltration and water damage, which should be minimized by the northerly orientation.

3.12. Windows

3.12.0 General

This subsection pertains to all exterior windows.

3.12.1 Summary of Observations

Most of the building's original steel-sash windows had been replaced some time ago with extruded aluminum units, except at the north ends of the two wings, which retain their original steel ones.

With regard to general configuration, nearly all windows are divided into three equal-width sections, with a large, fixed central panel and two, vertically stacked panels on each side, each containing operable casement sashes below smaller fixed panes. However, a few of the original window openings had been at least partly bricked-in, with either no windows or with narrow units.

At least two variants of aluminum windows exist. In nearly all locations, they have fairly standard frames and mullions with roughly 2" wide profiles. In contrast, the three windows in the governor's conference room have very narrow vertical mullions.

Figures II-3.12(1-4) illustrate these observations.

Fig. II-3.12(1): Typ. Window Configuration

Fig. II-3.12(2): Atypical Narrow Units

Fig. II-3.12(3): Typ. Wide-Mullion Config.

Fig. II-3.12(4): Atypical Narrow Mulls.

A few loose and deflected window frames revealed that the new aluminum windows had been installed over the original steel frames, which were corroding. See Figures II-3.12(5 & 6).

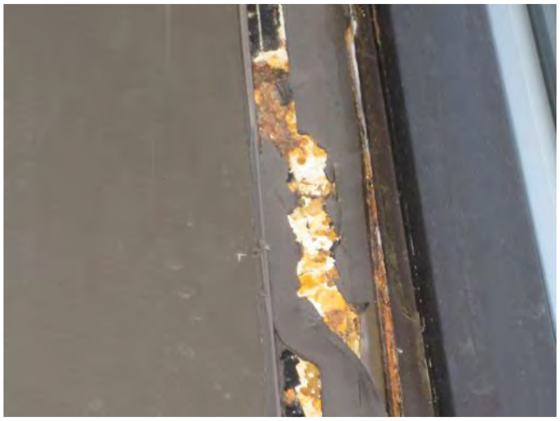

Fig. II-3.12(5): Corroding Steel Frame

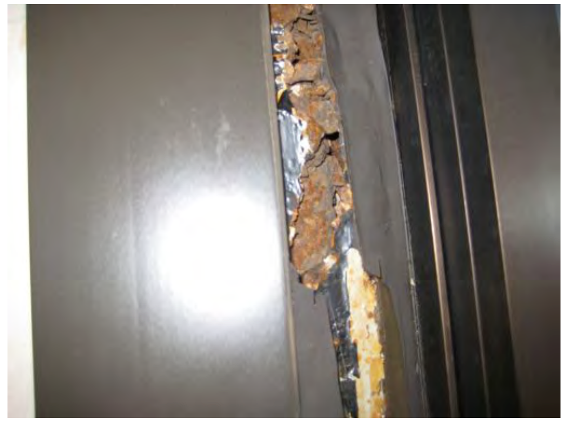

Fig. II-3.12(6): Corroding St. Frame

Although the original steel-sash windows contain rudimentary drainage provisions, such as notches to preclude damming, the newer aluminum units lack any integral drainage. Raised dams along outer sill edges block drainage from the sub-sash channels, whose various screw penetrations and holes clearly allow water into the frame extrusions, but sealant applied along all exterior junctures precludes outward drainage from the frames. The application of sealant over all joints is extremely unusual, and typically, such measures reflect ill-fated efforts to stop leakage. See Figures II-3.12(7-11).

Fig. II-3.12(7): Original Steel-Sash Window

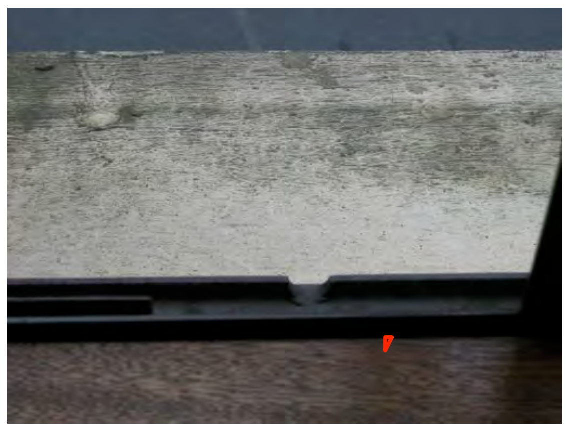

Fig. II-3.12(8): Drain Notch in St. Sill

Raised inner sill dam precludes inward spillage of water off sill below operable sash.

Continuous raised outer lip lacks any notches of holes to allow water atop sill to drain back out.

Figure II-3.12(9): Absence of Drainage Notches or Weeps in Outer Sill Lip

Hole in sill extrusion drains water off sill into sill extrusion, which appears to be fully sealed and unable to drain.

Figure II-3.12(10): Hole at Sill/Jamb Juncture Allows Water Into Sill Extrusion

Sealant applied along extrusion joints is very unusual, probably reflects effort to stop leakage.

Sealant applied below sill extrusion precludes drainage of water out from under sill.

Figure II-3.12(11): Perimeter of Sill Extrusion Sealed with Sealant

Note also that all other joints in aluminum window system are sealed with sealant.

Not surprisingly, my examination also revealed relatively widespread evidence of previous leakage, such as blistered plaster around and below windows, white deposits at many interior joints, elevated moisture content below some window sills, streaks on plaster below sills, and similar manifestations. In a couple of locations, some sort of oily streaks occur on interior mullion faces. While many such symptoms reflect leakage via masonry above these windows, others, such as those below midspans of interior sills and along joints in the aluminum extrusions, are more likely to reflect leakage via the windows themselves. Sealant along interior window frame joints, which is quite unusual, may also reflect an effort to stop leakage. Figures II-3.12(12-23) show some examples of these observed symptoms.

Fig. II-3.12(12): Streaks Bel. Window Sill

Fig. II-3.12(13): Plstr. Dam. Bel. Sill

Fig. II-3.12(14): Plaster Damage Below Sill

Fig. II-3.12(15): Elev. Moist. Bel. Sill

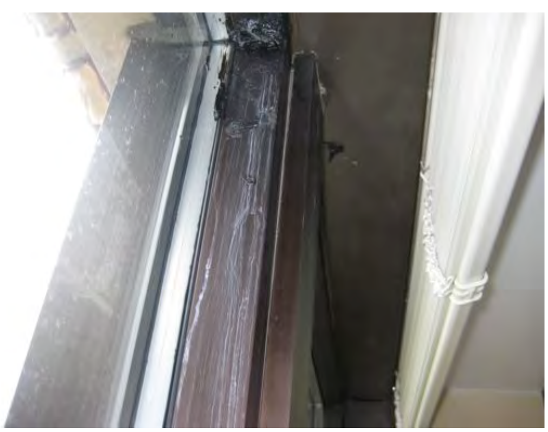

Fig. II-3.12(16): Streaks Bel. Window Head

Fig. II-3.12(17): Streaks on Mullion

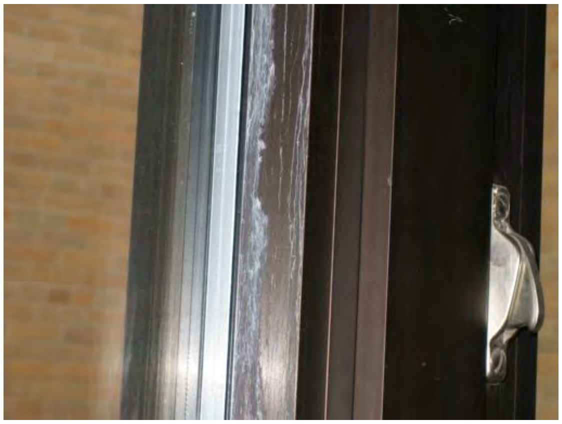

Fig. II-3.12(18): Streaks On Mullion

Fig. II-3.12(19): Oily Streaks on Mull.

Fig. II-3.12(20): White Dep. At Frame Jts.

Fig. II-3.12(21): White Dep. At Joints

Fig. II-3.12(22): White Dep. At Frame Jts.

Fig. II-3.12(23): White Dep. At Joints

In addition, the sills of the three windows above the portico occur quite close to the roof, and occasionally become buried in snow, increasing leak risk. These sills are capped with asphalt-coated copper sill flashings, which could lead to corrosion if copper-aluminum contact occurs. All joints in these windows are also sealed with sealant. See Figures II-3.12(24 & 25).

Fig. II-3.12(24): Sills Near Portico Roof **Fig. II-3.12(25): Cpr. Flshgs. Bel. Al.**

3.12.2 Analysis

The newer aluminum windows are flawed both in their design as well as installation.

The primary design flaw is that the windows lack any sort of integral drainage system. This is a fatal flaw, as it is simply not possible to seal all joints and perimeter conditions perfectly and permanently, and all modern window systems include integral drainage methods to accommodate the inherent infiltration. Various interior symptoms indicate that some of these windows leak, at least under severe weather conditions at highly exposed locations.

Installation issues relate to the securement of the aluminum windows over the steel frames of the original windows, as well as the improper sealing of numerous joints in the window extrusions.

The severely corroded steel frames behind the aluminum extrusions appear to reflect electrolytic corrosion, wherein fastening of the aluminum and steel elements together greatly accelerated corrosion. Water intrusion and condensation within the frames may have exacerbated this effect.

The sealing of the window extrusion joints should not be necessary, and in some locations precludes drainage of water back out of the extrusions. While window perimeters should generally be sealed, sealing at the sills should be executed in a fashion that does not block outward drainage. In these windows, the sill sealing may actually block such drainage.

Placement of three windows only a few inches above the portico roof also increases leak risk, particularly during periods of wet snow accumulation.

3.12.3 Projected Future Behavior

The problems plaguing the windows will persist.

The absence of an integral drainage system will continue to make the windows vulnerable to leakage, which may affect different windows at different times under varying conditions.

To the extent that any of the original steel frames still retain any integrity, continued corrosion will destroy these, and if the aluminum windows are secured to these frames, as appears probable to some degree, such securement will also become compromised.

The sealant applied to the numerous window extrusion joints will continue to fail, and water which enters via these joints will be hindered from draining back out by the same sealant joints below the entry points.

The three windows directly above the portico roof are likely to experience occasional leakage during snowy periods.

3.13. Roofs

3.13.0 General

This subsection pertains to four roof areas, including the large main roof, a small roof atop the stair tower, and two small roof areas atop the metal-clad additions on the building's north side. The portico roof is addressed separately with the portico in subsection II-5.6.

3.13.1 Summary of Observations

Only the large main roof was accessed directly, and concrete pavers atop it precluded examination except along perimeter conditions. The two lower roofs on the north side are also capped with pavers, limiting observations. However, a few germane observations could be made.

First, the assembly of these roofs apparently consists of a single-ply EPDM membrane over the building's concrete roof structure, with rigid polystyrene insulation capped with concrete pavers placed atop this membrane. This configuration represents an Inverted Roof Membrane Assembly, (IRMA), wherein the insulation occurs above the roof membrane.

A second major observation relates to all conditions where the roof membrane joins higher masonry walls above, such as along the base of the brick chimney, where the main roof joins the stair-tower walls and parapets, and where the two lower roofs abut the brick-clad walls. The roof membrane top edges at these junctures are secured with continuous termination bars, with sealant above the bars, but with no through-wall flashings to allow drainage from the masonry or stucco above.

Figures II-3.13(1-10) illustrate these observations.

Fig. II-3.13(1): Paver-Capped Main Roof

Fig. II-3.13(2): Paver-Capped Main Rf.

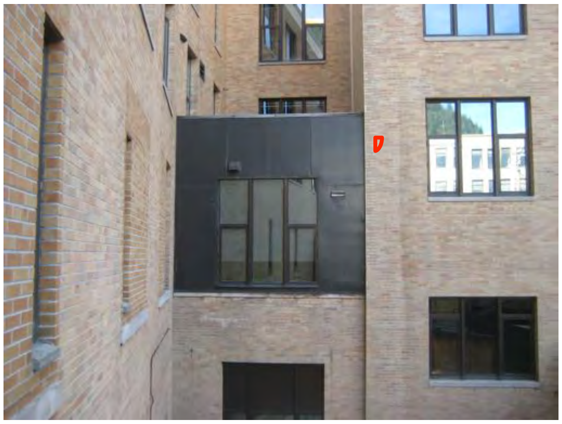

Fig. II-3.13(3): Paver-Capped Low Roof

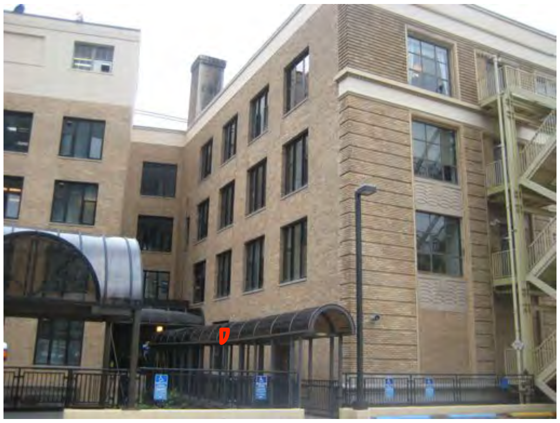

Fig. II-3.13(4): Paver-Capped Low Rf.

Fig. II-3.13(5): EPDM Roof w/IRMA Config.

Fig. II-3.13(6): Insul. Atop Rf. Membr.

Fig. II-3.13(7): Non-Drain. Roof-Wall Junct.

Fig. II-3.13(8): Sealed Roof-Wall Jnct.

Fig. II-3.13(9): Non-Drain. Prpt.-Wall Junct.

Fig. II-3.13(10): Sealed Roof-Wall Jt.

3.13.2 Analysis

Two primary issues relate to these roof areas.

First, the Inverted Roof Membrane Assembly, (IRMA), wherein the roof membrane is placed below the insulation, is particularly ill suited to a cold, wet climate such as Juneau's. This is because all water reaching these roofs has to percolate through the insulation joints to the membrane, then migrate along the membrane's top to the drains. In the process, this cold water extracts a lot of heat from the building. In a cold, wet climate such as Juneau's, this IRMA configuration effectively negates essentially all value of the insulation, and results in appreciably increased energy consumption.

The non-draining junctures of the roof membrane to abutting walls are quite improper, and substantially increase risk of leakage below such transitions. This may be one reason why the stairwell's east-facing brick wall, as well as several chimney walls, had been painted with an elastomeric coating, probably reflecting an effort to stop infiltration below.

3.13.3 Projected Future Behavior

The ill-suited IRMA roof configuration will continue to drain energy from the affected roof assemblies, resulting in appreciable waste and needless operation costs.

Leak risk will also persist below the various ill-conceived, non-draining roof membrane-wall junctures, requiring vigilant re-coating of the masonry walls above them, and causing recurring leakage below weather-exposed walls.

4. EXTERIOR MASONRY SUB-ELEMENTS

4.0. General

This section of the report addresses issues related to the various exterior masonry sub-elements, such as the stone and terra-cotta water tables, stone window sills, marble panels, etc.

4.1. Lower Stone Water Table at Level 2

4.1.0 General

This subsection pertains to the stone water table that extends at level 2 around the building's more public façades on the west, south, east, and north sides, but not in the north courtyard.

4.1.1 Summary of Observations

A horizontal band consisting of a large, projecting stone water table, with a second, vertically faced stone band above this, extends at level 2 around the building's public façades. Observations related to this band concern its securement, general design, and condition.

With regard to securement, the drawings show the large pieces secured with 5/8" vertical steel rods within the joints below the windows, and with a continuous steel angle where columns occur.

With regard to design, this water table lacks any flashings on top or under it, allowing permeation into the water table and the masonry below. Consequently, it displays appreciable degradation, erosion, cracking, and exfoliation. A large portion east of the south entry has spalled off between my 2006 and 2010 visits, and other sections are in process of spalling. See Figures II-4.1(1-14).

Fig. II-4.1(1): Cracking in Band Abv. W.T.

Fig. II-4.1(2): Crack Above Wtr. Tbl.

Fig. II-4.1(3): Cracking in Band Abv. W.T.

Fig. II-4.1(4): Crack Above Wtr. Tbl.

Fig. II-4.1(5): Cracking in Band Abv. W.T.

Fig. II-4.1(6): Crack Abv. & In W.T.

Fig. II-4.1(7): In-Progress Spalling of W.T.

Fig. II-4.1(8): Spalling & Degradation

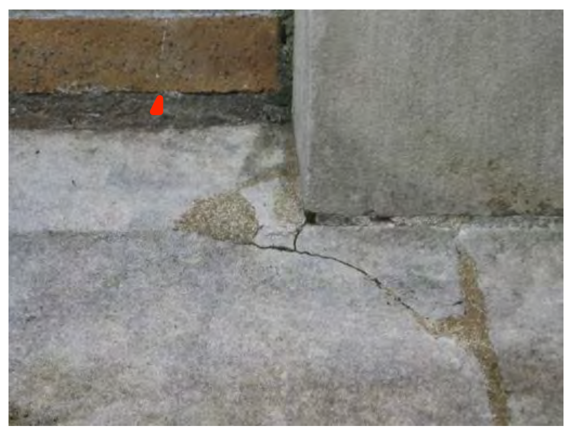

Fig. II-4.1(9): Spalling Near Steel Anchor

Fig. II-4.1(10): Spalling Near Anchor

Fig. II-4.1(11): In-Progress Spalling of W.T. **Fig. II-4.1(12): Edge Spalling**

Fig. II-4.1(13): Spalled Water Table Top **Fig. II-4.1(14): Spalled W.T. Top**

4.1.2 Analysis

The water table's securement at the windows appears inadequate to resist lateral loads, though it seems notably beefier where it runs past embedded concrete columns. It is probable that the anchors have begun to corrode, compromising securement to variable degrees, depending on weather exposure.

Absence of flashings atop and below the water table allows infiltration into the water table and masonry below, greatly accelerating degradation, spalling, and risk of interior leakage. However, the current degradation does not yet appear to have irretrievably damaged this water table.

