

## **IV. OPTION 1: RETROFIT EXISTING STRUCTURE AND MASONRY**

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### **1. GENERAL INTRODUCTION**

#### **1.0. General**

This section addresses issues of general applicability to Part IV: Option 1: Retrofit Existing Structure and Masonry.

Subsection 1.1 includes General Format Notes, which describe the general formatting.

Subsection 1.2, Introductory Notes, outlines some general considerations.

Finally, subsection 1.3, Overall Description of the Option 1 Corrective Approach and its Limitations, provides a summary description of the overall approach and its limitations.

#### **1.1. General Format Notes**

This Part outlines general Option 1 corrective recommendations for the various elements. For clarity, individual recommendations are provided for the various systems within Primary Sections, and are formatted same as Part II: Summary of Observations & Analysis, 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 primary section is divided into subsections, each addressing individual sub-components, for optimal clarity. For example, section 2 is further subdivided into the following subsections:

- 2.0 General
- 2.1 Basic Structure of Building
- 2.2 Foundations
- 2.3 Lowest-Level Concrete Floor Framing
- 2.4 Level 1 Concrete Floor Slab
- 2.5 Brick Chimney
- 2.6 Securement of Large Masonry Cladding Elements
- 2.7 Interior Hollow Clay Tile Walls
- 2.8 Large Mechanical Equipment

Each primary subsection is yet further divided into three secondary subsections. For example, subsection 2.1, which pertains to the building's basic structure, is divided as follows:

- 2.1.0 General
- 2.1.1 Basis of Recommendations
- 2.1.2 Recommended Corrective Actions

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

The second subsection, Basis of Recommendations, summarizes problems affecting the existing construction, and explains the reasoning for the recommended corrective course.

The third constitutes the Recommended Corrective Actions. Where yet-greater level of detail is required, each subsection may be further subdivided as appropriate.

## 1.2. Introductory Notes

This report's primary intent is to evaluate the building's major problems to a sufficient degree to develop generally feasible corrective approaches, and to also determine the general ranges of possible construction costs for the different approaches. It is beyond this report's scope to develop highly detailed construction detailing for all of the conditions. Rather, the scope of this report is to identify corrective approaches sufficiently for rough cost estimates to be prepared, thus assisting in the selection of appropriate approaches.

While recommendations are provided individually for each major element for optimal clarity, this should not be misconstrued as representing some sort of "menu", wherein some recommendations are executed while others are not. In many cases, recommendations pertaining to several elements must be executed to solve a particular problem, and doing only some of the work would not suffice. For example, the severe infiltration observed at the portico ceiling, which may partly originate at the portico roof, certainly also reflects infiltration from the wall above the portico, and correcting only the portico roof would not solve this particular problem.

In some cases, several possible corrective options appear feasible even within this basic "retrofit" approach described in this Part. In such cases, such possible approaches are also described.

While the recommendations represent appropriate approaches for solving the problems plaguing this building, they do not constitute any sort of construction documents describing the work in sufficient detail. A separate set of construction drawings and specifications must be prepared, on the basis of these recommendations, to optimize the opportunity that the problems are corrected.

It is also critical to stress the absolute importance of adequate construction supervision by qualified personnel during the corrective work to assure that the actual construction follows the design. As but one example, in my own career, which now spans over a quarter century and includes roughly 600-800 projects in the field of the exterior envelopes, I have not yet observed one single project which completely followed the design with respect to the exterior envelope.

## 1.3. Overall Description of the Option 1 Corrective Approach and Its Limitations

The recommendations are divided into numerous subsections, each of which addresses a particular element. While this approach provides specific information in a highly retrievable format, the resulting fragmentation may obscure the overall context from which the individual recommendations spring. This section attempts to provide the more holistic explanation.

In brief, this approach strives to retain existing elements to the greatest reasonable degree. All existing masonry that can be salvaged without incurring needlessly large costs, relative to other options, and that can provide adequate safety, performance, and projected lifespan, are generally kept in this approach. However, some elements, such as the front portico or windows, are so damaged or ill suited that replacement is warranted even within this "retrofit" option.

It is critical to note that this "retrofit" option is not technically ideal. In fact, it possesses some inherent vulnerabilities that can at best be minimized, but not fully corrected. For example, the existing exterior wall assemblies are deficient both structurally and from a water-infiltration perspective. Execution of the structural recommendations described in this Part should greatly enhance the building's structural integrity, though the existing building will retain a degree of vulnerability compared to Option 2. With regard to water infiltration, the masonry walls are inherently moisture absorbent and completely lack any flashings or barrier system to drain water back out of the masonry, causing interior infiltration symptoms scattered around the building's perimeter. The recommended work in this approach should limit, but may not entirely eliminate, interior leakage. A further problem is that the exterior brick is in many locations seriously damaged and is spalling. While such spalling can be slowed with consolidating agents, it cannot be effectively stopped, and the brick cladding will continue to shed its outer face over the longer-term. It is critical to understand that this approach may not completely solve all problems at all locations, and that the current spalling and weather degradation will continue, though more slowly. For these reasons, PL:BECS does not recommend this approach.

## **2. STRUCTURE**

### **2.0. General**

This section addresses larger-scale structural considerations. It is divided into nine subsections, each of which pertains to a specific sub-element of the structure.

### **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 Basis of Recommendations**

This building's 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. In addition, structural steel frames occur on the 3<sup>rd</sup> and 4<sup>th</sup> levels of the east wing. Along exterior walls, the concrete beams and columns are embedded within longer wall sections comprised of brick masonry, with 4" thick, non-structural terra-cotta along the interior faces of these exterior masonry walls, and plaster or other interior finish applied over this.

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.

A structural analysis performed as part of this report's scope by the engineering firm of Swenson Say Fagét confirmed that this building possesses excessive vulnerability to seismic damage. This concern is exacerbated by my field investigation, which revealed some previous seismically induced damage, which may have weakened some sub-elements of the building.

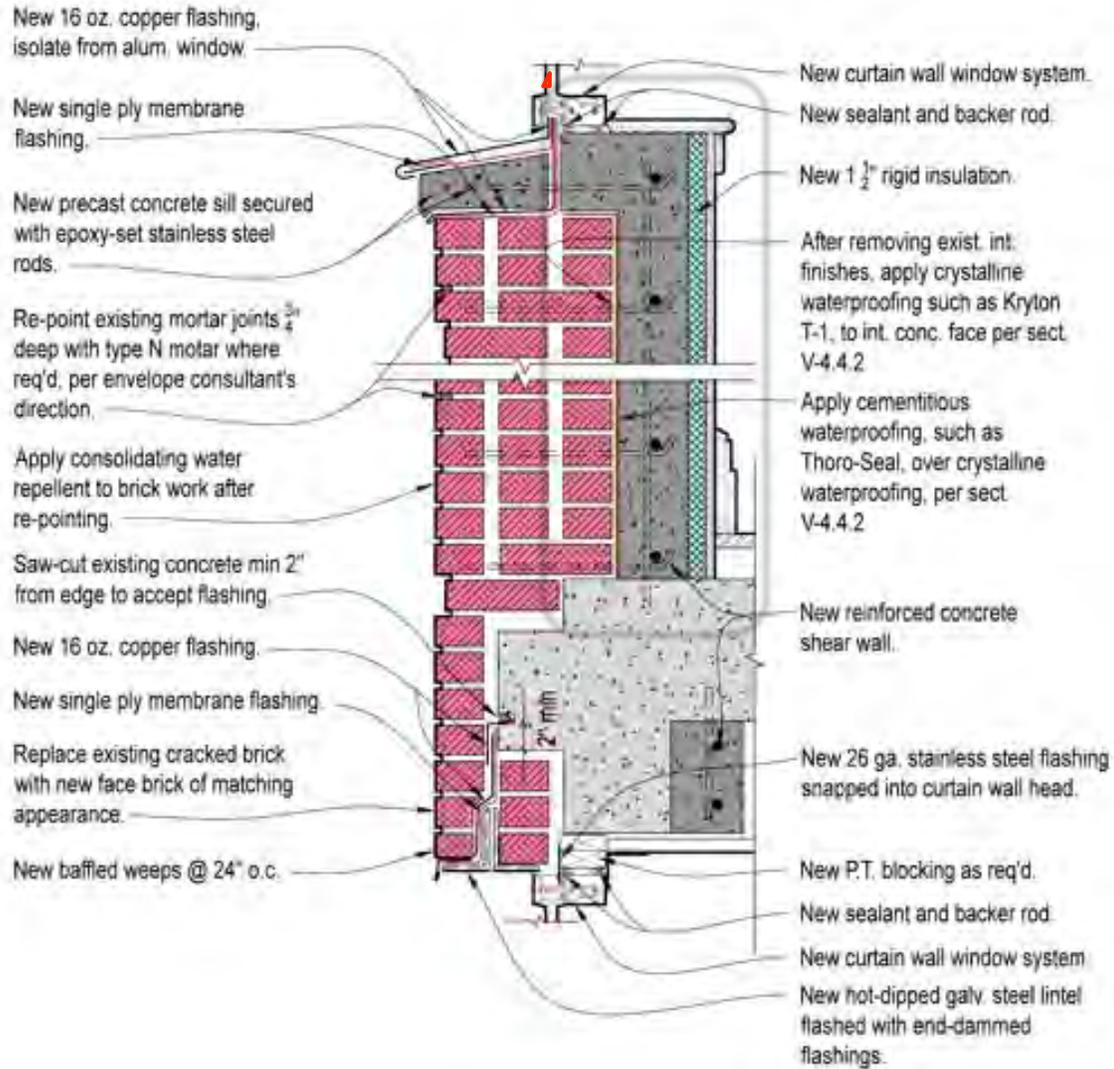
#### **2.1.2 Recommended Corrective Actions**

With regard to the building's overall structural frame, recommended corrective work largely aligns with recommendations of the 12/31/10 PL:BECS report, and consists of the replacement of much of the existing interior non-structural terra-cotta, or hollow clay tile, along the building's exterior walls with reinforced concrete piers and shear walls.

These added shear walls and piers occur on all floor levels, though they become progressively less extensive toward the upper floor levels, as one would expect. They vary in thickness, with new concrete piers generally near the building's outer corners being 12" thick, while in most other locations, only 4" thick concrete walls replace the hollow clay tile wall finish. At the northern portions of both wings at the ground floor level, 6" thick concrete shear walls are added. Large concrete grade beams are also added to the foundation system, as described in section IV-2.2.2. In contrast to the 12/31/10 PL:BECS report, which also assumed that the new concrete shear walls would extend along inner faces of the existing concrete columns, the analysis by Swenson Say Fagét concluded that these would not be of much help, and consequently, interior concrete shear walls are generally not being added along inner faces of the existing concrete columns.

In general, the work consists of the removal of existing interior finishes and the hollow clay tile to expose underlying brick construction. The inner brick and mortar faces are then coated with a crystalline waterproofing agent, such as Kryton T-1, followed by a cementitious waterproofing agent, such as Thoro-Seal. A grid-work of either Heli-Fix helical anchors, or epoxy-set, 5/8" ø stainless steel all-thread rods is then drilled into the inner faces of the brick, extending to about 2" short of the exterior wall face. These rods should be spaced about 16" apart in both directions, and should be tied to the new wall's reinforcing steel. Finally, new concrete shear walls are placed, either via the shot-crete method or with one-sided forms. Steel furring, rigid insulation, vapor barrier, and interior finishes are then installed over the new concrete.

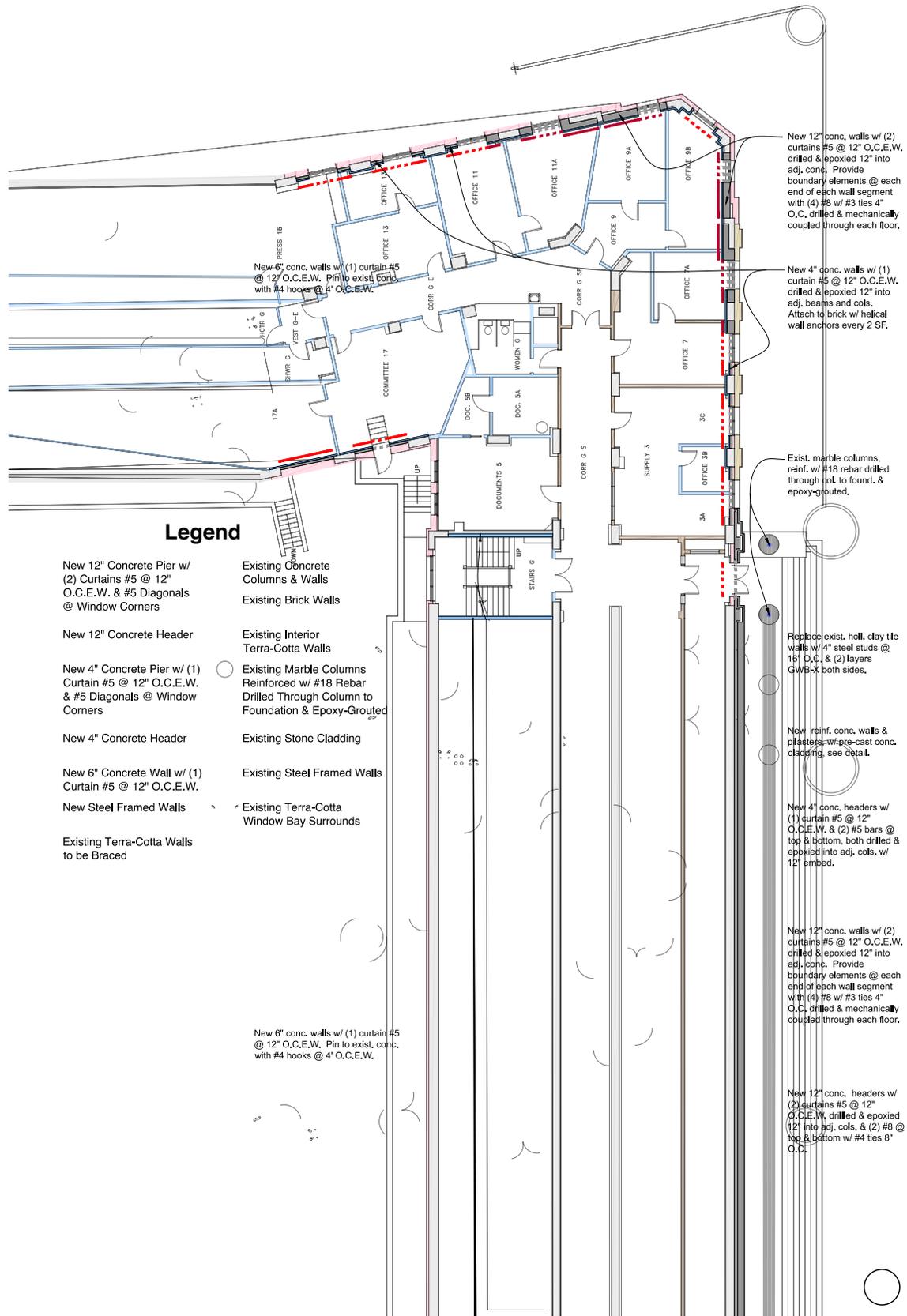
Figure IV-2.1(1) shows a typical detail with the interior shear wall added to the existing brick walls, and Figure IV-2.1(2) shows a photo of generally similar work being executed to stabilize an existing concrete wall. Figures IV-2.1(3-8) then show each of the building's floor plans with specific locations and thicknesses of the new shear walls and piers indicated. See also Figure IV-2.2(1), which shows the related structural work at the foundation level.



**Figure IV-2.1(1): Typical Interior Concrete Shear Wall**

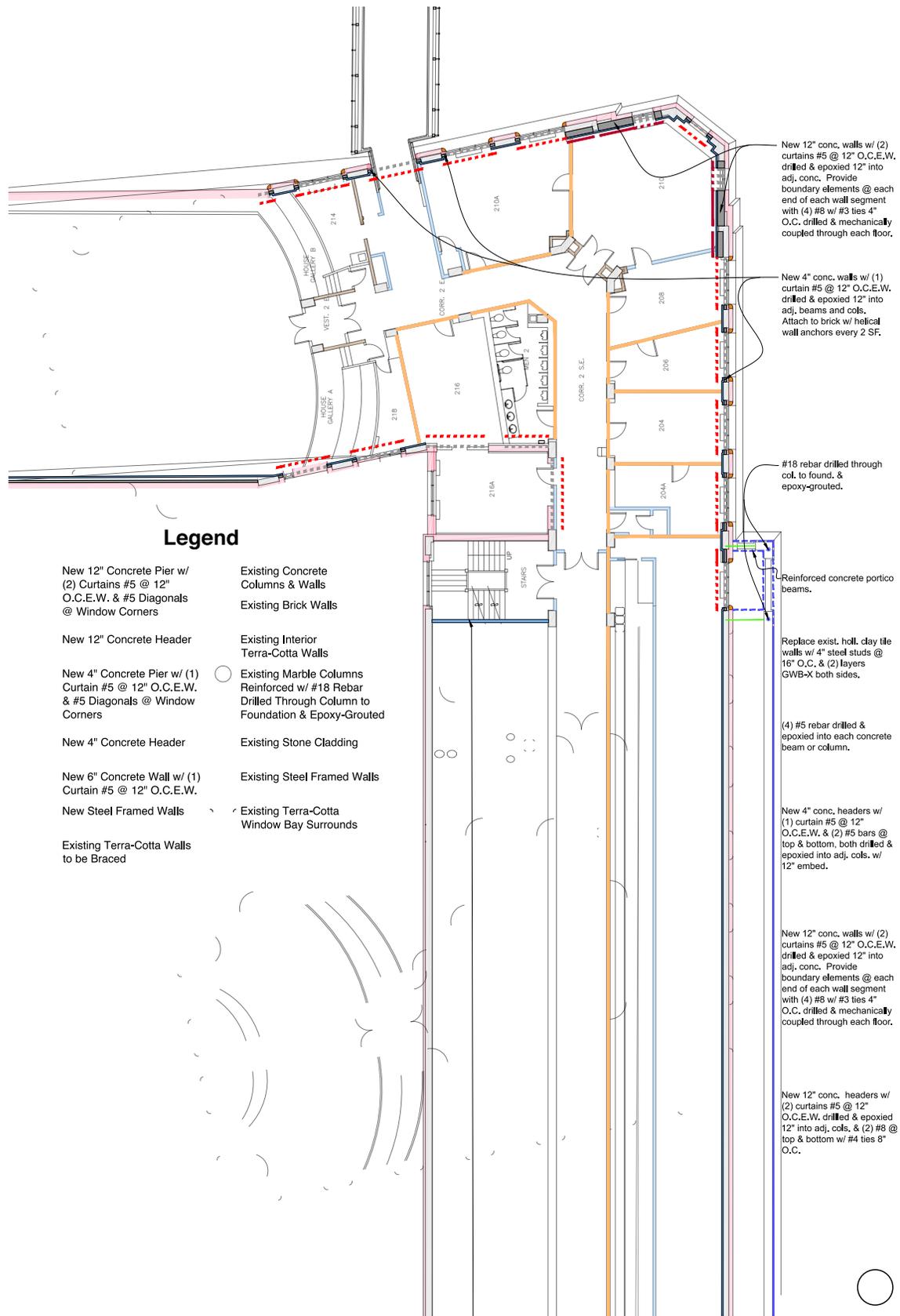


**Figure IV-2.1(2): In-Progress Installation of Interior Concrete Shear Wall**

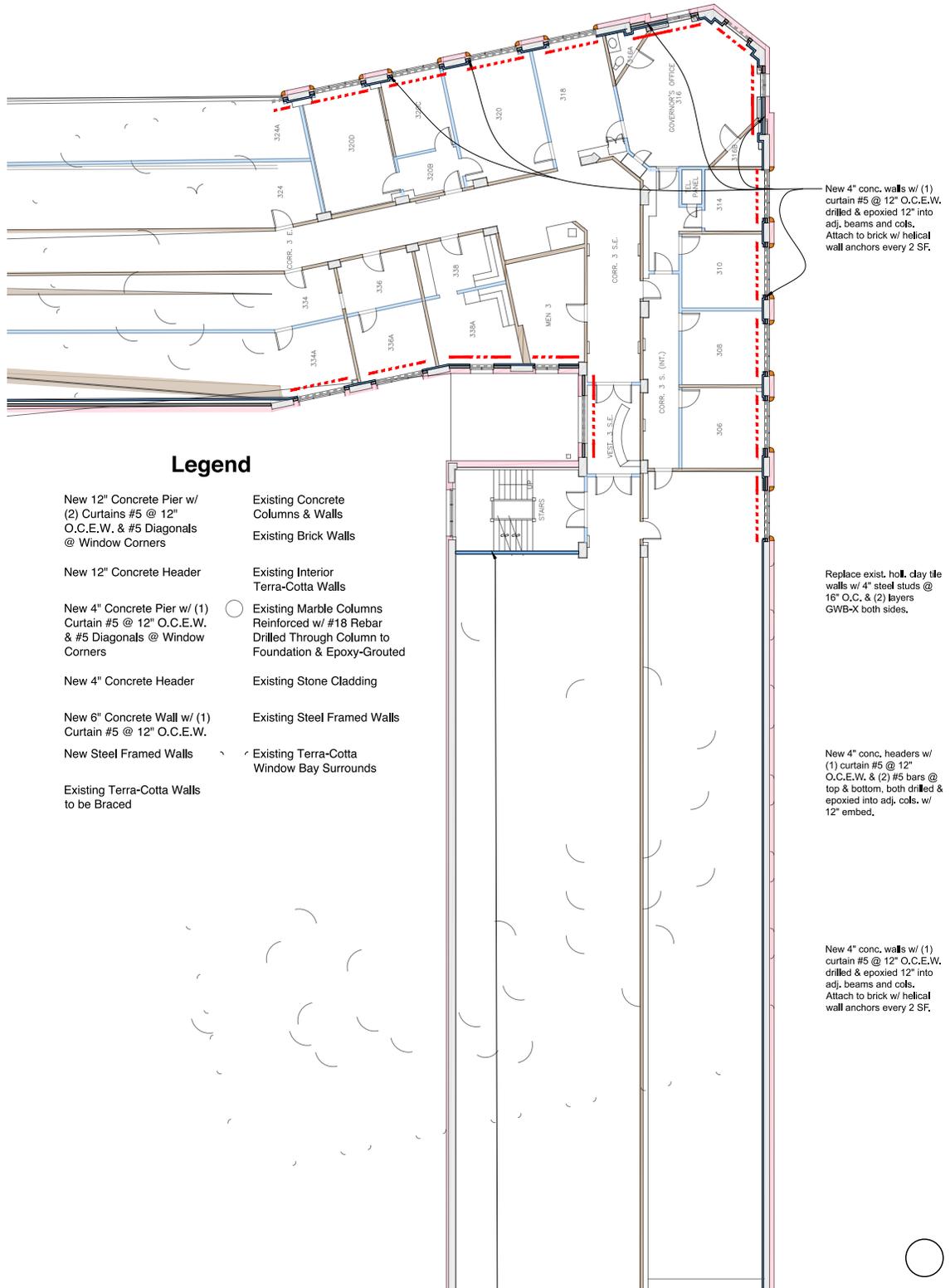


**Figure IV-2.1(3): Structural Reinforcing of Building Frame - Ground Floor Level**

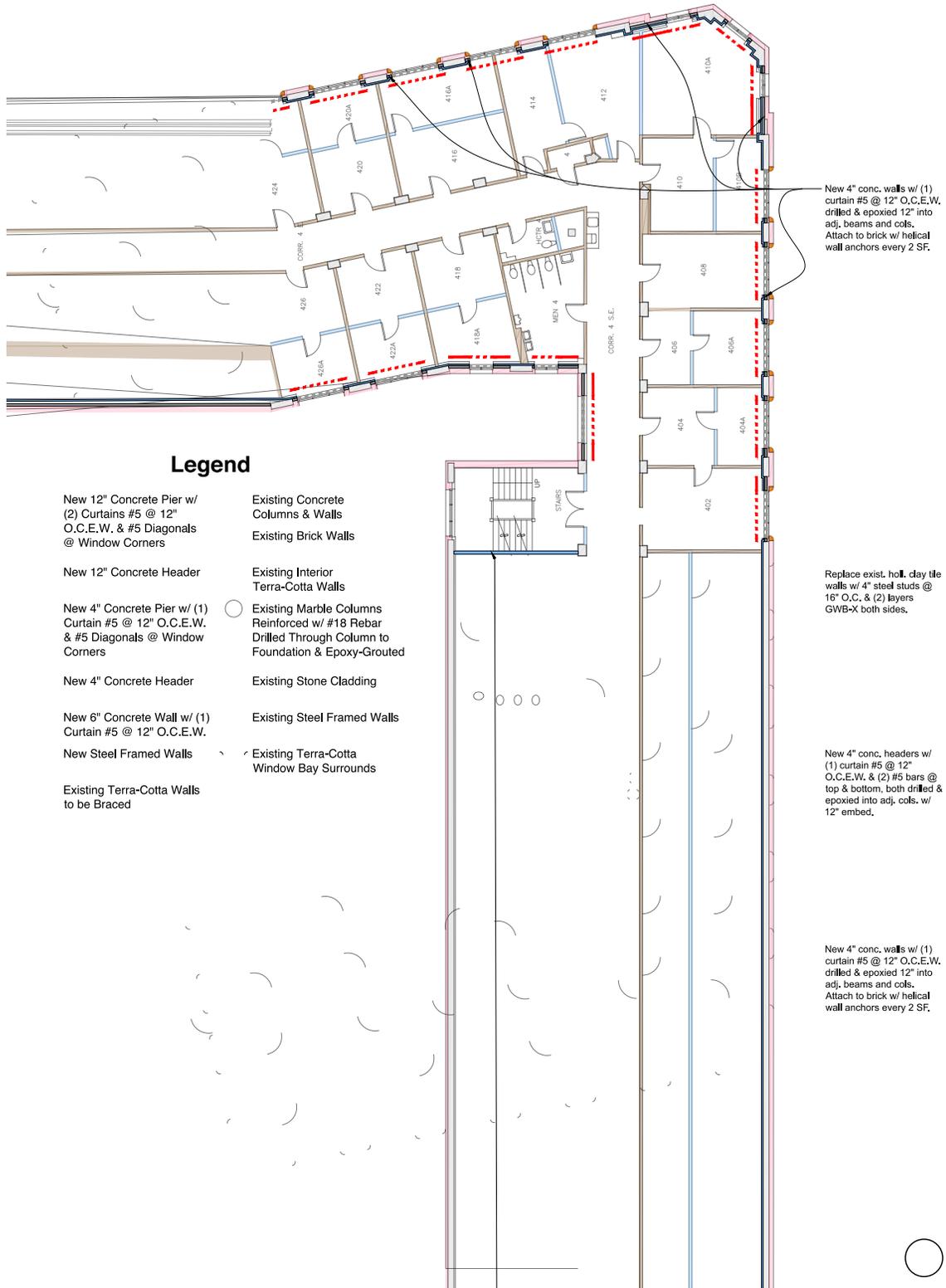




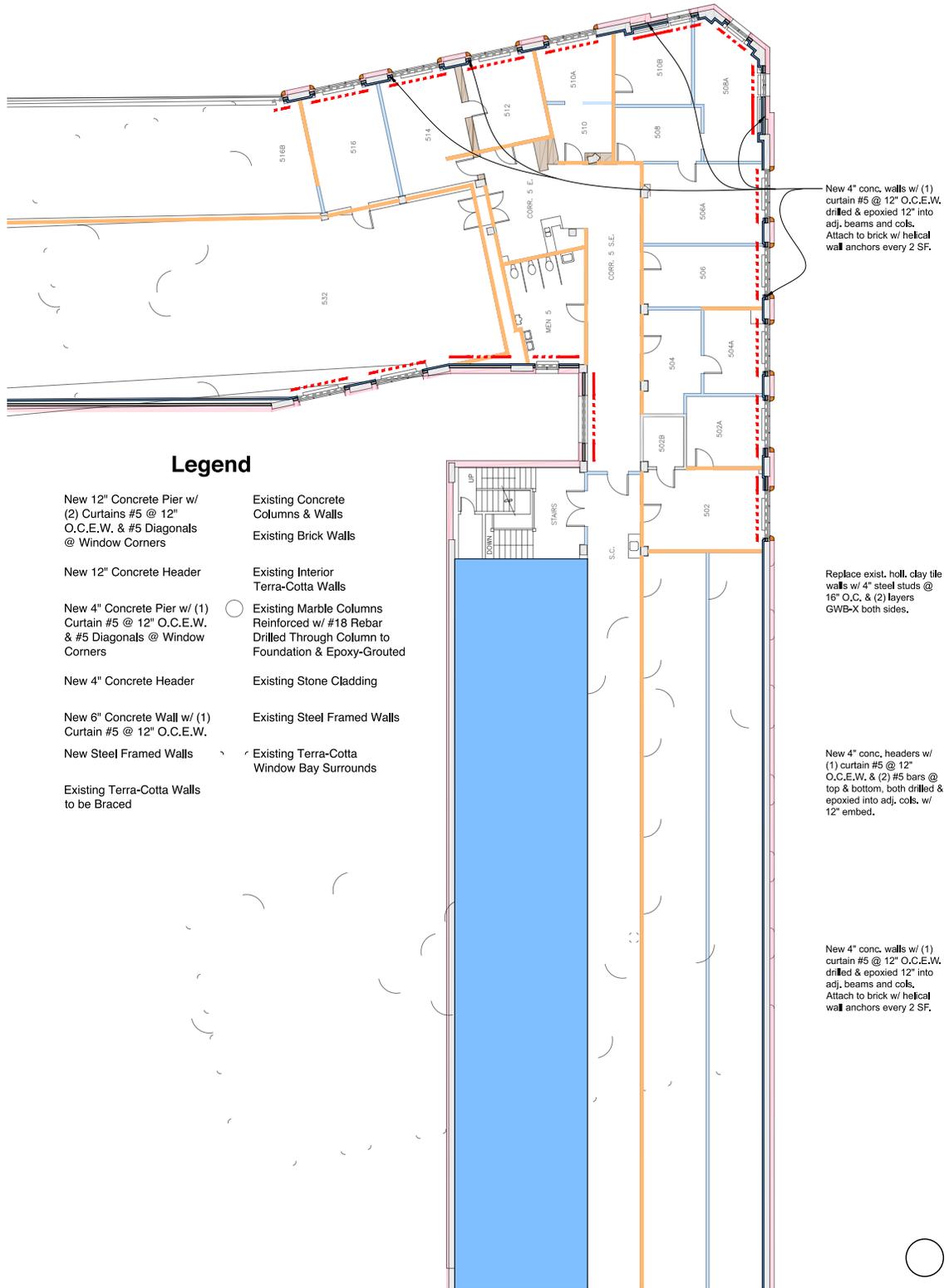
**Figure IV-2.1(5): Structural Reinforcing of Building Frame - Floor Level 2**



**Figure IV-2.1(6): Structural Reinforcing of Building Frame - Floor Level 3**



**Figure IV-2.1(7): Structural Reinforcing of Building Frame - Floor Level 4**



**Figure IV-2.1(8): Structural Reinforcing of Building Frame - Floor Level 5**

## 2.2. Foundations

### 2.2.0 General

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

### 2.2.1 Basis of Recommendations

The foundation consists of a grid-work of many individual, mostly square footings of 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.

Very wet soils occur in the crawl space under the building, with a small, continuous stream running through this space. Consequently, the foundations suffer variable degrees of corrosive spalling and efflorescence, indicating moisture absorption into the concrete.

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

With regard to structural adequacy, analysis indicates that the foundation system is generally adequate for resisting vertical gravity loads, but does not suffice to resist lateral loads. Consequently, some beefing-up is warranted. In brief, this consists of the addition of several large grade beams, as described in greater detail in subsection IV-2.2.2.

From a degradation perspective, the existing foundations are not in too bad a condition, but are experiencing variable degrees of corrosive spalling and efflorescence, which in itself can also lead to spalling as the salts recrystallize near the concrete's surface. In the longer-term, this process would lead to the destruction of these foundations. Therefore, some corrective measures are also advisable to limit this intrusion of water into the concrete.

However, the conditions affecting these foundations pose some inherent challenges, which may limit the effectiveness of many possible corrective measures, so a bit of discussion is warranted.

The minimum course, which should be applied in any case, would be to correct the existing damage, by removing loose concrete, cleaning the exposed steel, and restoring the concrete with new shot-crete, as described in greater detail in subsection IV-2.2.2. This should be combined with measures to limit atmospheric humidity and enhance crawl space drainage per subsection IV-3.1.2. The limitation of this approach is that it will repair existing damage, but will do little to slow-down further degradation, as water will continue to be sucked into the concrete from the wet soils. Thus, this approach alone represents a maintenance program that would need to be continued indefinitely, though probably at 10-year intervals, perhaps even longer.

The effort to actually slow-down the degradation is greatly complicated by the site's conditions, including its perpetually wet, densely compacted soils and deep burial of the foundations within the soils, which effectively precludes access to these foundations. These conditions mean that the concrete foundations may be very difficult to dry out, and dampness of the concrete will limit the effectiveness of many possible corrective measures, which typically involve permeating the concrete with different products to retard corrosion or reduce absorptivity. Another possible approach would be to try waterproofing the soils underlying the foundations, but again, this involves permeating the soils with chemical grouts, and while this works very well in dry sand, it may prove of little benefit with permanently wet, dense glacial till. Yet another possible approach would be to apply crystalline waterproofing to the exposed concrete surfaces, but again, the crystalline waterproofing is not likely to be able to permeate through the very thick concrete to have much effect on the footing bottoms, thus limiting the effectiveness of this approach.

Let me touch upon these considerations in greater detail, starting with application of a corrosion-retarder, such as Sika FerroGard 903. This fluid coating is applied to exposed concrete surfaces, then permeates the concrete to its reinforcing steel, which it coats and retards further corrosion. The problem is that the product may not permeate the concrete very well if it is already saturated with water, which it is and this is difficult to avoid since the soils never dry out in Juneau.

Another possible approach would be to permeate the concrete with absorption-reducing agents, such as ProSoCo Conservare Damp-Course Fluid. This is more typically used to permeate stone masonry, but the work consists of drilling accessible faces of the concrete with a pattern of holes, then injecting this fluid to permeate the concrete. The challenge with this again relates to the existing wetness of the concrete, which may limit effectiveness of this approach.

Yet another possible approach would be to inject the underlying soils with a chemical grout, such as Avanti AV-315 or AV-330, to create a waterproof soil blanket under each footing. However, while this would be a fine approach if the soils consisted of dry sand which would readily accept this grout, saturated dense glacial till may prove much less suitable for this approach. Further, the very deeply buried footings effectively make this approach unfeasible in this case.

Application of crystalline waterproofing, such as Kryton T-1, also appears to pose some limitations in this case. This is typically applied as a water-borne slurry to damp concrete, and the product permeates into the concrete matrix, then crystallizes to reduce porosity and absorption. This can work very well in stopping infiltration into a space through concrete, but in this case, the accessible concrete surfaces are often separated by many feet from the footing bottoms where the waterproofing agent is most needed.

In short, while a number of different approaches can be tried, alone or in combination, to limit moisture absorption and resultant corrosive spalling, due to the conditions affecting this building, many approaches are effectively precluded, and all of these measures should be considered experimental, and should be field-tested on a small number of footings to help evaluate their effectiveness prior to wholesale application. These considerations drive the following recommendations.