4.1.3 Projected Future Behavior

The water table's securement may pose some risk to pedestrians below in case of earthquake. Continued corrosion of these anchors will compromise securement further, and will contribute to localized spalling near the water table top, which may have already begun.

The water table and to a lesser extent the masonry directly below it will also experience accelerating degradation due to continued infiltration resulting from the absence of flashings atop and under this water table.

4.2. Terra-Cotta Window Bay Surrounds

4.2.0 General

This subsection pertains to the multi-colored terra-cotta border elements that surround all vertical window bays at levels 2-5 around the building's public façades on the west, south, east, and north sides, but not in the north courtyard.

4.2.1 Summary of Observations

Observations related to the window surrounds again concern securement, design, and condition.

The securement was not examined, but the drawings indicate that these surrounds are secured with "non-corroding" metal hooks suspended from steel lintels above the 4th and 5th level window heads. No specific securement method appears called out for the vertical "jamb" pieces, though some hooks may exist there as well. It is not clear whether "non-corroding" metal hooks had been used, and the supporting lintels consist of standard, non-galvanized steel.

The only design-related issue concerns the masonry above the terra-cotta heads. As with the rest of the building, no drainage provisions had been incorporated, and in fact, sealant seals the junctures separating the terra-cotta heads from the brickwork above, precluding drainage.

The condition of these terra-cotta elements varies greatly around the building. In many locations, these elements appear to still be in generally good condition, with no visible weathering symptoms, other than some color fading. See Figures II-4.2(1 & 2).

Fig. II-4.2(1): Terra-Cotta in Good Condition

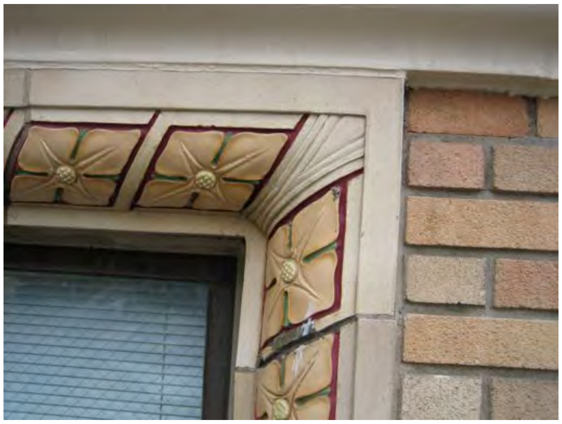

Fig. II-4.2(2): T.-C. in Good Condition

Elsewhere, many pieces are discolored by what appears to be lime. See Figures II-4.2(3-6).

Fig. II-4.2(3): Terra-Cotta Discoloration

Fig. II-4.2(4): T.-C. Discoloration

Fig. II-4.2(5): Terra-Cotta Discoloration **Fig. II-4.2(6): Discoloration, Cracking**

Proceeding up the damage scale, a still fairly limited number of pieces have begun to show cracking and spalling of their outer faces, ranging from minor short cracks to complete face spalling. Figures II-4.2(6-12) illustrate the range of this type of damage.

Fig. II-4.2(7): Terra-Cotta Cracking **Fig. II-4.2(8): Terra-Cotta Cracking**

Fig. II-4.2(9): Terra-Cotta Face-Spalling **Fig. II-4.2(10): T.-C. Face-Spalling**

Fig. II-4.2(11): Terra-Cotta Face-Spalling **Fig. II-4.2(12): T.-C. Face-Spalling**

Let me return to the non-draining masonry above the terra-cotta window heads. As noted, the joints directly above these heads had typically been sealed with sealant, precluding drainage from behind the brickwork above. Lime staining below these joints, and moss growth in some mortar joints directly above them, as well as spalling and efflorescence on the underside of these heads clearly indicate that water is trying to drain out of the masonry above the heads. See Figures II-4.2(13 & 14).

Fig. II-4.2(13): Lime Streaks Bel. Sealed Jt. **Fig. II-4.2(14): Lime St., Moss Growth**

Some of these sealed joints near the top of the south elevation had become widened to roughly an inch from their original ½" width. In many such widened locations, the terra-cotta directly below has become cracked, in places quite badly. Such symptoms often indicate corrosive expansion of embedded steel. However, examination of the steel lintel in the location of the worst apparent damage revealed a deeply embedded, non-galvanized, non-flashed steel lintel with very minimal corrosion. This indicates that the observed damage is resulting from freeze-spalling. See Figures II-4.2(15-20).

Fig. II-4.2(15): Widened Joint Abv. T.-C.

Fig. II-4.2(16): T.-C. Cracking Bel. Jt.

Fig. II-4.2(17): Cracking Bel. Sealed Joint

Fig. II-4.2(18): T.-C. Cracking Bel. Jt.

Fig. II-4.2(19): Cracking Bel. Sealed Joint

Fig. II-4.2(20): Minor Lintel Corrosion

4.2.2 Analysis

The condition of these terra-cotta window surrounds is highly variable, depending on weather exposure. Many pieces are minimally degraded, and could probably last another 40 years, perhaps more. On the other hand, a small number are already seriously damaged, and will spall chunks onto the ground below. Perhaps a quarter fall somewhere in-between, and are likely to begin cracking and spalling within a decade or two.

A primary design flaw affecting these terra-cotta surrounds concerns the non-draining brickwork above the heads. As a consequence of the absence of drainage provisions above these heads, water within the brickwork drains directly into the terra-cotta heads, which then direct this water down the terra-cotta jamb surrounds. When the water freezes and expands, it rips the terra-cotta pieces, causing the observed cracking and spalling.

This infiltration is also likely to lead to corrosion of the steel lintels, and probably of the wire hooks securing the terra-cotta heads, although such corrosion does not yet appear to be a significant factor, probably reflecting the fact that the cornice, which had since been removed, had afforded appreciable protection for these heads, and also due to the apparently deep embedment of the lintels.

4.2.3 Projected Future Behavior

The degradation affecting these terra-cotta surrounds will continue and will accelerate, particularly at the upper reaches of the south and east elevations, while such degradation will continue to be slower at the north and west sides and at lower portions. The worst areas near the top of the south elevation may begin dropping threateningly large chunks at any time, and this risk will increase with time.

4.3. Upper Terra-Cotta Water Table at Level 5

4.3.0 General

This subsection pertains to the wide horizontal band that separates the 4th and 5th level windows.

4.3.1 Summary of Observations

This band consists of three different profile types, all composed of terra-cotta, including a projecting water table with a sloping top and a multi-colored "soffit" at the top of this band, a flat-panel middle band, and a smaller rounded, projecting "brow" above the 4th level window heads. The entire band has been painted with an elastomeric coating, precluding direct examination of the outer glazed surfaces. However, valuable observations could be made in spite of this.

With regard to design, the same typical issues affect this band as all other masonry on the building. Namely, no through-wall flashings occur above the upper water table, no flashing caps protect the projecting water table, and no drainage flashings drain water out from the bottom of this band.

This observation provides a good introduction to a discussion of this band's condition, which, though variable, ranges up to seriously degraded in many locations. For example, the uppermost projecting water table band in places appears in reasonably good condition, to the extent one can discern through the elastomeric coating. Elsewhere, in-progress spalling can be seen through the coating on this band, and in various other places, the spalling of this upper band is quite advanced, with chunks of the surface gone. Figures II-4.3(1-16) illustrate these observations.

Fig. II-4.3(1): 3-Part Terra-Cotta Band

Fig. II-4.3(2): Minor Degradation

Fig. II-4.3(3): Minor Degr. of Top W.T. Band

Fig. II-4.3(4): Incipient Spalling

Fig. II-4.3(5): In-Progress Spalling

Fig. II-4.3(6): In-Progress Spalling

Fig. II-4.3(7): In-Progress Spalling

Fig. II-4.3(8): In-Progress Spalling

Fig. II-4.3(9): Serious Spalling of Top Band

Fig. II-4.3(10): Serious Spalling

Fig. II-4.3(11): Serious Spalling of Top Band Fig. II-4.3(12): Serious Spalling

Fig. II-4.3(13): Serious Spalling of Top Band Fig. II-4.3(14): Serious Spalling

Fig. II-4.3(15): Serious Spalling of Top Band Fig. II-4.3(16): Serious Spalling

Similarly, the condition of the flat-panel terra-cotta band below the water table is also variable, though in general, this band displays notably lesser degradation, with only a few areas fully spalled-off and fewer areas of incipient spalling. In one location on the north side of the east wing, rust staining exiting a crack in this band indicates that corrosion is occurring behind this panel. Figures II-4.3(17-20) illustrate these observations.

Fig. II-4.3(17): Middle Band in Decent Cond. Fig. II-4.3(18): Incipient Spalling

Fig. II-4.3(19): Corrosion Exiting Mid. Band Fig. II-4.3(20): Serious Spalling

Finally, with regard to securement, no anchors were directly examined, but a review of the drawings revealed that the uppermost water table band appears to be reasonably secured by embedment within the masonry backing. However, the panels of the middle band are secured via ¼" ø "non-corroding" metal hooks which loop around vertical steel reinforcing bars located at the panel joints. This appears to be rather minimal, and corrosion is likely to have begun compromising these anchors, at least at the steel reinforcing bars.

4.3.2 Analysis

The absence of appropriate through-wall flashings and flashing caps atop the water table, combined with Juneau's challenging climate, has effectively destroyed this band. Though some additional lifespan could be squeezed out through restoration efforts, this does not appear warranted in view of the scope of this project, and the relatively high cost of any retrofit effort compared to the lifespan extension.

4.3.3 Projected Future Behavior

This element will continue degrading at an accelerating rate, and small pieces will continue to fall off, posing some hazard to people below. Continued corrosion of the anchors will also begin compromising integrity, which could lead to larger chunks falling off, especially in earthquakes.

4.4. Marble Panels at Level 5

4.4.0 General

This subsection pertains to four flat marble panels embedded within the level 5 brickwork.

4.4.1 Summary of Observations

Four marble panels occur within the level 5 brickwork. Two are roughly 3 ½ feet wide and 6 ½ feet tall, and two are the same height but only about a foot wide. The drawings show these as consisting of 2 ½" thick marble, indicating that the larger panels weigh roughly 700 pounds each, while the smaller ones should weigh near 200 pounds. My drawing review did not reveal any specific method for securing these panels, and instrument detection revealed only tenuous and seemingly random signals, implying that these panels may be secured only with mortar bond. Tapping on these panels also revealed many apparently hollow areas, implying only partial mortar bond.

The outer surfaces of these panels are quite rough and eroded, indicating fairly heavy sandblasting, which appears to reflect natural and serious weathering. Some of the marble's veins appear to be possibly cracked. The panel bottom edges are stained dark, resembling mildew staining. Figures II-4.4(1-6) depict these observations.

Fig. II-4.4(1): Marble Panels

Fig. II-4.4(2): Surface Erosion

Fig. II-4.4(3): Poss. Anchor Loc., Erosion

Fig. II-4.4(4): Erosion, Poss. Cracking

Fig. II-4.4(5): Black Staining at Panel Bott. **Fig. II-4.4(6): Staining, Spalled Brick**

4.4.2 Analysis

Though these panels are affected both by weathering and possibly inadequate anchorage, it appears that at least at this stage, the questionable securement represents the primary possible concern.

The weathering degradation is largely a visual distraction, and not much of that, since these panels are so high above any viewing point that the surface erosion is not apparent. The surface erosion may tend to increase moisture absorption, but this can be largely addressed with application of appropriate penetrating repellents. The possible short cracks along veins can also exacerbate infiltration and subsequent freeze-spalling, so this could be a more serious consideration.

The questionable securement could pose a risk to pedestrians below in case of earthquake, as well as possibly due to freeze-spalling.

4.4.3 Projected Future Behavior

The weathering degradation and surface erosion will continue, producing ever-coarsening roughness, which could increase moisture absorption, thus accelerating degradation further. Freezing of water that may penetrate the surface cracks could also lead to spalling.

However, the questionable securement appears to be the primary concern, which could pose a risk to pedestrians below.

4.5. Cornice-Parapet Band at Roof Level

4.5.0 General

This subsection pertains to the entire height of the multi-part band above the level 5 windows and brickwork.

4.5.1 Summary of Observations

The entire band has been painted with an elastomeric coating, precluding direct examination of its composition. However, valuable observations could be made in spite of this.

This horizontal band consists of five different sub-elements. A narrow, protruding rounded terra-cotta band extends along the bottom, with flat terra-cotta panels above this. A protruding narrow band occurs above this. This element is at variance from the construction drawings, and its composition was not tested, but it could be a sedimentary stone, such as sandstone or limestone. Above this is a flat-surfaced band that probably consists of stucco. The parapet cap sits on top of this.

Three primary considerations apply to this band. First, the current configuration does not reflect the building's design or original construction, in that the design included a significant, protruding terra-cotta cornice, which was built, but as a consequence of its ill-advised design, was removed after about three decades due to its degradation.

The second issue concerns this band's securement to the structure, which primarily applies to the flat terra-cotta panels near the bottom. Per the drawings, these panels secure with ¼" ø wires of "non-corroding" metal looped around vertical steel rods within recessed channels in the concrete back-up wall. Checking for embedded steel with instruments revealed only very random and weak signals, casting some uncertainty about this securement.

Another securement concern reflects the fact that tapping on the assumed stucco band above the protruding band produced many hollow sounds, indicating that the stucco may be delaminating in places. In at least one location on the north side, this assumed stucco band appears to bow out, again implying possible delamination.

The third consideration relates to the condition of this band, most notably to the protruding band about 3 feet from the wall top, which is in extremely poor condition. It is in fact disintegrating, dropping up to fist-sized chunks onto the portico roof and ground below. During one visit to the roof, I personally observed one such chunk fall off and shatter on the portico roof below.

Another noteworthy condition-related observation concerns a steel lintel embedded deep within the brickwork directly below this band, which somewhat surprisingly suffered only minor surface corrosion. Figures II-4.5(1-10) illustrate these observations.

Fig. II-4.5(1): Cornice-Parapet Band

Fig. II-4.5(2): Disintegration

Fig. II-4.5(3): Disintegration

Fig. II-4.5(4): Disintegration

Fig. II-4.5(5): Disintegration

Fig. II-4.5(6): Disintegration

Fig. II-4.5(7): Disintegration

Fig. II-4.5(8): Disintegration

Fig. II-4.5(9): Disintegration **Fig. II-4.5(10): Minor Lintel Corrosion**

4.5.2 Analysis

Three primary considerations apply to this band.

The most obvious relates to the severe degradation of its protruding mid-band, which will continue to seemingly randomly shed stone chunks ranging up to about fist-sized, posing an ongoing and immediate risk to pedestrians. During my most recent 2012 visit, I pointed out some "ready-to-go" pieces directly above a walkway on the building's north side, which were removed the next day. <u>However, ongoing degradation will continue to produce possibly dangerous chunks, so ongoing vigilance and removal of loose pieces are critically important.</u>

A much less apparent issue may relate to the securement of the large flat panels, which appears questionable. This could also pose risk to pedestrians below, primarily during earthquakes. I venture a hunch that appreciable additional freeze-spalling damage would need to occur before weathering issues alone would pose a risk of entire panels becoming displaced, though some limited surface spalling has begun to affect these panels.

The yet-more subtle issue concerns the cornice, which no longer exists, having been removed due to its degradation resulting from its ill-advised, though not atypical design. While subtle, this issue is quite significant, and warrants some explanation.

Let me begin by reiterating that the primary killers of masonry include one-way passage of water through it, and water-absorption followed by freezing. Both lead to spalling and pulverization of the masonry's outer surfaces, though water's one-way transport typically affects the innermost surfaces, while freeze-spalling affects the outermost ones. My investigations revealed both interior and exterior face degradation, unambiguously indicating that both factors are at work on this building. This is not surprising, as Juneau's climate provides near-ideal conditions for masonry destruction, with 220 rainy days annually and 5-months of daily sub-freezing temperatures. To combat this destructive climate, the masonry should ideally be kept as warm and dry as often and for as long as possible.

A projecting cornice can actually help maintain marginally, but helpfully higher temperatures, as well as limit the frequency, duration, and severity of wetting. Not wishing to write a chapter on these subjects, let me at least quickly touch upon both the temperature and wetting issues, as these claims are often met with initial incredulity.

With regard to temperature elevation, the coldest conditions are typically reached on clear winter nights, when all matter radiates infrared heat into the cold Universe. Any projection that limits exposure to the sky also limits this outward radiation, thus helping keep the temperature of any material somewhat higher. One can see this shadowing effect on grass below trees on cold clear mornings, for example, where the grass not overhung with the tree crowns is covered with frost, while the grass "shaded" by the crowns is frost-free. Similar observations can be made regarding dew-formation on car surfaces facing away from such "radiant shadows", etc.

In short, the building itself raises its own ambient temperature by shadowing itself, and any projecting roof overhang, cornice, or similar features only help enhance this warming effect. The masonry does not need to be kept toasty warm, but any temperature elevation can appreciably reduce the severity of freeze-spalling.

Now, let me proceed to the wetting-reduction effect of a properly designed cornice. Although many may hold the impression that since rain typically falls at an angle, a projecting cornice can only shelter the uppermost portions of the wall below it, as one might naturally project the falling angle to assume that rain will strike the building face below this line. Figure II-4.5(11) illustrates this common, though mistaken, assumption.

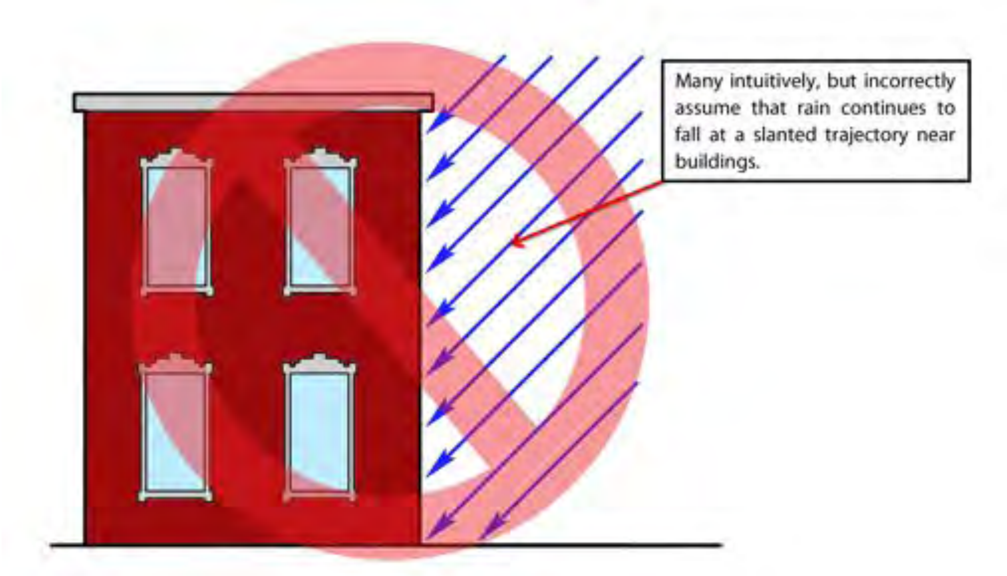

Fig. II-4.5(11): Incorrectly Assumed Rain Trajectory Near Building Faces

In reality, the reason why rain typically falls at an angle is that much of the time, some minor wind pushes the droplets sideways, producing the sloped fall-line, which otherwise would be straight down. This lateral wind force needs to be continually applied near the bottom of the falling trajectory, for if this wind is somehow removed, the droplets would fall along a curved, steepening path.

Since wind cannot blow through a building, it is deflected around it. The airflow near its top is deflected upward over its roof, and the airflow below splits and travels around the corners or falls down before hitting the wall. This removes the lateral force on the droplets, causing them to fall along steepening arcs, rather than wetting the building. Under most conditions, this effect will cause only the uppermost bands of building walls to become wet, even if not sheltered by a cornice or roof overhang. The outer vertical building corners also typically receive more rain exposure than mid-faces. Figure II-4.5(12) illustrates this wind effect. As this claim has often met with disbelief, Figures II-4.5(13-18) show actual buildings during rains or showing stain evidence of this phenomenon. More specifically, Figure II-4.5(13) shows the lee face of a short building, with a narrow wet band along its top, Figures II-4.5(14-16) show the lee and windward faces of three different buildings after three days of heavy and windy rains, and Figures II-4.5(17 & 18) show two stained faces of a building near the Alaska Capitol. All of these photos clearly show that most water reaching the wall surfaces drains down from the uppermost band, rather than resulting from direct rain strikes. This, in turn, should illustrate the benefit afforded by a projecting cornice, which can help deflect away from the building the vast majority of water that would otherwise drain down the walls to damage the masonry.

The surprisingly limited corrosion found at the top lintel also implies that it had benefited from this sheltering effect when the cornice was in place, causing its corrosion to be delayed, though some of this can also be ascribed to the lintel's deep embedment within the masonry.

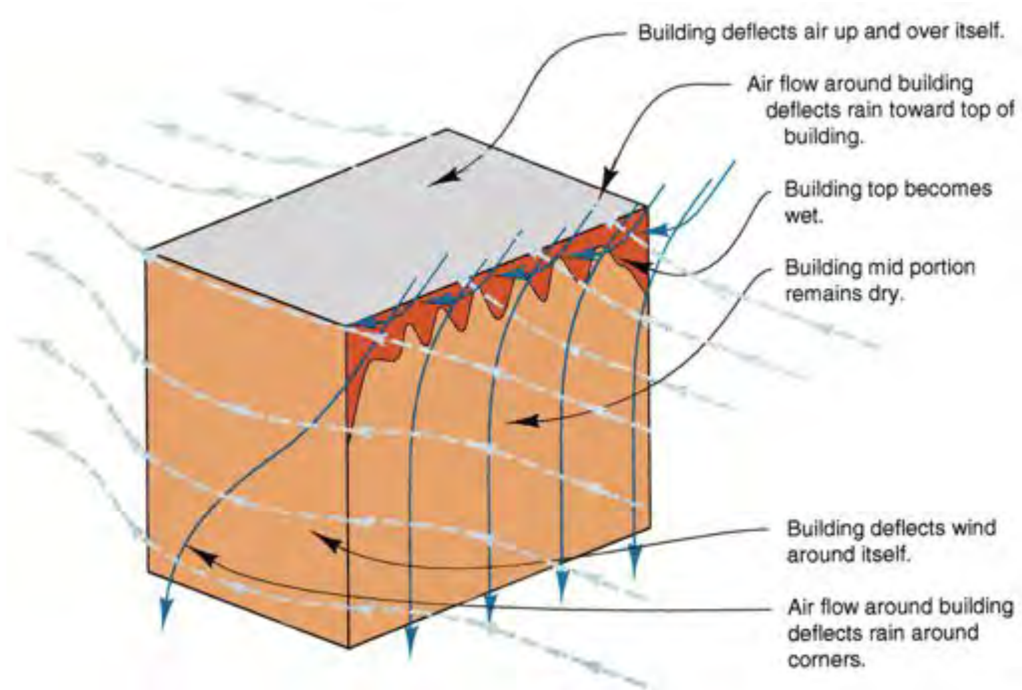

Fig. II-4.5(12): Typical Wind-Flow and Rain Trajectory Near Buildings

Fig. II-4.5(13): Wetting Pattern on Lee Side

Fig. II-4.5(14): 3rd Rain Day Wetting

Fig. II-4.5(15): 3rd Rain Day Wetting Pattern

Fig. II-4.5(16): 3rd Rain Day Wetting

Fig. II-4.5(17): Stain Pattern, Juneau

Fig. II-4.5(18): Stain Pattern, Juneau

4.5.3 Projected Future Behavior

The severe degradation of the protruding mid-band will continue to pose a hazard to pedestrians below.

The questionable securement of the flat terra-cotta panels could also pose risk to pedestrians below, primarily during earthquakes.

The absence of a protective cornice substantially increases the frequency, duration, and severity of wetting of the exterior masonry. This, combined with the many ledges and absorption surfaces resulting from the recessed brick headers and mortar joints, Juneau's destructive climate, among other factors, will continue to subject this building's masonry to appreciably accelerated weathering degradation.

4.6. Stone Window Sills

4.6.0 General

This subsection pertains to the stone sills which occur along the full height of three vertical window bands at the building's SE corner, along levels 0 and 1 on the east and west elevations, at level 1 of the north ends of both wings, and at nearly all windows facing the courtyard.

4.6.1 Summary of Observations

As with many other elements of this building, relevant observations can be divided into issues of securement, design, and condition.

With regard to securement, these sills appear to rely entirely on mortar bond, with no mechanical anchors. Further, the mortar under most of these sills is degraded and largely delaminated. Thus, these sills appear to be held in place primarily via friction.

With regard to design, these sills, like essentially all other elements on this building, lack any flashings under them or flashing caps atop them. Some interior plaster damage below window sills may indicate infiltration via these un-flashed sills.

In general, the condition of these sills is variable, but for the most part degradation is limited. Various sills have chipped corners and edges, some surface erosion, and one sill on the east face of the west wing is seismically cracked.

Figures II-4.6(1-6) illustrate these observations.

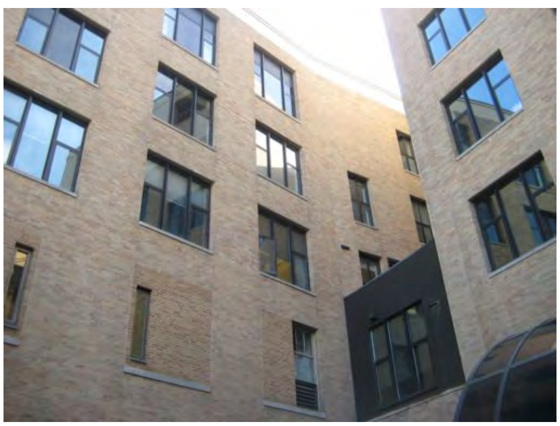

Fig. II-4.6(1): Stone Sills, Courtyard Area

Fig. II-4.6(2): Sill in Good Condition

Fig. II-4.6(3): Minor Chipping & Erosion

Fig. II-4.6(4): Minor Surface Erosion

Fig. II-4.6(5): Moderate Surface Erosion

Fig. II-4.6(6): Cracked Stone Sill

4.6.2 Analysis

Three primary considerations apply to these sills.

First, lack of mechanical securement poses some increased risk of dislocation during earthquakes, which may present a hazard to pedestrians below. However, compared to similar risks posed by several other elements, this appears to be a relatively moderate risk at most. The one cracked sill on the east side of the west wing poses increased risk, as its outer portion is fully cracked-off.

The absence of flashings below and/or atop these sills exposes the stone to weathering degradation, and also increases risk of interior infiltration.

In general, the condition of these sills is reasonably good, given their age and climate. To a fair degree, this probably reflects the fact that most, though not all, such sills are not fully weather-exposed, being either low on the building and below the protruding, sheltering level 2 water table, or by being on the building's north side.

4.6.3 Projected Future Behavior

Lack of mechanical securement will continue to pose relatively minor-to-moderate risk to pedestrians in case of earthquake.

The absence of flashings will continue to cause relatively slow degradation of most of these sills, and of the brickwork directly below them, except at higher portions of the SE corner, where more rapid degradation should be expected. Infiltration and plaster damage may also result from this flaw, again especially at the SE corner.

4.7. Steel Window-Head Lintels

4.7.0 General

This subsection pertains to the steel lintels above windows that do not have terra-cotta panels above them. These occur along the full height of three vertical window bands at the SE corner, at levels 0 and 1 on the east and west elevations, at level 1 of the north ends of both wings, and at all windows facing the courtyard.

4.7.1 Summary of Observations

Relevant observations pertain to the lintel design and their resultant condition.

With regard to design, these lintels typically consist of doubled-up steel angles that support the brickwork above. They are plagued by several flaws that may be ascribed to design. First, like essentially all other elements, they lack any flashings. Many are also sealed to the brickwork directly above them, thus precluding drainage. Further, these lintels consist of standard steel.

These design-related flaws have resulted in the expected symptoms. The lintels display varying degrees of corrosion. Many in relatively sheltered locations, such as those near wall bases, or located on the west face of the east wing, are still in good condition, with only minor surface corrosion. In contrast, lintels in more exposed locations, such as those at the building's SE corner or on the east face of the west wing, display more advanced corrosion, which, however, still appears moderate and is less advanced than one might expect, given the building's age and climate. Some elevated moisture readings and interior plaster damage near window heads may also relate to the absence of lintel flashings. Figures II-4.7(1-10) illustrate these observations.

Fig. II-4.7(1): Very Minor Lintel Corrosion

Fig. II-4.7(2): Minor Lintel Corrosion

Fig. II-4.7(3): Moderate Lintel Corrosion

Fig. II-4.7(4): Sealed Gap Abv. Lintel

Fig. II-4.7(5): Moderate Lintel Corrosion

Fig. II-4.7(6): Moderate Corrosion

Fig. II-4.7(7): Moderate Lintel Corrosion

Fig. II-4.7(8): Moderate Corrosion

Fig. II-4.7(9): Corrosion Stain on Sealant

Fig. II-4.7(10): Moderate Corrosion

In addition, one lintel on the east face of the west wing appears to have sagged, as have the two brick courses above this lintel, causing a relatively wide gap and mortar delamination above the full width of the window. The lintel at this location is among the most corroded on the building. See Figures II-4.7(11 & 12).

Fig. II-4.7(11): Sagging Brick Above Lintel

Fig. II-4.7(12): Gap Abv. Sag. Lintel

4.7.2 Analysis

The absence of end-dammed flashings atop these lintels contributes to lintel corrosion and also to some of the interior plaster damage near window heads.

The sealing of the lintels to the brick above is counter-productive, as it entraps moisture atop these lintels, accelerating corrosion and exacerbating leak risk.

Use of standard steel for these lintels, with no corrosion protection such as galvanizing, greatly exacerbates corrosion. In fact, the relatively good condition of most lintels is somewhat surprising, given Juneau's climate and the building's age.

The one sagging lintel may be beginning to fail due to corrosion.

4.7.3 Projected Future Behavior

The lintels will continue to corrode, and leakage may persist above some of the weather-exposed windows as a result of the absence of flashings and drainage provisions. This will lead to laminar corrosion, wherein the steel corrodes in distinct layers, causing the brick above to become lifted, which also often causes the supporting brick below the lintels to spall. Figures II-4.7(13 & 14) depict the eventual fate of these lintels, as photographed on another project.

Fig. II-4.7(13): Severe Lintel Corrosion

Fig. II-4.7(14): Spalling Bel. Lintel

5. ENTRY PORTICO

5.0. General

This section pertains to all elements that comprise the entry portico. It is subdivided into subsections, each of which addresses the portico's various components, such as its support base, stairs, columns, etc.

5.1. Support Base For Portico Entry and Stairs

5.1.0 General

This subsection pertains to the portico's support base, including its support structure, granite paving, granite stairs, and granite-clad column plinths.

5.1.1 Summary of Observations

The base structure consists of a series of concrete and brick walls protruding southward from the building. Granite paving, about 9" thick, spans across the tops of these closely spaced walls.

My 2010 field examination revealed signs of stress and deflection that had affected this portion of the portico, as well as other parts of the building. Observed symptoms included obvious differential movement between portions of the entry stairs and the portico floor, as well as cracking of the granite paving and elements above it. The entry stairs and portico floor varied by up to about 3/4" from their original installation elevations, with those portions located below the marble columns typically having been deflected downward.

Much of this differential deflection had been corrected by my 2012 visit, by which time the stairs and paving had been re-leveled, though not entirely.

Figures II-5.1(1-8) depict these observations.

Fig. II-5.1(1): Portico Sub-Structure

Fig. II-5.1(2): Condens. @ Granite

Fig. II-5.1(3): Granite Stair Deflection

Fig. II-5.1(4): Paving Deflection

Fig. II-5.1(5): Re-Leveling of Granite Stairs

Fig. II-5.1(6): Paving Crack

Fig. II-5.1(7): Cracked Portico Roof Support

Fig. II-5.1(8): Cracked Support Stone

5.1.2 Analysis

With regard to the genesis of the observed deflections and cracking, a variety of causes could possibly have contributed to some of these symptoms. However, these symptoms, especially when considered together with relatively widespread manifestations of similar stresses and deflections affecting other portions of the building, are most consistent with seismically induced deflections dating back to some past earthquake(s). To be more specific, the symptoms imply that the columns had swayed in the E-W direction parallel to the building face. This caused the serious cracking of the stone beams supported by these columns. These beams moved E-W with the column tops, but rotated at the building face, which remained mostly in place. The stone cladding supporting these beam ends also rotated with these beams, as its minimal wire anchors allow free rotation of this cladding. This rotation caused the closely spaced cracking of the stone support cladding's bottom pieces, as well as the large, though short crack in the nearby granite paving. This same mechanism caused the cracking observed in the supporting pilaster capitals and adjacent stone window head.

These seismically induced stresses may also have deflected the supporting walls under the portico and caused these to settle down differentially, causing the uneven paving and stairs.

No specific analysis is offered concerning the portico base structure's structural adequacy, as the drawings offer limited information. However, review by the structural engineer did not reveal any major concerns with this base.

5.1.3 Projected Future Behavior

Based on the conclusion that the observed deflections reflect damage from a past earthquake, it appears unlikely that the differential settlement will progress in the absence of subsequent earthquakes.

However, future earthquakes may exacerbate the damage already sustained. The deflections that had already taken place may have weakened the elements supporting the portico, and if this is the case, the portico base could have increased susceptibility to the progression of such damage during subsequent earthquakes.

5.2. Marble Columns

5.2.0 General

This subsection pertains to the portico's four marble columns and associated capitals.

5.2.1 Summary of Observations

Each of these four columns consists of three round marble sections that taper toward their tops, with ornamental stone capitals atop these.

The large marble column sections are laid atop each other, with "cube dowels" within the joints.

My field investigation uncovered several distinct observations.

First, as already noted in section II-5.1.1, the bases supporting these columns have become deflected downward, causing portions to be up to 3/4" lower than adjacent portions.

The marble columns had become weathered and seriously eroded on their SW, SE, and NE exposures. Reddish-brown oxide staining was also observed on some columns. Many cracks, some hairline in width while others appreciably wider, affect the column surfaces. Very high water absorption at such cracks indicates that the cracks are deep.

Figures II-5.2(1-12) illustrate these observations.

Fig. II-5.2(1): Marble Portico Columns

Fig. II-5.2(2): Portico Beams & Cols.

Fig. II-5.2(3): Deep Cracking in Columns **Fig. II-5.2(4): Deep Cracking**

Fig. II-5.2(5): Erosion & Cracking in Cols. **Fig. II-5.2(6): Deep Cracking**

Fig. II-5.2(7): Deep Cracking in Columns **Fig. II-5.2(8): Deep Cracking**

Fig. II-5.2(9): Erosion & Cracking in Cols.

Fig. II-5.2(10): Oxide Staining

Fig. II-5.2(11): High Moist. Absorp. @ Crack

Fig. II-5.2(12): High Absorption

5.2.2 Analysis

Several salient issues pertain to these columns.

First, their structural design is clearly inadequate in the sense that the three primary marble sections comprising each column are only “aligned” with each other via the “cube dowels” within the mortar joints between the adjacent sections, but are not really fastened together in any effective fashion. This makes them potentially susceptible to failure in a significant earthquake.

Second, marble may not have been the optimal material to use for these exterior columns. Marble is sensitive to acidic solutions, and over time, slightly acidic rains will etch and erode the surface, which was already observed. Further, marble is characterized by veins, which can lead to differential erosion, which was also observed. Perhaps more significantly, such veins often represent lines of structural weakness, which are susceptible to cracking if subjected to seismic forces. The many relatively wide, and possibly deep cracks along such veins may indicate that some seismic cracking along these veins had already occurred, though it is difficult to discern to what degree this may have compromised the structural integrity of these columns.