### **2.2.2 Recommended Corrective Actions**

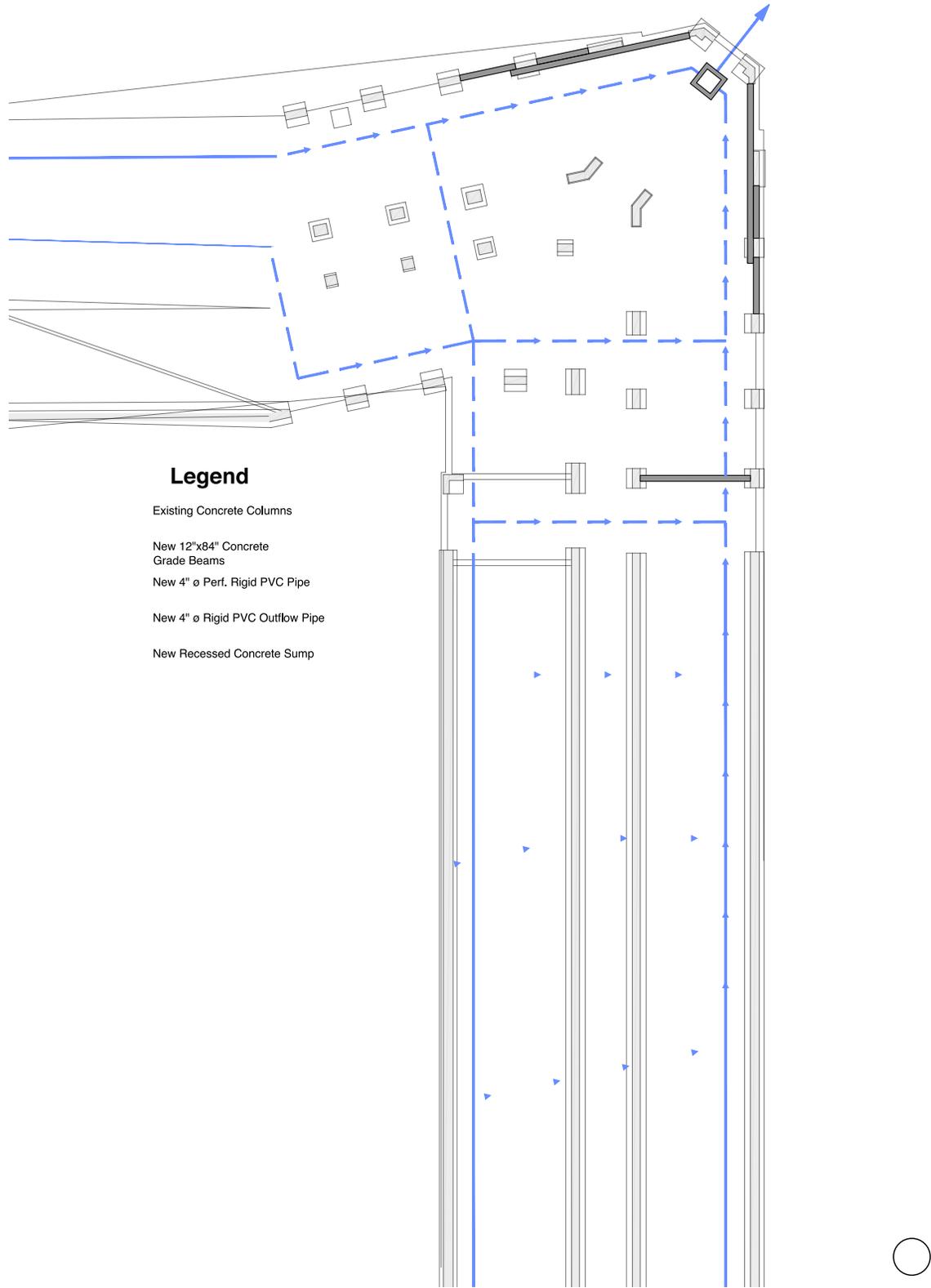
Primary corrective measures include addition of new grade beams at strategic locations, repairing existing damaged foundations, enhancing drainage, and controlling humidity. As the purpose of this phase of this project is to roughly determine probable construction cost ranges for various approaches, I further recommend that a budget be allowed for testing some possible additional measures to help retard further degradation.

Drainage enhancements and humidity measures are described in greater detail in subsection IV-3.1.2.

The structural enhancement of these foundations consists of adding new concrete grade beams at the building's SW and SE corners, as well as near the entry portico, as shown in Figure IV-2.2(1). The new grade beams should be 12" thick and 84" tall, extending downward 7'-0" from the undersides of the ground-level concrete floor beams.

To limit the destruction of the new grade beams by moisture absorption, as is occurring with the existing foundations, the grade beams should incorporate several measures. First, any reinforcing should be of stainless steel, or hot-dipped galvanized steel as a minimum, to control corrosion. To limit shrinkage cracks and resultant moisture entry, a low shrinkage, low-water concrete mix with polypropylene fiber reinforcing and Kryton KIM admixture should be used.

See Figure IV-2.2(1) for the configuration of these new grade beams.



**Figure IV-2.2(1): Structural Reinforcing of Foundation System**

Now, let me tackle the degradation issue. The basic recommendations include enhancing drainage and controlling humidity per subsection IV-3.1.2, repairing existing foundation damage, and testing possible measures for retarding further degradation.

Correcting the existing damage consists of removal of all loose concrete to expose corroding steel, blasting the exposed steel to bare, bright steel, coating this steel with a zinc-rich primer such as Tnemec 90-97 Tneme-Zinc, and then restoring the original concrete shape with fiber-reinforced shot-crete. Any steel that becomes exposed and that has become seriously corroded should be cut out and replaced with new stainless steel rods before embedding with new shot-crete. To enhance the new shot-crete's resistance to infiltration, admixtures such as Kryton KIM can be added per the manufacturer's recommendations. This work represents the Option 1 "Base Bid" for the foundation repair, and should be executed at all locations. This work should repair existing accessible damage, and should restore the foundation system's integrity for at least 10 years. The owner is advised to check the foundations every 5 years or so, and to perform this same repair work as the need arises. I would venture a guess that this may not need to be repeated any more frequently than about 10 years apart, probably notably longer.

In addition, I believe that in spite of the aforementioned challenges, a combination of measures may help retard further degradation, and should at least be tested. This work includes the following steps, listed in order of execution, which in this case is quite important.

1. Expose Foundation Pier Sides & Clean & Repair Concrete

Excavate about 6" of soil away from foundation pier sides to expose the uppermost portions to view. Brush and rinse off efflorescence and dirt, and remove any spalled concrete to create sound, clean concrete surfaces. Clean and repair steel and concrete as outlined in the previous paragraph describing Base Bid work.

2. Inject Damp-Course Fluid Into Exposed Parts of Piers

Drill downward-sloping, 1" diameter holes, about 6" deep and spaced about 12" apart, into the exposed piers directly above the excavated soils. Inject ProSoCo Conservare Damp-Course Fluid per the manufacturer's directions, into these holes. Upon completion, fill drilled holes with grout with Kryton KIM or T-1 admixture.

3. Apply Corrosion Inhibitor

Apply Sika FerroGard 903 to tops and sides of concrete piers above drilled holes per manufacturer's directions, then rinse all residue and allow to penetrate. This product should permeate the concrete, coat the reinforcing, and help retard further corrosion.

4. Apply Crystalline Waterproofing to All Exposed Concrete Surfaces

After fully rinsing the corrosion inhibitor and allowing it to permeate the concrete per manufacturer's directions, apply Kryton T-1 to the sides and tops of the exposed foundation piers. This will permeate the concrete and reduce infiltration.

5. Backfill Around Footings

Replace soils removed to expose foundation pier sides with concrete lean-mix, Controlled-Density-Fill, (CDF), or similar backfill.

## 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. See also section IV-3.1: Lowest-Level Crawl Space for related information.

### 2.3.1 Basis of Recommendations

This floor consists of a concrete slab integrally poured with concrete floor beams and joists. Issues germane to this floor system relate to structural adequacy and degradation.

With regard to structural adequacy, analysis by Swenson Say Fagét did not uncover any major deficiencies, thus requiring no “beefing-up”.

On the other hand, degradation is an issue, as many, perhaps most, of the concrete joists display widespread, fairly serious corrosive spalling, particularly near their midspans. The bottoms of these joists had in most locations spalled off, exposing corroding reinforcing steel, resulting from moisture intrusion. However, in contrast to the spalling affecting the foundations, the only moisture source reaching these joists consists of atmospheric humidity in the wet crawl space. Left uncorrected, this degradation will continue, and will eventually compromise the structural integrity of the entire floor system.

### 2.3.2 Recommended Corrective Actions

Primary corrective measures include repairing existing damaged floor joists, enhancing drainage, and controlling humidity.

Drainage enhancements and humidity measures are described in greater detail in subsection IV-3.1.2.

Correcting the existing joist damage consists of removal of all loose concrete to expose corroding steel, blasting the exposed steel to bare, bright steel, coating this steel with a zinc-rich primer such as Tnemec 90-97 Tneme-Zinc, and then restoring the original concrete shape with fiber-reinforced shot-crete. Any steel which becomes exposed and which has become seriously corroded should be cut out and replaced with new stainless steel rods before embedding with new shot-crete. This work represents the Option 1 “Base Bid” for the floor repair, and should be executed at all locations. This work should repair existing accessible damage, and should restore the floor system’s integrity for at least 10 years. The owner is advised to check the floor system every 5 years or so, and to perform this same repair work as the need arises. I would venture a guess that this may not need to be repeated any more frequently than about 10 years apart, probably notably longer.

In addition, I believe that coating the underside of the entire floor system, especially the joists and beams, with a penetrating corrosion inhibitor may help retard further degradation. This work includes the following steps, listed in order of execution, which in this case is quite important.

#### 1. Clean & Repair Concrete

Brush and rinse off efflorescence and dirt, and remove any spalled concrete to create sound, clean concrete surfaces. Clean and repair steel and concrete as outlined in the previous paragraph describing Base Bid work.

#### 2. Apply Corrosion Inhibitor

Apply Sika FerroGard 903 to all sides of joists, beams, and floor slab per manufacturer’s directions. This product should permeate the concrete, coat the reinforcing, and help retard further corrosion.

## **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 Basis of Recommendations**

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

Where visible, significant cracking was observed very near the building's outer corners, where typically fairly wide, often closely spaced cracks were located. Due to their size, locations, and spacing, these cracks appear seismically induced.

In addition, one continuous, straight crack was observed running a few feet south of the wall separating the boiler room from the shop. This crack parallels this wall, and probably occurs along a pour joint, which has also probably been widened by seismic activity.

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

### **2.4.2 Recommended Corrective Actions**

No structural beefing-up appears needed at this floor system. Recommended corrective measures include injecting all accessible floor cracks with epoxy, such as Sika Sikadur Injection Gel, Sikadur 35, etc., as appropriate for specific conditions.

## **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 Basis of Recommendations**

This chimney consists of 2-wythe, 9" wide brick walls, lined with 4 ½" thick firebrick spaced 3" from the brick structure. It is capped with two stone rings that 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 degraded, with extensive surface erosion, 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, with no through-wall flashings to drain water out from behind the outer brick wythe.

Visually, this chimney is a utilitarian structure, visible only to a limited extent from the building's north side, which itself is rather utilitarian. In other words, from an architectural perspective, it would generally be best for this chimney to be invisible.

Technical issues relate to structural considerations as well as to moisture infiltration.

Structural concerns relate to overall stability as well as to its stone cap securement. Analysis by Swenson Say Fagét confirmed my suspicion that as constructed, it lacks adequate seismic resistance. The absence of any mechanical securement of its heavy capstones, combined with its degraded mortar, increase vulnerability to seismic displacement, posing risk to people below.

From a water-infiltration perspective, the chimney suffers from ill-conceived, though for its time typical design, especially for Juneau's climate, whose 220 rainy days and roughly 150 days with sub-freezing temperatures each year pose a deadly combination for all forms of masonry. The basic flaws are that it lacks any flashing caps to preclude water entry, and similarly lacks any flashings to drain water out from behind the brick above the roof. Consequently, moisture within the masonry drains into the roof assembly, which may explain why it has been painted with an elastomeric coating. As expected, spalling, mortar erosion, and similar symptoms are evident, and the chimney is fairly degraded. Left uncorrected, the degradation will accelerate, and occasional leakage into the roof assembly will also occur, as the elastomeric coating cannot reliably preclude water entry into the masonry.

### **2.5.2 Recommended Corrective Actions**

As this chimney is neither very visible nor particularly attractive, I recommend the easiest and least-costly approach for addressing the structural and infiltration issues affecting it. In brief, this consists of dismantling its top to lower it to 8 feet above the roof, cleaning and parge-coating the brick, then over-cladding with a metal cladding with a drainage cavity.

Lowering the chimney height alone allows the remaining portion to have adequate seismic stability. This is unlikely to cause any detrimental effects, and if odors became problematic, the chimney could be extended with a sheet-metal flue and housing. Parge-coating the brick will enhance integrity further by surface-bonding the brickwork, and will also help protect against moisture intrusion. The recommended metal over-cladding will have very limited visibility, and can easily improve on the chimney's current appearance.

Specific chimney recommendations are as follows, and as depicted in Figure IV-2.5(1):

1. Dismantle Existing Chimney Top Portion & Clean Remaining Part

Dismantle brickwork and stone caps to lower chimney to roughly 7'-6" above adjacent roof. Remove all elastomeric coatings, loose mortar, spalled brick, and any other loose or foreign matter to expose sound clean brick and mortar.

2. Drill Cap Anchors Into Top of Brick Cap

Drill Helifix anchors or 1/2"Ø epoxy-set stainless steel threaded rods about 4" into the tops of the outermost and innermost brick wythes, spaced about 24" apart in a staggered fashion. Leave rods protruding up about 3".

3. Cast New Concrete Cap Ring Atop Chimney

Cast new concrete cap with an outward sloping top atop the brick. Make inner cap thickness about 8", outer about 5". Cast outer cap edge minimum 2 1/2" past outer brick face.

4. Retrofit Reglet Base Flashing Above Roof Membrane Termination

Saw-cut mortar joint about 4" above top of existing roof membrane and install upper portion of 2-piece, 24-gage stainless steel or 16 oz. copper flashing into saw-cut, then insert backer-rod and sealant.

5. Apply Parge Coat to Chimney Brick

As repointing of the existing seriously degraded chimney mortar would be recommended in any case, it would probably be less costly to simply apply a cementitious parging coat, and this is my recommendation, as this can also enhance the chimney's integrity and infiltration resistance. Specifically, I recommend that a 3/8"-1/2" thick parge coat of type S mortar, reinforced with polypropylene fibers, be applied and troweled smooth over the cleaned outer brickwork. To limit absorptivity, I also recommend addition of Kryton KIM or a similar admixture to the parge coat.

6. Install Lower Portion of 2-Piece Reglet Base Flashing Begun in Step 4

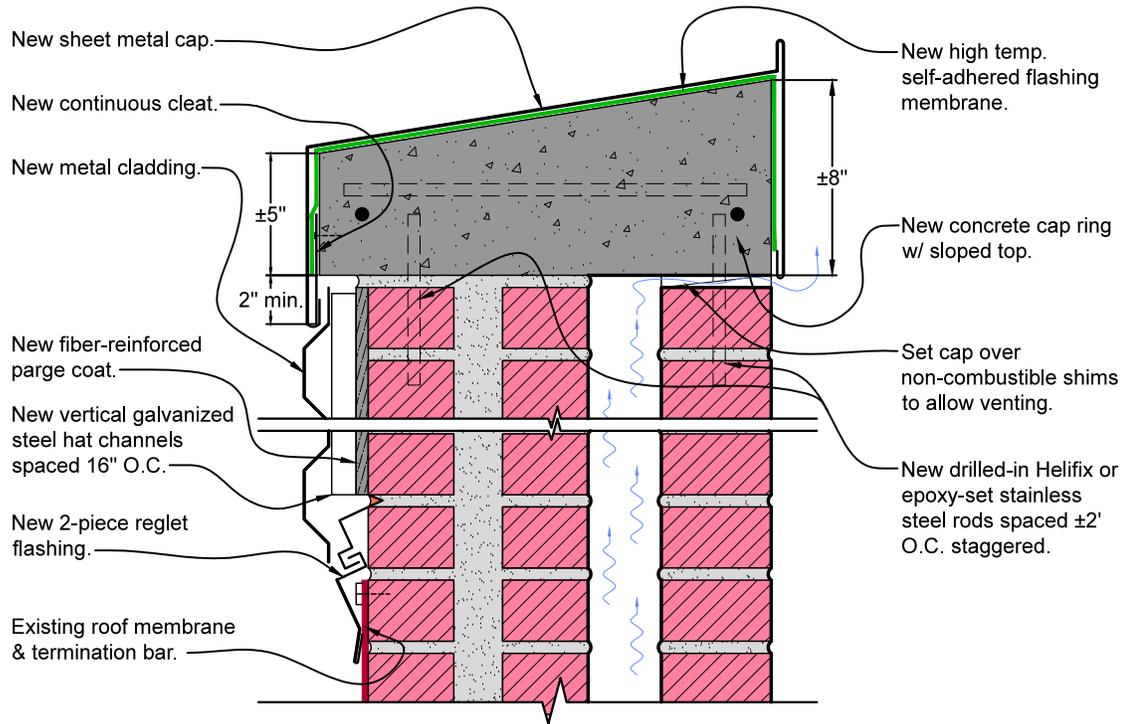
Snap-in lower portion of 24-gage stainless steel or 16 oz. copper flashing to fully cap top of roof membrane or parapet-top flashing.

7. Over-Clad Chimney with Metal Cladding

After parge coat is fully cured, install galvanized steel vertical hat channels near chimney corners and spaced 16" on center in-between, then secure new sheet-metal cladding over this, along with corner trim, etc. as needed. The new cladding can consist of 24-gage pre-finished galvanized or stainless steel, or 16 oz. copper. Dissimilar metals, if any, should be isolated from each other.

8. Install Flashing Cap Atop Chimney

Install continuous cleat of 24-gage galvanized or stainless steel or 16 oz. copper along outer-lower portion of new concrete cap, then apply high-temperature self-adhered flashing membrane, such as Grace Vycor Ultra, over top of concrete cap and over cleat and into chimney flue. Make sure to terminate the membrane at the bottom of the concrete cap, before reaching brick, to allow gasses to vent from behind the firebrick. Then, cap the chimney top with a sheet metal cap of 24-gage galvanized or stainless steel or 16 oz. copper.



**Figure IV-2.5(1): Recommended Chimney Modifications**

## **2.6. Securement of Large Masonry Cladding Elements**

### **2.6.0 General**

This subsection pertains to the securement of the various masonry cladding elements to the primary building structure and to each other. Such elements 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 Basis of Recommendations**

Various of the building's large masonry elements are either not secured to the primary construction in any fashion other than with mortar bond, or where various steel anchors had been used, they appear widely spaced and minimal in many locations.

Further, the mortar bond securing some of these elements has generally degraded, and in some cases has been fully compromised. Some of these elements had also become cracked, further compromising their securement. In addition, corrosion has begun to compromise many of these anchors.

In short, the building appears lacking with respect to the securement of many large masonry elements to the structure and to each other. While this does not threaten the integrity of the building as a whole, it poses risk to pedestrians below in case of an earthquake. This risk will only increase with ongoing loss of mortar bond and corrosion of steel anchors.

### **2.6.2 Recommended Corrective Actions**

In general, recommended corrective actions for this securement issue vary substantially between the different elements, and are thus outlined in greater detail in the subsections addressing these elements individually.

This subsection only provides a "catch-all" recommendation that any larger masonry elements that may not be addressed individually elsewhere be anchored. For clarity, the term "larger elements" refers to masonry blocks whose total volume exceeds about 1.5 CF and whose weight exceeds about 200 pounds. Any such elements not addressed elsewhere should be anchored to the back-up walls and primary structure with a minimum of two Helifix or ½" ø stainless steel threaded rods, and such anchors should be spaced as needed to equal an approximate anchor density of 1 anchor per 2 SF.

## 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 Basis of Recommendations

Many interior partition walls consist of 4" hollow clay tile, with plaster or other finishes applied over these. In many locations on floor levels 1, 2, and 5, these heavy walls stop above the ceilings, with no connections to the upper floor slabs. These partition walls pose a risk of collapsing in earthquakes.

### 2.7.2 Recommended Corrective Actions

The tops of the typical partition walls should be braced to the concrete floor system above them. In general, the bracing consists of installing a steel channel to capture the tops of the hollow clay tile walls, with steel angles bolted or welded onto this channel, spaced roughly 4 feet apart, and extending up at an approximate slope of 45 degrees to the undersides of the concrete beams or floor joists above, to which these should be secured.

Where these hollow clay tile walls occur around elevator and stair shafts, they cannot be easily braced, and at these locations, it is simpler to just replace these walls with steel-framed walls with two layers 5/8" type X GWB both sides to maintain the needed fire rating.

Figure IV-2.7(1) depicts a typical bracing method for the partition walls, while Figures IV-2.7(2-7) indicate the locations where the bracing or replacement with metal stud walls is recommended.

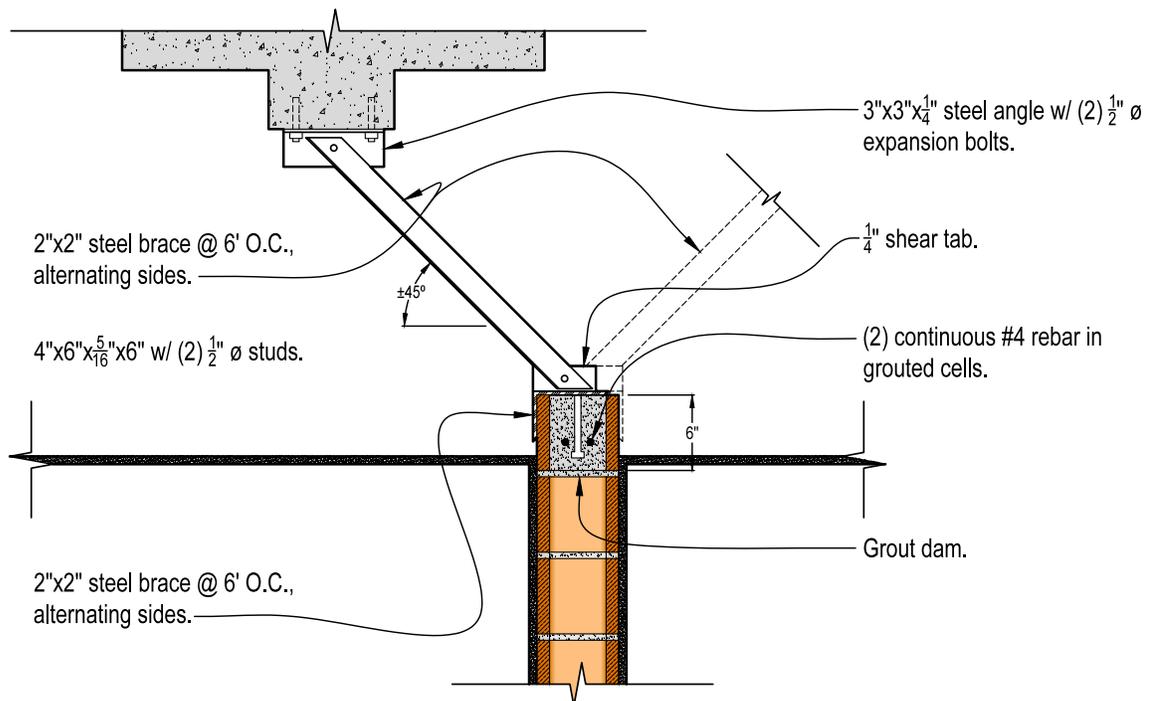
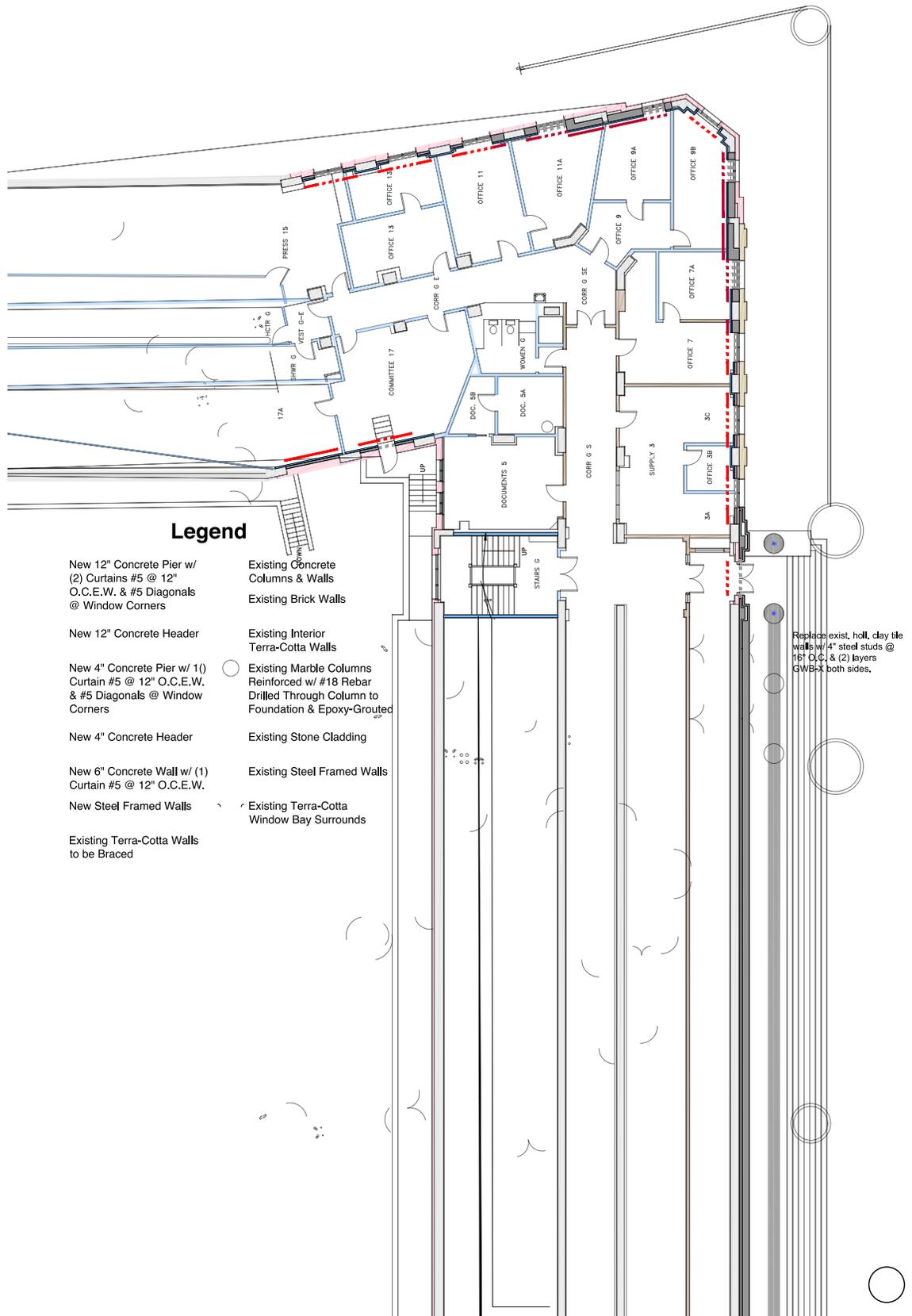
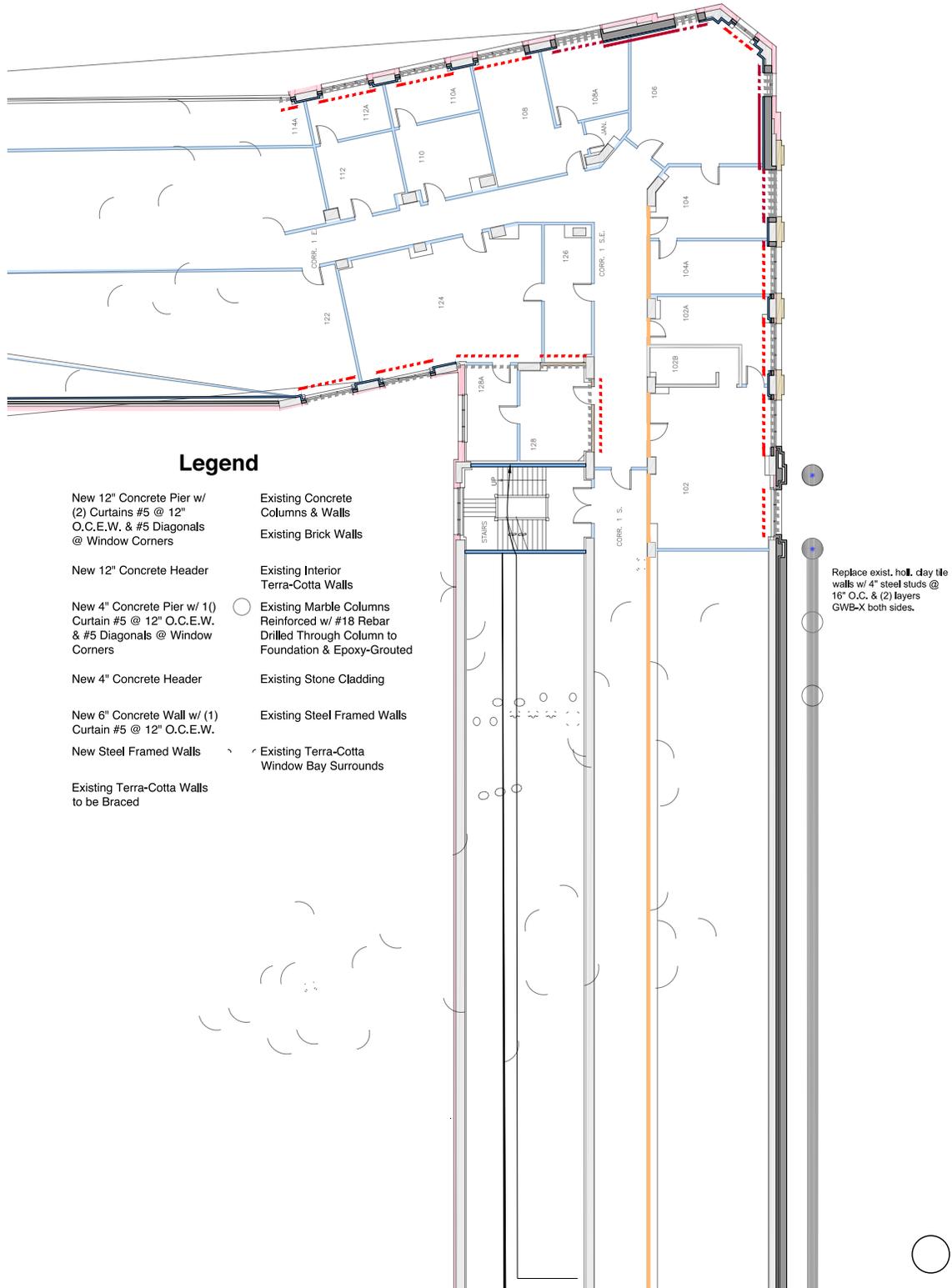


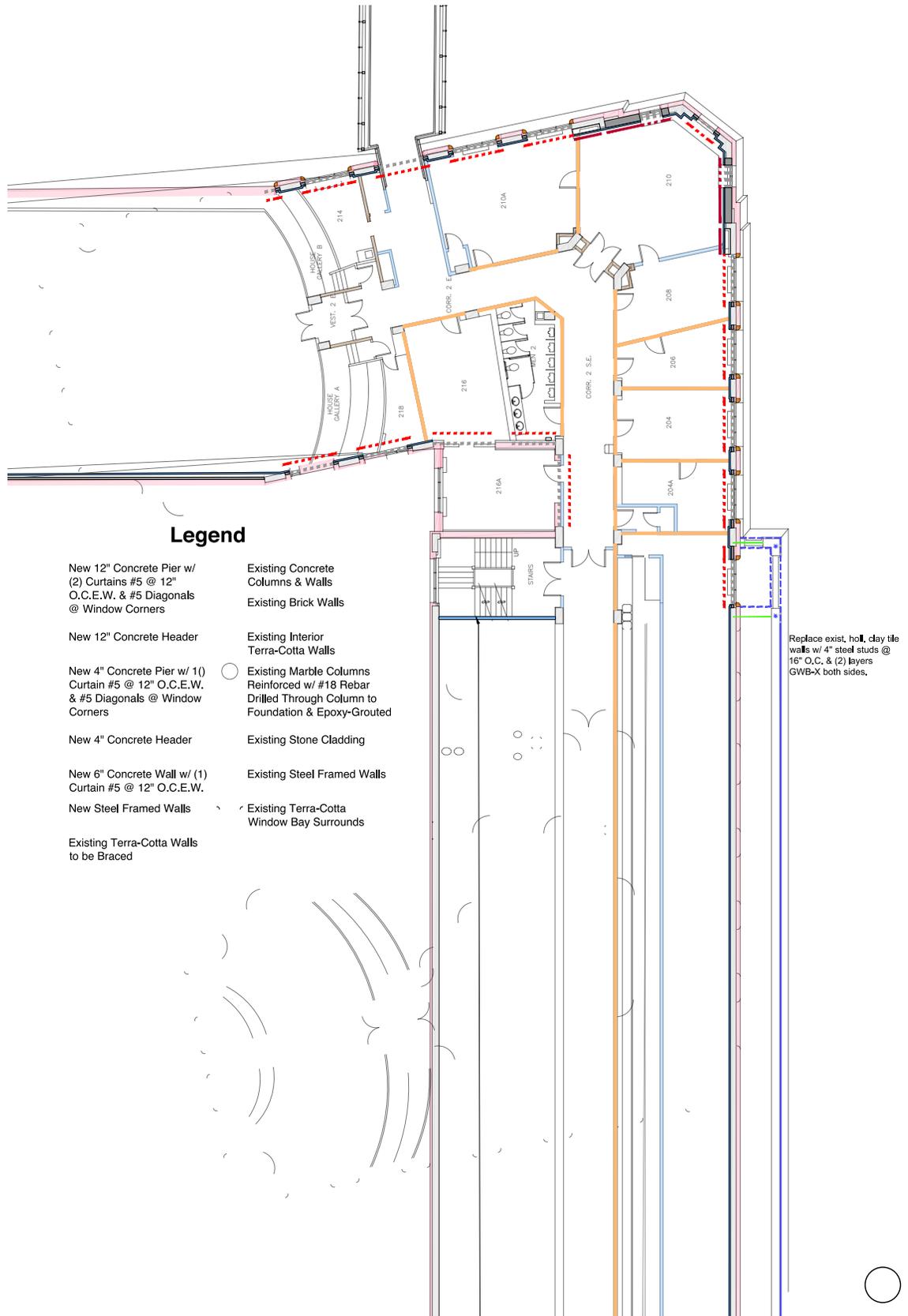
Figure IV-2.7(1): Recommended Hollow Clay Tile Wall Top Bracing