Such cracks, once formed, allow subsequent infiltration of water, and when this is combined with freezing temperatures, the expansion of the entrapped ice leads to progressive pushing apart of the stone. Conditions when these columns are both wet and freezing occur frequently in Juneau, and in view of the building’s 80 years of existence, this phenomenon is likely to have already begun compromising the integrity of these columns. Appreciable water infiltration into even the minutest hairline cracks was confirmed by testing.

Another concern relates to the stone column capitals, and how the stone beams sit atop these. The issues related to these capitals pertain to the lack of connection between the columns and the capitals as well as between the capitals and the stone beam sections above, the specific configuration of these capitals, the composition of the capitals, and the specific configuration in which the stone beams bear on these capitals. These considerations are outlined in greater detail in section IV-5.2.2 of my 12/31/10 report, and are repeated here only skeletally.

With regard to the connections between the capitals and the columns below and stone beams above, only "cube dowels" occur between the top of the marble columns and the stone capitals, and no mechanical connection of any sort exists between the top of the capital and the stone beam above. This implies that these connections rely primarily on mortar bond. This lack of mechanical connections is worrisome, as extremely heavy and brittle elements are stacked atop each other right above the main entry with little holding these together and in place. As my investigation also revealed significant cracking and loss of mortar bond, it is certain that the bond had been compromised, in places completely, and cannot be relied upon. Many of these stones may be merely stacked like blocks, with no interconnection to adjacent pieces at all. This consideration appears to pose potentially significant risk in case of an earthquake.

The other three issues about these capitals, concerning their configuration, composition, and how they support the beams above, are so intertwined that they need to be discussed together.

Concerning their configuration, these capitals project roughly 9" past the column faces. This creates relatively weather-exposed horizontal ledges that become wet during windy rains. This typically leads to greatly accelerated degradation.

This concern is exacerbated by how the beams sit atop these capitals. In brief, the sections of the E-W beam spanning across the tops of the four columns bear only on the cantilevered edges of the stone capitals, and do not extend above the marble columns at all.

Although the E-W beam sections as well as the south ends of the N-S crossbeams are tied together with an embedded concrete-and-steel beam above the beam sections, I believe that there are grounds for some concern related to the bearing configuration atop these columns, particularly in view of the seismic damage observed at some of these beam ends.

5.2.3 Projected Future Behavior

Two basic considerations relate these columns, including weathering degradation and potential seismic risk. These two phenomena act synergistically. For example, the seismic cracking in the columns allowed deep water infiltration into these cracks, and upon freezing, the expanding entrapped ice pulled these cracks farther apart, leading to yet-accelerated water infiltration.

With regard to the fate of the marble portions of these columns, the above-described processes will continue, leading eventually to their crumbling into distinct pieces. Future earthquakes can greatly accelerate this process by causing deep cracks, thus exacerbating weathering. The presence of seemingly significant cracks in these columns raises particular concerns with respect to possible future seismic events.

The lack of "inter-connectedness" between the column sections, and in particular between the column tops and the roof structure above, combined with the beam loading configuration which concentrates stresses onto the cantilevered portions of the stone capitals, raise serious concern about future seismic stability of these columns and the entire portico. This concern is aggravated by the observed damage and cracking within these columns and supported roof structure.

5.3. Stone Cladding on Exterior Building Wall

5.3.0 General

This section pertains to the stone cladding along the building's exterior wall, but only where it occurs under the portico roof. While this cladding wraps the entire base of the south façade, it forms the structural support for the N-S stone beams that support the portico roof. Consequently, at the portico, this cladding is used in a structural fashion, although this cladding's components are identical at both the portico and beyond it.

5.3.1 Summary of Observations

Relevant observations pertain to structural securement of the cladding elements and to their condition.

With regard to basic configuration and securement, this cladding consists of very large stone pilasters, which align with the four marble columns, along with smaller peripheral pieces. The large pilaster pieces and the abutting larger stone pieces are secured to the embedded concrete columns with 3/8" ø ties which wrap around the concrete columns, then enter into the horizontal mortar joints between the larger pieces, and turn down 2" into holes drilled into the tops of each pilaster piece. In one location, below the second window west of the portico, one such embedded metal tie had corroded sufficiently to spall the stone.

Two primary observations relate to this cladding's condition. The first pertains to widespread and, in places, severe cracking of the structural cladding pieces as well as in the portico base below this cladding and in the portico roof structure supported by this cladding. Wide, sometimes closely spaced cracks occur in the granite paving directly below the cladding pilasters, in the pilaster pieces, at the stone window heads below the portico roof, and in the stone capitals as well as in the stone beams supporting the portico roof. While I found relatively minor symptoms of such stress in the stone cladding away from the portico, major cracks were observed at the bases of the jambs of all three entry doors below the portico. These also occur below the large, short stone crossbeams at the portico ceiling. Figures II-5.3(1-8) depict such cracking, generally starting at the top and proceeding downward.

Fig. II-5.3(1): Cracks in Head, Capital, Beam

Fig. II-5.3(2): Cracked Roof Beam

Fig. II-5.3(3): Beam-Building Separation **Fig. II-5.3(4): Cracked Str. Cladding**

Fig. II-5.3(5): Cracked Structural Cladding **Fig. II-5.3(6): Cracked Str. Cladding**

Fig. II-5.3(7): Cracked Structural Cladding **Fig. II-5.3(8): Cracked Fl. Bel. Pilaster**

Other "condition-related" observations pertain to widespread, severe moisture infiltration, which is much more pronounced in the sheltered location below the portico roof than at the adjacent, weather-exposed locations. For example, severe staining and efflorescence affect the cladding's upper reaches and the adjacent ceiling. Moderate corrosion affects the steel window lintels below the portico's ceiling, and infiltration is apparent inside these sheltered windows. Highly elevated moisture and reddish staining on the interior marble tile imply that anchor corrosion is occurring. Highly elevated moisture near the cladding's bottom also indicates moisture intrusion. Further, the bottoms of all metal doorjambs display serious corrosion. See Figures II-5.3(9-16).

Fig. II-5.3(9): Staining Below Portico Roof

Fig. II-5.3(10): Staining Below Roof

Fig. II-5.3(11): Sheltered Lintel Corrosion

Fig. II-5.3(12): Interior Window Leaks

Fig. II-5.3(13): Interior Oxide Staining

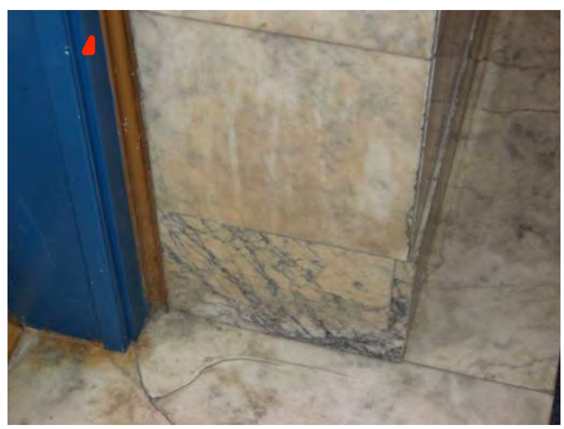

Fig. II-5.3(14): Int. Oxide Staining

Fig. II-5.3(15): Moisture @ Sheltered Cldng. Fig. II-5.3(16): Shltrd. Jamb Corr.

5.3.2 Analysis

Many problems affecting the "portico" portion of the stone-clad walls are similar to those affecting these same walls away from the portico. These are not repeated here in detail.

The problems plaguing these walls fall into two broad categories. The first relates to structural integrity, while the latter concerns water-infiltration and long-term integrity. These are closely intertwined, as the long-term infiltration has exacerbated issues of structural integrity.

As with all other exterior wall types on this building, this wall does not provide much lateral force-resisting capacity, with non-structural brick infill between relatively slender concrete columns.

As with the weather-exposed portions of the stone-clad walls, the stone's securement to the structure is inadequate at the portico, providing nearly inconsequential wire anchors spaced with an approximate density of one anchor per 15 square feet of stone cladding. Further, the long-term and relatively severe moisture infiltration that has been draining into this wall has almost certainly compromised the integrity of even this minimal securement.

Concern regarding the stone's securement is severely heightened by the support of the stone crossbeams by the cladding pilasters, which are seriously damaged by seismic cracking, as well as by displacement and cracking affecting the pilaster capitals and the ends of the crossbeams. The combination of these factors poses serious risk in future earthquakes.

The second broad category of issues pertains to water infiltration and resultant degradation. This cladding lacks through-wall flashings, weep provisions, and other features desirable in masonry-clad walls. However, of greatest concern is the long-term severe infiltration draining into this wall from the masonry above the portico roof. This infiltration has detrimentally affected essentially all parts of this wall. This has by now almost certainly compromised the steel wire ties securing the stone, has begun corroding steel lintels above windows, and damaged the stone.

5.3.3 Projected Future Behavior

The problems plaguing this stone-clad wall pose serious risks.

This wall is vulnerable to significant seismic damage. Inadequate spacing of anchors, combined with eight decades of degradation, corrosion, and seismic damage, significantly increase susceptibility to damage and collapse during earthquakes. This concern is particularly exacerbated by the apparently compromised support of the portico roof's crossbeams by the pilasters, due to cracking and dislocation affecting both tops and bottoms of these pilasters.

Infiltration from masonry above the portico roof, and perhaps from the roof itself, will continue to degrade the cladding, window lintels, doorjambs, and interior surfaces at scattered locations.

5.4. Portico Roof Structure

5.4.0 General

This section pertains to the elements comprising the portico's roof structure, including the entablature beam, embedded concrete beam above the entablature, stone crossbeams, steel lintels, stone water table, concrete roof slab, stone ceiling panels, and related elements.

5.4.1 Summary of Observations

Relevant observations pertain to structural support of the roof structure and its securement to the building, and to the roof structure's condition.

With regard to basic configuration, the roof structure consists of four short stone N-S crossbeams. Their north ends sit atop the stone pilasters along the building's exterior face, while their south ends rest on the marble columns. Three similar stone beams span in the E-W direction over the column capitals, and are tied together with a small concrete and steel beam atop them. This concrete beam is tied back to the building's brick walls with very small steel straps spaced roughly 6'-0" apart. Ornate stone ceiling panels are placed across the tops of the stone beams, but are not mechanically secured. A horizontal stone water table sits atop the concrete beam over the marble columns and continues around the corners to the building face. These stone water table sections are also not mechanically secured to the portico roof. Short brick cripple walls are laid atop the stone ceiling panels and the stone beams to support a 3 ½" thick sloping roof slab.

My investigation uncovered worrisome manifestations affecting this roof structure. As many of these also relate to other components, some are outlined in greater detail elsewhere, and are only repeated here in a cursory fashion. As with nearly all other elements on this building, my findings concerning the roof structure fall into the two broad and interrelated categories of structural adequacy and water infiltration and resultant damage.

In brief, the field findings of direct structural concern are as follows. First, the large stone N-S crossbeams are supported by the stone pilaster capitals and by the marble columns. However, there are no mechanical connections, other than questionable mortar bond, between these crossbeams and their supporting columns, pilasters, and capitals.

Further, the supporting marble columns display possibly structurally significant cracking, and the three sections comprising these columns are secured to each other only with "cube dowels", which provide very limited attachment between these sections.

Also, the pilasters supporting the north ends of these crossbeams are cracked in many locations at their very tops and very bottoms, and such cracking appears to have appreciably compromised the integrity of these pilasters.

The crossbeams also display relatively severe cracking at the south ends of the far west and far east beams, and additional cracking occurs at both their north and south ends. Seismic displacement has separated the ends of these beams from the structure at some of their north ends. In places, the observed cracking and displacement have greatly reduced the effective bearing surface supporting these beams.

Structurally-related observations pertaining to the three E-W entablature beam sections spanning across the tops of the marble columns concern the absence of any direct mechanical connections between these beams and the column tops, as well as apparently limited bearing surfaces afforded by the stone column capitals. In brief, no mechanical connections secure these beam sections to the columns or capitals below, although a composite concrete-steel beam spanning in the E-W direction above the beam at least connects the various sections together. Further, the E-W beam sections bear mostly on the cantilevered portions of the column capitals.

In short, it appears that the roof structure was inadequate to begin with, and has been appreciably compromised by seismic damage. Figures II-5.4(1-12) illustrate these observations.

Fig. II-5.4(1): Cracks in Head, Capital, Beam

Fig. II-5.4(2): Cracked Crossbeam

Fig. II-5.4(3): Cracked Beam End

Fig. II-5.4(4): Cracked Beam End

Fig. II-5.4(5): Cracked Beam End

Fig. II-5.4(6): Cracked Beam End

Fig. II-5.4(7): Cracked Beam End

Fig. II-5.4(8): Cracked Beam End

Fig. II-5.4(9): Cracked, Hanging Bm. Chunk

Fig. II-5.4(10): Cracked-Off Chunk

Fig. II-5.4(11): Cracked Support Pilaster

Fig. II-5.4(12): Cracked Column

A further observation concerns both structural and water-infiltration issues. Namely, profuse signs of long-term infiltration are apparent at the portico ceiling, and such infiltration can be traced fully down within the stone wall cladding. These signs include efflorescence, lime, and brownish as well as reddish staining. Tapping on the stone ceiling indicates that the moisture degradation may by now have caused internal, concealed delamination within the stone. The reddish staining may be an indication that the minimal steel straps securing the four marble column tops to the building have been compromised by corrosion. Further, the large, projecting stone water table pieces had become moderately degraded, with surface erosion, some spalling, loss of mortar, lichens growth, and similar manifestations. No through-wall flashings were found anywhere in the portico roof structure, or anywhere else on the building. See Figures II-5.4(13-18).

Fig. II-5.4(13): Leakage at Ceiling

Fig. II-5.4(14): Ceiling Leakage

Fig. II-5.4(15): Leakage at Ceiling

Fig. II-5.4(16): Ceiling Leakage

Fig. II-5.4(17): Leakage at Ceiling

Fig. II-5.4(18): Water Table Degrad.

5.4.2 Analysis

As with many other portions of this building, the portico roof structure is affected by the intertwined factors of structural and water-degradation issues.

Perhaps the most concise way to summarize the structural issues is to clarify that I would run, with a great deal of motivation, away from this portico in the event of even a moderate seismic tremor. Essentially all parts of the portico roof, and of the elements supporting it, appear inadequate in their initial design to begin with, and many of these have since been compromised further by seismic damage and water degradation.

Starting at the bottom of the roof-supporting structure, the marble columns and their stone capitals consist of separate sections with no connections between these, and cracking of possible structural significance has affected these columns.

Similarly, the stone pilasters supporting the portico roof's crossbeams are inadequately secured to the building structure as designed, and the metal ties which secure these have probably been damaged by seismic events, and have almost certainly been compromised by corrosion resulting from long-term infiltration. Cracking at both the tops and bottoms of these stone pilasters has further compromised the integrity of the structure supporting the portico roof.

Cracking and separation at the portico roof's N-S crossbeams appear to reflect additional seismic damage and further threaten the integrity of the roof structure.

Absence of any mechanical connections securing the stone ceiling panels, combined with apparent damage from long-term infiltration, poses additional hazards to pedestrians below.

The minimal steel straps securing the portico roof to the building walls were also never adequate to begin with, and these have by now almost certainly been compromised by corrosion.

The wide stone water table is ill conceived in its weather exposure, causing accelerated degradation. Absence of through-wall flashings allows infiltration into the roof structure, which may by now have also begun to corrode the steel channels within the concrete beam embedded within the roof structure.

5.4.3 Projected Future Behavior

In the absence of earthquakes, the portico roof structure will continue to experience accelerating degradation, which will pose an increasing safety risk.

Pieces of stone, ranging from very small to potentially life-threatening, are likely to fall off the ceiling panels and surrounding stone trim at seemingly random times, and freezing water within the ceiling panels may exacerbate this risk.

Cracking in the marble columns may progress deeper, again largely through the action of freezing expansion of entrapped moisture within these cracks.

Continued infiltration into the stone water table will cause accelerating degradation, particularly along the top outer surfaces, which may begin shedding pieces along the outer edge. Such infiltration is also likely to exacerbate corrosion of the steel channels and fasteners at the embedded concrete beam, which will eventually lead to cracking and spalling of the E-W sandstone entablature beam, especially along its outer face.

In the event of a moderate or greater earthquake, a wide range of possibilities appears plausible. The generally inadequate design, combined with past seismic damage and serious water degradation of many elements, makes serious, life-threatening failures entirely plausible.

5.5. Stone Railing

5.5.0 General

This section pertains to the stone elements comprising the portico roof's perimeter railing.

5.5.1 Summary of Observations

The railing consists of a horizontal base atop the water table, with railing "posts" above each column and at the building face. Spaced balusters sit atop the base, and are capped with a horizontal rail cap. The railing posts are capped with stone caps.

Primary observations again pertain to structural, general design, and condition considerations. With regard to structural issues, many of the stone railing pieces are not mechanically connected to any other elements, and rely entirely on mortar bond to stay in place. I was actually able to move a large cap piece directly above the stairs below, weighing roughly 200 pounds, back and forth, indicating this absence of connections as well as loss of mortar bond.

With respect to general design, this railing exposes all of its stone elements directly to the weather, with no flashing caps to limit infiltration into the stone, and no through-wall flashings to limit water intrusion into the water table and roof structure below.

This leads suitably to a discussion of the railing's general condition, which has been partly compromised by both seismic damage and weathering. In terms of weathering, the railing displays appreciable degradation, including extensive surface erosion, spalling, and loss of mortar bond and integrity, which in turn exacerbates water infiltration into the masonry below. Figures II-5.5(1-6) illustrate the weathering damage.

Fig. II-5.5(1): Railing Weathering

Fig. II-5.5(2): Railing Weathering

Fig. II-5.5(3): Railing Spalling

Fig. II-5.5(4): Railing Spalling

Fig. II-5.5(5): Railing Spalling

Fig. II-5.5(6): Loss of Mortar Bond

Cap can be moved freely.