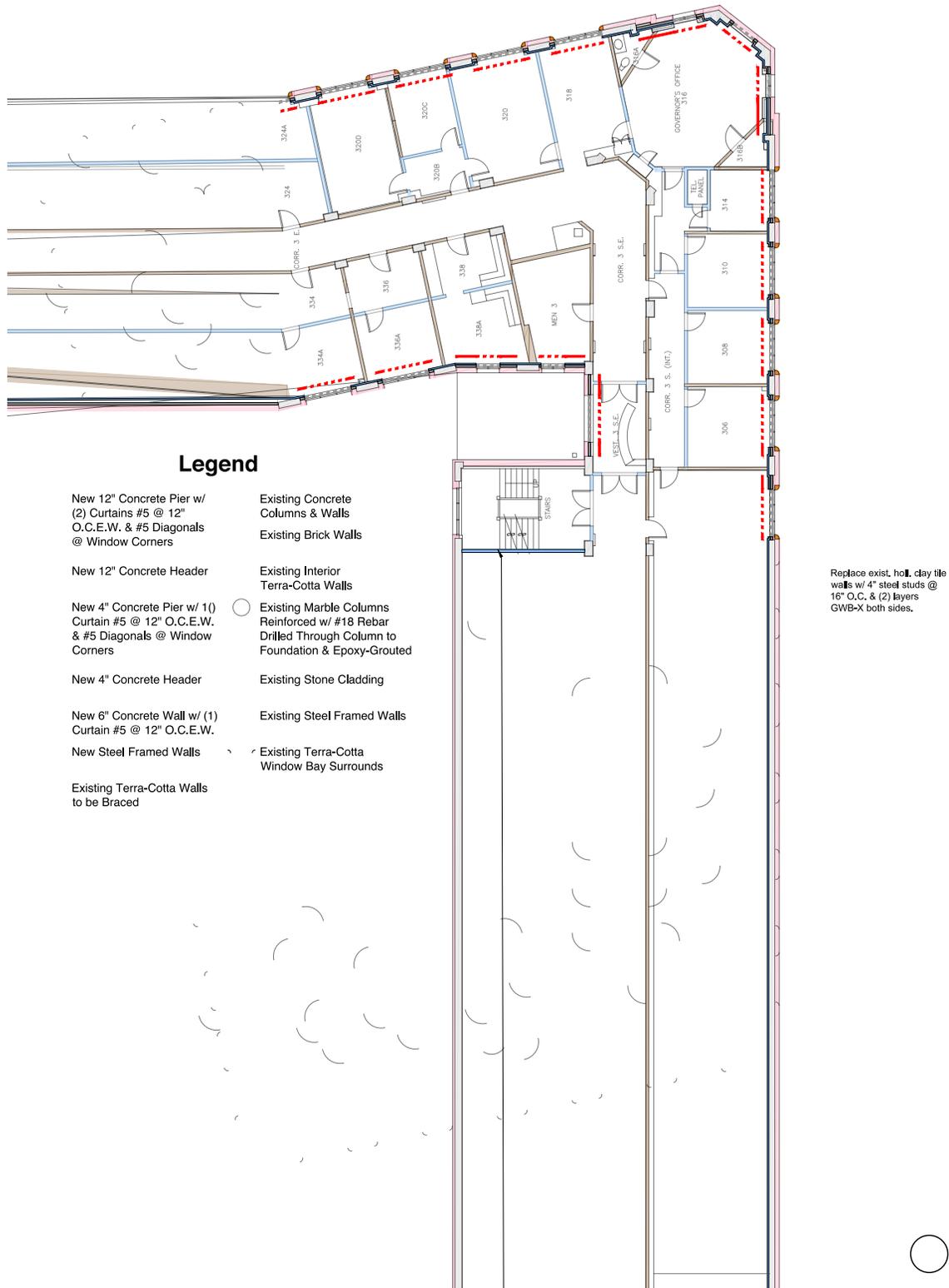
**Figure IV-2.7(2): Recom. HCT Wall Bracing/Replacement Locations-Floor Level 0**



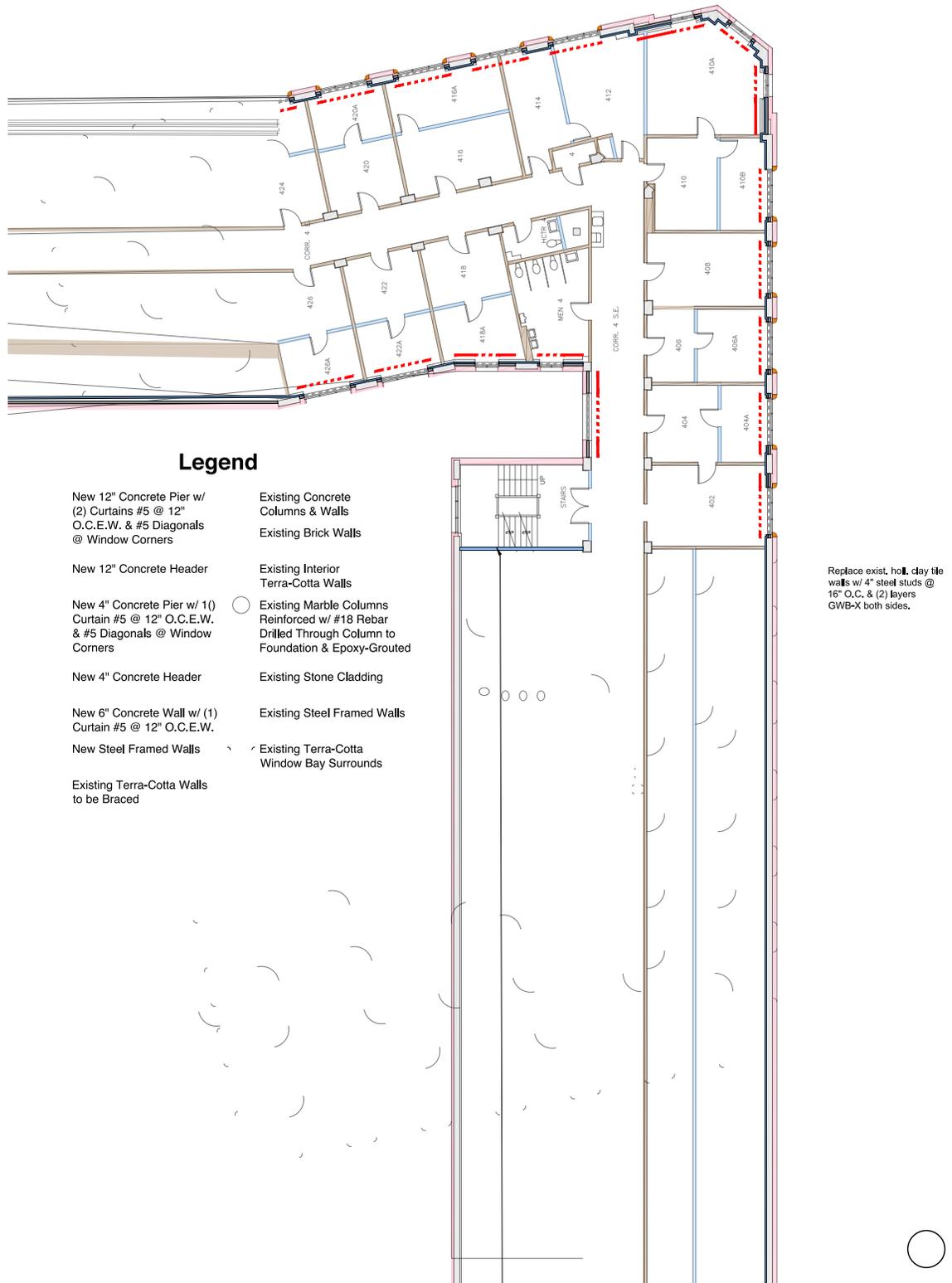
**Figure IV-2.7(3): Recom. HCT Wall Bracing/Replacement Locations-Floor Level 1**



**Figure IV-2.7(4): Recom. HCT Wall Bracing/Replacement Locations-Floor Level 2**



**Figure IV-2.7(5): Recom. HCT Wall Bracing/Replacement Locations-Floor Level 3**



**Figure IV-2.7(6): Recom. HCT Wall Bracing/Replacement Locations-Floor Level 4**



## **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 Basis of Recommendations**

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. These unsecured elements are quite heavy, and pose a risk of overturning or falling in earthquakes.

### **2.8.2 Recommended Corrective Actions**

These heavy elements should be secured to the floors under them, in the case of floor-mounted equipment such as the boiler, and should be braced to the concrete floor system above them where suspended, such as large ducts and piping.

In general, floor-mounted equipment should be bolted to the floors.

Suspended ducting, plumbing, and similar elements can be braced with steel straps spaced roughly 12 feet apart, and extending up at an approximate slope of 45 degrees to the undersides of the concrete beams or floor joists above, to which these should be secured.

### 3. PRIMARY EXTERIOR ENCLOSURE ASSEMBLIES & ELEMENTS

#### 3.0. General

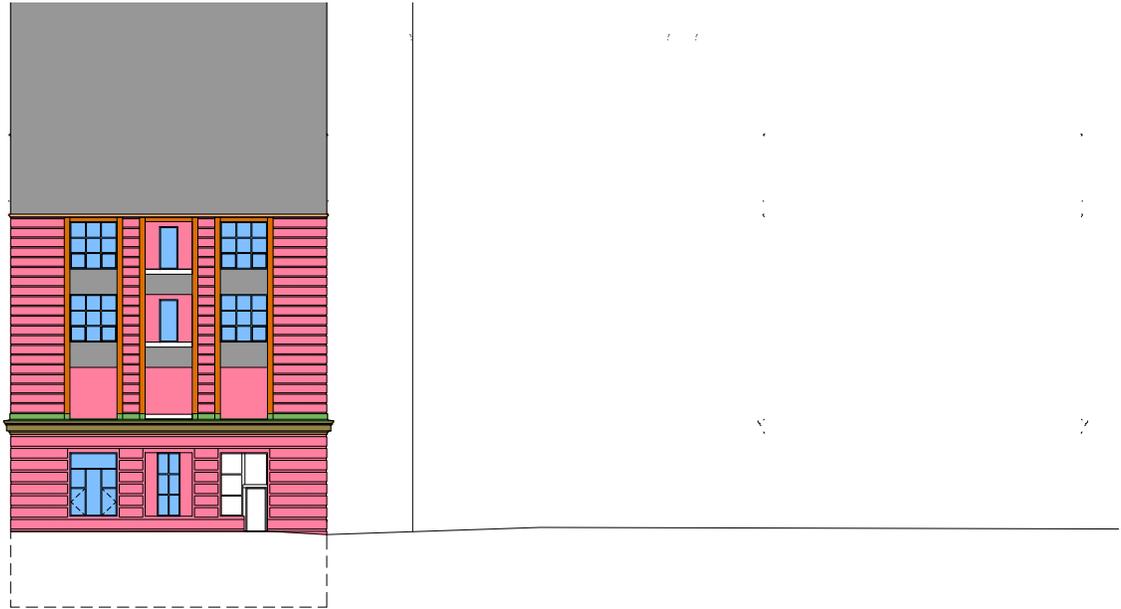
This section of the report addresses issues related to the building's primary exterior elements, such as wall assemblies, ground-level floor slabs, windows, roofs, and similar major components. It is divided into 14 subsections, each of which pertains to a specific primary element. Where appropriate, each subsection contains preliminary drawings depicting the described work. In addition, Figures IV-3.0(1-7) show the exterior elevations which reference the locations of specific details in the various subsections.



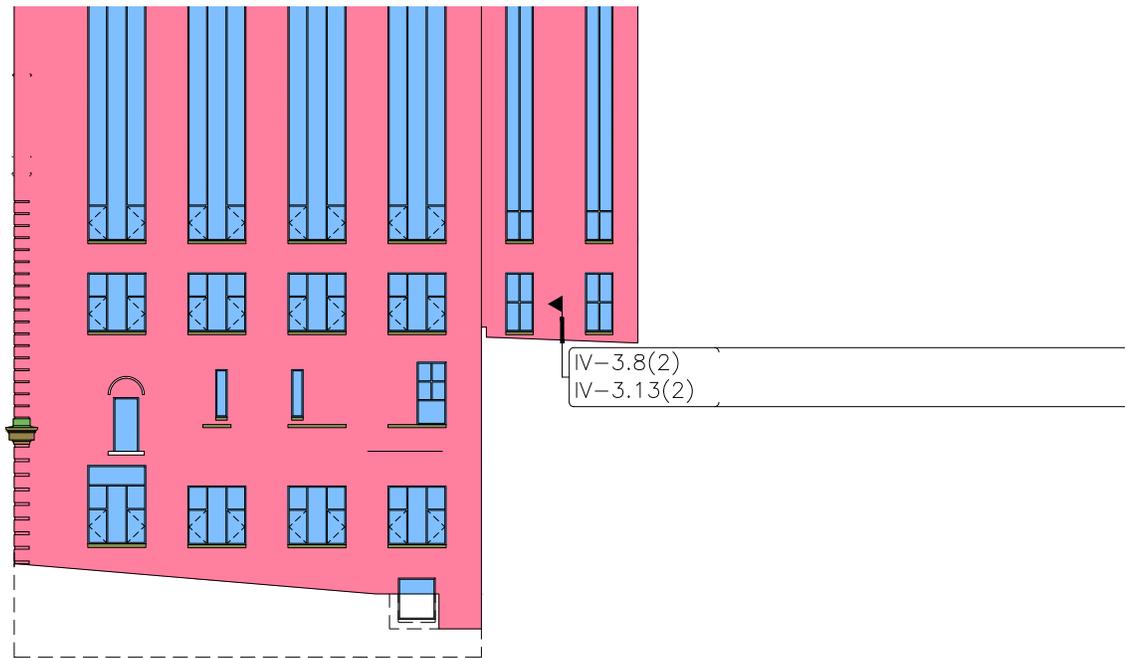
**Fig. IV-3.0(1): South Elevation**



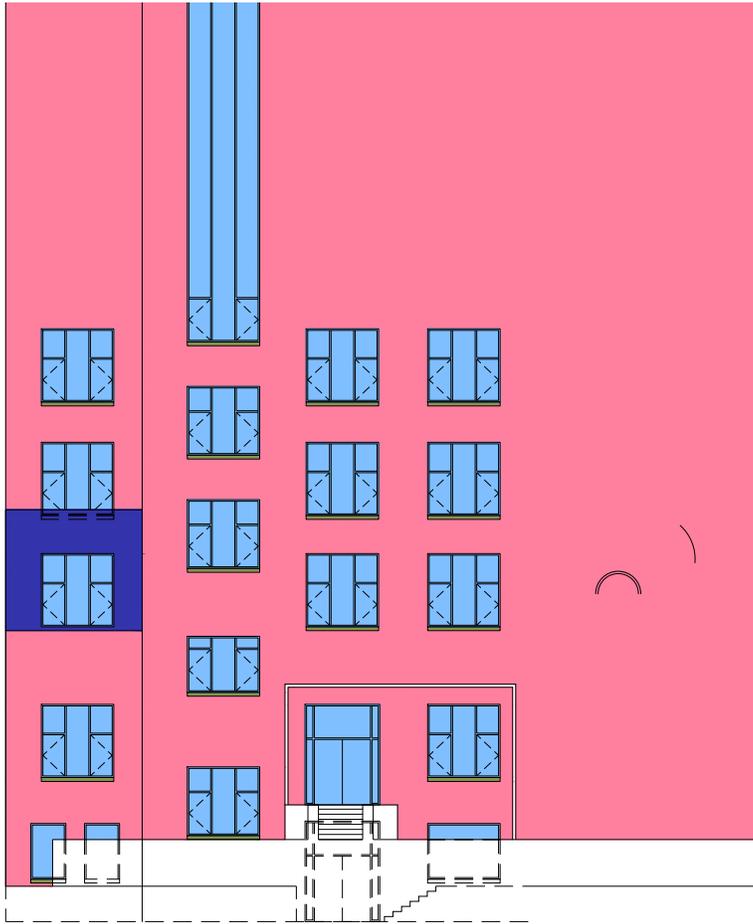
**Fig. IV-3.0(2): West Elevation**



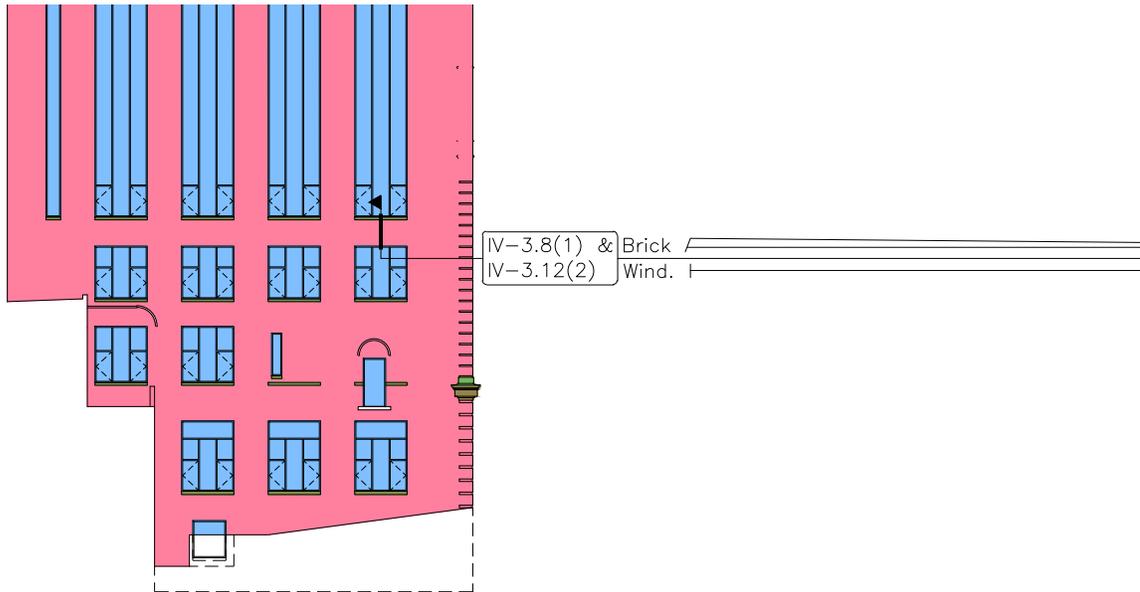
**Fig. IV-3.0(3): North Elevation**



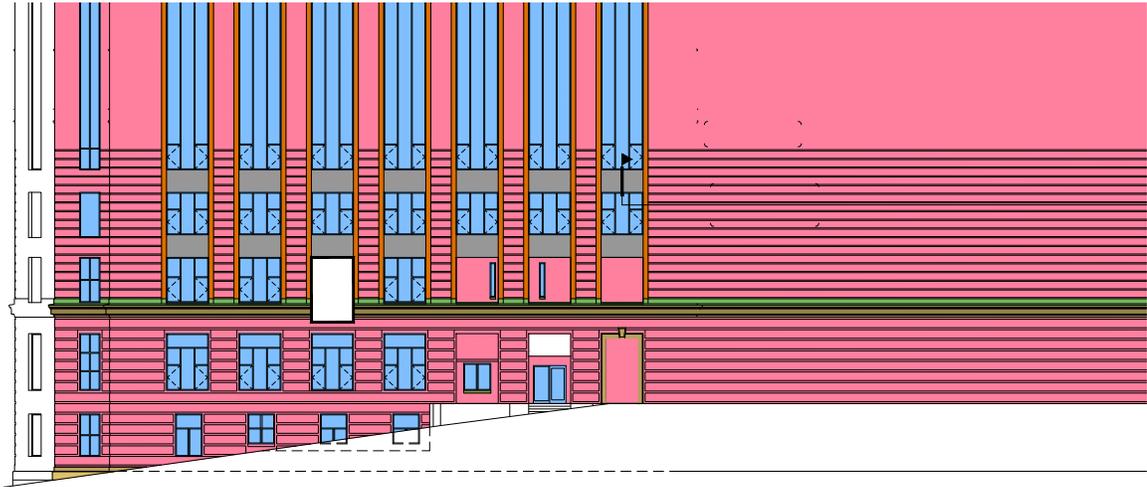
**Fig. IV-3.0(4): North Courtyard: West-Facing Wall**



**Fig. IV-3.0(5): North Courtyard: North-Facing Wall**



**Fig. IV-3.0(6): North Courtyard: East-Facing Wall**



**Fig. IV-3.0(7): East Elevation**

### **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 Basis of Recommendations**

Exposed sloping soil forms the crawl space floor, and the underside of the concrete-framed level-1 floor comprises its ceiling. The crawl space is characterized by very wet and humid conditions, with a small continuous stream running through this space. Consequently, many concrete elements, such as the foundations and floor joists, display corrosive spalling and efflorescence.

The exposed, water-saturated soils are having a very detrimental effect on the integrity of all exposed concrete. Water is being absorbed directly from soil into the foundations, but atmospheric moisture alone is causing the concrete floor joists to spall.

#### **3.1.2 Recommended Corrective Actions**

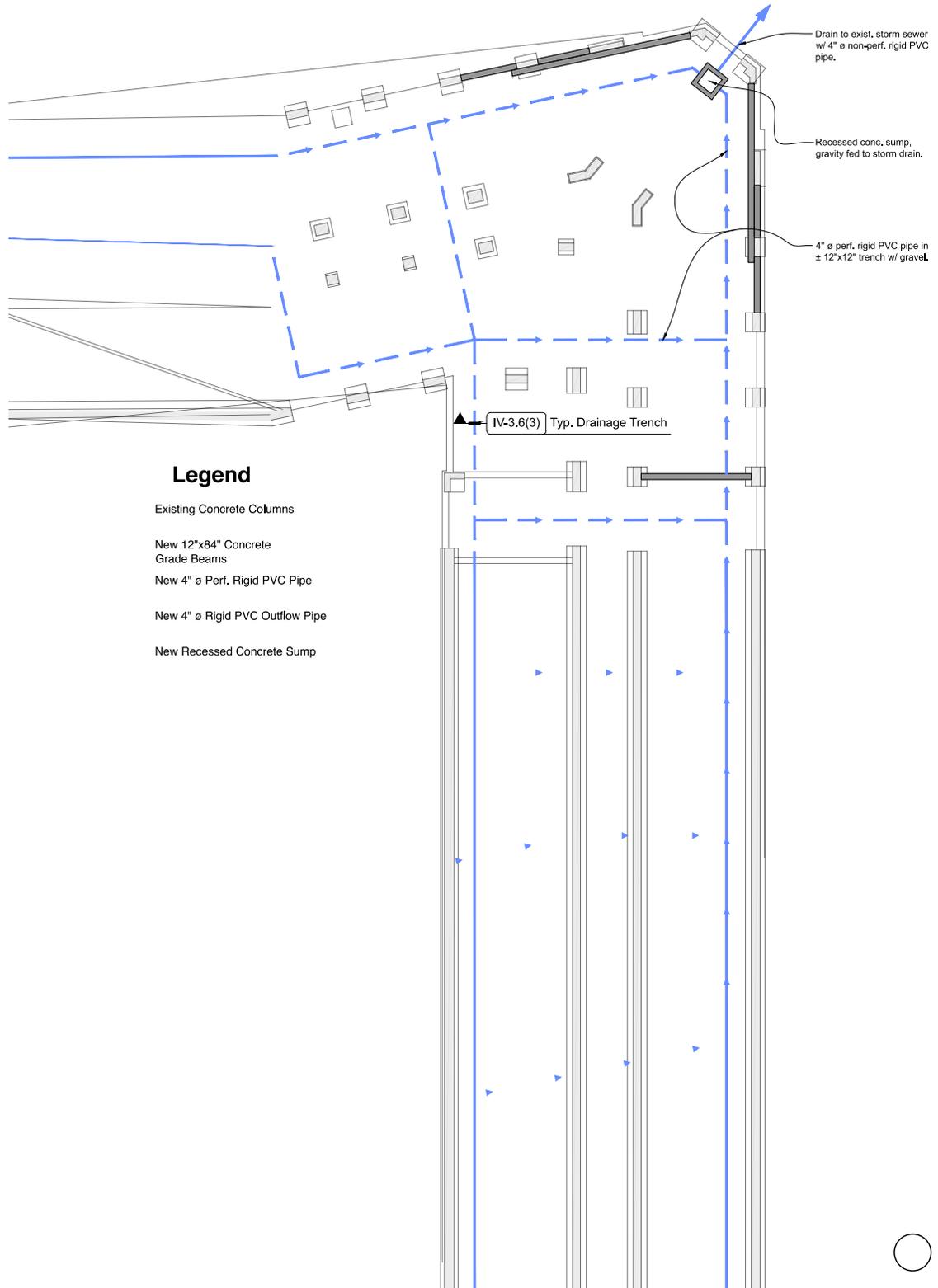
Please see subsections IV-2.2 and IV-2.3 for additional related corrective measures not described here. Recommended corrective measures within this section are two-fold, and include the installation of a gravity-fed drainage system and soil-capping with a cross-laminated vapor-barrier, as well as optional capping with a 2" thick, fiber-reinforced shot-crete "slab" to help protect the vapor barrier and further reduce humidity.

The recommended drainage system consists of excavating a grid-work of roughly 12" square trenches throughout the crawl space, as generally shown in Figure IV-3.1(1). To the extent feasible, these trenches should slope about 2% toward the SE corner, where a recessed, concrete-lined sump, about 3'-0" square and 2'-0" deep, should be installed. This sump should gravity-feed into the storm-drain via a 4"  $\emptyset$  non-perforated rigid PVC pipe.

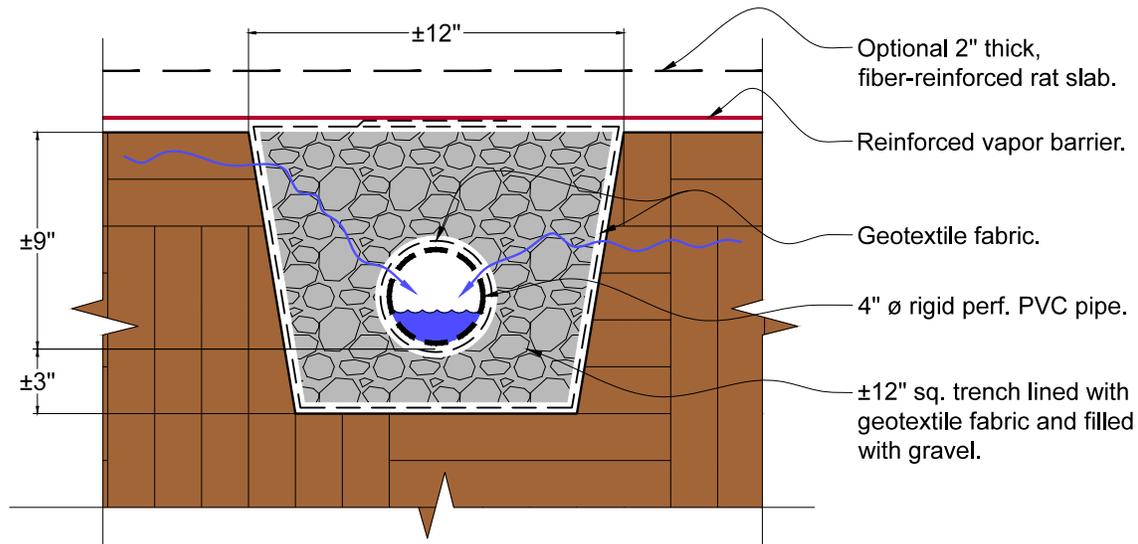
The trenches should be lined with a geotextile fabric, such as Mirafi 140 N, then filled with about 3" of gravel. This gravel base should be overlaid with 4"  $\emptyset$ , perforated rigid PVC pipes wrapped with geotextile fabric. Gravel should then fill the remainder of the trench, and the geotextile fabric should wrap over the top.

A heavy-duty, reinforced or cross-laminated vapor barrier, such as Griffolyn T-85, should then be placed over the entire crawl space floor. All laps and rips should be taped with the manufacturer's vapor-barrier tape, and the perimeters should also be taped to the perimeter foundations.

Figures IV-3.1(1 & 2) describe the work recommended in this subsection.



**Fig. IV-3.1(1): General Configuration of Recommended Drainage System**



**Fig. IV-3.1(2): Typical Drainage Trench**

## 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 Basis of Recommendations

These floor slabs were examined only in the west wing, where elevated moisture levels were detected within this slab in the shop area, and occupant-staff reported occasional leakage via a slab crack 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.

The drawings indicate that the boiler-room slab may incorporate waterproofing between two slabs, but this waterproofed sandwich-slab does not extend under the shop area, which has no waterproofing, and occasional limited leakage occurs there.

A wide spectrum of possible corrective approaches could be applied to control the slab infiltration, with a correspondingly wide spectrum of costs. At the extreme end, one could remove the existing floor slab, install sub-slab drainage and waterproofing systems, and replace the floor slab. This would be a very costly approach, which does not appear warranted by the shop-use of this area, which can generally accommodate some occasional limited dampness, unlike a carpeted office space, for example.

In view of these considerations, recommended corrective work is quite limited, and consists of injecting the leaky floor crack and floor-wall cold joints with epoxy. It should be understood that this may not prove entirely effective, but is recommended as a first approach due to its vastly lower cost and general moisture-tolerance of the affected spatial use. More robust, and costlier, measures can be retrofitted if the epoxy injection fails to solve the infiltration and the owner wishes to expend the funds for beefier measures.

### 3.2.2 Recommended Corrective Actions

Recommended corrective measures include injecting all accessible floor cracks and the perimeter of the shop slab where it joins the basement walls with epoxy, such as Sika Sikadur 35 Hi-Mod LV LPL, Sikadur 52, etc., as appropriate for specific conditions.

### **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 Basis of Recommendations**

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, though I was told that no current leakage affects this east-wing basement, in spite of the symptoms, which imply otherwise. In view of this, it appears prudent to assume that leakage is affecting the east wing walls, via shrinkage cracks, cold-joints, and possibly rock-pockets. Over the long term, this could begin affecting the walls' integrity through reinforcing corrosion.

#### **3.3.2 Recommended Corrective Actions**

No corrective work is recommended for the west wing's sub-grade walls, other than those outlined for the wall-floor junctures in subsection IV-3.2.2.

Recommended corrective measures at the east wing are as follows:

1. **Remove Interior Finishes from Locations Displaying Moisture Damage**

Remove interior finishes to expose interior concrete surfaces to view. Brush and clean off efflorescence and dirt, and remove any spalled concrete to create sound, clean concrete surfaces.

2. **Inject Epoxy Into All Exposed Concrete Cracks and Cold Joints**

Where removal of interior finishes reveals cracks or cold joints, inject these with appropriate epoxy resins, such as Sika Sikadur 35 Hi-Mod LV, etc.

3. **Repair Rock Pockets, Voids, and Similar Flaws**

Where rock pockets and similar flaws are found upon removal of the interior finishes, remove all loose concrete to sound concrete. Depending on conditions, fill all voids with Kryton Krystol Plug for actively leaking areas, or coat dry but flawed areas with Kryton Krystol T-1. Cap over this with Kryton Bari-Cote, then coat entire exposed concrete surface with Kryton Krystol T-1.

4. **Reinstall Interior Finishes**

Reinstall new interior finishes to match adjacent.

### **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 Basis of Recommendations**

This stone base, especially along the very bottom, has effectively been destroyed by moisture absorption and freeze-spalling. The securement of the stone to the structure is minimal to begin with, and the steel wire anchors 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. Further, continued corrosion will also compromise the stone anchors, leading to instability of this stone base.

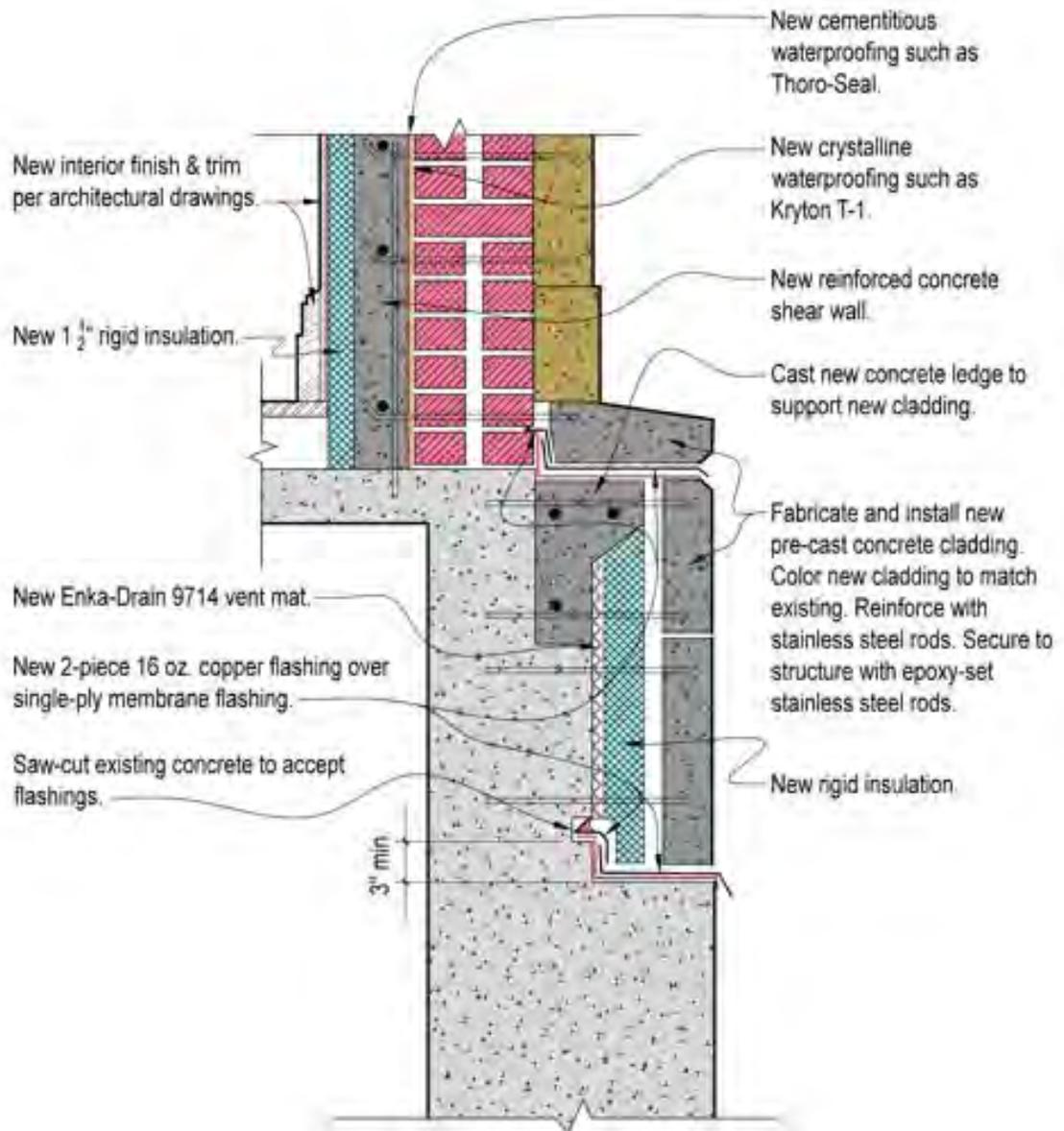
#### **3.4.2 Recommended Corrective Actions**

In view of the advanced degradation of this stone base, replacement with a pre-cast concrete cladding is advised.

The new cladding should be integrally colored and textured to match the existing stone cladding's appearance, and it should be reinforced only with stainless steel reinforcing to avoid future corrosion spalling. For cost estimating purposes, the cladding should be assumed 4" thick.

It can be anchored to the structure with epoxy-set stainless steel threaded rods, or with stainless steel embedded clips, etc.

Figure IV-3.4(1) depicts replacement of this stone base.



**Fig. IV-3.4(1): Stone Base Replacement with Restoration of Exist. Cladding Abv.**

In broad terms, the recommended corrective measures are as follows:

1. Stabilize Stone Cladding Above Stone Base

Stabilize the stone cladding above to allow removal of the stone base. In brief, stabilization would require drilling stainless steel anchor rods through the brick walls into the cladding, then casting interior concrete walls, as generally described in subsection IV-2.1. Once this upper cladding has been secured, the stone base can be removed.

2. Cast New Concrete Ledger Below Stone Base Water Table

A new reinforced concrete ledger should be cast directly below the projecting water table to support the new water table.