The railing also displays seismic stress, including cracking and dislocation, which is most evident at its juncture to the building face at the portico's NW corner. See Figures II-5.5(7-10).

Fig. II-5.5(7): Seismic Cracking of Railing

Fig. II-5.5(8): Seismic Cracking

Fig. II-5.5(9): Seismic Dislocation

Fig. II-5.5(10): Seismic Cracking

5.5.2 Analysis

The railing suffers from some ill-advised design and material choices and structural deficiencies.

The absence of mechanical connections between the railing's various pieces and abutting elements poses significant hazard in case of earthquake. This risk is greatly exacerbated by the significant loss of mortar bond observed at various locations, as well as by the seismic damage that already affects it.

With regard to design and materials, stone generally does not perform well if placed in weather-exposed locations with any skyward-facing surfaces. It absorbs water, which with subsequent freezing causes it to spall, exfoliate, and erode, and these symptoms are apparent on this railing. Flashing caps and through-wall flashings should have been incorporated to limit water intrusion and protect the stone from weathering.

5.5.3 Projected Future Behavior

From a weathering perspective alone, the factors that already affect this railing will continue to do so, though at an accelerating rate. Small pieces will continue to flake off, surface erosion will continue, and what little mortar bond still remains will also degrade. In the absence of future earthquakes, the condition of this railing will become unacceptable to the casual observer, probably within about 30 years.

However, the degradation and damage already suffered by this railing, if combined with even a relatively moderate earthquake, will pose major safety risks to pedestrians below.

5.6. Portico Roof, Drains, and Associated Flashings

5.6.0 General

This section pertains to the portico's roof membrane, drains, and associated flashings.

5.6.1 Summary of Observations

The roof slopes inward, toward the building, as well as east and west from a central ridge toward two drains. These drains are recessed within deep sumps. No overflow drains are provided.

The drawings show this roof as consisting of copper. However, my examination revealed that it consists of an asphaltic built-up roof membrane. Along the edges, the built-up roof laps over copper, which I initially took as flashings. However, the drawings, combined with my field examination, imply that perhaps copper sheet roofing had been installed originally, but due to leakage, a built-up roof may have been installed over the copper in an unsuccessful effort to address the leakage.

Along the roof's perimeter, copper counter-flashings are inserted about an inch into reveals in the stone along the portico's perimeter. Where this roof abuts the masonry building walls, the copper roof extends up the walls, and a copper flashing, inserted about 1" into the mortar joint, counter-flashes over this. No through-wall flashings occur at this juncture.

My field examination of the built-up roof revealed that it is quite degraded, and that it has largely delaminated from the copper at the interface to the building, allowing water to drain under the roof membrane. This may be a factor contributing to severe leakage apparent at the ceiling below.

Three window sills occur very close to the roof surface. Their sill flashings turn up along their edges and tuck under separate copper flashings inserted about an inch into the horizontal mortar joint below a stone band at the base of the masonry wall. These sill flashings penetrate under the aluminum windows, whose sills are sealed to these flashings, with no weep provisions. Figures II-5.6(1-8) illustrate these observations.

Fig. II-5.6(1): Portico Roof Configuration

Fig. II-5.6(2): Roof Drain in Sump

Fig. II-5.6(3): Roof Delamination

Fig. II-5.6(4): Roof Delamination

Fig. II-5.6(5): Roof Alligatoring

Fig. II-5.6(6): Ceiling Leakage

Fig. II-5.6(7): Roof-Building Juncture

Fig. II-5.6(8): Roof-Bldg. Juncture

5.6.2 Analysis

Relevant issues pertain to this roof's design and condition.

The roof's design is improper in several respects.

The primary flaw is that no through-wall flashings occur along the roof-wall junctures. As a result of this intrinsic flaw, water within the masonry walls above this roof migrates down within the masonry, and upon reaching the portico roof-wall juncture, it continues its downward migration into the roof below. Through-wall flashings should have been incorporated along this roof-wall juncture to capture this water and drain it back out of the wall, onto the portico roof. Correction of this flaw is severely complicated by the header courses in the brick walls, wherein the brick is turned 90 degrees to span across two adjacent wythes. These header courses, which occur at every 7^{th} brick course, create ledges, upon which water may accumulate and drain deeper inward into the wall. Thus, while retrofitting of through-wall flashings, though costly, is typically feasible and effective in solving these types of infiltration problems, it does not appear possible to correct this infiltration problem with absolute certainty by retrofitting such flashings in this case.

A generally similar flaw occurs at the portico's outer perimeter, where no through-wall flashings occur below the railing base, thus allowing water to permeate into the water table and beams below, causing leakage and degradation.

The absence of overflow drains is counter to typical code requirements, and can lead to overloading the roof in case the primary drains clog. However, in this case, this risk appears quite limited, so I don't believe this is a significant issue from any realistic perspective.

Several flaws also occur at the roof-window sill junctures. First, the close proximity of the roof surface to the sills is problematic, and increases leak risk, particularly during wet snow periods.

The fact that the copper sill flashings are sealed to the aluminum windows above them, combined with the absence of weep provisions in these windows, further exacerbates leak risk. Water inherently enters the aluminum window sills, and as these windows lack weeps and the copper flashings are sealed to the window extrusions, drainage is precluded from under the window sills, which probably contributes to the leakage.

The close proximity of copper flashings to aluminum windows may also pose added risk of electrolytic corrosion, as these two metals are not compatible, and must be isolated.

With regard to the roof's condition, the built-up membrane is quite deteriorated, and its delamination from the underlying copper along the building juncture makes this roof ineffective.

5.6.3 Projected Future Behavior

Ongoing infiltration into the roof structure and into the stone cladding below will persist unless some through-wall flashings are retrofitted along the roof/wall junctures. This will continue the already severe degradation of the stone ceiling and wall cladding. Corrosive degradation of the window lintels below the portico roof will also continue, and this may compromise the structural integrity of these lintels within perhaps forty years. Corrosion of the steel straps which secure the portico to the building, and of the steel ties which secure the stone pilasters and cladding to the building below the portico roof, will also continue, though it is quite plausible that the integrity of these elements may already have been effectively compromised in various locations by the long-term corrosion which has already occurred.

Occasional leakage may occur below the window sills, especially during periods of wet snow, due to the proximity of the sills to the roof. Infiltration is also likely to continue due to the absence of weeps in the aluminum window sills and the sealing of these sills to the copper flashings.

The absence of overflow drains poses some risk of overloading and possibly increased leak risk if either of the two primary drains clogs. In this case, the risk of overloading appears improbable.

6. INTERIOR ARCHITECTURAL ELEMENTS

6.0. General

This section addresses issues related to the interior architectural elements including the wall, floor, and ceiling construction and finishes.

6.1. Interior Faces of Exterior Building Walls

6.1.0 General

This subsection pertains to the portions of the interior architectural elements affected by the seismic retrofit and exterior wall renovation, primarily the interior faces of the exterior walls.

6.1.1 Summary of Observations

The interior faces of the exterior walls consist mostly of hollow clay tile surfaced with painted plaster. The Governor’s Office, the House and Senate Chambers, the House Speaker’s Office and the House and Senate Finance Committee Rooms and a few other rooms have wood paneling. The restrooms have ceramic wall tile finishes.

Most of the flooring is carpeting and most of the ceilings are suspended acoustical panel systems.

6.1.2 Analysis

No analysis applies to these aspects, other than to note that the interior finishes along the exterior walls will need to be removed to accommodate the structural and masonry work outlined elsewhere in this report.

6.1.3 Projected Future Behavior

This subsection does not apply to this aspect.

7. MECHANICAL SYSTEMS

7.0. General

This section addresses issues related to the building's mechanical systems, including heating, ventilation, plumbing, and fire sprinkler systems.

7.1. General Mechanical Systems

7.1.0 General

This subsection pertains to the mechanical systems affected by the work on the exterior walls, and mechanical systems affected by other seismic retrofit work.

7.1.1 Summary of Observations

The heating system for the building consists of oil-fired steam boilers located on the ground floor, steel steam distribution and condensate piping and cast iron registers. The registers are located primarily on the exterior walls and are fed by vertical risers from the crawl space. The piping is insulated with asbestos-containing insulation. The boilers were replaced in 2010 along with the associated piping. The vertical risers and cast iron registers are mostly original dating to the construction of the building.

Most of the building is not served by a mechanical ventilation system. The areas that are served include the east wing of the ground floor, the first floor, the House and Senate Chambers on the second floor and the Governor's office on the SE corner of the third floor. In addition there are exhaust systems serving the restrooms and the Legislative Lounge on the second floor.

The plumbing systems consist of domestic water supply piping and waste and vent piping. The piping is a mixture of original galvanized steel and more modern copper piping.

The fire sprinkler system was installed in 2009 and consists of steel piping.

7.1.2 Analysis

No analysis applies to these aspects, other than to note that some elements of the mechanical systems will need to be removed or relocated to accommodate the structural and masonry work outlined elsewhere in this report.

For example, the heating system piping and registers will need to be removed as part of the seismic retrofit and exterior renovation. The system will be converted to hot water from the existing steam heating.

The ventilation, plumbing and fire sprinkler systems will be unaffected by the retrofit and renovation and will remain, except where there may be a conflict in the crawl space or in interior walls that are retrofitted.

7.1.3 Projected Future Behavior

This subsection does not apply to this aspect.

8. ELECTRICAL SYSTEMS

8.0. General

This section addresses issues related to the building's electrical systems, including power, lighting and communication systems.

8.1. General Electrical Systems

8.1.0 General

This subsection pertains to the electrical systems affected by the work on the exterior walls and electrical systems affected by other seismic retrofit work.

8.1.1 Summary of Observations

The exterior walls generally contain very little in terms of electrical systems as most of the power, lighting and communication distribution is through the ceiling space and interior walls.

8.1.2 Analysis

Where the interior portion of the exterior walls is replaced allowing electrical devices to be added this will be done in coordination with the use of the interior spaces.

8.1.3 Projected Future Behavior

This subsection does not apply to this aspect.

III. GENERAL DISCUSSION OF CORRECTIVE OPTIONS

1. GENERAL INTRODUCTION

1.0. General

This report describes the building's various deficiencies in Part II, then presents three different corrective options in some detail, in Parts IV, V, and VI. This Part III provides a more integrated and holistic discussion of the relative advantages and inherent limitations of these three corrective approaches. The prime intent of this part is to afford the State of Alaska the opportunity to make the most technically informed corrective selections from the possible options.

1.1. Overall Summary of Deficiencies

In the case of this particular building, it is essential to understand the inherent limitations of the existing exterior masonry cladding elements as a basis for informed corrective decisions. Let me outline some of these considerations.

First, the building is deficient structurally, in that it is excessively vulnerable to seismic damage, and displays past earthquake damage, particularly at the entry portico, but scattered elsewhere as well. This poses safety hazards to occupants and pedestrians, as well as risks of costly damage. This issue can be addressed in a vaguely similar way in all three corrective approaches, and involves, among other things, addition of new concrete shear walls and foundations. In general, new concrete shear walls are proposed along the exterior building walls in all three corrective options. Similarly, the defects and extant damage to the entry portico warrant complete replacement of the portico roof structure in all three corrective options. This structurally-related work is quite major, with inherent disturbance of use, and with appreciable impacts on rooms abutting the exterior walls. Among other aspects, this work involves removal of interior plaster and hollow clay tile walls from the exterior walls, thus also exposing much mechanical and electrical work, such as piping and electrical conduits, etc., which will need to be relocated to accommodate the structural work. In short, this is a major project with large costs and substantial disturbance of occupants in all three options, even in the seemingly least disruptive Option 1, which attempts to maintain as much of the existing building as is feasible. At the same time, a project of this scope allows, and in many cases logically dictates, that other affected existing systems be upgraded to enhance performance, energy efficiency, comfort, safety, etc.

The building also suffers some interior leakage and moisture damage in its sub-grade floors and walls. These issues can also be addressed in the same fashion in all three primary corrective approaches.

The differences and underlying reasons for the three corrective approaches become apparent when the building's exterior masonry walls and related elements begin to be considered. Significant flaws affect these exterior masonry assemblies, requiring extensive work even in the seemingly least-disruptive Option 1 approach.

The deficiencies of the exterior masonry walls can be divided into the three categories of Structural Concerns, Water-Resistance Vulnerabilities, and Energy-Efficiency limitations.

Structurally, essentially all of the exterior masonry lacks adequate capacity to resist lateral loads, the masonry walls lack anchorage to the concrete structure, and most masonry elements, such as the large level 2 water table, lack adequate anchorage to the exterior walls. As outlined in paragraph 2 of this subsection, lateral load resisting capacity is enhanced in all three approaches by adding concrete shear walls. In addition, the Option 1 Restoration approach requires very significant re-anchoring of the exterior brick and stone elements. In the Option 2 and 3 approaches, such anchorage would be achieved in the process of replacing the brick cladding.

The existing exterior walls suffer a variety of fundamental water-resistance vulnerabilities, many of which are intricately interrelated. As all masonry is inherently absorbent, exterior masonry walls should incorporate drainage cavities, through-wall flashings, and weep provisions to limit the depth of water penetration, and capture and drain any water entering the walls back out. None of the existing exterior walls contain any such features. Further, the existing brick walls contain deeply recessed header courses and mortar joints, which greatly increase permeation and allow water to enter deeply into the wall assemblies. This has already caused appreciable degradation of the masonry, which in turn exacerbates yet greater permeation, resulting in a vicious cycle. The exterior faces of the brick have been deeply eroded, as if sandblasted, and this has removed the brick's most weather-resistant and most durable outer skin, making the brick walls yet more susceptible to further permeation and degradation.

From an energy-efficiency perspective, the existing exterior walls lack any insulation, and consequently, the building requires significant energy use to maintain thermal comfort through Juneau's prolonged cold season, which seems to extend from January 1st through December's end.

1.2. Inherent Limitations of Retrofit Approach

The building's structural, water-infiltration, and energy-efficiency issues should be addressed in all corrective options to the greatest feasible extent.

All three options described in this report address the structural concerns, although even in this respect, the Option 1 retrofit approach yields less satisfactory results than either of the other two options. This largely reflects the fact that Option 1 results in the heaviest structure of the three options, thus increasing lateral seismic loads and reducing seismic safety.

However, it is critical to understand that the Option 1 retrofit approach has very significant limitations when it comes to the water-infiltration and energy-efficiency considerations, which are so intertwined that they cannot be discussed entirely separately.

Let me begin with a brief discussion of masonry's twin mortal enemies of moisture saturation combined with freezing, and persistent one-directional moisture migration.

With regard to freezing of wet masonry, when water-saturated masonry freezes, the embedded water turns to ice and begins to expand. On the other hand, the masonry, like nearly all materials, shrinks with cooling, and the expansion of the embedded ice combined with the shrinkage of the masonry causes internal stresses, especially near the masonry's outermost faces, which leads to spalling of the outer masonry layers.

One-way moisture transport through masonry causes the masonry's integral salts to dissolve into the migrating water, which then transports these salts inward. At the masonry's inner faces, the water evaporates and leaves the salts behind, causing it to crystallize. Much like expanding water ice, the recrystallizing salts produce expansion stresses along the inner masonry faces, causing these to spall and pulverize.

Both of the exterior-face freeze-spalling and the inner-face crystallization-spalling were observed on this building, indicating that both phenomena are occurring.

Now, let me quickly jump to a brief discussion of Juneau's climate. In skeletal form, Juneau experiences roughly 220 rainy days annually, and freezing temperatures occur on every average day during the 5-month duration of the cold season. In short, Juneau's climate provides both ample water and freezing temperatures, and is inherently very challenging for all masonry.

In view of these considerations, it is important to keep the exterior masonry of this building as warm and as dry as dry as possible, and to limit the frequency of its wetting and freezing as much as possible. All three approaches attempt to limit the frequency and severity of wetting by reconstructing a roof-level cornice. However, in view of the existing serious damage to the outer brick faces, the many water-catching ledges, and the header courses in the existing brickwork, it is particularly important to limit water absorption and freezing.

Although a major project such as this can afford the opportunity to enhance energy efficiency by adding insulation, with the Option 1 retrofit approach, the addition of insulation will by definition lower the temperature of the outer masonry, thus causing higher moisture levels and greater frequency, severity, and duration of freezing temperatures. In other words, the currently energy-inefficient exterior walls actually help protect the masonry from degradation, as the escaping heat helps to dry and warm-up the masonry. Figure III-1.2(1) illustrates this effect. In view of this consideration, I do not recommend adding any more than roughly 2" of rigid insulation to the walls in the Option 1 retrofit approach, and even this should be done only in combination with the addition of the cornice to help reduce wetting frequency and severity. In short, one of the prime limitations of the Option 1 approach is that the energy efficiency of the exterior walls cannot be significantly enhanced without risking an acceleration of the already serious weathering degradation of the masonry. This consideration is a much lesser concern with either of the reconstruction approaches, as these would replace the seriously damaged, surface-eroded brick with new brick which still has its water-resistant fired outer skin, and infiltration into it can be further reduced by eliminating or greatly reducing the recessed header courses and mortar joints.

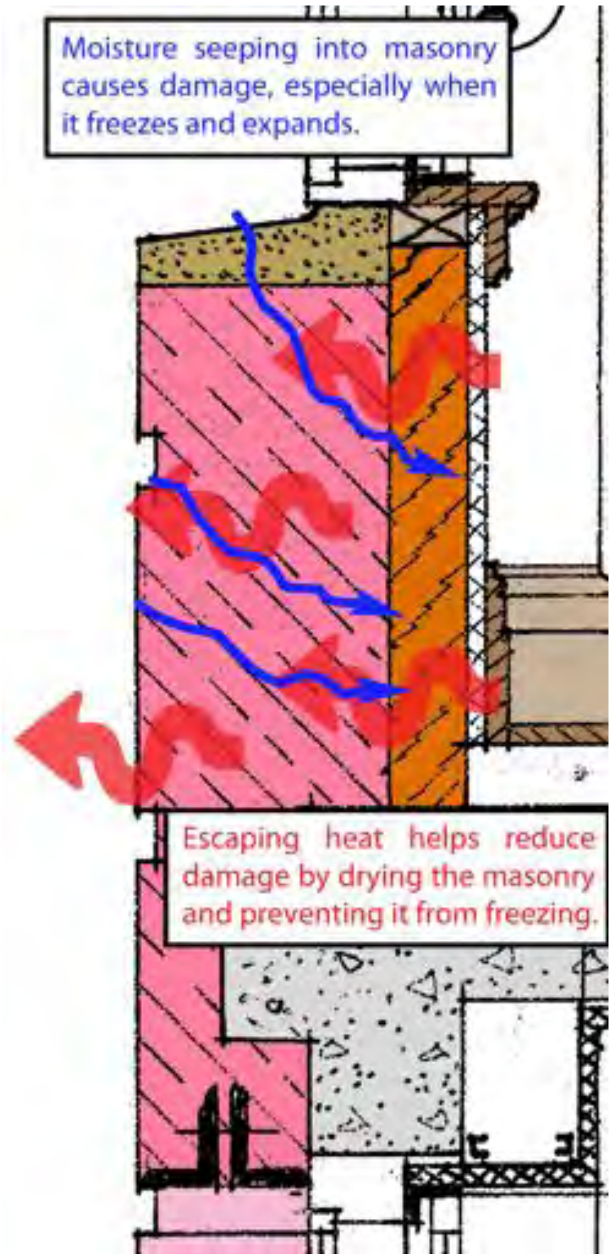

Figure III-1.2(1): Drying & Warming Effect of Current Energy-Inefficient Walls

The existing masonry walls are also inherently susceptible to continued degradation and interior leakage, as these lack any drainage cavities, through-wall flashings, or weeps, and the deeply recessed header courses and mortar joints, as well as the extant surface erosion, appreciably exacerbate moisture absorption and allow its deep penetration into the walls. While the recommended corrective actions for Option 1 include retrofitting of through-wall flashings at certain locations to reduce infiltration into the walls and into the portico roof in particular, the complete effectiveness of such retrofitted flashings cannot be guaranteed, as the many recessed header courses can allow water to penetrate inward of any retrofitted flashings. In short, while execution of the Option 1 retrofit option should appreciably slow-down further degradation and reduce interior infiltration, the brick will continue to degrade, and some degree of infiltration may also persist.

In short, the existing building's design is rather ill suited to Juneau's persistently wet and cold climate, and while the Option 1 retrofit approach attempts to alleviate the building's inherent vulnerabilities, it will only slow but not stop further degradation of the brick, and some interior leakage may also persist. In view of these considerations, I cannot recommend this retrofit approach, as the state will end up spending tens of millions of dollars to still have a relatively energy-consumptive building that will continue to visibly degrade with time, may still suffer some interior leakage, will require costly ongoing maintenance, and will not provide the same level of seismic safety of Options 2 or 3. This logic formed the basis for developing and evaluating the Option 2 and 3 approaches, for though these may seem like rather drastic cures, they both largely address the inherent limitations of the Option 1 retrofit approach.

1.3. Outline of Corrective Approaches

1.3.0 General

This subsection summarizes the three primary corrective approaches described in this report.

1.3.1 Approach 1: Retrofit Existing Masonry & Structure

This approach strives to retain existing elements to the greatest reasonable degree. All existing masonry which can be salvaged without incurring needlessly large costs, relative to other options, and which can provide adequate safety, performance, and projected lifespan, are generally kept in this approach. However, some elements, such as the front portico, terra-cotta panels, or windows, are so damaged or ill suited that replacement is warranted even within this "retrofit" option. This approach does not significantly alter the existing exterior wall assemblies, and thus retains their inherent vulnerabilities, as described in the preceding section III-1.2.

PL:BECS does not recommend this approach, as its projected construction cost of 18.1 million dollars represents roughly 83% of the projected cost of Option 2, while providing an exterior cladding which will continue to degrade, will require significant ongoing maintenance, is likely to require additional significant work within perhaps 40 years, produces a building which will need much higher ongoing heating expenses, will not yield quite comparable levels of seismic safety, provides somewhat less useable interior space, and which may continue to suffer some degree of ongoing interior leakage. In short, this approach costs nearly as much as Option 2, while providing a vastly inferior building whose exterior cladding may have 1/3 the lifespan of Option 2.

Figures III-1.3(1-7) illustrate this approach at several typical locations. Please see Part IV for a more detailed description of this approach.