3. Install New Membrane and Copper Base Flashings

Saw-cut a continuous horizontal reveal at least 3" above the existing concrete ledge to accept a new, double-layer base flashing consisting of a single-ply membrane capped with a 2-piece, 16-ounce copper flashing. The single-ply membrane can consist of Cetco Core-Flash 60. Figures IV-3.4(3 & 4) illustrate similar work at a different project.



**Fig. IV-3.4(3): Adhered Single-Ply Membrane Flashing & Saw-Cut Reveal**



**Fig. IV-3.4(4): 2-Piece Copper Flashing Over Single-Ply Membrane Flashing**

#### 4. Install Anchors For New Cladding

Quite a variety of anchoring methods can be used to secure the new cladding, and detailed analysis of optimal methods is beyond this cost-focused report's scope. In brief, anchor methods can include standard masonry veneer ties, embedded clips, as well as drilled-in, epoxy-set rods. The rod-method is described as a basis for cost estimating, though the specific method will probably have limited cost impact.

Regardless of specific anchoring method, all anchors should be type 304 stainless steel to avoid corrosion. The number of anchors per cladding piece will vary, depending on size of cladding piece being secured, but no fewer than two anchors should secure each piece, and at least one anchor should occur for every 2 SF.

With the rod method, the existing concrete wall should be drilled at least 4" deep, and roughly 1/2"  $\varnothing$  stainless steel threaded rods should be epoxy-set into these holes. The rods should be of sufficient length to penetrate into the cladding to within 1 1/2" of its outer surface.

#### 5. Install New Vent Mat and Rigid Insulation Over Existing Concrete Wall

Spot-adhere with sealant or otherwise secure new thin vent mat, Colbond Enka-Drain 9714 over the existing concrete wall face to facilitate drainage behind new insulation. Install vent-mat with fabric side facing outward.

Install rigid, 2" thick, extruded polystyrene insulation, such as Dow Board, over the vent mat and anchors.

#### 6. Install New Color-Matched Pre-Cast Concrete Cladding Over Lower Wall Portion

Drill or cast-in oversized holes into back side of pre-cast concrete cladding pieces to accept stainless steel rods. Drill holes to within about 1 1/2" of outer cladding surface. Inject holes with epoxy, set over anchor rods, and brace in place till epoxy sets.

#### 7. Install New Membrane and Copper Flashings Under Projecting Water Table

Saw-cut a continuous horizontal reveal along existing mortar bed joint in brick wall behind water table to accept a new, double-layer base flashing consisting of a single-ply membrane capped with a 2-piece, 16-ounce copper flashing. The single-ply membrane can consist of Cetco Core-Flash 60. Figures IV-3.4(3 & 4) illustrate similar work at a different project.

#### 8. Install New Color-Matched Pre-Cast Concrete Water Table Pieces

Drill or cast-in oversized holes into back side of pre-cast concrete water table pieces to accept stainless steel rods. Drill holes about 4" deep. Apply blobs of type S mortar over copper flashings, with gaps between blobs to allow drainage from under water table pieces. Inject holes in pieces with epoxy, set over anchor rods, and shim in place till mortar and epoxy set.

## 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 IV-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 IV-5.3.

### 3.5.1 Basis of Recommendations

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. This exacerbates moisture intrusion and interior leak risk, and accelerates degradation of the cladding and its metal anchors. Consequently, the cladding displays scattered erosion, cracking, mortar delamination, and similar symptoms. In addition, all ground-level stone sills in this cladding are cracked at one side.

The stone cladding pieces are secured with a single 3/8" ø steel wire drilled 2" into each of the larger 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. Further, these minimal anchors have begun to corrode, in a few locations causing spalling. Though this does not threaten the integrity of the building, it poses risk to pedestrians below in case of an earthquake.

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

However, unlike the stone base directly below, this cladding is not yet entirely destroyed, and its restoration appears feasible, though this will only yield a limited lifespan of perhaps another 40 years before corrosion of the existing anchors will bring about unsustainable spalling.

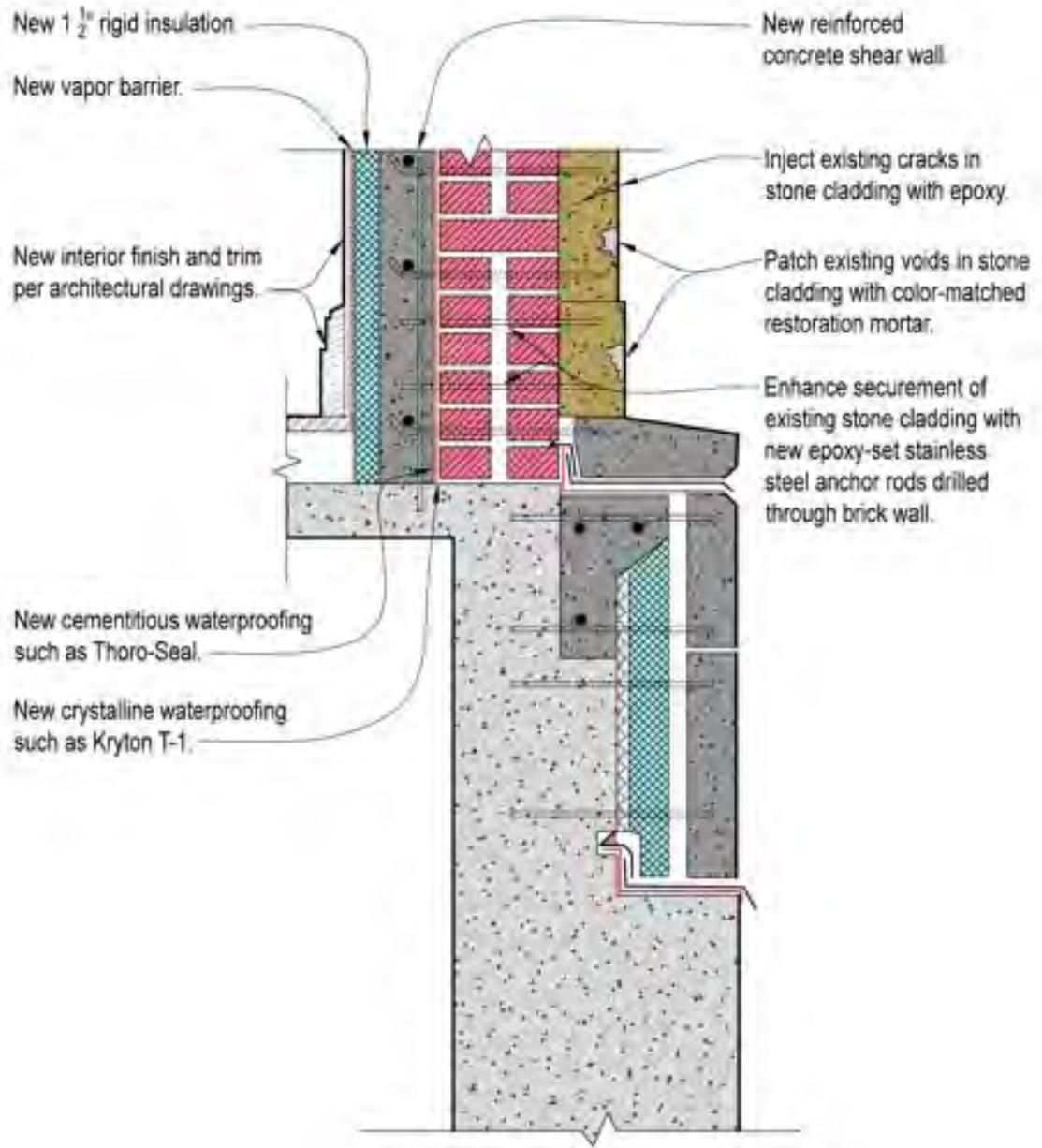
Another relevant consideration is the fact that this cladding must be replaced where it occurs under the portico roof, where it is seismically damaged and also serves the structural function of supporting the heavy portico roof. This is addressed in greater detail in subsection IV-5.3. This consideration argues for the replacement of this cladding even where not under the portico roof.

Similarly, as outlined in subsection IV-3.4, the stone base directly below this cladding also needs to be replaced, as it is essentially destroyed. This also argues in favor of wholesale replacement of this stone cladding, even though its life can be extended with lesser measures.

In short, the technically optimal corrective approach would be to replace the existing cladding, as this would better match the appearance of the adjacent portions which need to be replaced, and would provide a much longer-lived and better-secured cladding. Thus, I recommend the Cladding Replacement approach in Options 2 & 3 (Parts V & VI). Option 1 includes the Cladding Restoration approach, which would be to re-anchor and restore the existing cladding to harvest its remaining lifespan more fully, and to give the state some sort of cost comparison.

### 3.5.2 Recommended Corrective Actions

In general terms, the Cladding Restoration approach is depicted in Figure IV-3.5(1), and the verbal description of the work follows the drawing.



**Fig. IV-3.5(1): Stone Cladding Restoration**

The Cladding Restoration approach consists of the following steps:

1. Remove Int. Hollow Clay Tile and Install New Int. Concrete Walls and Pins at Levels 0 & 1

This work is described in greater detail in subsection IV-2.1.2.

The number of anchors per cladding piece will vary, depending on size of cladding piece being secured, but no fewer than two anchors should secure each piece, and at least one anchor should occur for every 2 SF.

Stainless steel, ½" ø rods would be drilled through the brick walls or concrete columns to penetrate the cladding to within 1 ½" of its outer surface, and should be epoxy-set in both the cladding and walls or columns.

2. Replace Stone Base Below Stone Cladding

This work is described in greater detail in subsection IV-3.4.2.

3. Inject Cracks in Stone Cladding with Epoxy

Major cracks in the cladding pieces should be injected with appropriate epoxy resins, such as Sika Sikadur 35 Hi-Mod LV, etc.

4. Restore Surface Voids, Spalled Areas, etc. with Appropriate Restoration Mortar

Surface voids, spalled areas, and similar surface flaws should be patched with appropriate restoration mortars, such as Jahn Restoration Mortar by Cathedral Stone Products Inc.

5. Repoint Eroded, Cracked, or Damaged Mortar Joints with New Mortar

Where existing mortar joints are cracked, eroded, or otherwise damaged, selectively repoint such joints to a minimum depth of ¾" with color-matched, type N mortar, and tool joints to match existing ones.

6. Clean Masonry Surfaces

Clean exposed masonry surfaces with appropriate cleaners, such as ProSoCo Sure-Klean 766 Limestone & Masonry Pre-Wash followed by Limestone & Masonry After-Wash, etc.

7. Consolidate and Seal Stone Cladding

Apply appropriate consolidating & repellent agent, such as ProSoCo Conservare H-100, etc.

## **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. Elements integral to these walls, such as steel lintels above the windows, are also addressed here.

### **3.6.1 Basis of Recommendations**

Issues affecting these brick-clad walls relate to their general design and the resultant cladding condition, and the walls' and cladding's anchorage to the primary structure.

In general, the design of these walls is not well suited to Juneau's cold, wet climate in several ways.

First, none of these walls incorporate any flashings or weep holes to drain any water back out of the brickwork. This contributes to interior leakage in various locations, exacerbates degradation, and is largely responsible for severe damage at the portico roof structure and ceiling.

Header courses, though structurally needed, encourage water penetration deep into the wall assemblies, and complicate retrofitting of effective drainage flashings.

Recessed header courses and deeply raked mortar joints also increase moisture intrusion and associated degradation of the brick and mortar.

As a consequence of these design issues, 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, variable degrees of lintel corrosion, widespread brick spalling, etc.

The brickwork also displays scattered, probably seismically induced cracks in some locations.

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.

With regard to anchorage, the brick wythes are well interconnected via many header courses. However, the brick walls themselves appear to rely primarily on mortar bond to the floor slabs that support them, and it is not clear whether the brick walls are connected to the concrete columns. This may pose a risk to pedestrians below in case of an earthquake.

The use of light-colored brick, which is often an indicator of lower-strength, more absorbent brick, may also have contributed to the fairly widespread spalling and surface erosion.

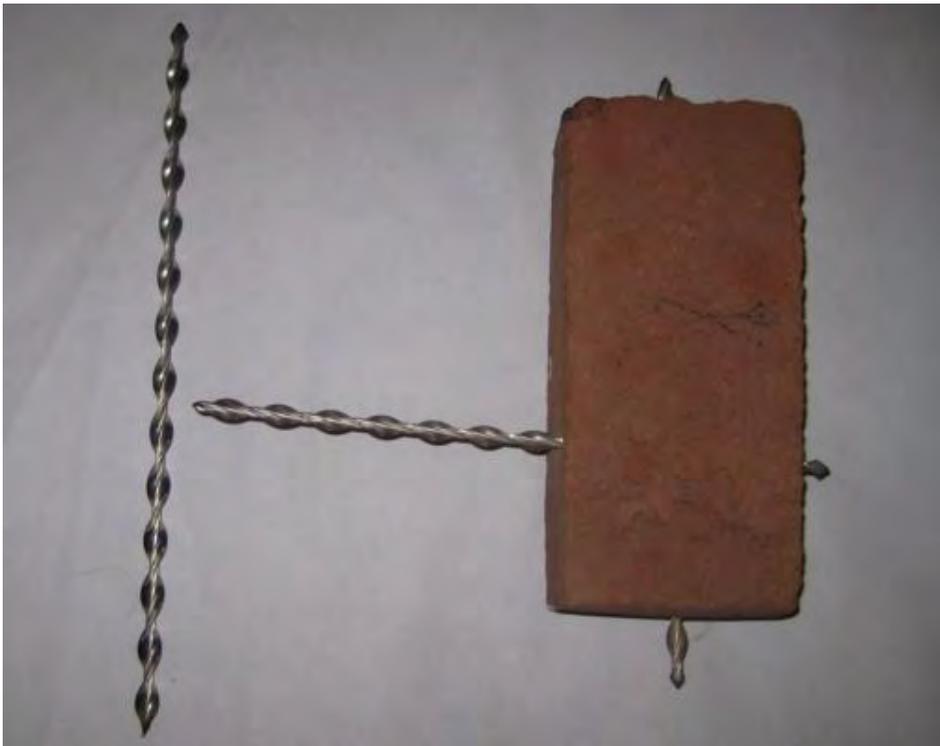
Unfortunately, Juneau's challenging climate, the specific configuration of the brickwork, and the already advanced erosion of the outermost brick faces, will lead to ongoing spalling, which can be slowed down, but cannot be effectively stopped, by treating with consolidating agents. This consideration, and the infiltration-prone wall assemblies, pose inherent limitations of this "retrofit" approach. With this approach, it appears prudent to plan on an ongoing maintenance program of re-sealing as well as replacement of spalling brick. Based on the degradation observed to date, I venture a guesstimate that after the initial replacement of presently spalled brick is executed as part of this work if this approach is pursued, roughly 0.5% of the brick in weather-exposed locations will continue to spall annually. Another way of saying that is that every 10 years, about 5% of the exterior brick wythe in weather-exposed locations may need to be replaced.

### 3.6.2 Recommended Corrective Actions

The recommended work is divided into three general categories, including structural anchorage, water-integrity enhancements, and restoration work. These often overlap in various locations. It is also critical for the work to be properly sequenced to maintain stability during the installation. For example, before brick can be removed to retrofit flashings, the brickwork above has to be re-anchored. However, a detailed discussion of sequencing considerations falls outside the scope of this phase of the work.

Let me begin with anchorage work, which itself can be divided into two categories, including anchoring brickwork where it occurs over concrete columns as well as where multi-wythe brick represents the entire wall assembly, with no existing concrete columns.

Where the brickwork occurs over existing concrete columns, which represents the large majority of the “public” façades, the brickwork can be anchored per conventional retrofit methods, using stainless steel helical “Helifix” anchors, shown in Figure IV-3.6(1).

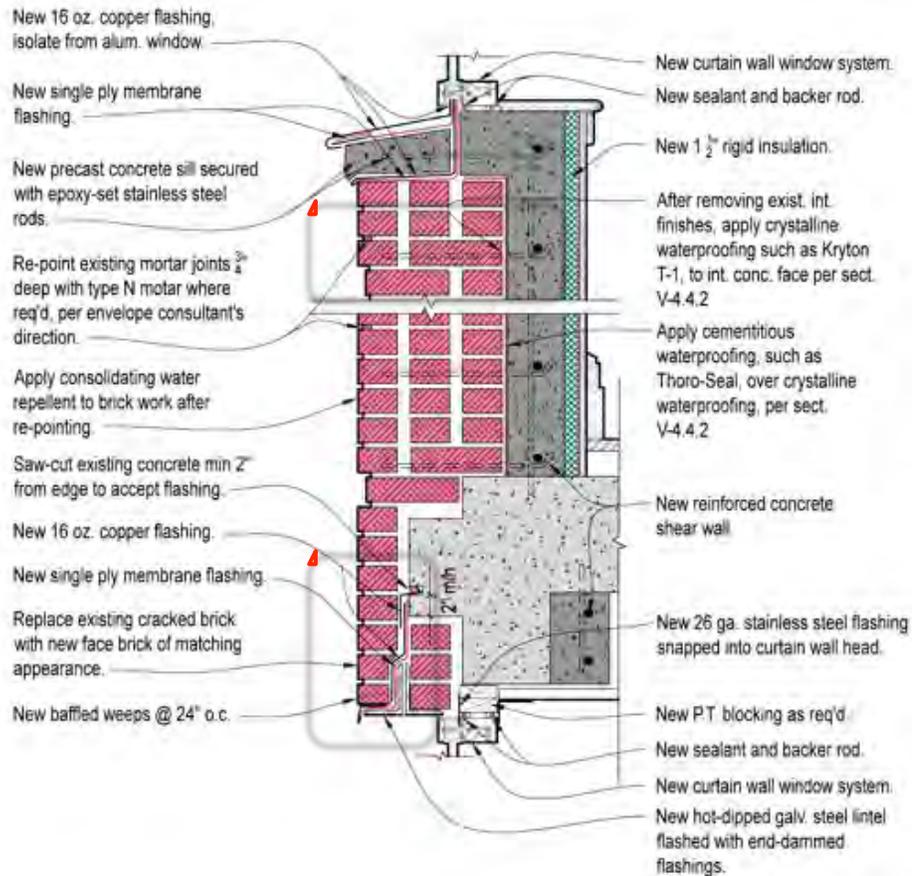


**Fig. IV-3.6(1): Helical Helifix Masonry Anchors**

These anchors should be drilled from the exterior through mortar T-joints at least 4” into the concrete columns. As the brickwork in most column locations includes two spaced wythes with a thickness of 9”, plus another joint between the brick and concrete, this will require 14”-16” drilled holes. After the drilled holes are cleaned out, the anchors should be installed and be recessed about 1” from the outer mortar face. The anchors should be spaced to provide at least 1 anchor per 2 SF of area. With the typical header coursing in this building’s brickwork, I recommend that the anchors be drilled into T-joints just above each header course, spaced 16” apart horizontally. This will yield a spacing of 16” horizontally and 18” vertically, which produces the desired 2 SF per anchor. A vertical line of anchors should be placed about 4” away from each vertical brick panel edge.

In locations where mortar joints are to be repointed, the repointing can be used to cap over the anchors. Where no repointing is needed, the anchors can be capped with an appropriate sealant, such as Dow 790, with sand added to the surface to mimic mortar.

Where the outer brick occurs over brick walls, which occurs only in some limited portions of the “public” façades, new interior concrete walls are also to be added, as described in subsection IV-2.1, and this affords an opportunity to drill the anchors from the interior and integrate these into the new concrete walls. This also allows the anchors to be drilled into the brick units, rather than into the mortar joints. The same “Helifix” anchors can be used for this, as well as epoxy-set stainless steel threaded rods, among others. Spacing should again be 16” apart horizontally and 18” apart vertically. Figure IV-3.6(2) shows this method at these brick walls.



**Fig. IV-3.6(2): Brick Anchorage and Lintel Flashings at Brick Walls**

The water-integrity enhancement work consists of retrofitting of interceptor flashings at strategic locations to drain water back out of the brickwork and avoid its excessive accumulation within the wall assemblies. Four different types of locations appear suitable for retrofit flashings, including:

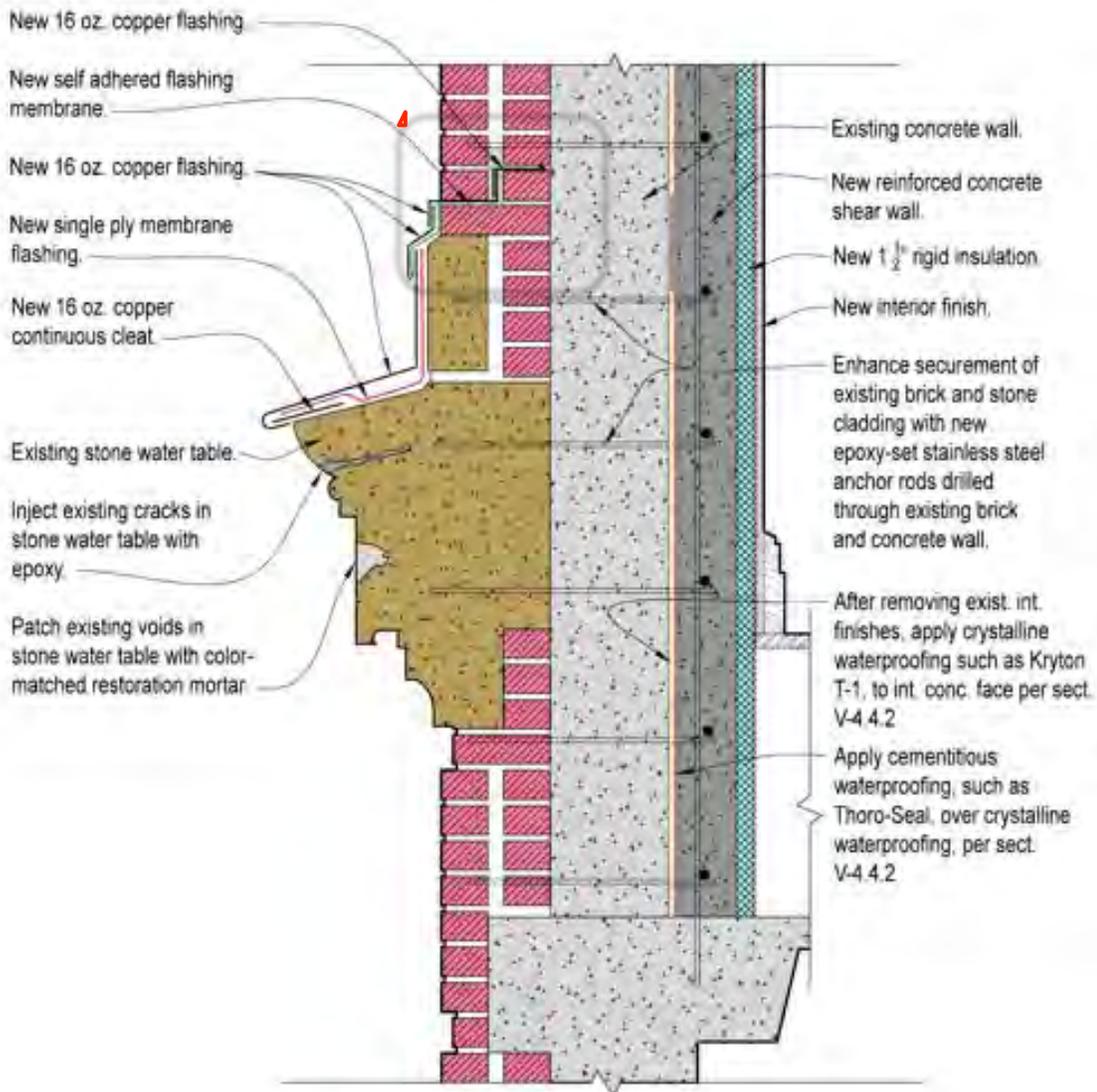
1. Above All Accessible Steel Window-Head Lintels

Where head lintels are exposed, such as at the SE corner, the existing lintels are corroding to varying degrees, and should be replaced. Figure IV-3.6(2) shows the basic method, which must begin by placing the interior concrete walls and brick anchors above, and will also probably require temporary bracing to maintain stability. About 5 brick courses above the lintel need to be removed to access the steel double-lintel. The outer of these should be replaced with a new, hot-dipped galvanized steel lintel. A saw cut should be made into the concrete lug above the heads to receive the upper portion of a 2-piece flashing. A membrane flashing, consisting either of a single-ply membrane such as Cetco Core-Flash 60, or a self-adhered membrane, such as Grace Vycor Plus, should then be adhered over the lintel and up the inner brick and concrete to the saw-cut. A 2-piece copper flashing should then be installed as shown in Figure IV-3.6(2), and the brick should be reinstalled, using type N mortar. Baffled weeps spaced 24” apart should be included for drainage.

2. Above the Level 2 Stone Water Table

The stone water table is degrading and needs to be capped with a flashing to retard further degradation. These water table flashings can be integrated with retrofitted through-wall flashings. Work related to the water table, including restoration, anchorage, and flashings, is described in section IV-4.1.

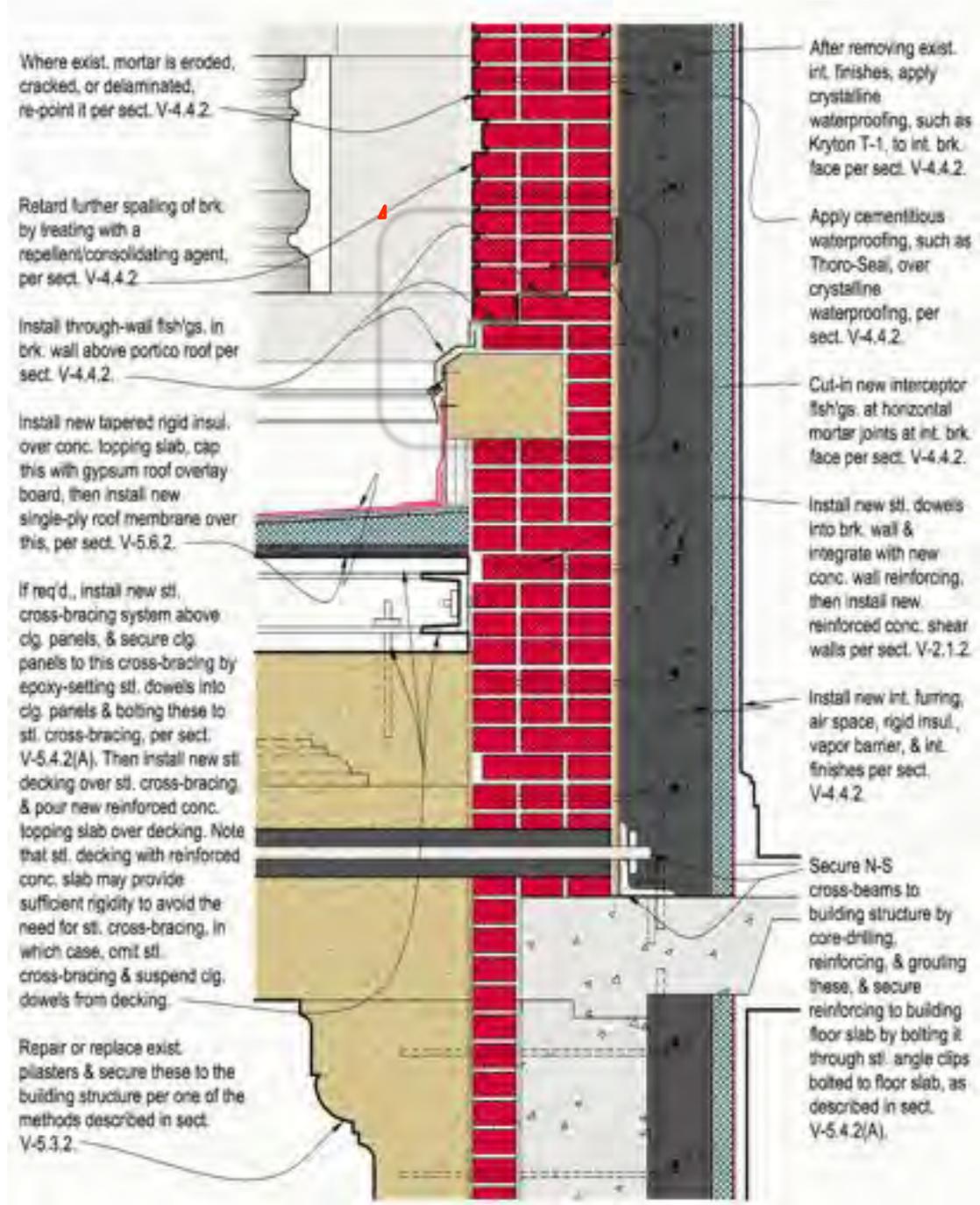
The through-wall flashings above the water table can be retrofitted by first re-anchoring the brick above, then removing two brick courses above the stone, saw-cutting the existing concrete column behind the brick to receive the upper portion of a 2-piece copper flashing. A membrane flashing, consisting either of a single-ply membrane such as Cetco Core-Flash 60, or a self-adhered membrane, such as Grace Vycor Plus, should then be adhered over the inner brick and concrete to the saw-cut. A 2-piece copper flashing should then be installed as shown in Figure IV-3.6(3), and the brick should be reinstalled, using type N mortar. Baffled weeps spaced 24" apart should be included for drainage.



**Fig. IV-3.6(3): Retrofitting of Through-Wall Flashings Above Water Table**

### 3. Above the Portico Roof

To limit the presently severe infiltration and damage to the portico roof structure, interceptor flashings should be retrofitted directly above the portico roof. The work is essentially very similar to the flashing retrofit above the water table, described in item 2 of this subsection and is not described in detail. Figure IV-3.6(4) shows the basic method where it occurs over brick walls. The work must begin by placing the interior concrete walls and brick anchors above, and will also probably require temporary bracing to maintain stability. The work also involves retrofitting of membrane flashings overlaid with copper flashings. After the flashings are installed, the removed brick should be reinstated, using type N mortar. Baffled weeps spaced 24" apart should be included for drainage.

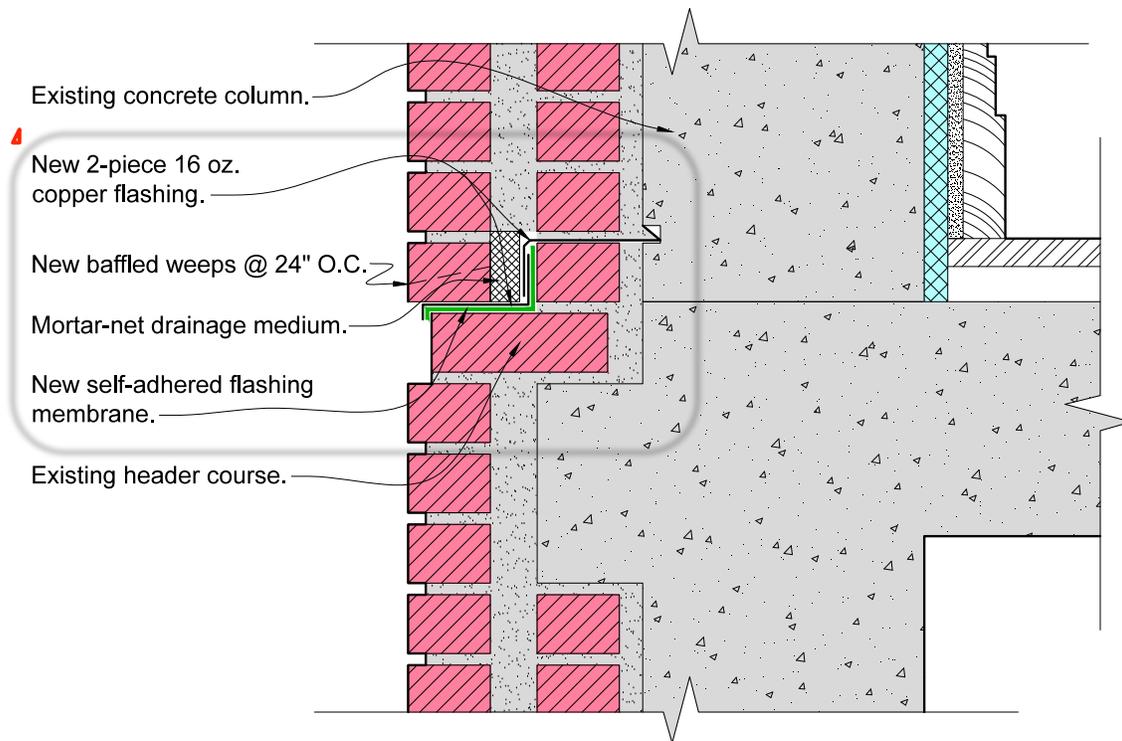


**Fig. IV-3.6(4): Retrofitting of Through-Wall Flashings Above Portico Roof**

#### 4. Along Level 3 & 4 Floor Slab Edges Directly Above the Portico

As explained in greater detail in subsection II-3.6.2, the header courses in the brickwork tend to exacerbate water penetration deeply into the brick walls, which limits the effectiveness of retrofitted flashings, as water may be able to bypass inward of these flashings. As it is critical to limit intrusion into the portico roof structure in particular, I also recommend that interceptor flashings be retrofitted along the edges of the level 3 and 4 floor slabs, but only in the four brick pilasters located above the portico. These flashings should preclude accumulation of water within these brick pilasters, thus limiting intrusion into the portico roof as well.

The work is essentially very similar to the flashing retrofit above the water table, described in item 2 of this subsection and is not described in detail. Figure IV-3.6(5) shows the basic method where it occurs over the concrete columns. The work must begin by anchoring the brick anchors above, and will also probably require temporary bracing to maintain stability. The work also involves retrofitting of membrane flashings overlaid with copper flashings. After the flashings are installed, the removed brick should be reinstated, using type N mortar. Baffled weeps spaced 24" apart should be included for drainage.



**Fig. IV-3.6(5): Through-Wall Flash'gs. @ Lvl. 3 & 4 Slab Edges Abv. Portico Roof**

The brick restoration work consists of replacing corroded accessible window-head lintels, replacement of spalled and cracked brick, repointing of eroded, cracked, and delaminated mortar, and application of a penetrating water repellent/consolidating agent.

Replacement of corroded accessible window-head lintels in these “public” brick-clad walls applies only to the 18 windows within the three vertical bands nearest to the SE corner. This work is already described in item 1 and Figure IV-3.6(2) of this subsection pertaining to the flashing retrofitting above such lintels.

Existing spalled or cracked brick should be replaced with new face brick of similar color and texture to closely resemble the existing brick. The new brick should be ASTM C-216 face brick, Grade SW, Type FBS. To the extent achievable with brick of similar color, the new brick should strive to exceed these standards in having a total 5-hour boiling water absorption of 13% maximum, a maximum 24-hour cold water absorption of 9%, maximum C/B ratio of 0.70, and an Initial Rate of Absorption, (IRA) in the range of 10-20 grams/30 sq. in./minute. As the only way to match the existing brick’s texture would be to sandblast the new brick, which is very damaging, I recommend that the new brick have a Mission texture, which is not too different in appearance, without having the detrimental effect of sandblasting. The new brick should be laid with a type N mortar. For cost estimating purposes, I would assume that roughly 5% of the brickwork at these public façades will need replacing.

Existing cracked, eroded, delaminated, or otherwise damaged mortar should be repointed to a minimum depth of  $\frac{3}{4}$ ”, using type N mortar, which should be recessed to match the existing mortar joints, but should be tooled to at least densify the surface. For cost estimating purposes, I would assume that roughly 20% of the brickwork at these public façades will need repointing.