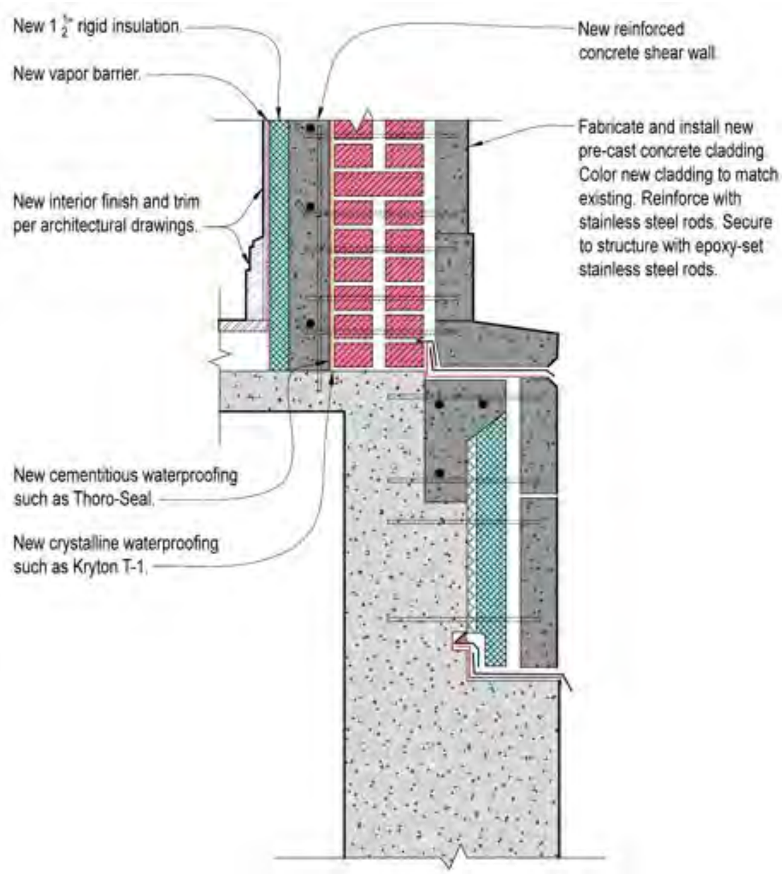

Fig. III-1.3(1): Option 1 Restoration Approach at Stone Wall Base, South Side

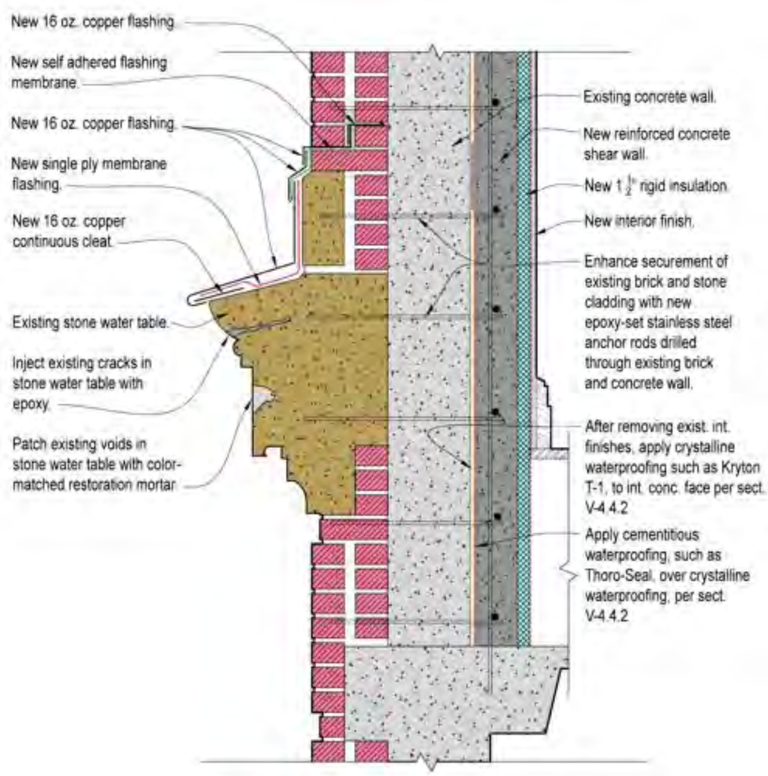

Fig. III-1.3(2): Option 1 Restoration Approach at Level 2 Stone Water Table

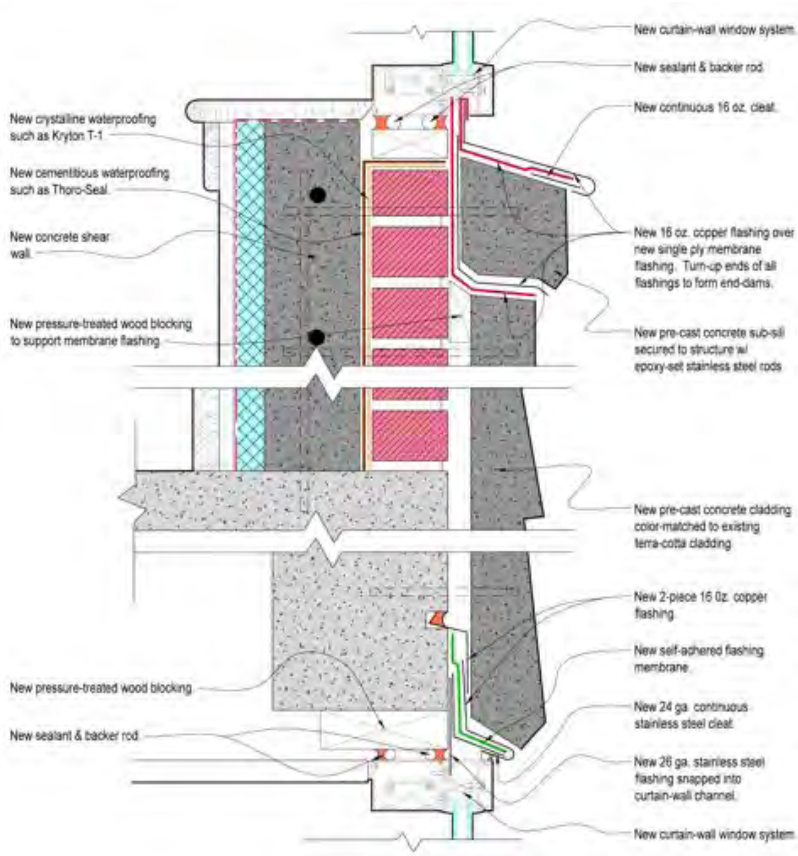

Fig. III-1.3(3): Option 1 Restoration Approach at Typical Public Façade Windows

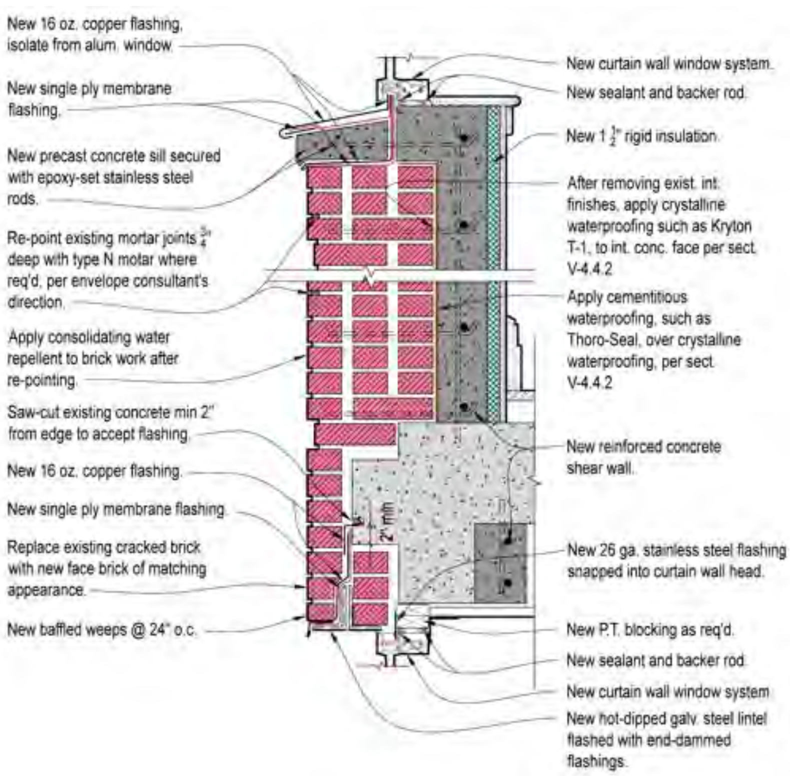

Fig. III-1.3(4): Option 1 Restoration Approach at Typical Stone-Sill Windows

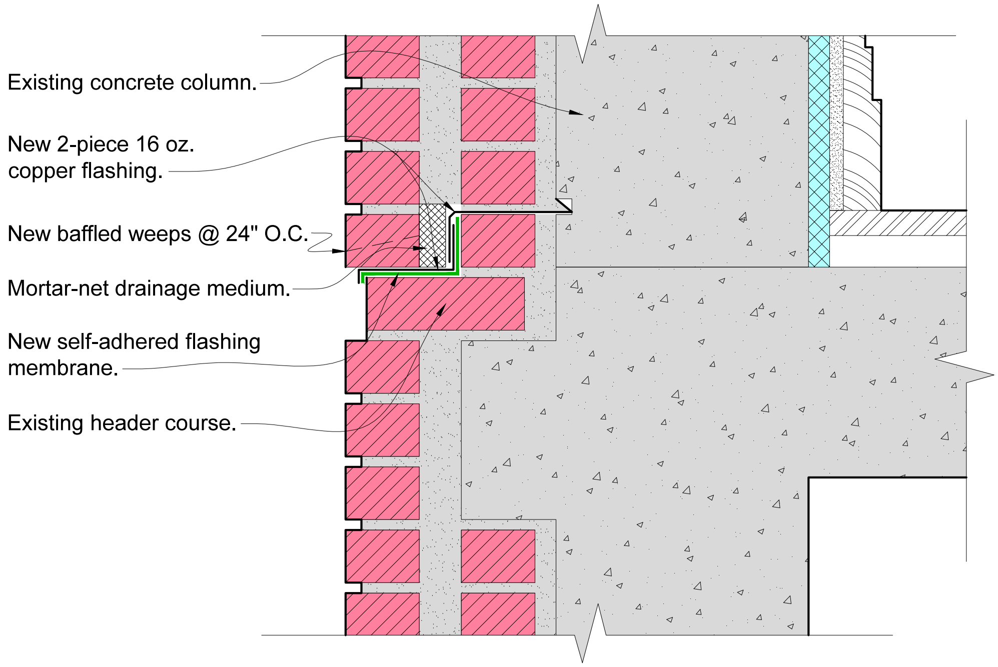

Fig. III-1.3(5): Option 1 Restoration Approach Through-Wall Flashing Retrofit

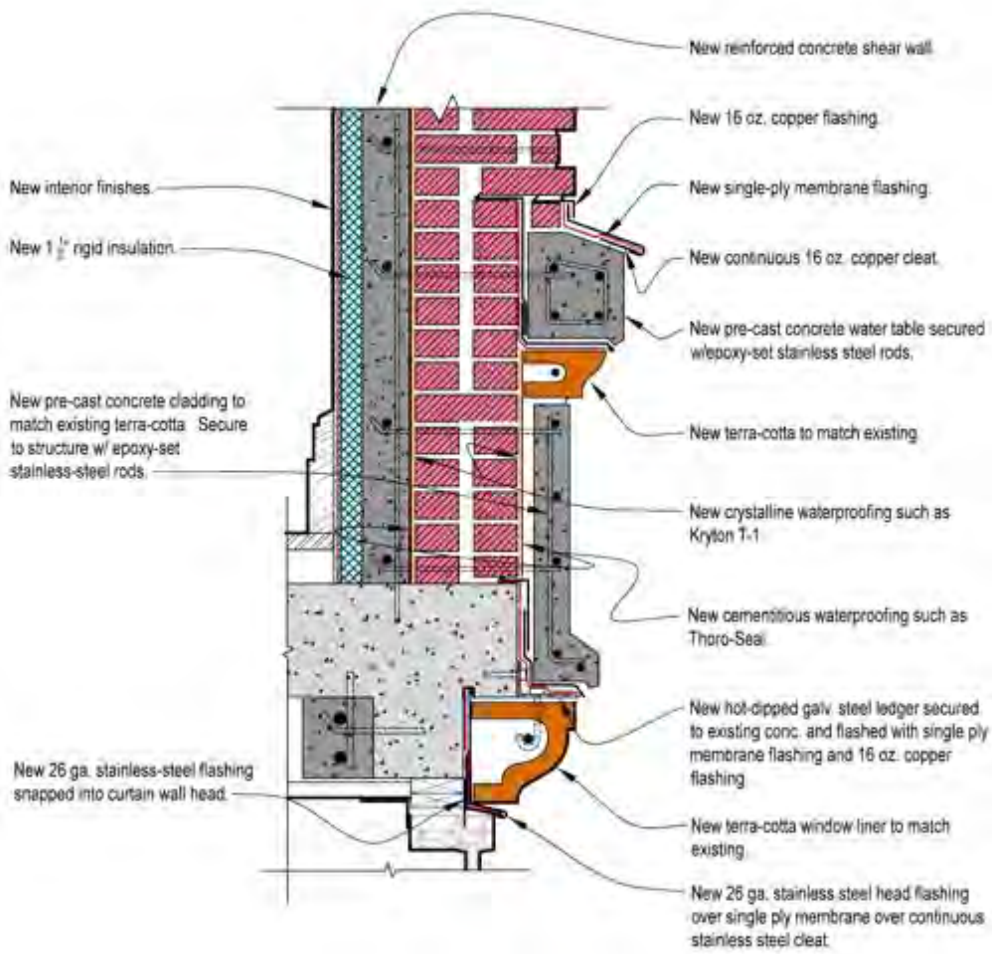

Fig. III-1.3(6): Option 1 Restoration Approach Above Level 4 Windows

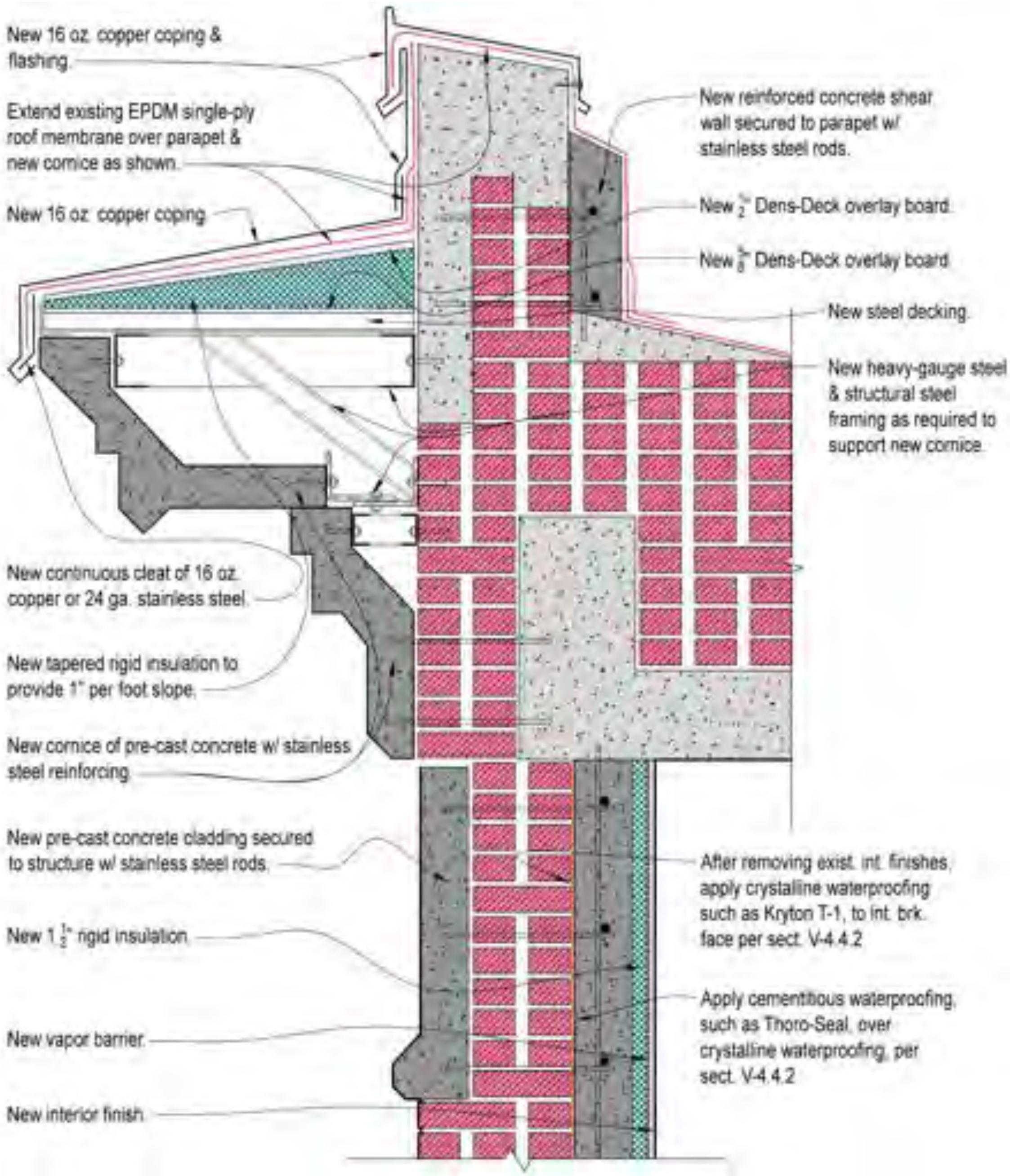

Fig. III-1.3(7): Option 1 Restoration Approach at Roof-Level Cornice-Parapet

1.3.2 Approach 2: New Masonry Veneer & Concrete Walls

This approach recognizes the inherent limitations of the Option 1 approach, and rather than recommending that millions of dollars be spent to still produce a flawed building whose masonry continued to erode away, it is technically much preferable to reconstruct its outer cladding system as a masonry veneer. As it initially appeared plausible that this approach may not actually be more costly, PL:BECS recommended that such an approach be evaluated for cost as a first step.

This approach also strives to retain the existing appearance to the greatest reasonable degree. However, it does so by removing essentially all exterior masonry, beefing up the existing concrete structure, casting new concrete back-up exterior walls, and re-cladding the building with a masonry veneer resembling the existing building, as originally designed.

This "Reconstruction" Option 2 represents the technically ideal approach, and is strongly recommended by PL:BECS. In fact, in view of its relatively limited added cost relative to Option 1, PL:BECS considers this the only reasonable approach. This reflects the fact that the projected construction cost of 18.1 million dollars for Option 1 represents roughly 83% of the projected construction cost of Option 2, so Option 1 is nearly as costly as Option 2, while Option 2 produces a building which is seismically safer, accommodates substantial added insulation to the exterior walls, and should appreciably enhance energy efficiency, yielding cost savings and greater comfort. Compared to the restoration approach of Option 1, it also results in a somewhat lighter structure with a thinner exterior wall profile, yielding added interior space, which is roughly in the range of 2,000 SF for the entire building. Properly executed, this approach should yield a low-maintenance cladding with a likely lifespan exceeding 120 years even in Juneau's masonry-challenging climate. Further, with proper execution, Option 2 can be guaranteed to avoid interior leakage. In short, this Option 2 approach yields a technically vastly better building with only limited additional cost.

In general, the work consists of the removal of all existing interior finishes, the hollow clay tile, and all exterior masonry to expose the existing concrete building frame.

New concrete walls, piers, and headers are cast between existing concrete columns per subsection IV-2.1.1. The exterior concrete faces are then coated with an asphaltic damp-proofing.

Galvanized steel ledgers are secured along all floor lines where needed to support the new brick veneer along each floor level.

The ledgers and the existing protruding concrete lugs are flashed with a double-layer flashing assembly of self-adhered flashing membrane capped with 26-gage stainless steel flashings where fully concealed, and with 16 oz. copper flashings where these become exposed to view.

New stainless steel veneer anchor channels, such as Dur-O-Wal DA904, are fastened to the concrete walls, spaced 16" apart horizontally, and vertically continuous.

A thin vent mat, such as Enka-Drain 9714, is placed against the damp-proofed concrete walls, with 4" thick extruded polystyrene insulation, such as Dow Board, is placed against this. Stainless steel veneer anchors, such as Dur-O-Wal DA931, are clipped into the channel slots, spaced 18" apart vertically. A thicker drain mat, such as Enka-Drain 9120, is placed over the insulation, fabric-side facing outward, to limit mortar clogging.

A new masonry veneer, consisting of ASTM C-216 face brick, Grade SW, at brick areas, or pre-cast concrete cladding at stone locations, is installed over this, largely to match the existing appearance, but with greatly reduced offsets and with concave-tooled mortar joints to limit water infiltration into the masonry. Horizontal 9-gage stainless steel wire seismic joint reinforcing is embedded within the horizontal joints spaced 18" apart vertically.

The new masonry should be cleaned and sealed with a penetrating water repellent, such as ProSoCo Weather-Seal Siloxane.

Figures III-1.3(8-14) illustrate this approach at several typical locations.