The brickwork will then need to be treated to remove the existing penetrating repellent to allow new consolidating repellent to absorb into it. The cleaned brick should then be treated with a consolidating repellent agent, such as ProSoCo H-100, per the manufacturer’s directions.

## 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 at the building's south, east, west, and north "public" façades.

### 3.7.1 Basis of Recommendations

The apparent condition of these elements varies appreciably between different locations. Many appear to still be in reasonably good condition, with relatively minor surface spalling.

However, these elements lack any drainage provisions, and 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 hairline cracking, which often coincides with locations of embedded steel, and can be an early indication of corrosive expansion. Such corrosion appears probable at the more exposed panels, and this may increase seismic displacement risk, posing a hazard to pedestrians below.

Above the entry portico, several panels have sloping mortar-wash sills, which are degrading seriously. Several nearby panels also have some grille penetrations with moss growth.

The damage to a majority of the panels is still pretty limited and largely visual at this stage. Many 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 few show more advanced degradation along their bottom edges, are already shedding small flakes, and require temporary maintenance now and will need replacement within about two decades.

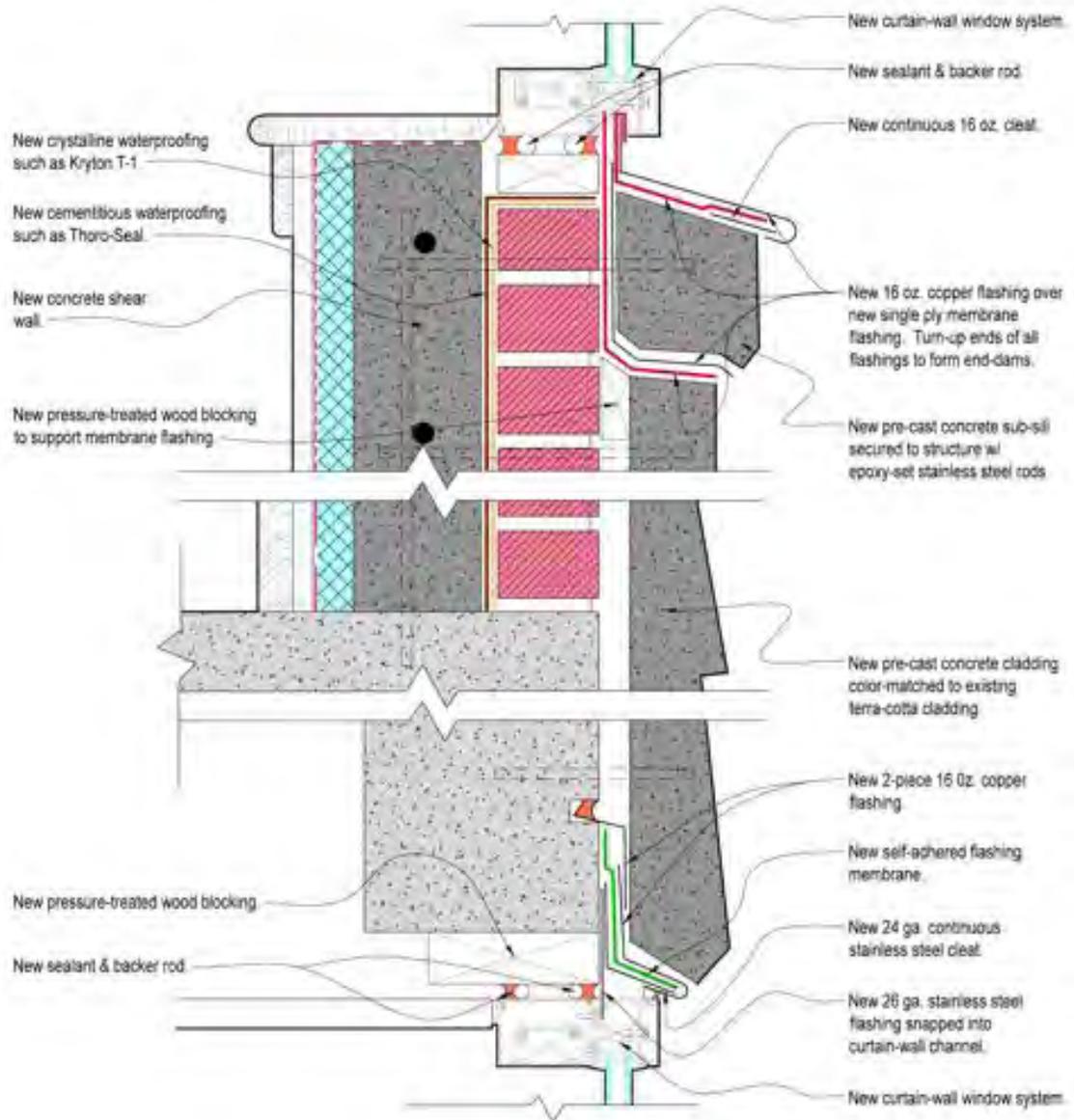
Although most of these panels do not yet appear to require urgent attention, it does not seem to make much sense to perform extensive restoration work at most other elements on this building's exterior and leave these terra-cotta panels in place, to be dealt with on a more urgent basis 20 years later. In other words, these panels are doomed to a lifespan ranging from 20 years for some panels to perhaps 40 years elsewhere, and the large-scale restoration project affecting many other elements provides a good opportunity to also address these panels to avoid the need for doing so fairly soon in any case.

### 3.7.2 Recommended Corrective Actions

In view of the reasoning outlined above, it seems prudent to include wholesale replacement of these panels as part of this major restoration effort. These panels could be replaced with new terra-cotta panels, pre-cast concrete panels, or Glass-Fiber-Reinforced-Concrete, (GFRC). Terra-cotta would obviously be closest in appearance, but would likely be more costly. Also, as these panels are one color, pre-cast concrete or GFRC can be integrally colored to match the existing terra-cotta.

For cost-estimating purposes, replacement with integrally colored pre-cast concrete panels reinforced with stainless steel should be assumed. The panels can be secured with embedded stainless steel clips, epoxy-set threaded rods, or similar methods.

To slow degradation, I recommend that these replacement panels consist of two pieces, one consisting of a sill piece directly below the windows, and the other below this, with a double-layer flashing of adhered single-ply membrane capped with 16 oz. copper installed between these two as well as atop the sill. The upper sill flashing should integrate with the new curtain-wall windows recommended in subsection IV-3.12.2. The single-ply membrane flashing should wrap over the top of the copper flashing to avoid contact between the aluminum window frame and the copper flashing. Figure IV-3.7(1) shows a generic detail for this work.



**Fig. IV-3.7(1): Replacement of Terra-Cotta Panels With Pre-Cast Concrete Panels**

## **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 excludes the stairwell walls. Elements integral to these walls, such as steel lintels above the windows, are also addressed here.

### **3.8.1 Basis of Recommendations**

These courtyard walls are plain in character, but though different in appearance, their construction is basically the same as of the more public walls addressed in section IV-3.6, and many of the same structural and design issues apply.

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 brick wythe outward of most embedded concrete columns. These walls also have interlocking header courses, which do not align with header courses in adjacent “public” walls.

Structural securement issues are basically the same as at the public brickwork. Namely, interlocking header courses tie parallel wythes together, but the overall 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, especially on the east-facing wall. This does not threaten overall integrity, but poses seismic risk to pedestrians below.

With regard to “weathering” considerations, the design of these walls is not well suited to Juneau’s cold, wet climate in several ways. 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, especially at upper reaches of the east-facing wall. The absence of flashings exacerbates damage and interior leak risk. Interlocking header courses, though structurally needed, also increase risk of deep water penetration.

Where these courtyard walls occur above the two small roof areas, the existing roofing terminates at the outer brick face, with no through-wall flashings. This is improper, and poses risk of interior leakage, though this risk is somewhat mitigated by the relatively sheltered locations of these transitions.

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.

Due to different weather orientations, the east-facing wall displays significant degradation, such as spalling, surface erosion, mortar stress, lintel corrosion, etc., while 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.

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

Unfortunately, Juneau’s challenging climate, the specific configuration of the brickwork, and the already advanced erosion of the outermost brick faces, especially at the east-facing wall, will lead to ongoing spalling, which can be slowed down, but cannot be effectively stopped, by treating with consolidating agents. This consideration, and the infiltration-prone wall assemblies, pose inherent limitations of this “retrofit” approach. With this approach, it appears prudent to plan on an ongoing maintenance program of re-sealing as well as replacement of spalling brick. Every 10 years, about 5% of the exterior brick wythe in weather-exposed locations may need to be replaced on the east-facing wall.

### 3.8.2 Recommended Corrective Actions

Recommended work at these walls is in many ways quite similar to the recommended work for the more public brick walls addressed in subsection IV-3.6.2, and is thus described in a more cursory fashion. Please see subsection IV-3.6.2 for more detailed information.

As with the public walls, recommended work is divided into three general categories, including structural anchorage, water-integrity enhancements, and restoration work. These often overlap in various locations. It is also critical for the work to be properly sequenced to maintain stability during the installation.

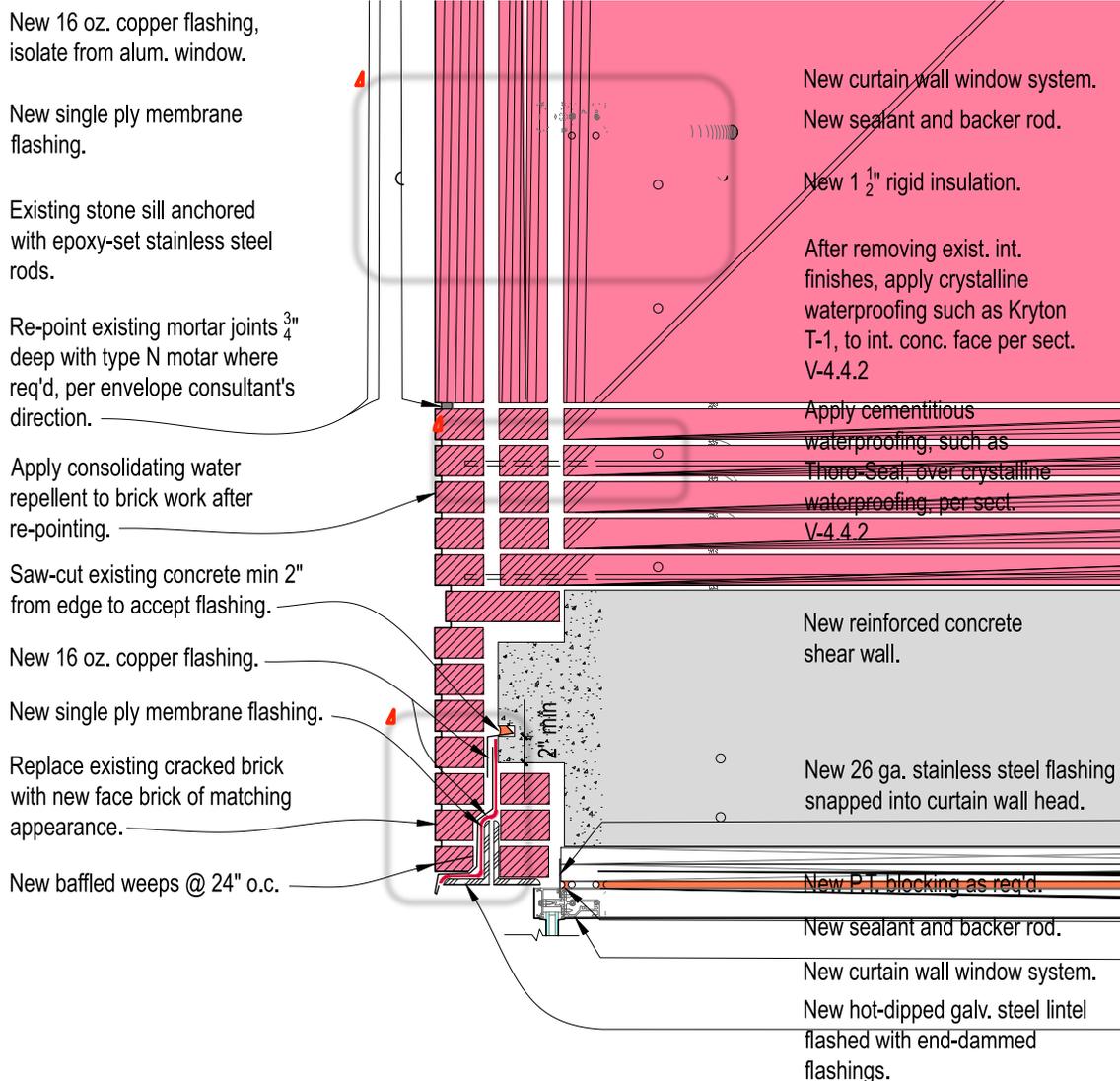
The anchorage work can be divided into three categories, including anchoring brickwork where it occurs over concrete columns, anchoring brickwork where multi-wythe brick represents the entire wall assembly, with no existing concrete columns, and also anchoring of window sills.

Where the brickwork occurs over existing concrete columns, which represents the majority of these wall areas, the brickwork can be anchored per conventional retrofit methods, using stainless steel helical "Helifix" anchors. These should be drilled from the exterior through mortar T-joints at least 4" into the concrete columns. As the brickwork in most column locations consists of a single brick wythe, plus another joint between the brick and concrete, this will require 8"-9" drilled holes. After the holes are cleaned out, the anchors should be installed and be recessed about 1" from the outer mortar face. The anchors should be spaced to provide at least 1 anchor per 2 SF of area. I recommend that the anchors be drilled into T-joints just above each header course, spaced 16" apart horizontally. This will yield a spacing near the desired 2 SF per anchor. A vertical line of anchors should be placed about 4" away from each vertical brick panel edge.

In locations where mortar joints are to be repointed, the repointing can be used to cap over the anchors. Where no repointing is needed, the anchors can be capped with an appropriate sealant, such as Dow 790, with sand added to the surface to mimic mortar.

Where the outer brick occurs over brick walls, which occurs mostly above and below windows, new interior concrete walls are also to be added, as described in subsection IV-2.1, and this affords an opportunity to drill the anchors from the interior and integrate these into the new concrete walls. This also allows the anchors to be drilled into the brick units, rather than into the mortar joints. The same "Helifix" anchors can be used for this, as well as epoxy-set stainless steel threaded rods, among others. Spacing should again be 16" apart horizontally and 18" apart vertically. Figure IV-3.8(1) shows this method at these brick walls.

With respect to anchoring of the window sills, the existing stone sills are mostly in reasonable condition, and can be reused. However, these sills will need to be removed at least temporarily to retrofit flashings under them, so it may be reasonable to also replace these sills with new pre-cast concrete ones, as recommended for Options 2 & 3. In either case, each sill should be anchored with two anchors drilled from the interior as shown in Figure IV-3.8(1). These can be helical "Helifix" type, epoxy-set threaded rods, or similar. They should consist of stainless steel to avoid corrosion.



**Fig. IV-3.8(1): Brick Anchorage and Lintel and Sill Flashings at Brick Walls**

The water-integrity enhancement work consists of retrofitting of interceptor flashings at strategic locations to drain water back out of the brickwork and avoid its excessive accumulation within the wall assemblies. Three different types of locations appear suitable for four types of retrofit flashings, as follows:

1. Above All Accessible Steel Window-Head Lintels

The existing lintels are corroding to varying degrees, and should be replaced, especially at the east-facing wall. Figure IV-3.8(1) shows the basic method, which must begin by placing the interior concrete walls and brick anchors above, and will also probably require temporary bracing to maintain stability. About 5 brick courses above the lintel need to be removed to access the steel double-lintel. The outer of these should be replaced with a new, hot-dipped galvanized steel lintel. A saw cut should be made into the concrete lug above the heads to receive the upper portion of a 2-piece flashing. A membrane flashing, consisting either of a single-ply membrane such as Cetco Core-Flash 60, or a self-adhered membrane, such as Grace Vycor Plus, should then be adhered over the lintel and up the inner brick and concrete to the saw-cut. A 2-piece copper flashing should then be installed as shown in Figure IV-3.8(1), and the brick should be reinstalled, using type N mortar. Baffled weeps spaced 24" apart should be included for drainage.

## 2. Under and Atop the New Pre-Cast Concrete Window Sills

To retard further degradation and limit infiltration, new double-layer flashings should be installed both under and atop the masonry window sills, which should be replaced with new pre-cast concrete sills.

After the existing interior terra-cotta finish, windows, and stone sills are removed, new interior concrete walls should be placed against the interior faces of the brick walls as outlined in subsection IV-2.1.2. Two anchor pins should be installed to protrude into each new pre-cast concrete sills as shown in Figure IV-3.8(1).

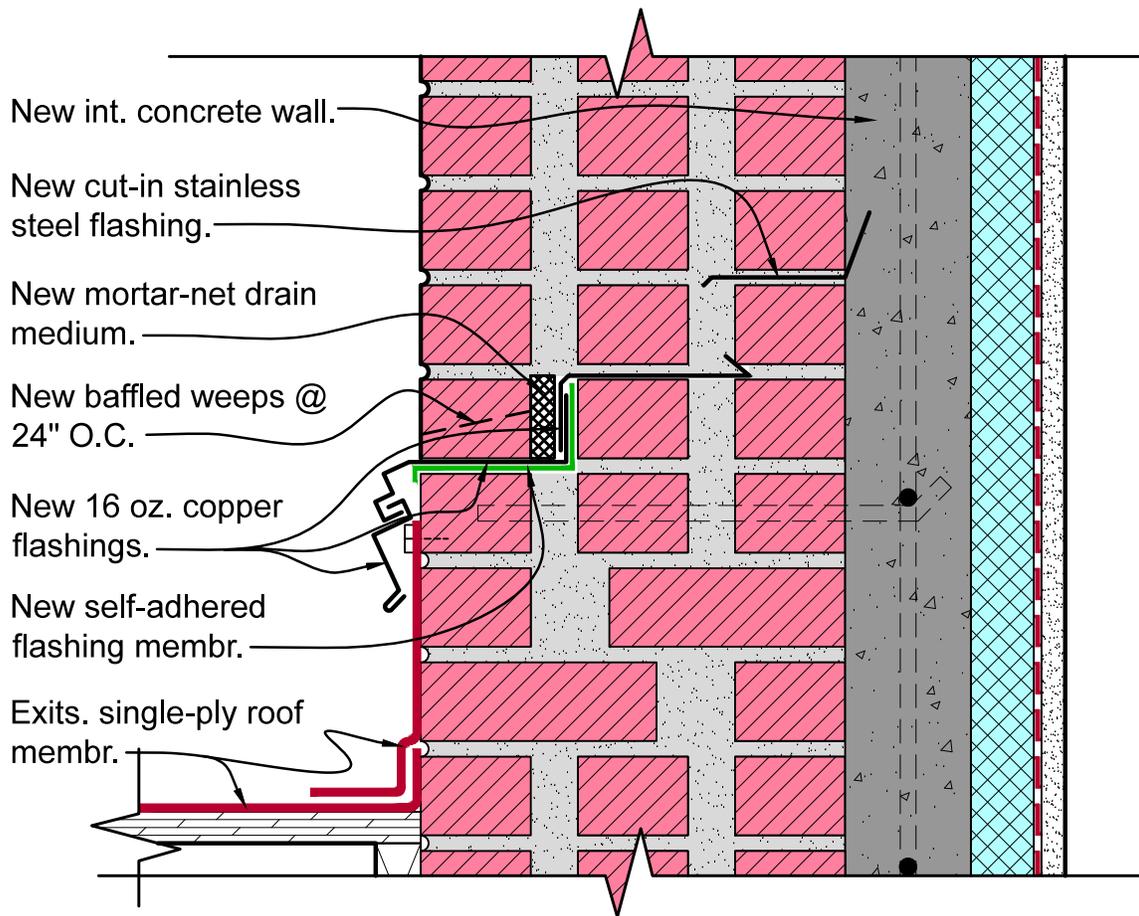
New, double-layer sub-sill flashings should then be installed under the new pre-cast concrete sills. These should consist of a membrane flashing, such as either a single-ply membrane such as Cetco Core-Flash 60, or a self-adhered membrane, such as Grace Vycor Plus, capped with a 16 oz. copper flashing, installed as shown in Figure IV-3.8(1).

The new pre-cast concrete sills should then be epoxy-set over the anchor pins. These should also be capped with double-layer flashing caps of membrane flashings with copper flashings atop these. The copper flashings should be isolated from the new aluminum windows by wrapping the membrane flashings over the copper at the windows.

## 3. Above the Two Low Roof Areas

The two low roof areas do not terminate properly along their junctures to the brick-clad walls, as the roof membrane extends up the brick walls and is secured to the outer brick faces with termination bars, with no through-wall flashings above to drain water from within the brick over the roofs. This poses a leak risk.

To limit this risk, interceptor flashings should be retrofitted directly above the two roof areas wherever these join with the brick-clad walls. The work is essentially very similar to the flashing retrofit above the water table, described in item 2 of subsection IV-3.6.2, and is not described in detail. Figure IV-3.8(2) shows the basic method where it occurs over brick walls. The work must begin by placing the interior concrete walls and brick anchors above, and will also probably require temporary bracing to maintain stability. The work also involves retrofitting of membrane flashings overlaid with copper flashings. After the flashings are installed, the removed brick should be reinstalled, using type N mortar. Baffled weeps spaced 24" apart should be included for drainage.



**Fig. IV-3.8(2): Through-Wall Flashings Above Low Roofs**

The brick restoration work consists of replacing corroded accessible window-head lintels, replacement of spalled and cracked brick, repointing of eroded, cracked, and delaminated mortar, and application of a penetrating water repellent/consolidating agent.

Replacement of corroded accessible window-head lintels is already described in item 1 and Figure IV-3.8(1) of this subsection pertaining to the flashing retrofitting above such lintels.

Existing spalled or cracked brick should be replaced with new face brick of similar color and texture to closely resemble the existing brick, using brick, mortar, and methods described in detail in section IV-3.6.2 for the public walls. For cost estimating purposes, I would assume that roughly 5% of the brickwork at the east-facing wall, and 1% at the west and north-facing walls will need replacing.

Existing cracked, eroded, delaminated, or otherwise damaged mortar should be repointed to a minimum depth of  $\frac{3}{4}$ " using type N mortar, which should match the existing mortar joints, but should be tooled to at least densify the surface. For cost estimating purposes, I would assume that roughly 80% of the brickwork at the east-facing wall, and 20% at the west and north-facing walls will need repointing.

The brickwork will then need to be treated to remove the existing penetrating repellent to allow new consolidating repellent to absorb into it. The cleaned brick should then be treated with a consolidating repellent agent, such as ProSoCo H-100, per the manufacturer's directions.

### **3.9. North Stairwell Walls, Brick & Stucco-Clad**

#### **3.9.0 General**

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

#### **3.9.1 Basis of Recommendations**

These walls are nearly identical to the courtyard walls, differing primarily in being taller, with the above-roof portion clad with stucco. The east and west walls consist of triple-wythe brickwork, while the north wall consists mostly of concrete columns wrapped with a single brick wythe. The south wall occurs only above the roof, and consists of double-wythe, stucco-clad brickwork.

The east-facing wall has been painted with an elastomeric coating, and suffers significant brick spalling. The coating has not proved successful in 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. 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.

The upper stucco band bulges outward in places, and some coating blisters indicate moisture intrusion behind the coating. The elastomeric coating spans across the stucco bottom onto the brick, precluding 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.

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. 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.

These walls also lack flashings or weep holes to drain water out of the brickwork above window-head lintels, which however appear to be in good condition, reflecting their more forgiving northerly exposure. No through-wall flashings occur where these walls join the two low roofs below, posing appreciable leak risk, particularly below 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.

Infiltration into the brickwork can be reduced through a combination of measures, but cannot be reliably fully stopped with the existing configuration.

#### **3.9.2 Recommended Corrective Actions**

In most respects, recommended work at these walls is identical to the work recommended for the other courtyard walls, as described in subsection IV-3.8.2, and is not repeated here. Please follow recommendations of subsection IV-3.8.2, except as noted here.

One difference between the stairwell walls and the other courtyard walls is that the interior terra-cotta finish is thinner, thus precluding the opportunity to add interior concrete walls, as is recommended for essentially all other exterior walls. Consequently, no new anchorage of the brickwork can take place at the stairwell's east, west, and south walls, or above or below any windows. However, where the brickwork occurs over existing concrete columns, which represents the majority of the north wall, the brickwork can be anchored per conventional retrofit methods, using stainless steel helical "Helifix" anchors. Please follow recommendations of subsection IV-3.8.2 for this re-anchoring work.

The new pre-cast concrete window sills should also be anchored per subsection IV-3.8.2.

Water-integrity enhancement work at the brick walls is identical to the work recommended in subsection IV-3.8.2 for the other courtyard walls, and includes retrofitting of flashings above window-head lintels, below and over the window sills, and above the two abutting low roof areas. Please follow recommendations of subsection IV-3.8.2 precisely for these flashings.

The brick restoration work at these stairwell walls is also identical to the courtyard walls, and recommendations of subsection IV-3.8.2 should be followed. Primary differences relate to different area percentages of brick replacement and mortar-repointing. In addition, the east-facing wall will need to have its elastomeric coating removed.

For cost estimating purposes, I would assume that roughly 10% of the exposed brickwork at the east-facing wall, and 1% at the west and north-facing walls will need replacing.

Similarly, I would assume that roughly 100% of the brickwork at the east-facing wall, and 20% at the west and north-facing walls will need repointing.

The brickwork will then need to be treated to remove the existing penetrating repellent to allow new consolidating repellent to absorb into it. The cleaned brick should then be treated with a consolidating repellent agent, such as ProSoCo H-100, per the manufacturer's directions.

With respect to the uppermost stucco-clad walls, which have limited visibility, I recommend the easiest and least-costly approach, which consists of over-cladding with a metal cladding with a drainage cavity, as also recommended for the chimney in subsection IV-2.5.2. Specific recommendations are as follows:

1. Retrofit Reglet Base Flashing Above New Cornice

Saw-cut mortar joint about 4" above top of new cornice, described in subsection IV-4.5.2, and install upper portion of 2-piece, 24-gage stainless steel or 16 oz. copper flashing into saw-cut, then insert back-rod and sealant.

2. Install Lower Portion of 2-Piece Reglet Base Flashing Begun in Step 1

Snap-in lower portion of 24-gage stainless steel or 16 oz. copper flashing to fully cap top of cornice-top flashing.

3. Over-Clad Stucco with Metal Cladding

Install galvanized steel vertical hat channels near corners and spaced 16" on center in-between, then secure new sheet-metal cladding over this, along with corner trim, etc. as needed. The new cladding can consist of 24-gage pre-finished galvanized or stainless steel, or 16 oz. copper. Dissimilar metals, if any, should be isolated from each other.

4. Install Flashing Cap Atop Parapet

Install continuous cleat of 24-gage galvanized or stainless steel or 16 oz. copper along outer-lower portion of parapet cap, then install strips of new EPDM roof membrane over top of parapet and over cleat and adhere to existing EPDM roof membrane. Then cap the parapet top with a sheet metal cap of 16 oz. copper.

## **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 recommendations related to this chimney are addressed holistically in section IV-2.5. The sole purpose of section IV-3.10 is to refer the reader to section IV-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 Basis of Recommendations**

These two newer, small walls consist of standard light-gage steel framing, with steel studs, gypsum exterior sheathing, probably building paper, an exterior metal cladding, and windows and doors. No drainage provisions were observed along the metal cladding's base. If drainage is not accommodated along the base, this would exacerbate risk of interior leakage and water damage to the lower portions of these walls. This concern is minimized by the walls' sheltered orientation. However, although these walls may not currently pose any actual problems, their cladding appears somewhat warped, and in view of the major project envisioned in this report, combined with the very small size of these walls, it appears advisable to include replacement of the cladding on these walls for cost estimating purposes.

#### **3.11.2 Recommended Corrective Actions**

For cost estimating reasons, replacement of the cladding on both of these small walls should be anticipated. This work would consist of removing the existing cladding and the assumed underlying building wraps as a first step. Following this, a drainage flashing would be installed along the cladding's base, and a 2-layer building wrap assembly would be placed over the gypsum sheathing. Perforated, 2" wide galvanized steel "Z" girts would then be installed horizontally over this spaced 16" apart and screwed to the underlying steel stud framing. A thin vent-mat, such as Enka-Drain 9714, would be fitted between the girts, fabric side facing outward, followed by 1 ½" rigid extruded polystyrene insulation. A new metal cladding would then be installed over the girts.

### **3.12. Windows**

#### **3.12.0 General**

This subsection pertains to all exterior windows.

#### **3.12.1 Basis of Recommendations**

Most of the original steel-sash windows had been replaced with extruded aluminum units, except at the north ends of the two wings, which retain the original steel ones. In addition, a few of the original openings had been at least partly bricked-in, with either no windows or with narrow units.

The aluminum windows appear to have been installed over the original steel frames, and at least some of the underlying steel frames are corroding severely, which probably reflects electrolysis, as contact between aluminum and steel should be avoided. Continued corrosion may compromise the securement of the aluminum windows.

The newer aluminum windows lack any integral drainage provisions. Not surprisingly, relatively widespread leakage evidence is associated with windows in scattered locations, such as blistered plaster, white deposits at many interior joints, elevated moisture content and streaks below some sills, etc. Sealant along both exterior and interior window frame joints, which is quite unusual, may also reflect efforts to stop leakage. The absence of a drainage system is a fatal flaw, as it is not possible to seal all joints and perimeter conditions perfectly and permanently, and the various interior symptoms indicate that some of the exposed windows leak.

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.

In short, the existing windows are exceedingly ill conceived, and doomed to recurring leakage.

### 3.12.2 Recommended Corrective Actions

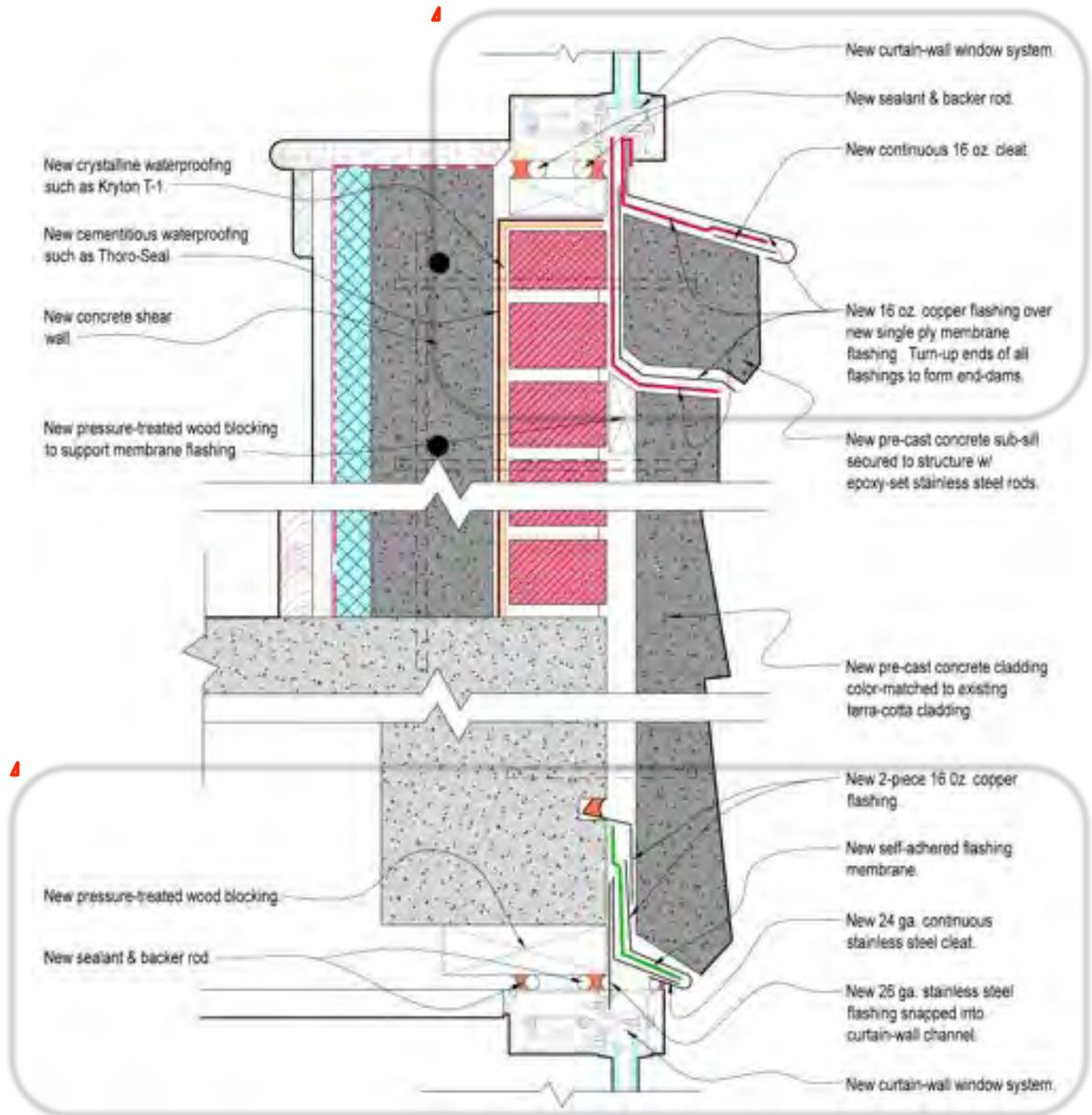
In view of the poor design and general condition of the existing window system, combined with ample evidence of leakage associated with these windows, I recommend that the existing aluminum windows be replaced with a high-performance curtain-wall system, such as Kawneer's 1600 Wall, with operable sashes of Kawneer's AA-900 window system glazed into the curtain-wall where such operable sashes are desired. In contrast to the existing system, the 1600 curtain-wall system incorporates a highly effective integral drainage system, with all panes individually drained for optimal performance.

Where operable sashes are desired to match the current configuration, Kawneer's AA-900 operable windows can be glazed into the curtain-wall, making these windows well suited for incorporation into this curtain-wall system.

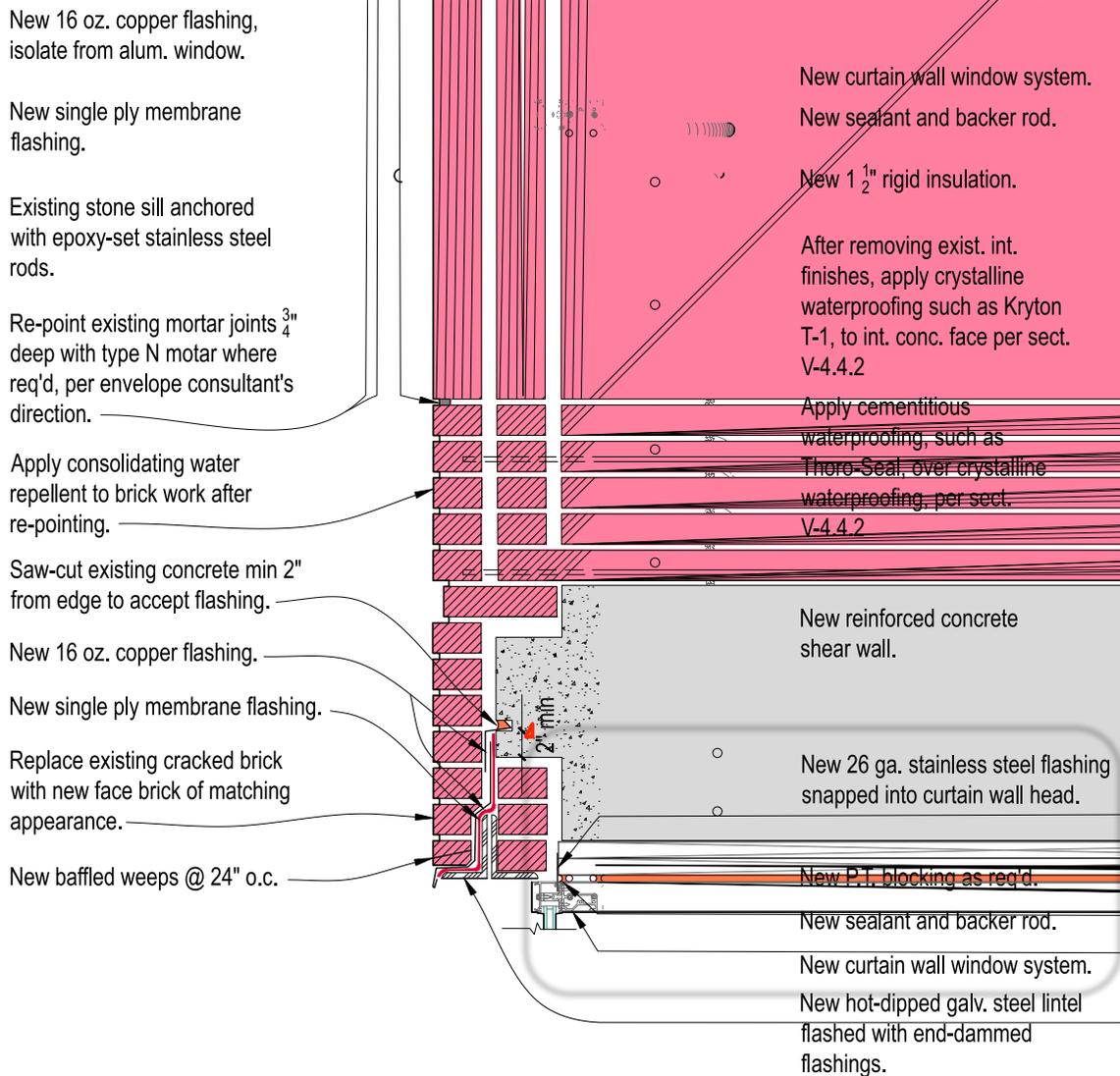
I further recommend that sheet metal sill flashings be installed to cap the exposed masonry sills under the windows. Such sheet metal sill flashings should be integrated into the curtain-wall glass channels in the bottoms of the extrusions. These flashings must either be galvanically compatible with the aluminum windows, or must be electrically isolated from them. For example, aluminum or stainless steel flashings can contact the aluminum window system, but copper flashings must be isolated from the windows by wrapping with either a single-ply roof membrane, such as Cetco Core-Flash 60, or a self-adhered flashing membrane, such as Grace Vycor Ultra.

I also recommend that twin flashings be installed above the window heads to help drain water away from the heads. The first should be a flat piece of stainless steel or aluminum that should snap into the head glass channel, which has an integral drainage system, and can thus drain any water that enters it. A second head flashing system should be installed over this, consisting of a stainless steel cleat, which should be capped with a self-adhered flashing membrane, and a copper flashing should snap over this.

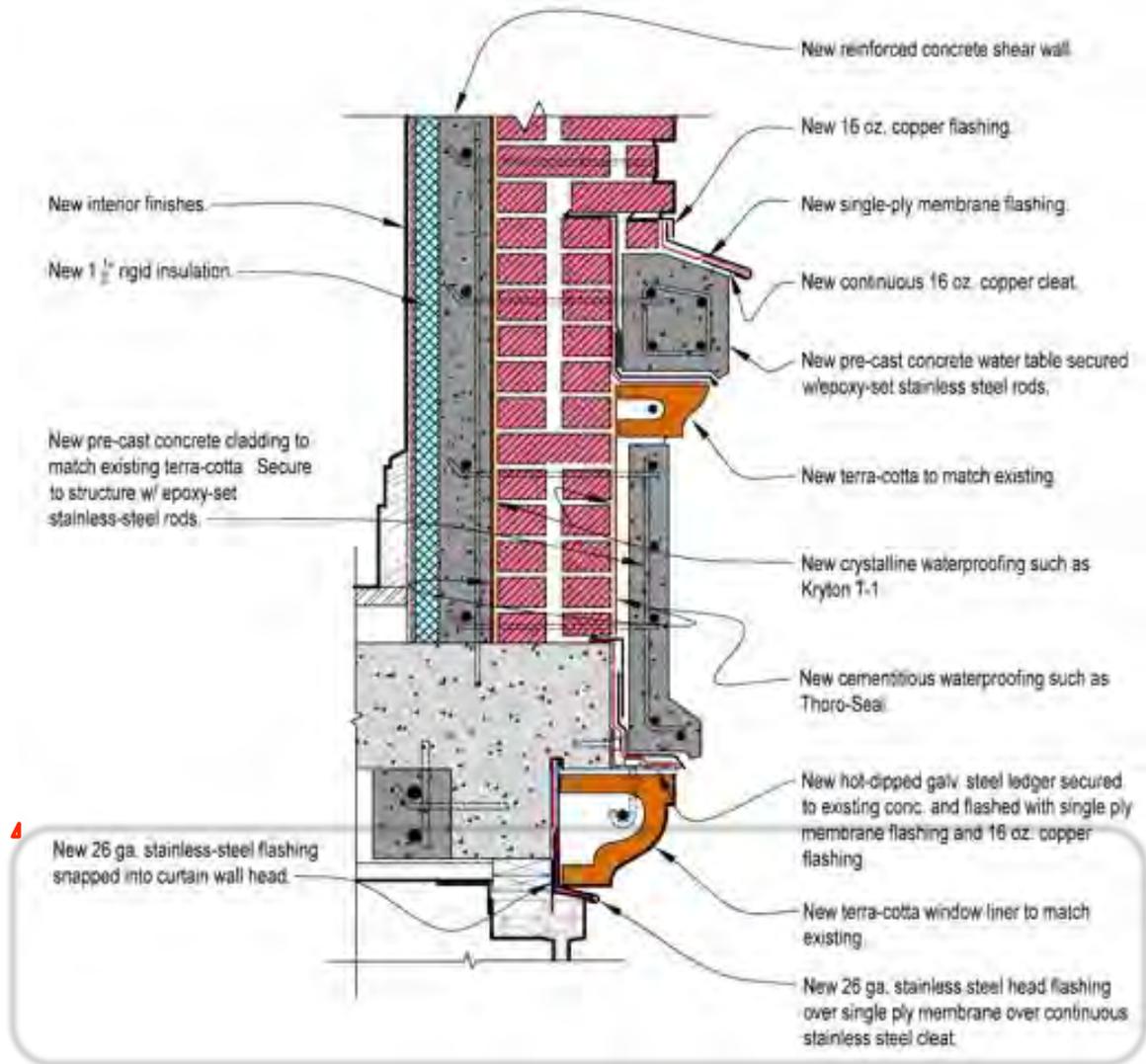
Figures IV-3.12(1-4) illustrate recommended installation detailing at sills and heads at several typical conditions at this building. Please note that these drawings also show different options for adjacent masonry work, some of which may not apply, so only the window installation methods should be followed. Further, some of the drawings are excerpted from the 12/31/10 PL:BECS report, so section references noted in these drawings pertain to that earlier report.



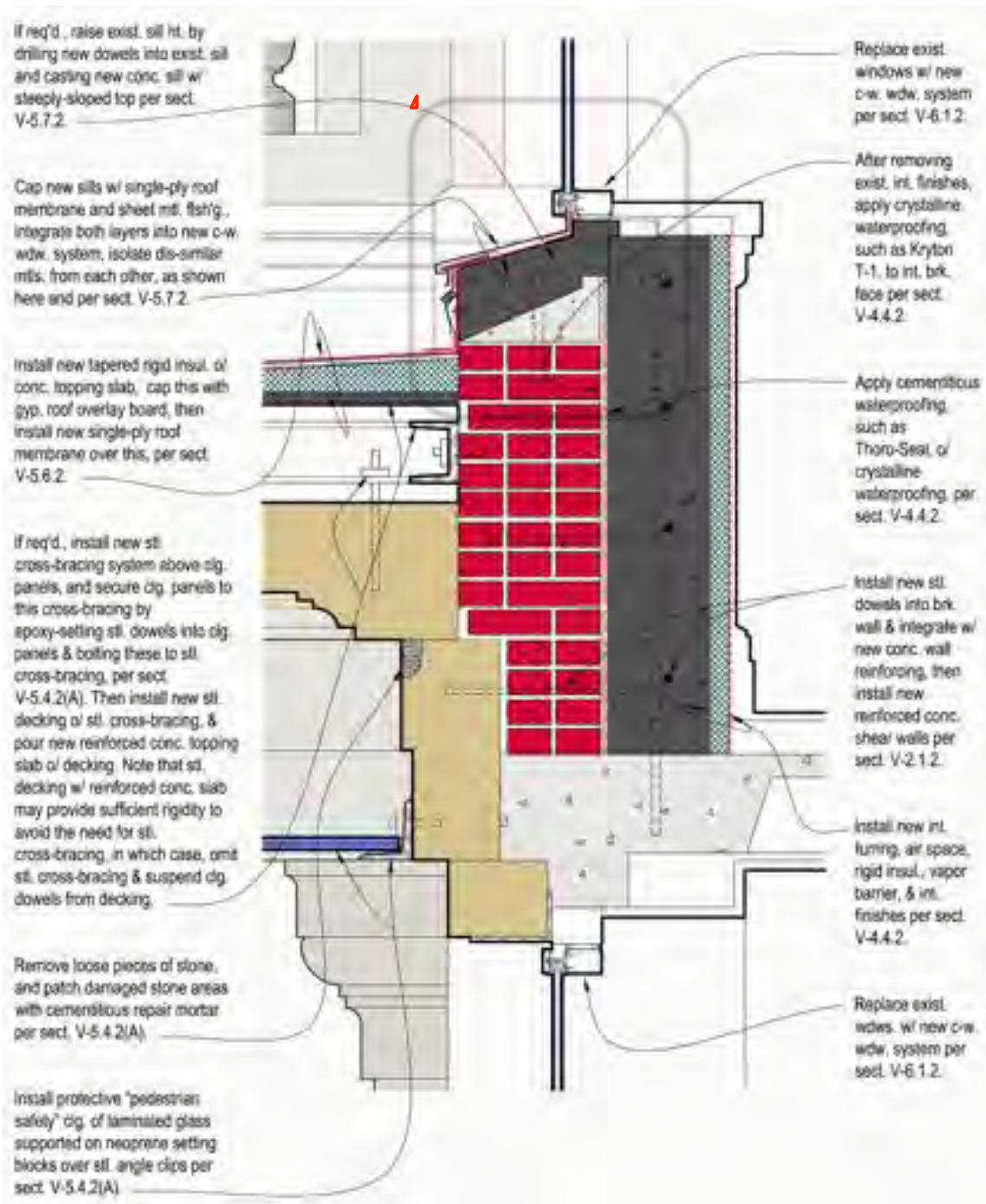
**Fig. IV-3.12(1): Window Head & Sill Installation at Typical Cladding Panel Loc.**



**Fig. IV-3.12(2): Window Head & Sill Installation at Typical Brick Wall Loc.**



**Fig. IV-3.12(3): Window Head Installation at Level 4 “Public” Façade Locations**



**Fig. IV-3.12(4): Window Sill Installation Above Portico Roof**

Note that this drawing is excerpted from 12/31/10 report, and section references pertain to that report. Also, aspects of the adjacent masonry work do not reflect updated recommendations of this report.

### **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 IV-5.6.

#### **3.13.1 Basis of Recommendations**

Concrete pavers atop the roofs precluded examination except along perimeter conditions. However, a few germane observations could be made.

First, the assembly of these roofs 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. This type of assembly is particularly ill suited to a cold, wet climate such as Juneau's, since all water 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, this IRMA configuration effectively negates essentially all value of the insulation, and results in appreciably increased energy consumption.

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 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. This non-draining configuration is quite improper, and substantially increases risk of leakage below such transitions, as moisture within the masonry drains into the roof assembly. 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.

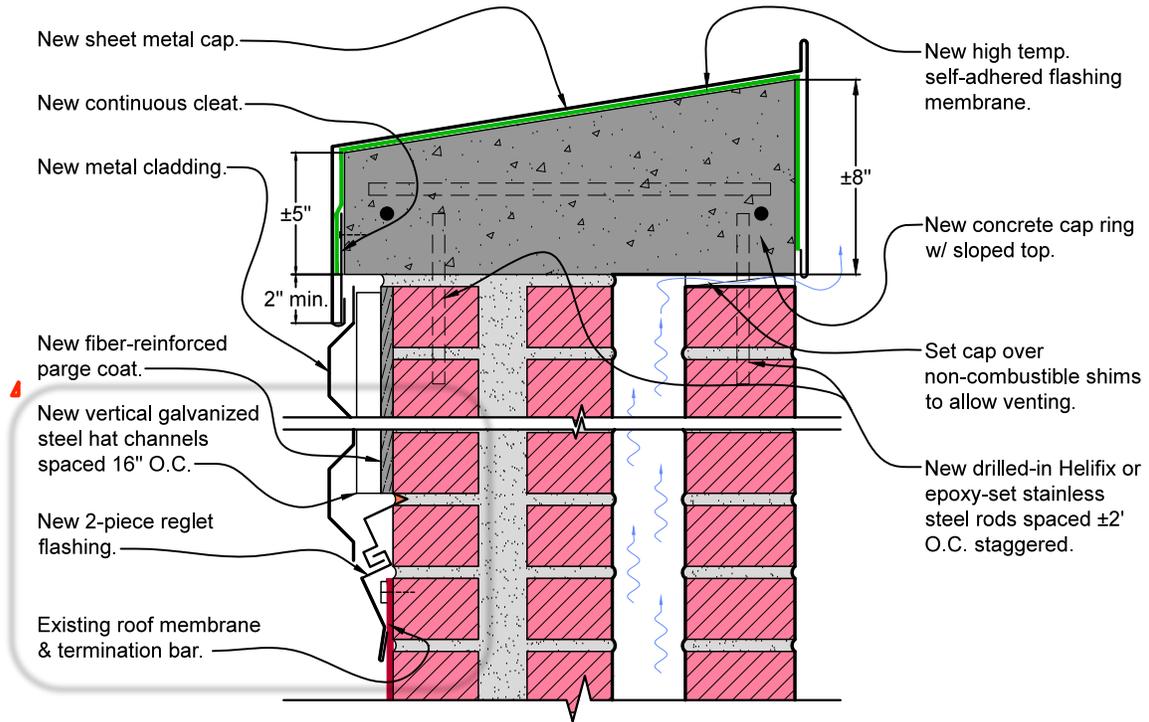
#### **3.13.2 Recommended Corrective Actions**

Although the Inverted Roof Membrane Assembly is exceedingly ill suited to Juneau's cold, wet climate, the EPDM membrane, where it could be examined, appeared to be in relatively new condition, with perhaps another two decades of lifespan. In view of this, it may be reasonable to wait till replacement is required before modifying the assembly type. Unfortunately, this implies that the building's energy usage will be needlessly high till the assembly can be altered. However, no work is recommended with respect to this replacement as part of this project.

However, when the time comes to replace the membrane on these roofs, I strongly recommend that the assembly be altered to place the membrane atop the rigid insulation, rather than under it.

The only aspects that need to be altered as part of this current project are the perimeter conditions where the roofs abut adjacent masonry or stucco-clad walls. This includes junctures of the roofs to the existing brick chimney, to the stucco-clad walls, and to brick walls where the lower roofs on the north side have brick walls on three sides.

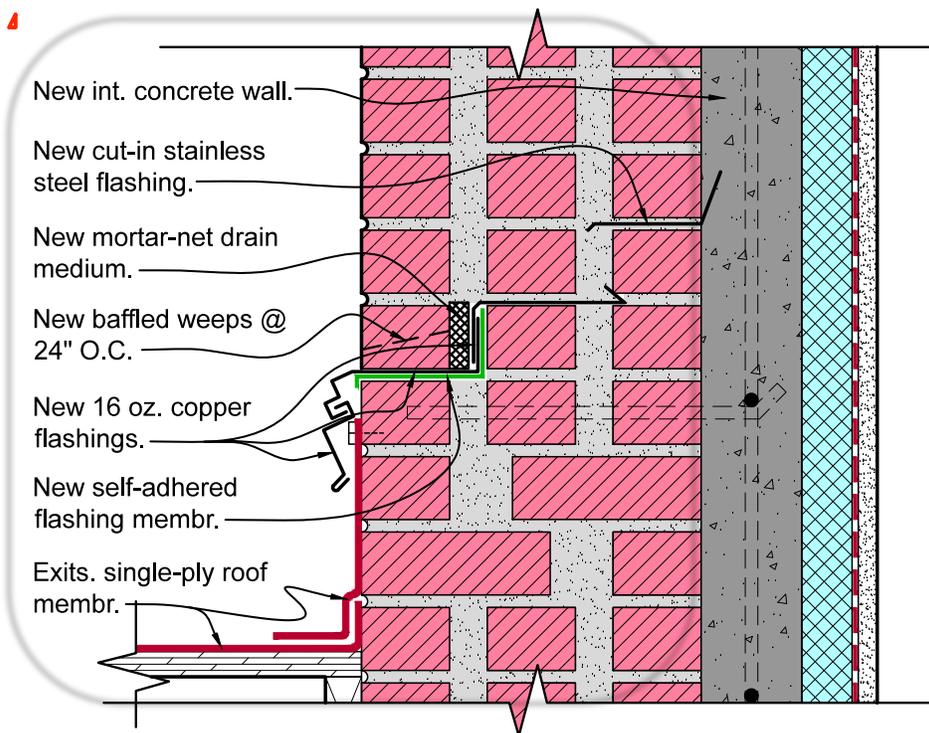
Recommended modifications to the roof-chimney junctures are described in subsection IV-2.5.2, and are shown in Figure IV-2.5(1), which is shown again here as Figure IV-3.13(1). In brief, the improper junctures of the roof to the chimney will be addressed by installing a reglet flashing above the roof membrane termination and over-cladding the chimney with a metal cladding. See Figure IV-3.13(1).



**Figure IV-3.13(1): Recommended Modifications at Chimney-Roof Junctures**

Recommended modifications to the roof-stucco wall junctures are described in subsection IV-3.9.2, and are fundamentally similar to the roof-chimney junctures depicted in Figure IV-3.13(1).

Recommended modifications to the roof-brick wall junctures are described in subsection IV-3.8.2, and involve retrofitting of through-wall flashings. They are shown in Figure IV-3.8(2), repeated here for the reader's convenience as Figure IV-3.13(2).



**Fig. IV-3.13(2): Recommended Modifications at Roof-Brick Wall Junctures**

## 4. EXTERIOR MASONRY SUB-ELEMENTS

### 4.0. General

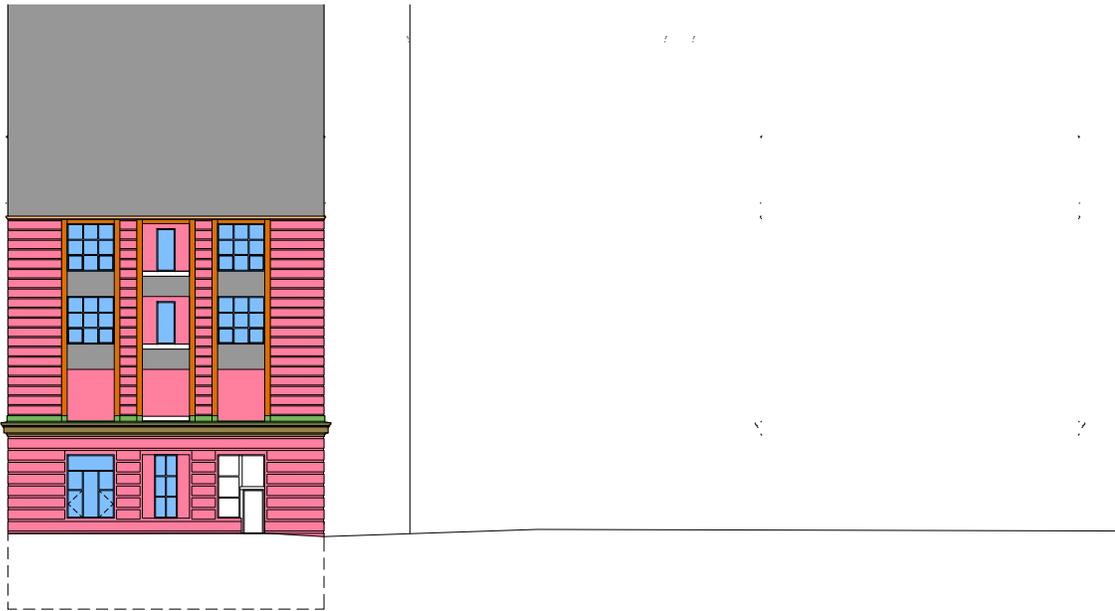
This section of the report addresses issues related to the various exterior masonry sub-elements, such as the stone and terra-cotta water tables, stone window sills, marble panels, etc. It is divided into 8 subsections, each of which pertains to a specific primary element. Where appropriate, each subsection contains preliminary drawings depicting the described work. In addition, Figures IV-4.0(1-7) show the exterior elevations which reference the locations of specific details in the various subsections.



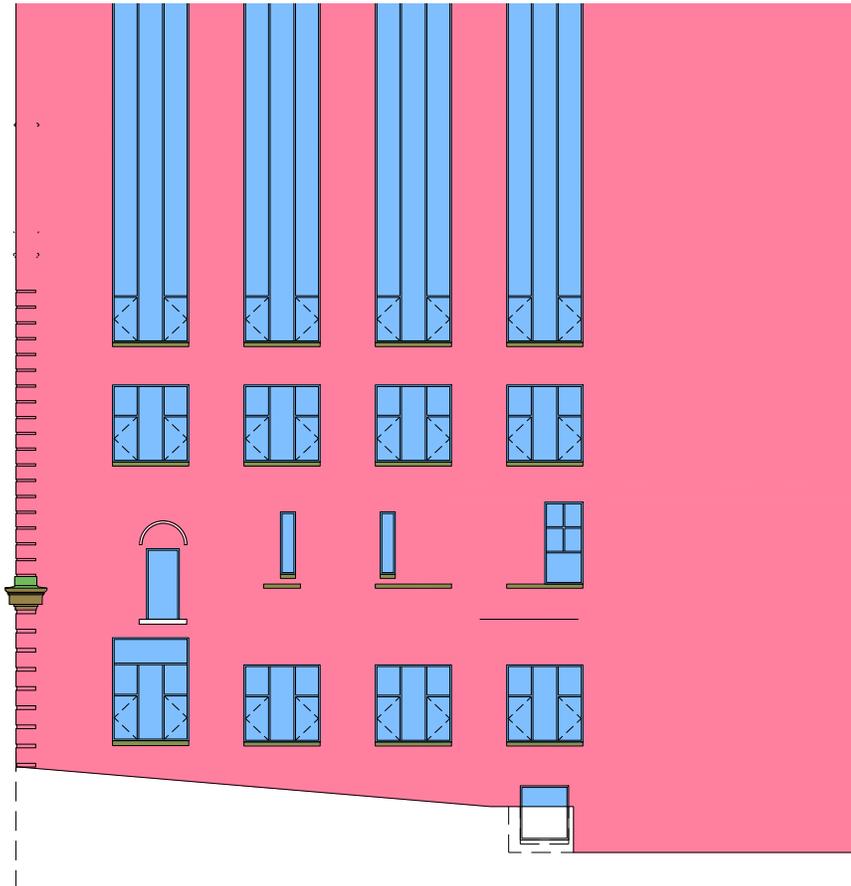
**Fig. IV-4.0(1): South Elevation**



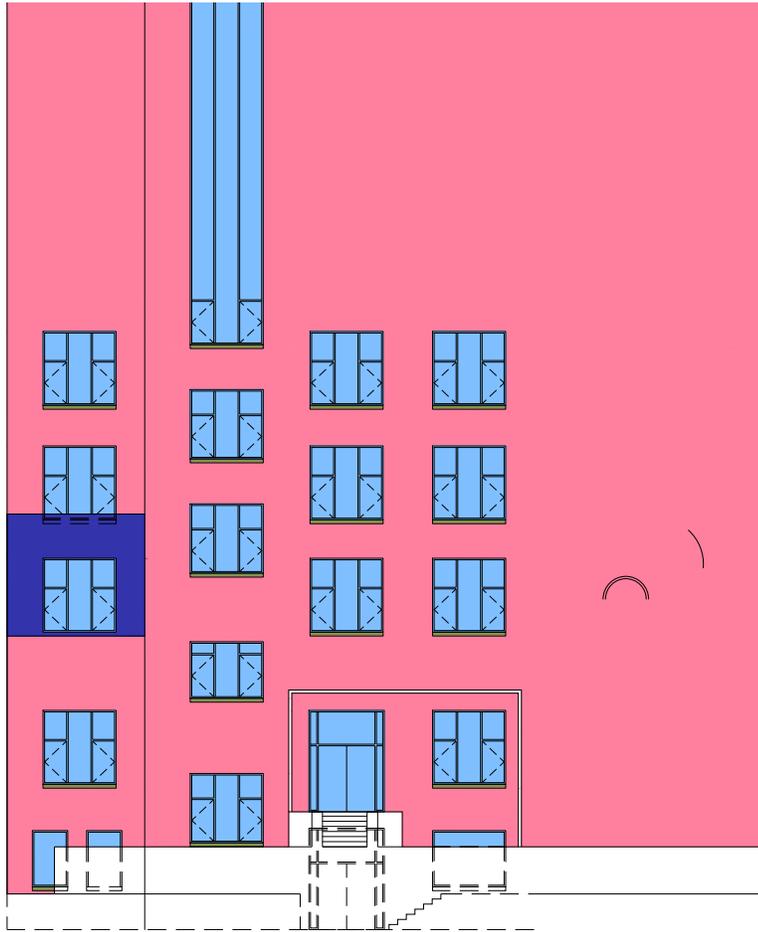
**Fig. IV-4.0(2): West Elevation**



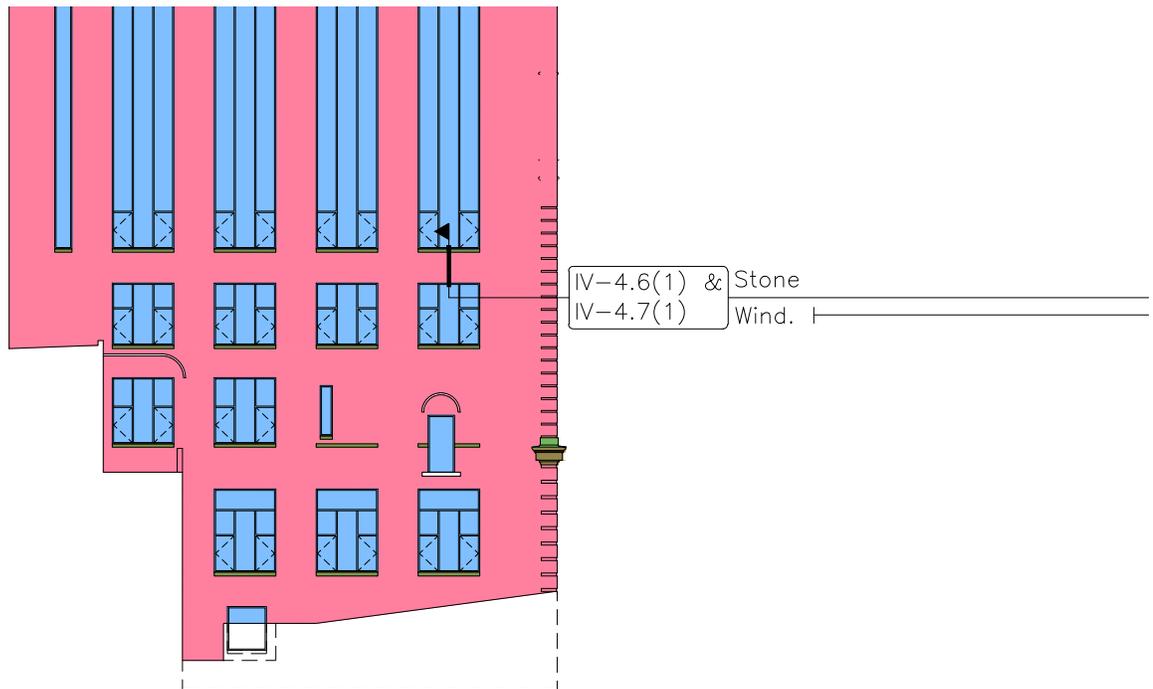
**Fig. IV-4.0(3): North Elevation**



**Fig. IV-4.0(4): North Courtyard: West-Facing Wall**



**Fig. IV-4.0(5): North Courtyard: North-Facing Wall**



**Fig. IV-4.0(6): North Courtyard: East-Facing Wall**



**Fig. IV-4.0(7): East Elevation**

## 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 Basis of Recommendations

The water table's securement at the windows appears inadequate for lateral loads, though it is 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 exposure. This may pose some risk to pedestrians below in case of earthquake.

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. Although the degradation does not yet appear to have irretrievably damaged this water table, it will only accelerate if left unprotected.

### 4.1.2 Recommended Corrective Actions

The recommended corrective work for this water table includes three primary components, including enhancing anchorage, restoration, and retrofitting of flashings. Figure IV-4.1(1) depicts most of the corrective steps described here, though it does not show all design changes.

Anchorage enhancements should take place first. In brief, this involves drilling through the existing brick or concrete walls from the interior at least 6" into the inner face of the stone pieces, then epoxy-setting ½" ø stainless steel threaded rods into these holes. Where this work occurs at the concrete walls, the holes will be drilled through the concrete walls and epoxy-set into these as well. Where the water table runs past brick walls, new interior concrete walls will be placed against these, so the rods can be tied to the new concrete wall reinforcing and become embedded in the concrete. The rods should be placed in two horizontal rows spaced 16" apart vertically, and the rods should also be spaced about 16" apart within each row, but not fewer than two anchors should be drilled into each water table piece in each row.

The flashing retrofit work consists of several integrated flashing pieces. This work must be properly sequenced with the restoration work, and is not necessarily listed in installation order. It includes installation of through-wall flashings in the brickwork directly above the water table band, as well as capping of the top surface of the water table with flashing caps. The through-wall flashing's purpose is to intercept water draining down within the brick above and drain it out of the wall. The flashing caps will help protect the water table from degrading further.

Installation of the through-wall flashings should be done after the brick walls above have been re-anchored and may require some temporary bracing. This work consists of removing one or perhaps two courses of the outer brick wythe above the upper water table band, saw-cutting through the horizontal mortar joint in the inner brick wythe, adhering a self-adhered flashing membrane over the brick below this saw-cut, installing a 16-oz. copper flashing over the self-adhered flashing, then insertion of a copper or stainless steel flashing in the previously-made saw-cut in the inner wythe. The saw-cut should then be packed with type N mortar, and the removed brick should then be reinstalled, with baffled weeps spaced 24" O. C. placed in every third head joint to allow water to drain out.

Capping of the water table should take place after at least the top surfaces had been cleaned, rebuilt with restoration mortar, etc. This work begins by installing a continuous, 3"-4" wide cleat of 16 oz. copper or 24-gage stainless steel along the outer edge to protrude at least ½" past the water table edge. This cleat should be secured to the stone with appropriate stainless steel or copper stone fasteners. The top of the water table should then be capped with an adhered single-ply membrane flashing, such as Cetco Core-Flash 60, which should adhere over the cleat at the outer edge, cover the water table top, and extend vertically up the upper stone face. A 16-oz. copper flashing should then be clipped over the continuous cleat and be secured to the upper stone band with stainless steel or copper stone fasteners along its uppermost edge. Another 16-oz. copper flashing should cap over the top edge of the water table flashing and tuck under the through-wall flashing above.

Restoration work includes the following steps, which need to be sequenced properly with the flashing retrofit work, and are not necessarily listed in installation order:

1. Inject Cracks in Stone with Epoxy

Major cracks in the water table pieces should be injected with appropriate epoxy resins, such as Sika Sikadur 35 Hi-Mod LV, etc.

2. Restore Surface Voids, Spalled Areas, etc. with Appropriate Restoration Mortar

Surface voids, spalled areas, and similar surface flaws should be patched with appropriate restoration mortars, such as Jahn Restoration Mortar by Cathedral Stone Products Inc.

3. Rout and Seal Vertical Mortar Joints Between Pieces

Rout all vertical mortar joints between water table pieces to a depth of about ¾", insert closed-cell backer rod, such as Dow Ethafoam, into these reveals, and install appropriate silicone sealant, such as Dow 790, over the backer rod. Apply sand to wet sealant to mimic mortar. Test sealant-stone compatibility prior to installing to ascertain that sealant will not stain stone.

4. Repoint Damaged Horizontal Mortar Joints

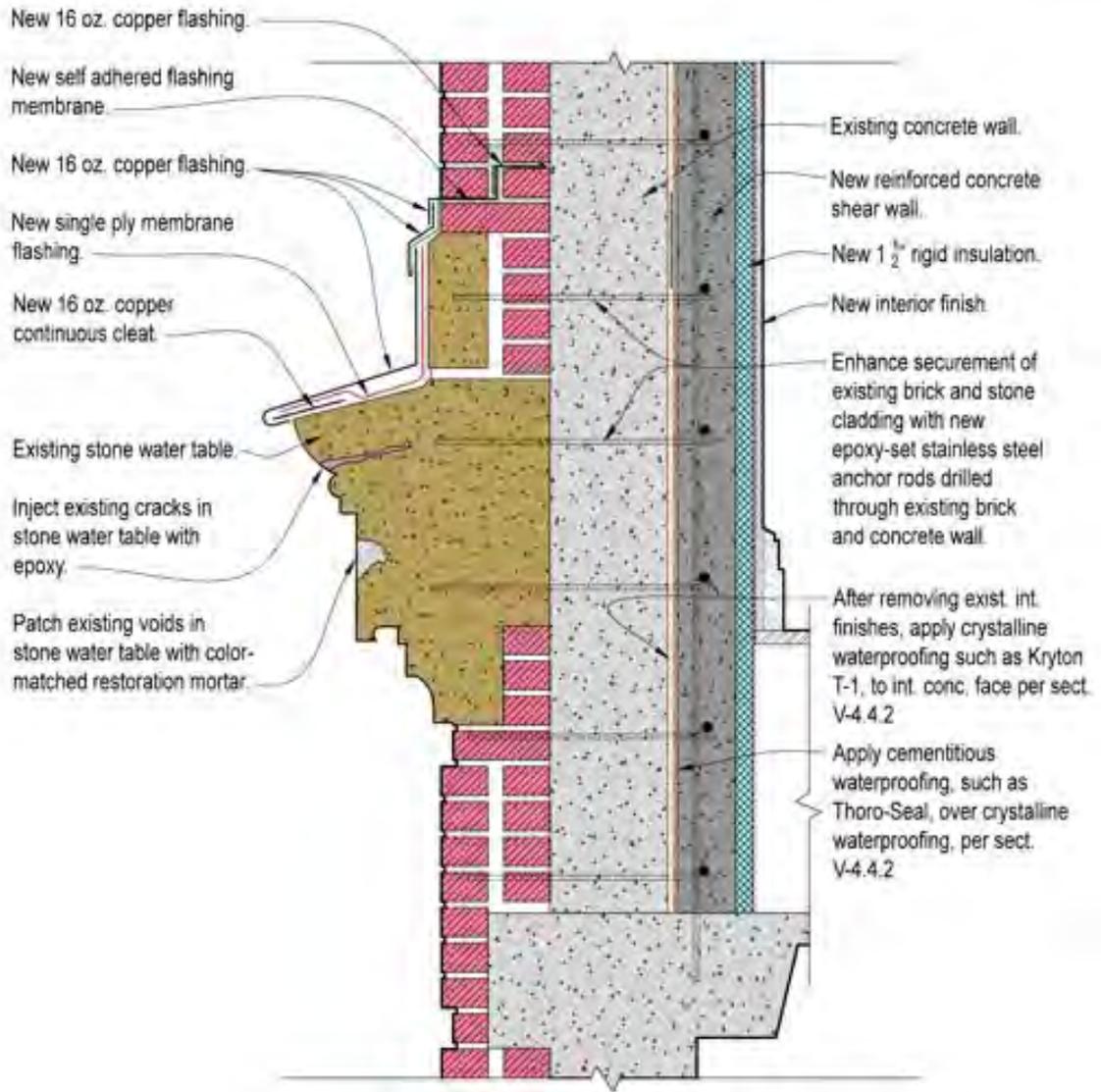
Where existing horizontal mortar joints are cracked, eroded, or otherwise damaged, selectively repoint such joints to a minimum depth of ¾" with color-matched, type N mortar, and tool joints to match existing ones.