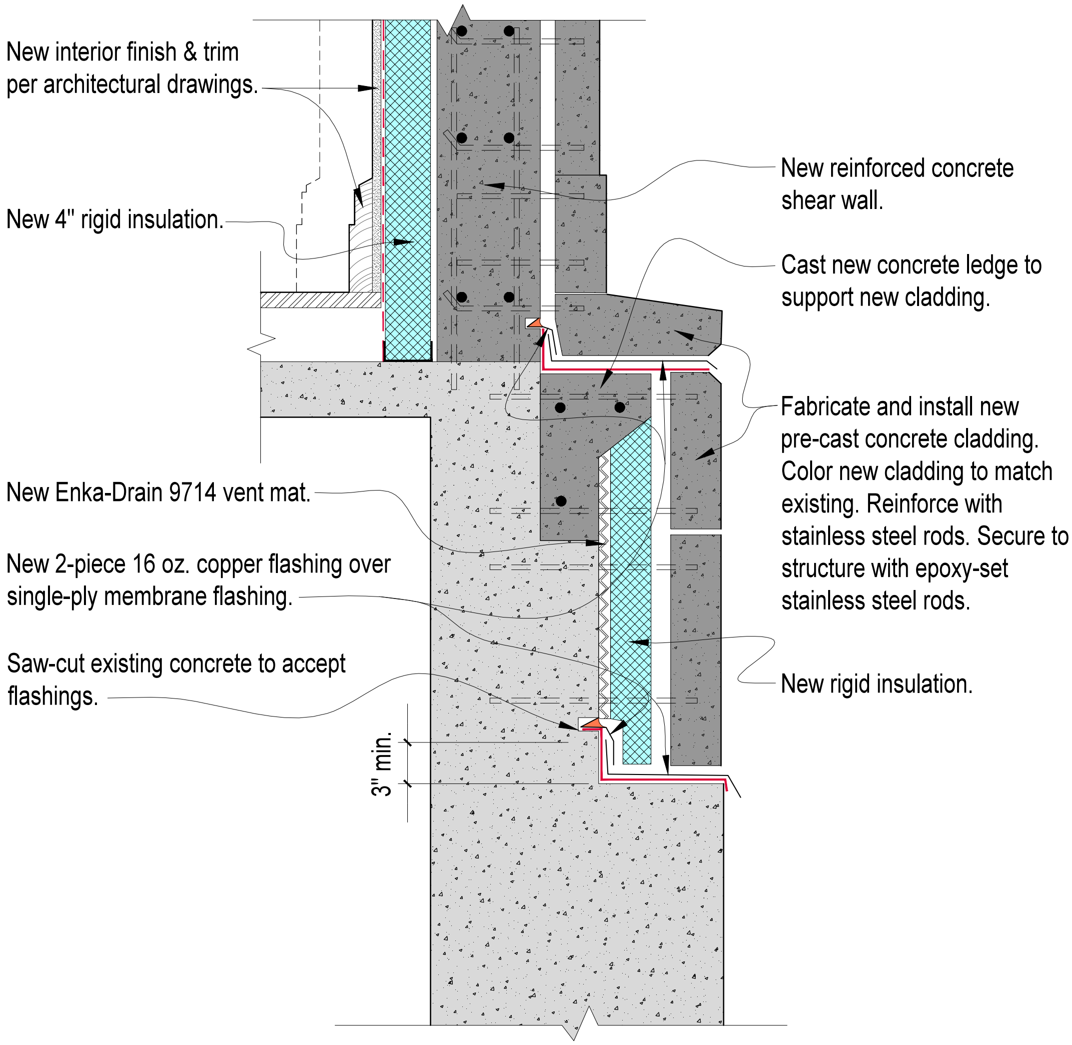

Fig. III-1.3(8): Option 2 New Masonry Veneer Appr. at Stone Wall Base, S. Side

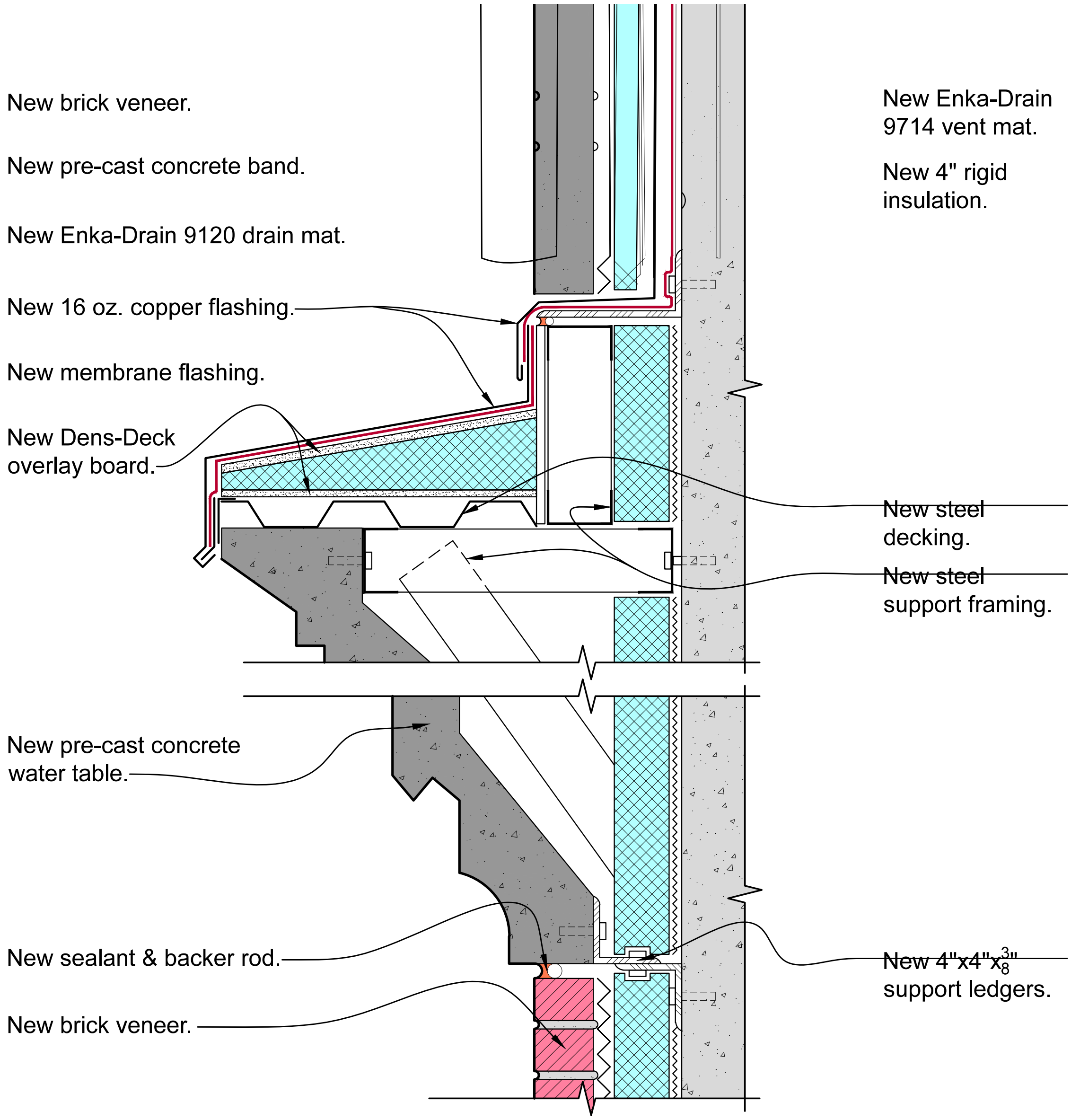

Fig. III-1.3(9): Option 2 New Masonry Veneer Appr. at Level 2 Stone Water Table

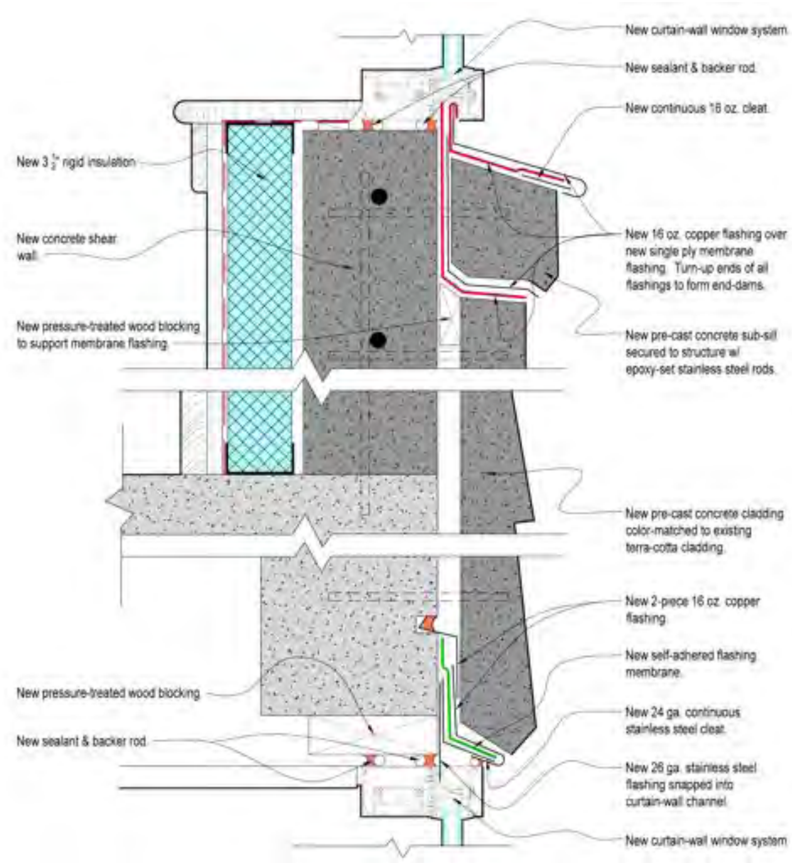

Fig. III-1.3(10): Option 2 New Mas. Veneer Appr. at Typ. Public Façade Windows

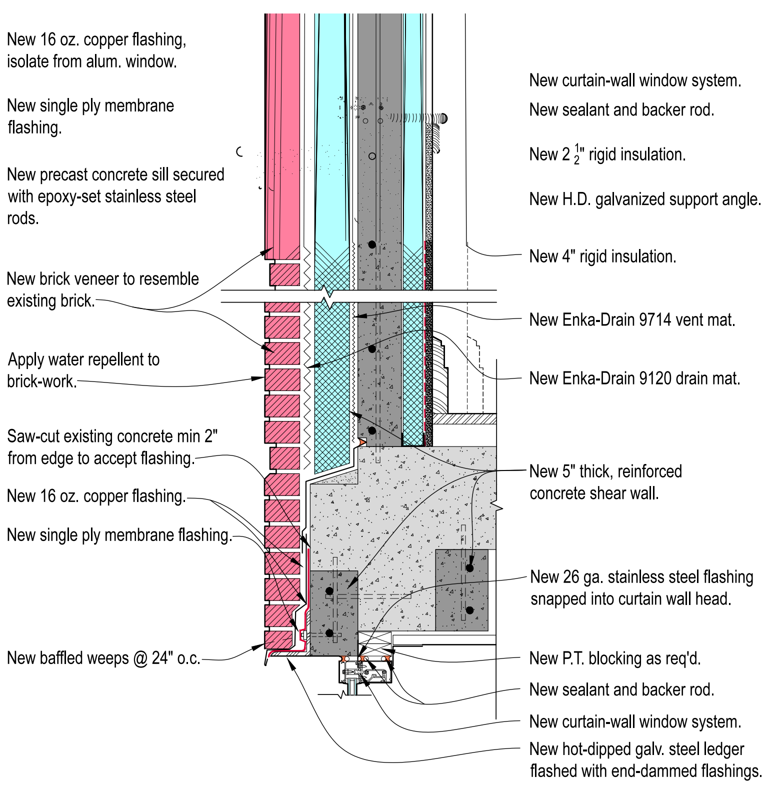

Fig. III-1.3(11): Option 2 New Masonry Veneer Appr. at Typ. Stone-Sill Windows

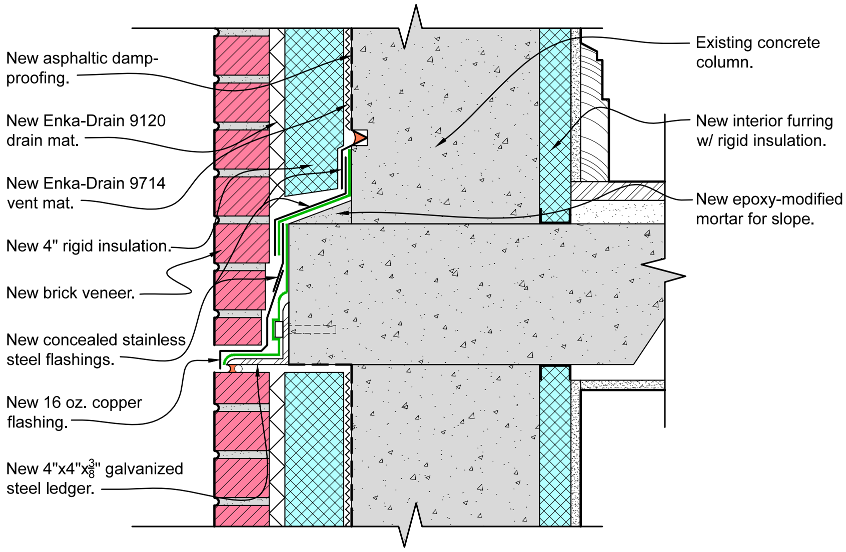

Fig. III-1.3(12): Option 2 New Masonry Veneer Appr. at Typ. Floor-Level Ledger

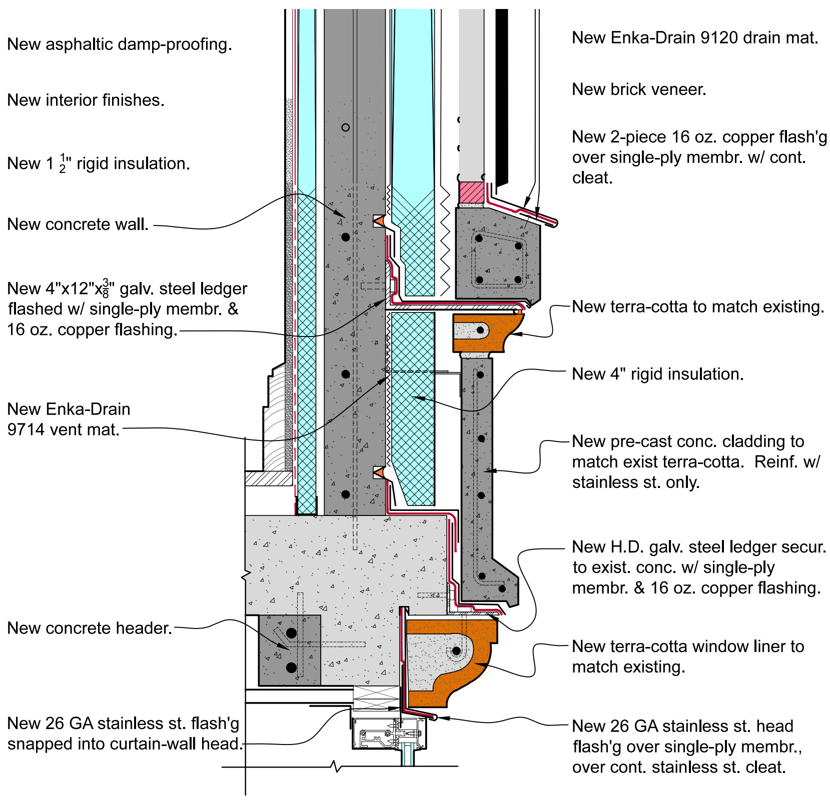

Fig. III-1.3(13): Option 2 New Masonry Veneer Appr. Above Level 4 Windows

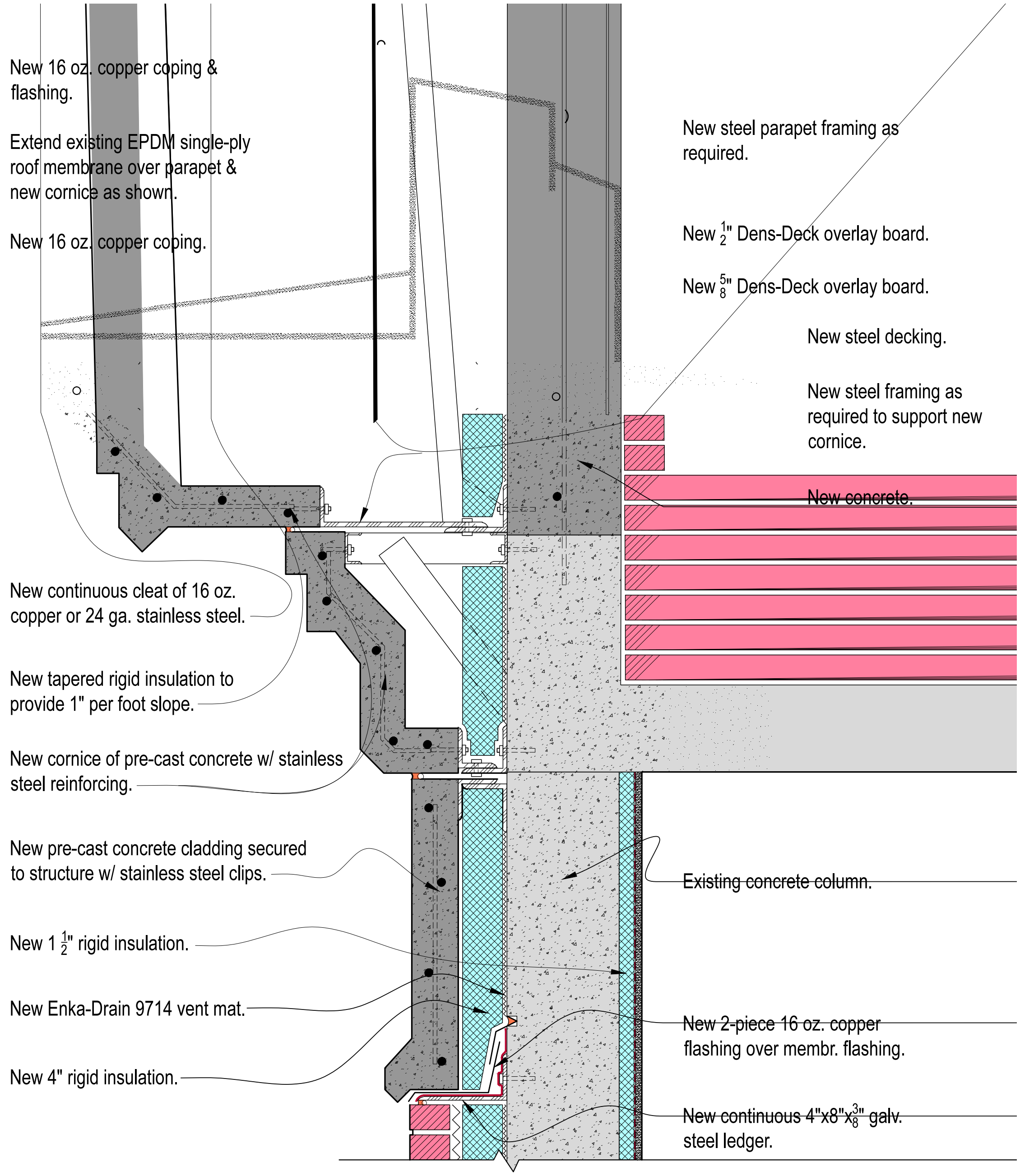

Fig. III-1.3(14): Option 2 New Mas. Veneer Appr. at Roof-Level Cornice-Parapet

1.3.3 Approach 3: New Masonry Veneer & Concrete & Steel-Framed Walls

This approach also recognizes the inherent limitations of Option 1, and also recommends replacement of the exterior cladding with a new masonry veneer. It differs from Option 2 only in that while Option 2 placed cast-in-place concrete walls inward of the masonry veneer at essentially all locations, Option 3 adds such concrete shear walls only where needed to resist lateral loads, and uses standards steel-framed walls elsewhere. In essentially all other respects, Option 3 mimics Option 2.

Where such framed walls occur, the assembly, exterior-to-interior, consists of the masonry veneer placed over a ¾” drain mat, such as Enka-Drain 9120, over 4” rigid insulation, over 3/16” vent-mat, such as Enka-Drain 9714, over 2-layer building wrap, over 5/8” exterior gypsum sheathing, over 6” deep, 16-gage steel studs spaced 16” apart. Batt or rigid insulation can be used within the framing cavities. Over the framing’s interior face would be a 6-mil cross-laminated vapor barrier, and 5/8” gypsum wallboard.

This Option 3 was evaluated because it initially appeared to possibly represent a less-costly approach than Option 2. However, this approach should not be viewed as technically equal to Option 2, and was not recommended by PL:BECS for a major institutional building in Juneau’s climate. Interestingly, the evaluation revealed that this Option 3 approach actually costs a bit more than Option 2, with a projected construction cost of 22.5 million dollars, compared to 21.9 million dollars for the technically preferable Option 2. In view of its higher cost and lesser qualities, Option 3 can readily be discarded.

However, for sake of completeness, let me also briefly outline the reasons for why this Option 3 yields an inferior building. My reservations about this approach include both technical and architectural considerations.

Technical concerns with this approach center on the certainty of recurring internal condensation and associated risks of corrosion, as well as possible risk of fungal infestation.

More specifically, the corrosion concern reflects the vulnerability to losing effective anchorage of the masonry veneer. The stainless steel ties that secure the masonry veneer to the walls are screwed through the gypsum sheathing to the steel stud flanges. If stainless steel screws are used, there remains a risk of corrosion right where the one or two screw threads engage the galvanized steel studs, where even very localized corrosion of the stud flanges around the screw threads can negate the veneer tie securement. I don’t think this risk should be underestimated in Juneau’s perpetually wet and cool climate.

The fungal concern relates to the use of gypsum sheathing in such a damp climate, especially for a major institutional building with a hopefully longer lifespan than most. Although the recommended Dens-Glass Gold sheathing is silicone-treated to resist absorption, having observed mildew growth even on vertical glass, I would not entirely dismiss the risk of at least localized fungal colonization.

An additional draw-back of this approach is that ironically, it requires appreciably more foundation work, as well as thicker concrete shear walls extending up the building’s full height near its corners, to make up for the loss of the new thin concrete walls under and above the windows which are included in Options 1 and 2, but not 3. As a consequence of these thicker concrete walls, the office spaces near the building corners at all floor levels lose some floor space.

For these reasons, I do not consider the Option 3 approach technically equal to Option 2, and strongly recommend Option 2.

As this approach is otherwise essentially identical to Option 2, it is not described in detail here. Please see subsections III-1.3.2 and Part VI for more detailed descriptions.

Also, since Options 2 and 3 are very similar, many of the same drawings describe both options. Thus, Figures III-1.3(15 & 16) illustrate only a couple of typical locations where these differ from Option 2.

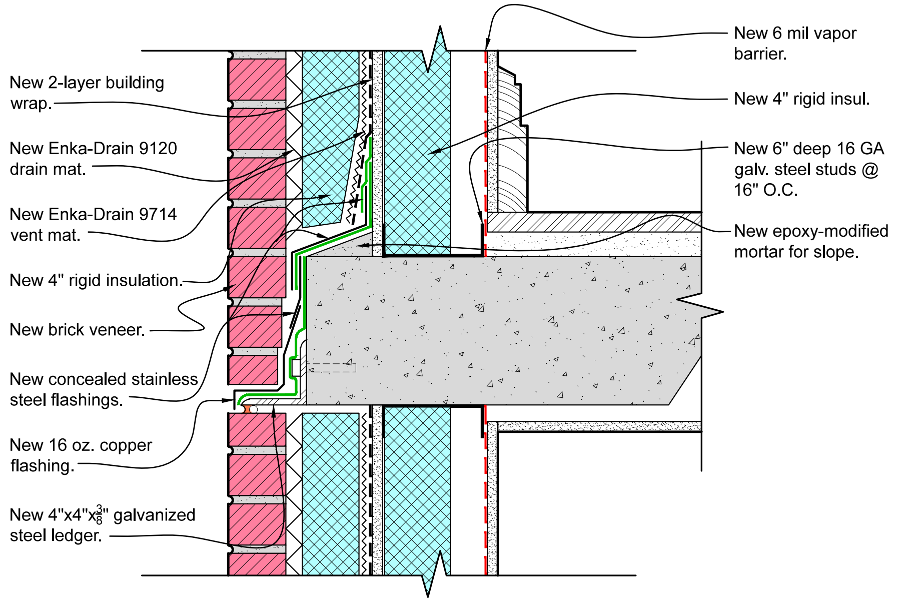

Fig. III-1.3(15): Option 3 New Masonry Veneer Appr. at Typ. Floor-Level Ledger

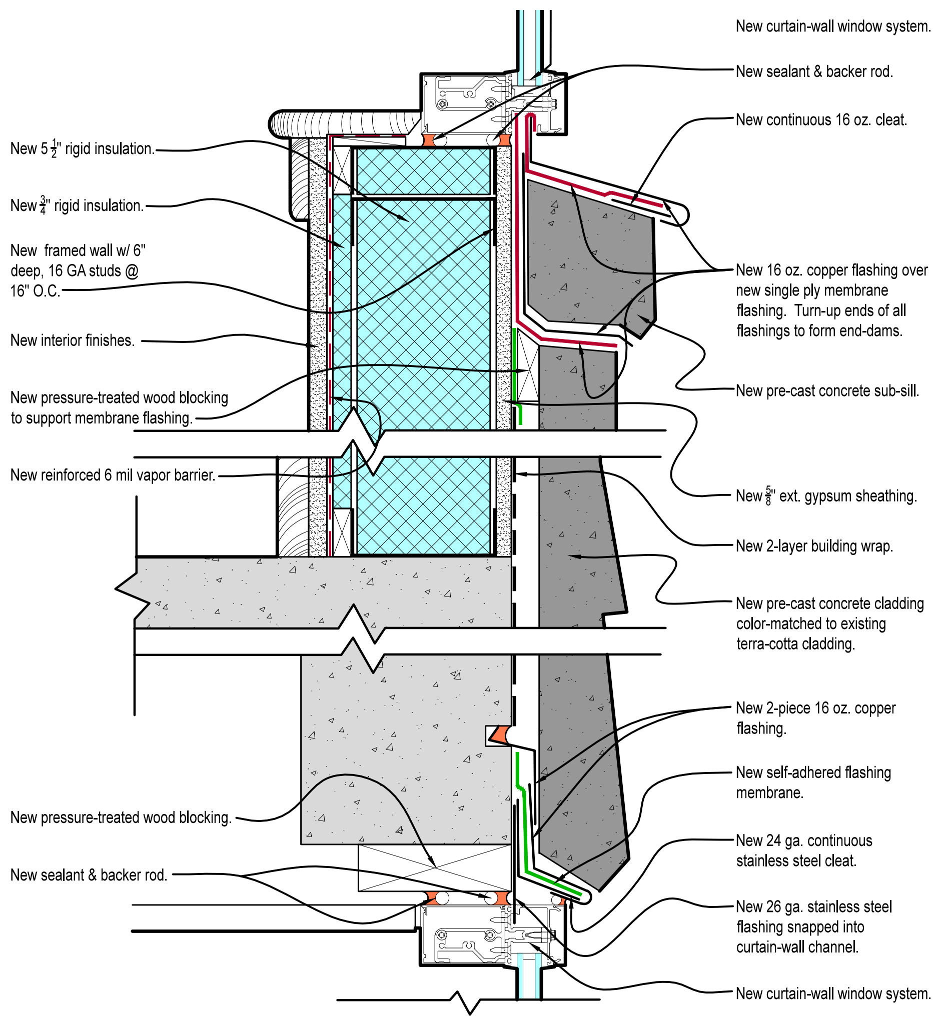

Fig. III-1.3(16): Option 3 New Mas. Veneer Appr. at Typ. Public Façade Windows