5. Clean Masonry Surfaces

Clean exposed masonry surfaces with appropriate cleaners, such as ProSoCo Sure-Klean 766 Limestone & Masonry Pre-Wash followed by Limestone & Masonry After-Wash, etc.

6. Consolidate and Seal Stone Cladding

Apply appropriate consolidating & repellent agent, such as ProSoCo Conservare H-100, etc.



**Fig. IV-4.1(1): Water Table Flashing, Anchorage, and Restoration Work**

Note that interior concrete walls occur only at brick walls and not at concrete columns. See subsection IV-2.1.2 for interior concrete wall locations, thicknesses, & reinforcing.

## 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 Basis of Recommendations

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

A primary design flaw affecting these terra-cotta surrounds concerns the non-draining brickwork above the heads. Due to 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 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.

The condition of these terra-cotta elements ranges from generally good to notably damaged by cracking and face-spalling. 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.

Although one could wait a decade or more before needing to address these elements, it makes no sense to try squeezing more life from these pieces in view of the major masonry restoration work about to take place, so replacement of these pieces is advised at this stage.

### 4.2.2 Recommended Corrective Actions

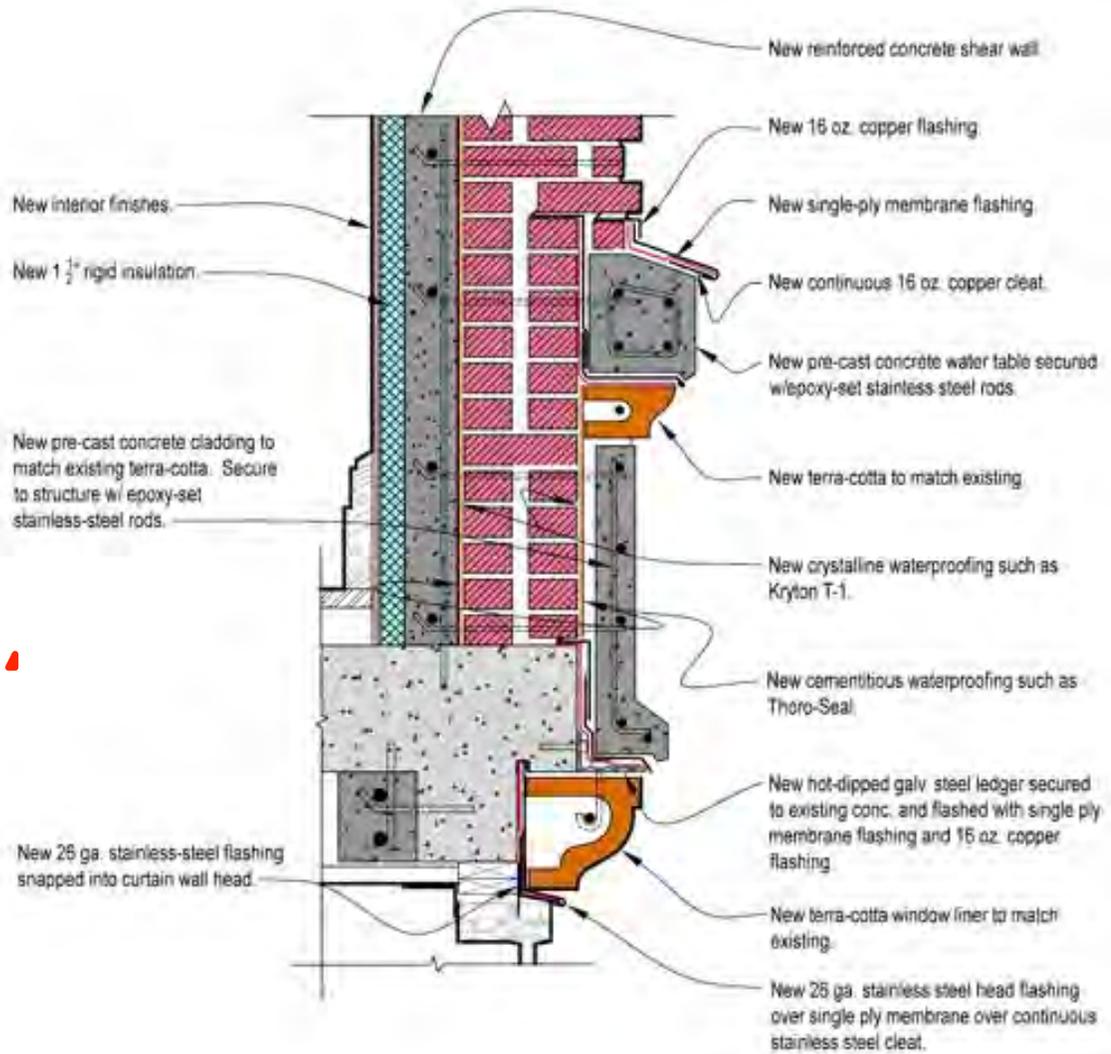
The recommended corrective work consists of replacing all existing terra-cotta window bay surrounds with new terra-cotta pieces. Figure IV-4.2(1) depicts the corrective work at the level 4 window heads, which must be coordinated with the work recommended for the upper water table band above this, as described in subsection IV-4.3.2.

Since these elements are multi-colored and highly repetitious, they should be replaced with new terra-cotta pieces of matching design. They should be mortar-set and secured with stainless steel wire anchors.

New hot-dipped galvanized steel lintels should be installed and flashed above the level 4 window heads, as described in more detail in subsection IV-4.3.2.

Although similar replacement and flashing of steel lintels above the level 5 window heads would be optimal, such work would be difficult to achieve at that location, and it appears feasible to leave the existing lintels in place at this location, as the recommended new cornice directly above this will help shelter these and limit corrosion. In view of this, the accessible faces of these level 5 lintels should be blasted to remove all rust, new stainless steel hooks should be secured to these, and the lintel faces should be painted with a zinc-rich primer, such as Tnemec 90-97 Tneme-Zinc. All reinforcing and anchorage embedded within the new terra-cotta should be of stainless steel to avoid corrosion.

New stainless steel and single-ply membrane flashings should be installed above the level 4 and 5 window heads, behind the new terra-cotta, as described in more detail in subsection IV-3.12.2.



**Fig. IV-4.2(1): Terra-Cotta window Bay Surround Replacement at Level 4 Heads**

## 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 4<sup>th</sup> and 5<sup>th</sup> level windows.

### 4.3.1 Basis of Recommendations

This multi-part band suffers from a lack of flashing caps and through-wall flashings, and the mechanical securement of the flat panels in its mid-portion may be marginal and possibly partly compromised by corrosion.

The absence of appropriate through-wall flashings and flashing caps atop the water table has effectively destroyed significant portions of this band, with widespread and severe spalling affecting weather-exposed locations. 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.

In view of this, wholesale replacement of this band appears most suitable.

### 4.3.2 Recommended Corrective Actions

The recommended corrective work consists of replacing the entire band with new pre-cast concrete and terra-cotta pieces, along with installation of new, continuous steel support ledgers above the level 4 windows and above the adjacent brick, as well as installation of new flashing caps and through-wall flashings. Figure IV-4.3(1) depicts the corrective work at this band, which must be coordinated with the work recommended in subsection IV-2.1.2 related to the addition of interior concrete walls, subsection IV-3.6.2 for the brick wall corrections, and subsection IV-4.2.2 for the level 4 window heads.

While the monochromatic projecting water table and the flat panels below can be replaced with pre-cast concrete, the multi-colored terra-cotta “soffit” under the water table should be replaced with terra-cotta to match the existing pieces.

The replacement work includes the following steps, which need to be sequenced properly, and are not necessarily listed in installation order:

1. Stabilize Existing Brick Walls & Remove Existing Terra-Cotta Band

After the interior concrete walls are added and the brickwork above this band is anchored, the existing terra-cotta band elements should be removed to expose the underlying concrete and brick walls, which should be cleaned of all mortar and debris. This work may require additional temporary bracing to support the brickwork above.

2. Install Continuous Support Ledgers Along Band Bottom

Install Hot-Dip galvanized steel ledgers continuously along bottom of band. The ledgers' bottom legs should be sufficiently wide to essentially fully support the future pre-cast concrete band to be installed above this. Secure these to the edges of the concrete floors with expansion bolts or epoxy-set stainless steel threaded rods. Incorporate attachment hooks for terra-cotta window heads below the ledgers.

3. Flash New Support Ledgers

Saw-cut horizontal mortar joint in brick or concrete wall behind band directly above the floor slab top to create ¾” deep reveal. Adhere new single-ply membrane flashing, such as Cetco Core-Flash 60, over ledger and up back-up wall to saw-cut. Cap over this with 2-piece, 16-oz. copper flashing. Insert top of upper flashing into saw-cut, then insert closed-cell backer rod, such as Dow Ethafoam, and fill remaining reveal with sealant.

4. Apply Crystalline and Cementitious Waterproofing to Brick and Concrete Back-Up Walls

Apply crystalline waterproofing, such as Kryton Krystol T-1 to exposed faces of brick and concrete back-up walls and allow to permeate per manufacturer's directions. Apply cementitious waterproofing, such as Thoro Thoroseal, over treated brick and concrete back-up walls.

5. Install New Pre-Cast Concrete and Terra-Cotta Bands

Where anchors had not yet been installed as part of the work described in subsection IV-2.1.2, install new stainless steel anchors for pre-cast concrete panels and terra-cotta pieces. Different types of anchors can be used, including bolted clips, epoxy-set threaded rods, etc. Install 4 anchors per pre-cast concrete panel.

Fabricate and install new pre-cast concrete panels with stainless steel reinforcing.

Fabricate and install new multi-colored terra-cotta pieces to match existing ones atop the pre-cast concrete panels. Secure with stainless steel hooks and bars and set in mortar.

6. Flash Over New Terra-Cotta Band

Saw-cut horizontal mortar joint in brick or concrete wall behind band one course above the projecting water table to create 3 ½" deep reveal. Adhere new single-ply membrane flashing, such as Cetco Core-Flash 60, over terra-cotta band and up back-up wall to saw-cut. Cap over this with 2-piece, 16-oz. copper flashing. Insert top of upper flashing into saw-cut, then pack joint with type N mortar.

7. Install New Pre-Cast Concrete Water Table and Brick Course Above It

Where anchors had not yet been installed as part of the work described in subsection IV-2.1.2, install new stainless steel anchors for pre-cast concrete water table pieces. Different types of anchors can be used, including bolted clips, epoxy-set threaded rods, etc. Install anchors spaced roughly 16" apart, but not fewer than 3 anchors per piece.

Fabricate and install new pre-cast concrete water table pieces with stainless steel reinforcing to match profiles of existing water table.

Reinstall one brick course directly above water table, but leave horizontal bed joint above this free of mortar.

8. Flash Over New Terra-Cotta Band

Secure 3"-4" wide continuous strip of either 16 oz. copper or 24 gage stainless steel along top outer edge of water table to serve as a continuous cleat. Adhere new single-ply membrane flashing, such as Cetco Core-Flash 60, over water table band and one course up brick wall to empty mortar joint. Cap over this with 2-piece, 16-oz. copper flashing. Insert top of upper flashing into empty mortar joint, then pack joint with type N mortar.

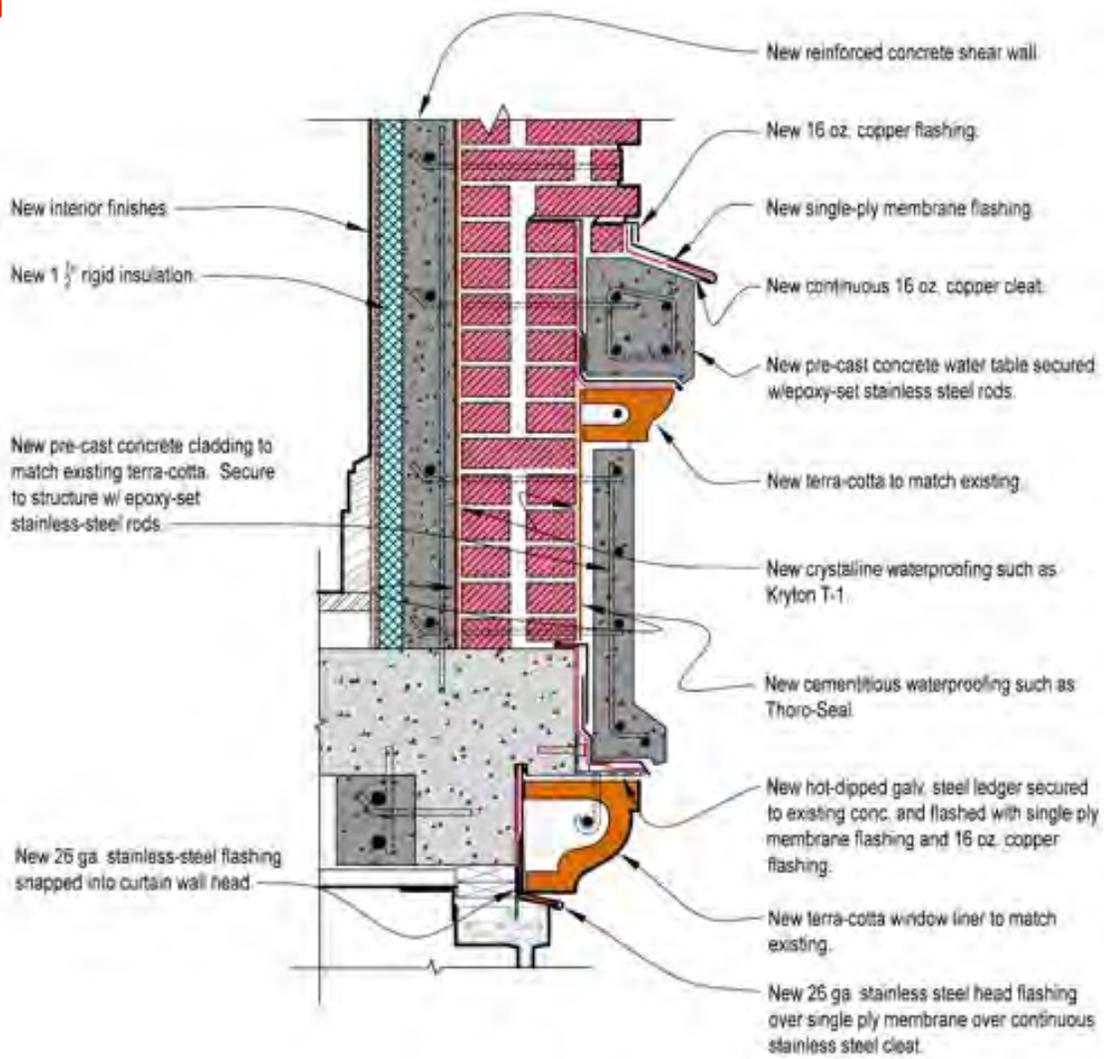
9. Fill Vertical Joints Between Pieces with Backer Rod and Sealant

Install baffled weeps, such as Dur-O-Wal Cell-Vent, at bottoms of vertical joints in flat panels directly above flashings, then fill all remaining vertical joints between pieces with closed cell backer rod, such as Dow Ethafoam, leaving a 3/8" deep reveal. Fill reveal with appropriate sealant, such as Dow 790, and apply sand to outer sealant faces to mimic mortar.

10. Seal New Pre-Cast Concrete Elements

Apply appropriate water repellent, such as ProSoCo Weather-Seal Siloxane PD or SL-100 to pre-cast concrete surfaces. Protect other surfaces from the sealer.

Figure IV-4.3(1) illustrates this work.



**Fig. IV-4.3(1): Terra-Cotta Water Table Band Replacement Abv. Level 4 Windows**

## **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 Basis of Recommendations**

Four marble panels occur within the level 5 brickwork. Two are relatively large, with about 23 SF of area and weighing roughly 700 pounds, while two smaller panels have about 7 SF of exposed area and weigh about 200 pounds each. Two issues pertain to these panels.

First, it is not clear whether any mechanical anchors secure them, and they may rely primarily on mortar bond for securement. Further, the mortar appears to be significantly delaminated, based on random tapping. The questionable securement represents the primary concern, which could pose a hazard to pedestrians below, particularly in earthquakes.

Second, the outer surfaces are seriously weathered and eroded. Some of the marble's veins appear to be possibly cracked. The panel bottom edges are stained. This degradation is largely a minor visual distraction, since these panels are so high above the street level. The surface erosion may increase moisture absorption, but this can be largely addressed with appropriate repellents. The possible short cracks along veins can also exacerbate infiltration and subsequent freeze-spalling, which could be a more serious consideration.

#### **4.4.2 Recommended Corrective Actions**

The recommended corrective work consists of enhancing anchorage, injecting apparent cracks with epoxy, and cleaning and sealing the surfaces.

The panels can be anchored by drilling either helical Helifix pins or epoxy-set threaded rods through the stone panels and back-up brick into the existing concrete walls. Only stainless steel anchors should be used, and should be set into the back-up concrete walls at least 4". They should be recessed about ¾" from the outer panel faces, with the remaining holes filled with appropriate sealant with sand embedded to mimic the stone. Dow 790 may be an appropriate sealant for this, but it should be tested for compatibility with this marble to assure that it will not stain the stone. The two larger panels should be anchored with 9 anchors, consisting of 3 rows of 3 anchors each, while the two smaller panels can be secured with 3 anchors.

The apparent cracks in the panels can be injected with a low viscosity epoxy, such as Sika Sikadur 35 Hi-Mod LV to re-glue the panels. However, this method should first be tested to assure that the epoxy does not stain the stone.

Although the surface erosion could be addressed by re-polishing, this would be costly and would provide very little benefit, as it cannot be seen from the street level. Therefore, no polishing is recommended.

However, the panels should be cleaned and sealed to limit infiltration and slow-down further degradation. Cleaning can be achieved with products such as ProSoCo Limestone Restorer or 766 Limestone & Masonry Pre-Wash and Limestone After-Wash. Sealing can be achieved with ProSoCo NST 400, NST-600, or Weather-Seal H40, which will also help consolidate the stone surface.

## 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 Basis of Recommendations

Three primary considerations apply to this band.

First, the current configuration does not reflect the building's original design, which included a significant, protruding terra-cotta cornice. This was built, but was removed after about three decades due to its degradation. As noted in subsection II-4.5.2, though the original cornice was improperly designed and required removal, a properly designed cornice can provide very beneficial weather protection for all elements below. In view of the inherent vulnerability of these masonry elements, reconstruction of a properly designed cornice of similar appearance to the original one should be considered mandatory.

The second issue concerns this band's securement to the structure, which primarily applies to the flat terra-cotta panels near the bottom. In brief, securement of these panels appears questionable, and has probably been somewhat compromised by corrosion. A lesser securement concern is that the stucco portion of this band may be delaminating in places. Both may pose risks to pedestrians below, especially in earthquakes.

The third consideration relates to the condition of the protruding band within this element, which is in extremely poor condition. It is in fact disintegrating, dropping up to fist-sized chunks onto the portico roof and ground below. This poses a serious, ongoing risk to pedestrians below.

### 4.5.2 Recommended Corrective Actions

The combination of problems affecting this band can best be addressed by removal of what remains of its original construction, and replacement with a new, projecting cornice of similar appearance to the original one, but made of pre-cast concrete elements supported by steel framing. Figure IV-4.5(1) depicts the general nature of the recommended replacement cornice.

In brief, the recommended work begins by removing all remnants of this cornice band. The bottom projecting terra-cotta band and the flat terra-cotta panels above would then be replaced with a single band of pre-cast concrete, which can be secured to the structure with stainless steel clips or epoxy-set threaded rods, with a minimum of 4 anchors per panel piece.

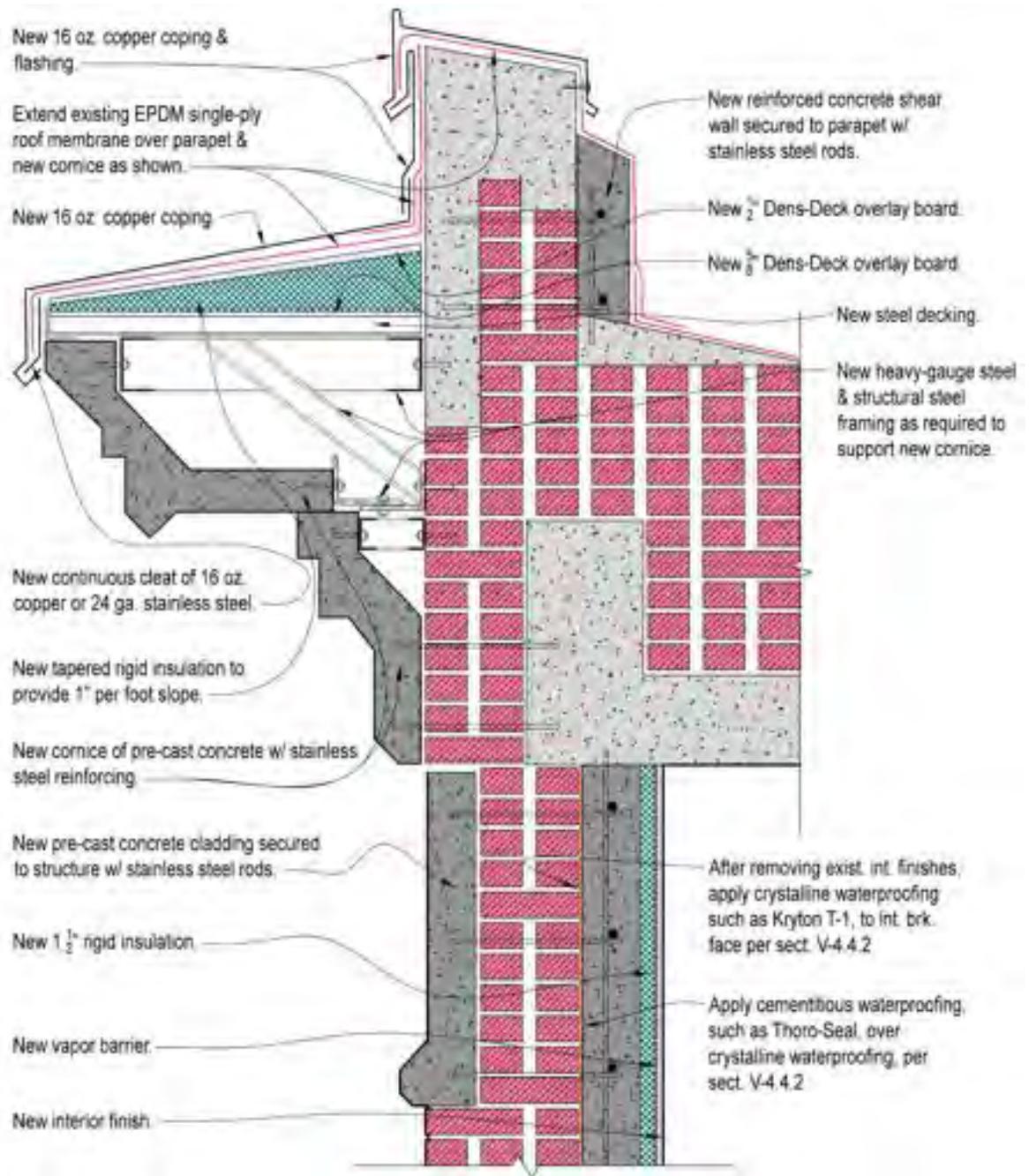
Above this, a new structural support framework of hot-dipped galvanized steel would be constructed, capped with galvanized steel decking. Pre-cast concrete soffit panels, fabricated to mimic the original cornice and reinforced with stainless steel, would then be secured to this steel support structure.

New 5/8" gypsum overlay board, such as Georgia Pacific Dens-Deck, would be secured over the decking, and would be capped with tapered rigid insulation, sloped at 1/2" per foot as a minimum, to provide slope. Another layer of 5/8" gypsum overlay board would be secured over this.

A continuous 24-gage stainless steel cleat would be secured along the outer edge. A single-ply membrane, such as Cetco Core-Flash 60, TPO roofing membrane, or a similar membrane, would cap over this cleat and extend over the cornice top and up the parapet wall to its top.

Finally, a 16 oz. copper cap flashing would be secured over this, and would be counter-flashed along the parapet face with another 16 oz. copper flashing. This counter-flashing could be fabricated to interlock with a new 16 oz. copper parapet coping, though this could also be secured with a separate cleat.

Figure IV-4.5(1) illustrates the general construction of the recommended cornice.



**Fig. IV-4.5(1): General Configuration of New Cornice**

## 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 Basis of Recommendations

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 rely entirely on mortar bond, with no mechanical anchors. Further, the mortar under most sills is largely delaminated. Thus, these sills appear to be held in place primarily via friction. Lack of mechanical securement poses some increased risk of dislocation during earthquakes. However, this appears to be a relatively moderate risk.

With regard to design, these sills lack any flashings under or atop them. Some interior plaster damage below the sills indicates infiltration via these sills. The absence of flashings below and/or atop these sills exposes the stone to weathering degradation, and also increases infiltration risk.

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.

### 4.6.2 Recommended Corrective Actions

In view of the reasonably decent condition of most of these sills, two options appear feasible.

The first would be to patch and anchor the existing stone sills, and cap over their top surfaces with flashing caps. This is described here as part of Option 1, depicted in Figure IV-4.6(1).

A somewhat technically preferable approach, though a notably costlier one, would be to replace the existing sills with pre-cast concrete ones. This would allow installation of flashings under the sills as well as over them, thus limiting interior infiltration risk to a minimum. This is described in Option 2 & 3 (Parts V & VI).

In the restoration approach, the existing stone sills would be anchored to the new interior concrete walls with either stainless steel helical Helifix anchors, or epoxy-set threaded rods. Each sill should be anchored with at least two rods.

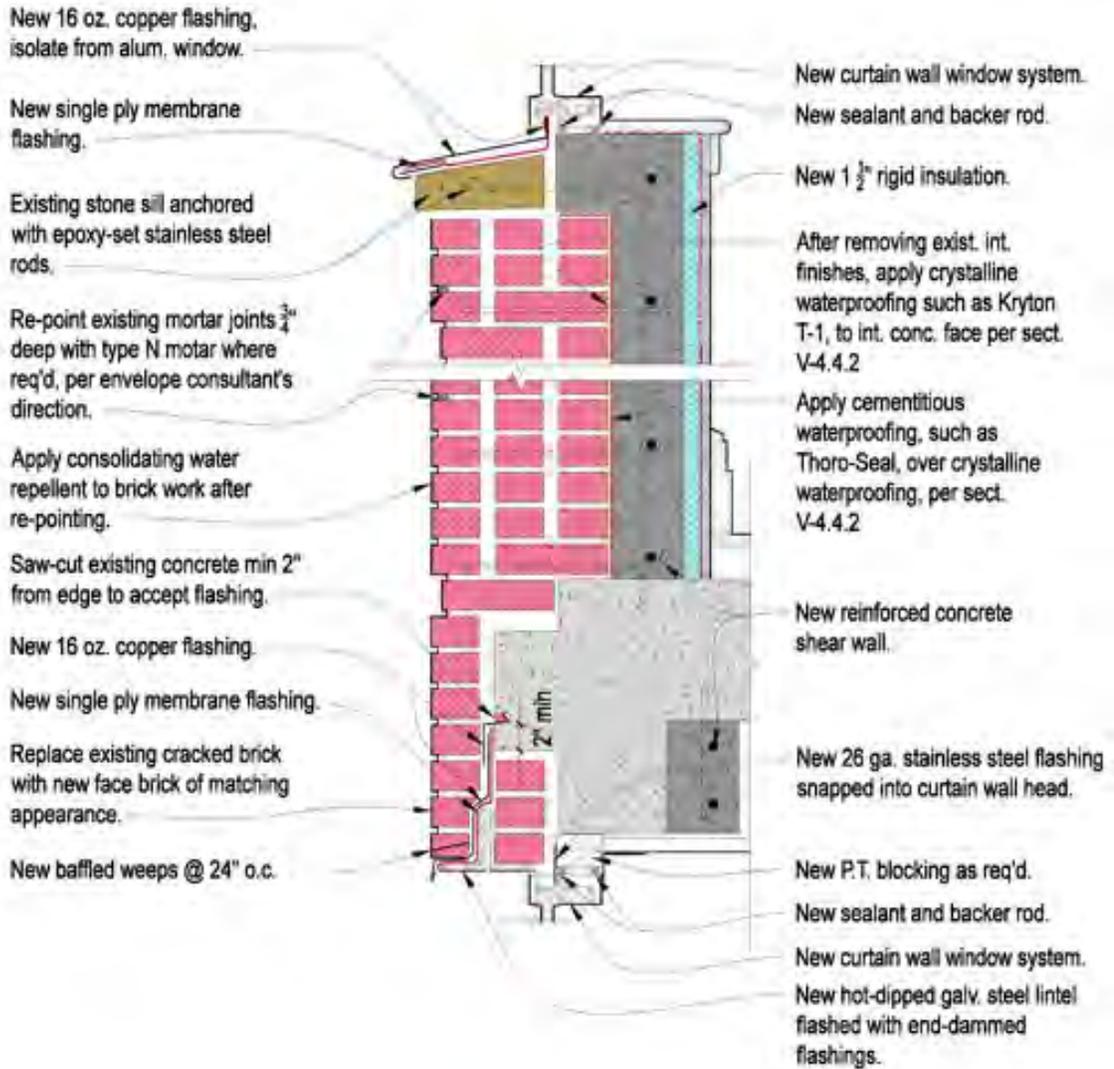
The one seriously cracked sill on the east side of the west wing should be re-glued with epoxy injection, using an appropriate epoxy resin, such as Sika Sikadur 35 Hi-Mod LV, etc.

Surface voids, spalled areas, and similar surface flaws should be patched with appropriate restoration mortars, such as Jahn Restoration Mortar by Cathedral Stone Products Inc.

The exposed sill surfaces should be cleaned with appropriate cleaners, such as ProSoCo Sure-Klean 766 Limestone & Masonry Pre-Wash followed by Limestone & Masonry After-Wash, etc.

Prior to capping, the sills should be treated with an appropriate consolidating & repellent agent, such as ProSoCo Conservare H-100, etc.

The stone sills should then be capped with a single-ply membrane flashing capped with 16 oz. copper flashings. This should be done by first securing continuous cleats of 16 oz. copper or 24-gage stainless steel along the outer sill edges, then adhering a single-ply membrane such as Cetco Core-Flash 60 over the cleats and sills, and integrating this membrane into the channels in the bottoms of the new curtain-wall windows. Finally, 16 oz. copper flashing caps with up-turned ends should clip over these cleats and into the curtain-wall window channels. The up-turned ends should be counter-flashed with copper flashings cut into the jamb brick joints.



**Fig. IV-4.6(1): Restoration, Anchorage, and Flashing of Existing Sills**

## **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 Basis of Recommendations**

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.

Consequently, the lintels display varying degrees of corrosion, ranging from minor in many sheltered locations to moderate where more weather-exposed. Some elevated moisture readings and interior plaster damage near window heads may also relate to the absence of lintel flashings.

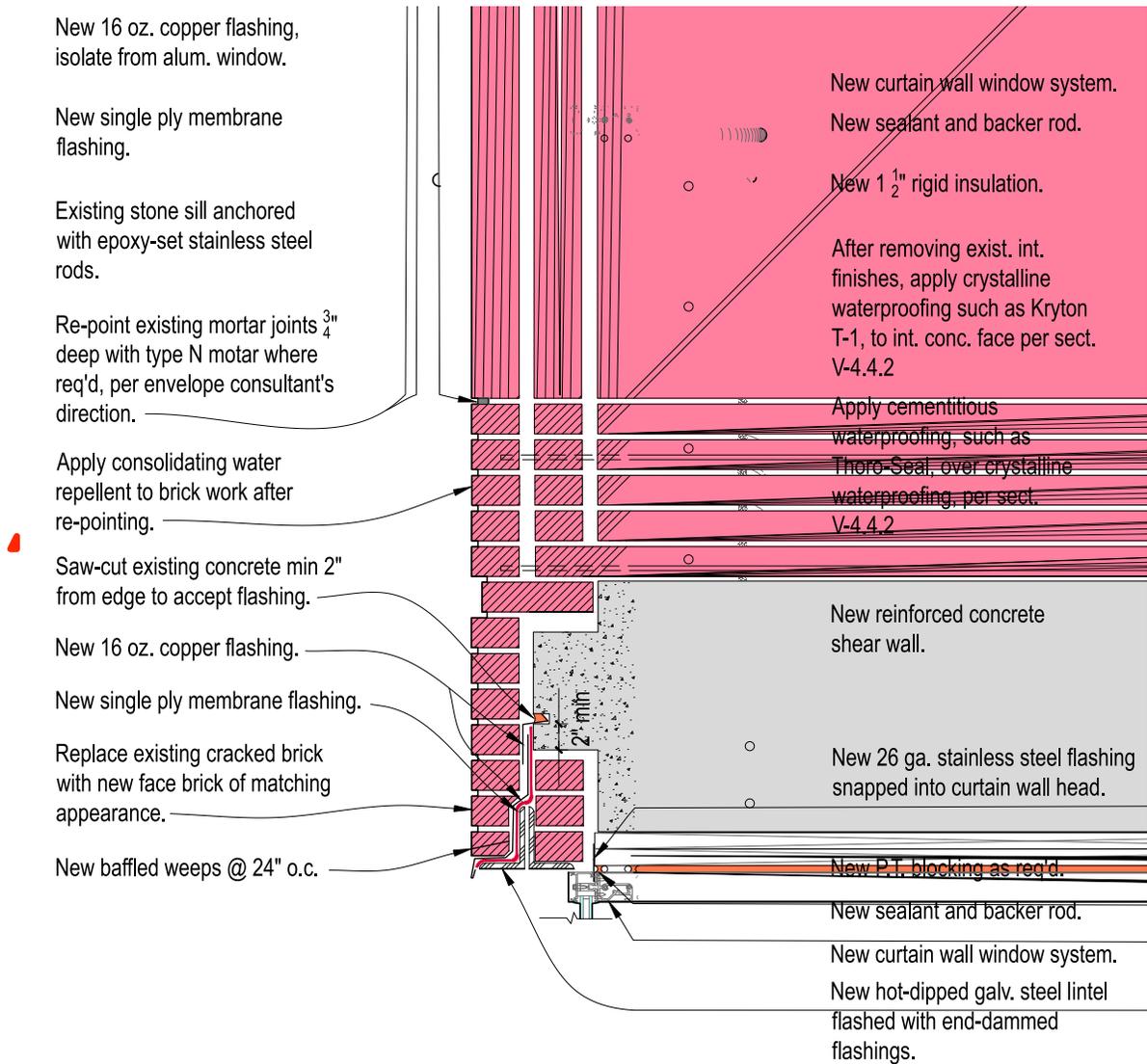
In addition, one lintel on the east face of the west wing appears to have sagged, as have the two brick courses above this lintel, causing a relatively wide gap and mortar delamination above the full width of the window. The lintel at this location is among the most corroded on the building.

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.

### **4.7.2 Recommended Corrective Actions**

Although many of the existing lintels are still in decent condition and could provide several decades of additional life, their current un-flashed configuration contributes to scattered interior leakage, and the scope of this retrofit project warrants replacement of the outer, accessible lintels as part of this approach. This work is depicted in Figure IV-4.7(1).

In brief, this work must begin by placing the interior concrete walls and brick anchors above, and will also probably require temporary bracing to maintain stability. About 5 brick courses above the lintels need to be removed to access the steel double-lintels. The outer of these should be replaced with a new, hot-dipped galvanized steel lintel. A saw cut should be made into the concrete lug above the heads to receive the upper portion of a 2-piece flashing. A membrane flashing, consisting either of a single-ply membrane such as Cetco Core-Flash 60, or a self-adhered membrane, such as Grace Vycor Plus, should then be adhered over the lintel and up the inner brick and concrete to the saw-cut. A 2-piece copper flashing should then be installed as shown in Figure IV-4.7(1), and the brick should be reinstalled, using type N mortar. Baffled weeps spaced 24" apart should be included for drainage.

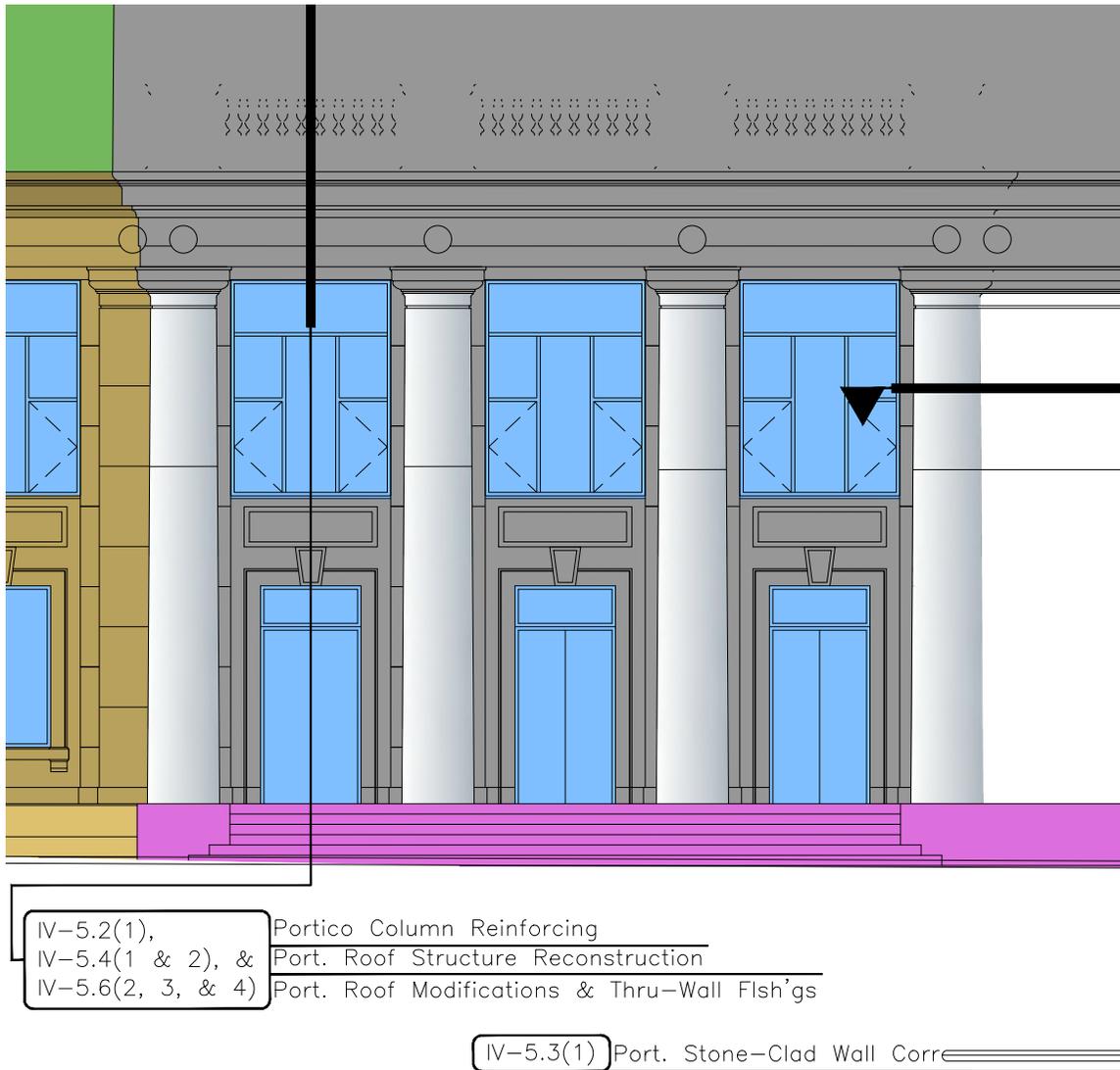


**Fig. IV-4.7(1): Window-Head Lintel Replacement and Flashing**

## 5. ENTRY PORTICO

### 5.0. General

This section pertains to all elements that comprise the entry portico. It is subdivided into 7 subsections, each of which addresses the portico's various components, such as its support base, stairs, columns, etc. Where appropriate, each subsection contains preliminary drawings depicting the described work. For clarity, Figure IV-5.0(1) shows the locations of specific details in the various subsections.



**Figure IV-5.0(1): Portico South Elevation**

## **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 Basis of Recommendations**

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. Symptoms included 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.

Although a variety of causes could have contributed to these deflection symptoms, they are most consistent with seismically induced deflections dating back to some past earthquake(s). No specific analysis is offered concerning this element's structural adequacy, as the drawings offer limited information. However, review by the structural engineer did not reveal any major concerns with this base.

Based on the conclusion that the observed deflections reflect damage from a past earthquake, it is 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 so, the base could have increased susceptibility to further damage in subsequent earthquakes.

### **5.1.2 Recommended Corrective Actions**

This section provides guidance for corrective work related to the portico base structure, including the stairs, exterior paving, and related elements.

Unfortunately, insufficient available information precludes specific guidance on what repairs are needed, as I was unable to examine the underlying structure which supports the columns, stairs, and portico floor, and thus do not know what damage may exist, if any.

In view of this limitation, my primary recommendation concerning this aspect is that additional evaluation should be performed as part of the next phase of corrective work, which will hopefully allow examination of the concealed portions below the portico entry paving.

## **5.2. Marble Columns**

### **5.2.0 General**

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

### **5.2.1 Basis of Recommendations**

Several salient issues pertain to these columns.

First, their structural design is clearly inadequate, as in the three primary marble sections comprising each column are only "aligned" with each other via "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 was not the optimal material for these exterior columns, as it is sensitive to acids, and over time, slightly acidic rains will etch and erode the surface, as has already occurred on three sides of each column. Further, marble veins can experience differential erosion, which was also observed. These veins often represent lines of weakness, and are susceptible to seismic cracking. A fair bit of apparently significant, deep cracking along these veins has already occurred, which may have somewhat compromised the structural integrity of these columns.

Such cracks also allow appreciable water infiltration. When combined with freezing temperatures, the expansion of the entrapped ice leads to progressive pushing apart of the stone. These columns are both wet and freezing very frequently, and in view of the building's 80-years of existence, this is likely to have already begun compromising the integrity of these columns.

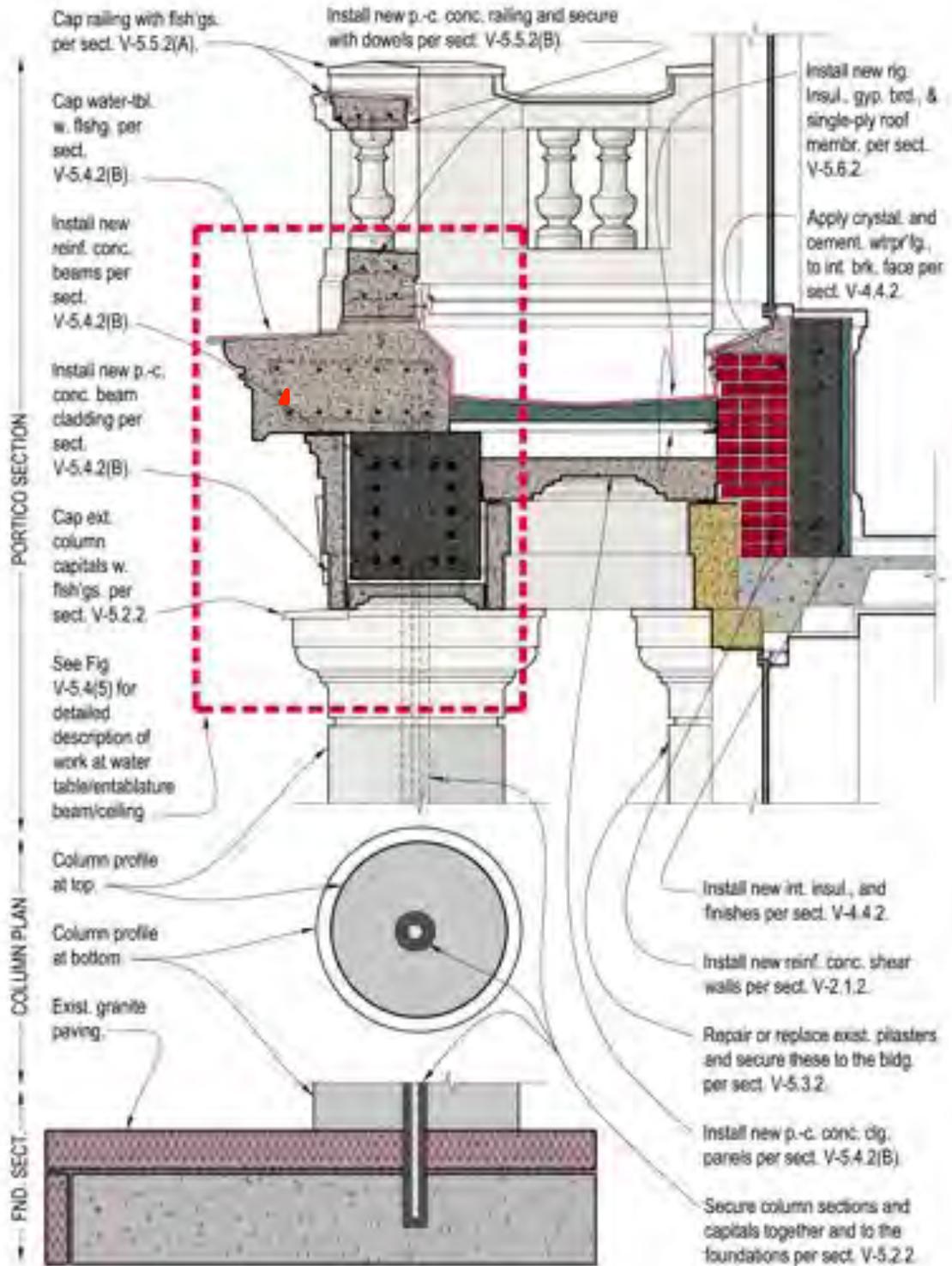
Another concern relates to the stone capitals, and how the stone beams sit atop these. The issues related to these capitals are outlined in greater detail in section IV-5.2.2 of my 12/31/10 report, and are repeated here only skeletally. In brief, various beam sections bear only on the cantilevered portions of the capitals, which are not mechanically secured to the marble columns, nor are the beams connected to the capitals. 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. This poses significant risk in an earthquake.

### **5.2.2 Recommended Corrective Actions**

This section provides guidance for corrective work related to the portico columns.

A significant clarification needs to precede the corrective work description. Namely, due to the serious damage to the portico roof structure and supporting stone cladding, and the extensive scope of this overall project, I strongly recommend complete reconstruction of the roof structure and supporting cladding, as described in other sections. In view of this complete reconstruction approach, it would also be technically best to replace these columns with reinforced concrete columns clad with 2"-3" thick marble, which would produce nearly identical appearance with a more reliable structural system, possibly at comparable or even lower cost. The marble would have some vertical joints, which could be visually minimized. However, it is my understanding that the marble columns came from an Alaskan quarry, and are of historical significance to the state. In respect of this, the described approach keeps the existing columns, but reinforces and restores them to enhance safety and longevity.

To interconnect the column sections, capitals, roof beams, and foundations, the existing columns should be core-drilled full-height and into the foundations, followed by epoxy-grouting steel reinforcing from the foundations to the tops of the new concrete roof beams described in subsection IV-5.4.2. The reinforcing should either be stainless steel or hot-dipped galvanized steel if at all possible, as use of standard steel would doom the columns to eventual corrosive destruction, though this could take a century to manifest. The reinforcing should be equivalent to #18 bars. Alternately, Dywidag Systems International, (DSI), Cintec, and perhaps others, provide special reinforcing bars for this precise application. Figure IV-5.2(1), excerpted from my 12/31/10 report, depicts the general configuration of this reinforcing work.



**Figure IV-5.2(1): Portico Column Reinforcing**

This is excerpted from PL:BECS 12/31/10 report and notes reference that report.

To restore the columns' integrity, the various larger cracks should be injected with appropriate epoxy pastes and/or low-viscosity epoxies. To limit risk of discoloration, materials and methods should first be tested in small, least-visible locations. Epoxy Paste products include Flexi-Fill 530 by Edison Coatings Inc., Sika Sikadur Injection Gel-Standard Set, among others. Low viscosity epoxies include Edison Coatings Flexi-Weld 520, Sika Sikadur 35 Hi-Mod LV, among others.

The somewhat weathered and damaged stone capitals can either be replaced with matching new pre-cast concrete ones, or the existing ones can be cleaned and restored.

If new concrete capitals are used, they should consist of low-shrinkage, integrally colored, pre-cast concrete with stainless steel reinforcing. They should be color-matched to the existing stone. This approach would fully address any weakening and damage which has affected the existing capitals, and would provide sound connections between the columns and the beams.

Alternately, the existing capitals can be patched where needed with a color-matched restoration mortar, such as Cathedral Stone Products Jahn Restoration Mortar. This approach would not fully restore integrity, and would not be appropriate if structurally-significant cracks affect them.

With either approach, the weather-exposed, upward-facing tops of these capitals should be protected by appropriate flashings, which should consist of a non-corroding sheet metal, such as 16 oz. copper, underlain with a membrane flashing, such as Cetco Core-Flash 60, or a similar membrane. Such flashings should fully cap the outer, weather-exposed top surfaces, and turn-up and integrate with the beam faces above.

To restore the eroded, etched, and stained surfaces, the marble columns can be cleaned and polished. The iron oxide staining affecting primarily the westernmost column can be removed with a combination of ProSoCo's T-1087 stain remover mixed with Stand-Off Poultrice Powder, applied over the stained areas, then removed by rinsing. Re-polishing of the marble columns can be achieved by machine grinding with ultra-fine grit. However, this is a costly effort, and will require great care to avoid surface undulations from uneven polishing.

## **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 of the portico roof. Consequently, at the portico, this cladding is used in a structural fashion.

### **5.3.1 Basis of Recommendations**

This cladding consists of large, mortar-set stone pilasters, aligned with the four marble columns, as well as smaller pieces. The pilasters support the stone roof beams above. Thus, this cladding is a structural element at the portico.

With regard to basic configuration and securement, this cladding consists of large stone pilasters aligned with the marble columns, along with smaller peripheral pieces. The large pilaster pieces are minimally secured to the embedded concrete columns, and it is probable that corrosion has largely compromised these ties, as a result of water intrusion from above.

Further, widespread and significant cracking affects these stone pilasters at their bases as well as at their tops, and the stone beam-ends atop these pilasters have in places moved away from the building face. Some of these beam-ends are supported by pilaster capitals that have cracked, compromising these beam supports yet further.

Additional cracking affects various other pieces of this stone cladding, including some of the stone lintels above windows.

Water infiltration from above the portico roof has also begun to corrode the steel lintels above some of the windows below the portico roof. Moisture permeates the full height of the cladding, causing corrosion staining on the interior marble tile in the entry vestibule, corroding the bottoms of the entry doorjambes, and compromising the steel ties securing the stone to the building.

In addition to these cladding-related concerns, this wall does not provide much lateral force-resisting capacity, with non-structural brick infill walls between slender concrete columns.

This stone cladding also lacks any flashings or weep provisions to contain and drain water.

In short, the stone-clad wall below the portico roof presents major concerns. The basic wall assembly lacks lateral load-resisting capacity, posing risk of major damage in an earthquake. The stone cladding, which supports the portico roof, is seriously damaged by widespread cracking, dislocation, and corrosion of the inadequate ties which secure it to the concrete columns, posing serious risk of collapse during an earthquake. Embedded steel lintels above some windows have also begun to corrode.

### **5.3.2 Recommended Corrective Actions**

This section provides guidance for corrective work related to the stone-clad wall at the portico.

In brief, the issues needing corrective work include the following:

1. Inadequate lateral load-resisting capacity of the wall assembly.
2. Widespread, and in places structurally significant cracking and displacement of the roof-supporting stone pilasters and adjacent stone elements.
3. Inadequate connection of the stone cladding to the wall structure.
4. Corrosion of steel lintels above windows.
5. Absence of flashings and drainage provisions in the stone cladding at appropriate locations.

The severity of damage to the portico roof-supporting structural cladding, and the extensive scope of the overall project, makes replacement of this cladding the most viable option. Removal of the existing cladding will also make it feasible to address this wall's other issues from the exterior, in contrast to other walls on this building. This will avoid the need to impact the interior of the entry vestibule.

In view of this, the recommended work consists of the following steps, which are depicted in Figure IV-5.3(1):

1. Remove Existing Stone Cladding

After removing the portico roof structure, the stone cladding in the portico area should be removed.

2. Install Anchors to Secure Existing Interior Terra-Cotta and New Concrete Walls

Drill new stainless steel helical Helifix or epoxy-set threaded rods through existing brick and concrete into interior terra-cotta walls to help secure these. Place anchors 16" O. C. horizontally and 18" O. C. vertically to produce an anchor density of 2 SF/Anchor. Leave outer ends of anchors protruding about 3" from existing brick or concrete at future concrete walls and 8" at future concrete columns.

3. Install New Steel Reinforcing for Future Concrete Columns and Walls

For cost-estimating purposes, assume that the thicker piers will be reinforced with two curtains of #5 reinforcing @ 12" O. C. E. W., and that the abutting thinner concrete walls will be reinforced with one curtain of #5 bars @ 12" O. C. E. W. In addition, (2) #5 hooked dowels spaced 48" O. C. should be drilled and epoxy-set into the existing concrete columns.

4. Install New Concrete Columns and Walls

Cast new concrete piers and walls against the outer faces of the existing walls. For cost-estimating purposes, assume that the piers will be 12" thick and the thinner abutting walls will be 5" thick.

5. Apply Asphaltic Emulsion Coating Over Exterior Faces of New Concrete Columns and Walls

Spray asphaltic emulsion coating over exterior faces of new concrete walls and columns.

6. Install New Galvanized Steel Ledgers Above Window and Door Heads

Install new hot-dipped galvanized steel ledgers above window and door openings; secure these to new concrete walls with stainless steel expansion or epoxy-set bolts. For cost estimating purposes, assume that 4" x 4" x 3/8" steel ledgers would be secured with 5/8"  $\varnothing$  expansion bolts spaced 24" O. C.

7. Install New Membrane and Sheet Metal Flashings Along Wall Bases and Over All Ledgers

Install new Cetco Core-Flash 60 membrane flashings over all ledgers and along all wall bases, and cap over these with 16 oz. copper flashings.

8. Install New Anchorage for New Pre-Cast Concrete Cladding

Install new stainless steel clips as needed to secure new pre-cast concrete cladding. Install 4 anchors per large cladding piece.

9. Install New Thin Vent Mat and Rigid Insulation Against Outer Face of New Concrete Walls

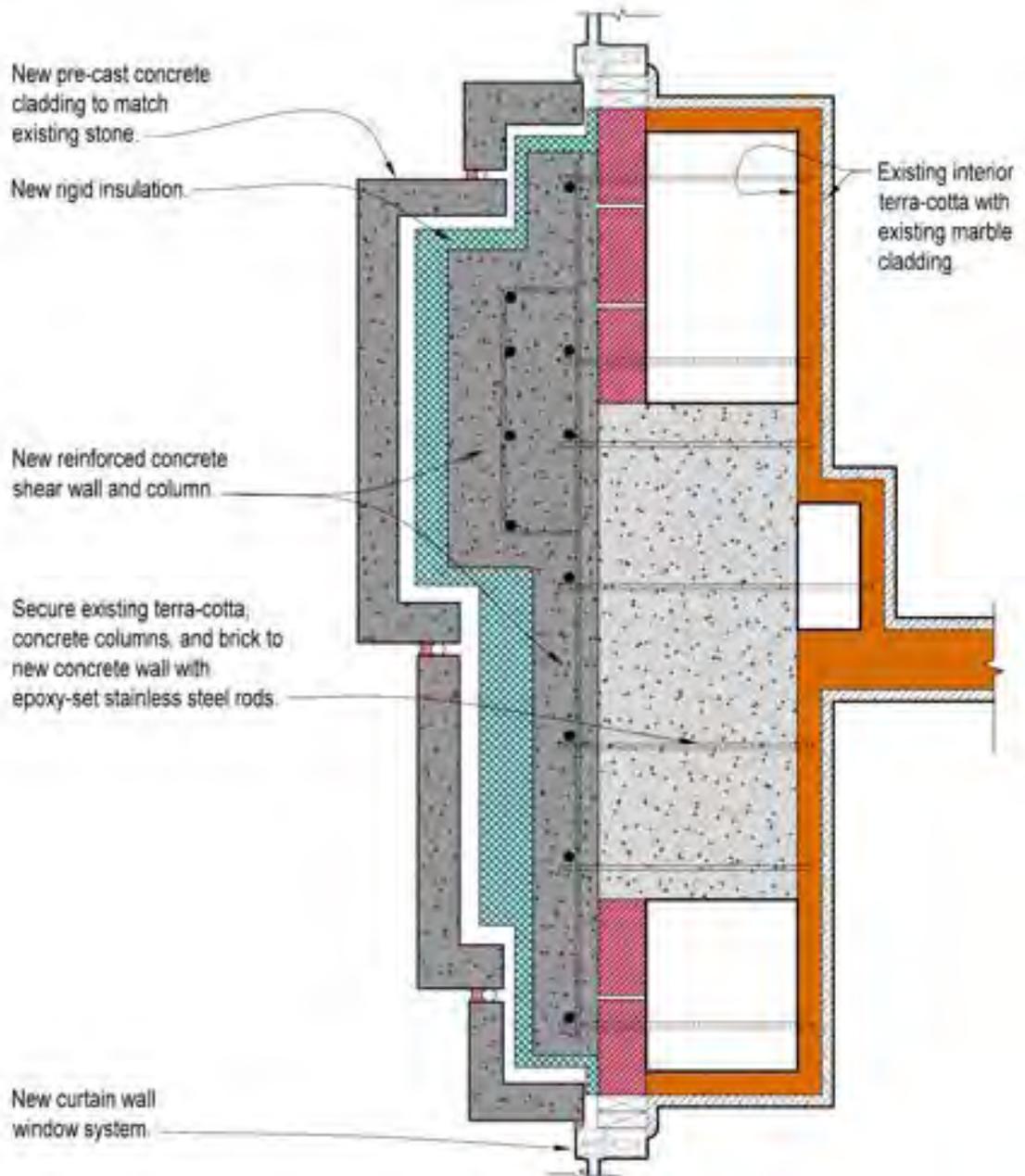
Install new Enka-Drain 9714 vent-mat, fabric side outward, against new concrete walls, then secure new extruded polystyrene insulation over this. Vary insulation thickness as needed to maintain a 1" free air space separating insulation from new pre-cast concrete cladding.

10. Install New Color and Texture-Matched Pre-Cast Concrete Cladding

Fabricate and install new pre-cast concrete cladding, matching existing stone cladding in specific configuration, color, and texture. Reinforce new cladding with stainless steel, and embed stainless steel anchors.

Install baffled weeps, such as Dur-O-Wal Cell-Vent at bottom of cladding, spaced roughly 24" apart, but located at bottoms of vertical joints.

Seal joints between pieces with closed-cell backer rods, such as Dow Ethafoam, and Dow 790 silicone sealant. Embed color-matched sand into sealant surfaces to mimic mortar joints.



**Figure IV-5.3(1): Typical Portico Stone-Clad Wall Corrections**

## 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 Basis of Recommendations

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

The roof structure consists of four short stone N-S crossbeams and three similar E-W beams which span 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 loosely placed across the tops of the stone beams with no connections. A horizontal stone water table sits atop the concrete beam over the marble columns and continues to the building face. These stone water table sections are also not mechanically secured to the portico roof. Short brick cripple walls atop the stone ceiling panels support a 3 ½" thick sloping roof slab.

Many worrisome manifestations affect this roof structure. Many also relate to other components and are outlined elsewhere. Findings concerning the roof structure fall into the two interrelated categories of structural adequacy and water infiltration and resultant damage.

In brief, structural concerns 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 not secured to each other.

Also, the pilasters supporting the crossbeams are appreciably compromised by cracking.

The crossbeams also display relatively severe cracking. Seismic displacement has separated the ends of these beams from the structure at some locations. 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 above the stone beams 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.

A further observation concerns both structural and water-infiltration issues. Namely, profuse, long-term infiltration has damaged many elements of this roof structure, including its stone ceiling, beams, and the inadequate steel straps which secure the portico to the structure, which are by now probably compromised by corrosion.

The combination of inadequate securement and significant weather degradation has made the entire portico roof structure susceptible to seismic failure, and even in the absence of earthquakes, the damaged portico poses a hazard to pedestrians below.

#### 5.4.2 Recommended Corrective Actions

This section provides guidance for corrective work related to the portico roof structure.

In brief, the issues needing corrective work include the following:

1. Absence of connections between the roof-supporting stone beams and the building.
2. Structurally significant cracking and displacement of the roof-supporting stone beams.
3. Woefully inadequate connection of the overall portico roof to the building structure, which has been further compromised by corrosion due to long-term water infiltration.
4. Absence of mechanical securement of the heavy stone ceiling panels, combined with possibly significant degradation of these panels due to long-term water infiltration.
5. Absence of any structural elements, such as cross-bracing, to resist lateral loads.
6. Absence of connections between the stone beams and the supporting columns.
7. Absence of flashings at appropriate locations in the roof structure to preclude water infiltration and associated damage to structural elements.

In short, as with most other elements of this building, the portico roof structure suffers from twin, interrelated issues of structural inadequacy and water infiltration and associated damage. My 12/31/10 report outlined two possible approaches for addressing these issues, which could be described as “restoration” and “replacement”. However, these were based on the assumption that only the portico would be retrofitted. In view of the much-expanded corrective scope of the current project, the “restoration” approach is not appropriate, and only the “replacement” approach is described here. Figures IV-5.4(1 & 2) depict this general approach.

This approach would begin with the installation of scaffolding and safety measures as needed.

Following this, the entire roof structure above the stone column capitals would be removed, leaving only the marble columns and their capitals in place. The capitals could also be replaced if found too damaged, which however does not appear to be the case.

Shafts would be drilled through the marble columns to secure the sections together, per subsection IV-5.2.2. The new column reinforcing would extend through each column into its concrete foundation.

If it were deemed preferable to replace the stone capitals, new ones of color-matched, low-shrinkage concrete with stainless steel reinforcing, would be secured atop the columns with additional stainless steel dowels per the structural engineer’s design, in addition to the central reinforcing bars. It would also be helpful to incorporate crystalline waterproofing, such as Kryton KIM admixture, into the concrete mix to limit water intrusion into these capitals. However, it appears feasible to keep the existing stone capitals, in which case, these should also be drilled-through to allow enhanced securement to the marble columns with epoxy-set dowels.

Reinforced concrete beams would be cast-in-place atop the column capitals. These beams should be roughly 8”-10” narrower than the existing stone beams to allow for new pre-cast concrete cladding panels to match the existing appearance. The beam tops should extend to the bottom of the water table.

New ceiling panels, matching the appearance of the existing ones, but composed of color-matched, reinforced, pre-cast concrete, would be installed between the concrete beams. These panels could be substantially thinner and lighter than the existing ones, and could be supported on steel angles secured to the sides of the beams and to the building’s brick wall.

The roof drain lines would be extended to relocate the roof drains along the centerline of the roof.

The existing stone water table pieces could be reinstalled atop the concrete beams. However, since these have to be removed to allow the other work to be installed, it would probably be less costly to fabricate and install new, color-matched water table pieces of pre-cast concrete, reinforced with stainless steel. These new pieces would be secured to the new concrete beams with epoxy-set dowels or via another method. If pre-cast concrete water table pieces are used, incorporation of crystalline waterproofing, such as Kryton KIM admixture, is advisable.

Steel decking would be secured atop the new concrete beams, or on continuous steel angles. If needed for added rigidity, a concrete slab could be cast atop this. If not needed, a gypsum roofing board, such as Georgia-Pacific Dens-Deck, could be installed over the decking. Tapered rigid insulation would be installed atop the slab or gypsum roof board to provide roof slope toward the centrally located roof drains.

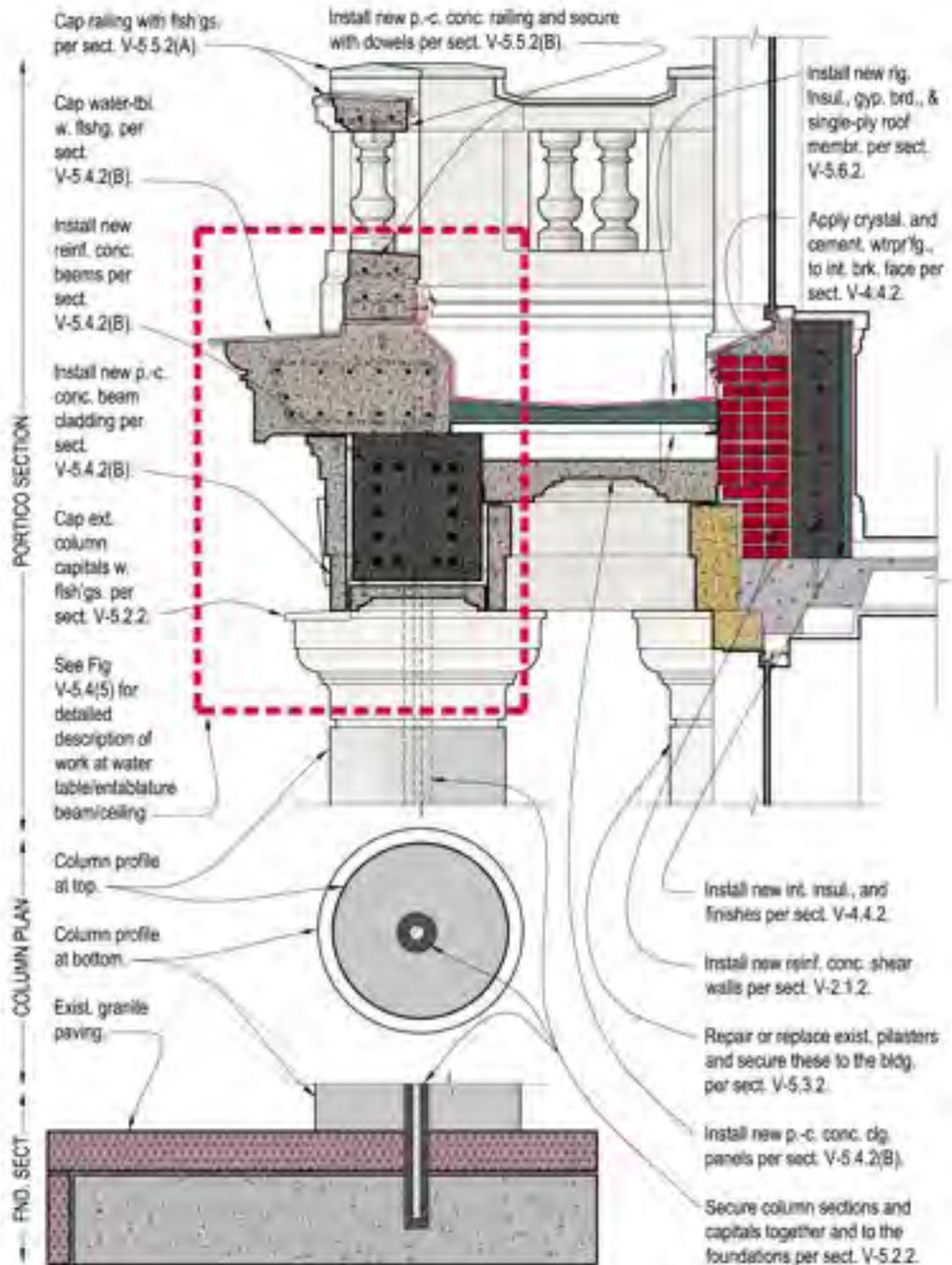
The top surfaces of the water table would be capped with a double-layer flashing system, consisting of a membrane, capped with a non-corroding sheet metal flashing. Both layers would cap the exposed surface, and extend under the railing base and turn-up the inner edges. Both layers would also form up-turned sleeves around the dowels used to secure the stone railing base. The membrane flashing should ideally be compatible with the roofing membrane. Materials such as TPO roofing, Cetco Core-Flash, Sarnafil PVC roofing membrane, or similar membranes, would be well suited to this application, depending on the roof membrane used. The sheet metal flashing could consist of 16 oz. copper. Due to the large exposed surfaces, the outer edges of the sheet metal flashings would be secured with continuous cleats, and would also need to be fairly heavy-gage, such as 16-20 oz. copper or 24-22 gage stainless steel.

New double-layer flashings, as generally described for the water table pieces and in subsection IV-5.2.2, would be installed to cap over the outer, weather-exposed tops of the column capitals. These flashings would extend roughly 3" up the concrete beam faces and be inserted into saw-cut or integrally cast reglet reveals. These flashings would integrate with similar flashings running along the full length of the outer concrete beams.

The new concrete beams would be clad with pre-cast concrete panels to match the existing appearance. These panels could be secured to the concrete beams with epoxy-set stainless steel dowels or clips.

The work described in this subsection would produce a vastly enhanced portico roof structure, which would be essentially indistinguishable from the existing portico's appearance.

That is a general summary of the work recommended within this approach. As it is nearly impossible to describe such work adequately in text alone, Figures IV-5.4(1 & 2) depict this approach. Figure IV-5.4(4) is a section through the portico roof between the columns, while Figure IV-5.4(2) shows the portico's outer edge, including the entablature beam and water table, in greater detail. Please note that both drawings are excerpted from my 12/31/10 report, and the notes reference sections of that report, rather than this one.



**Figure IV-5.4(1): Recommended Portico Roof Structure Reconstruction**

Note that this drawing is excerpted from the 12/31/10 report, and its notes reference sections of that report. Further, this drawing does not entirely align with the work described here. For example, the stone cladding shown at the building face should be changed to pre-cast concrete cladding.

If conc. topping slab is placed atop steel roof decking, install new tapered rigid insulation over the topping slab, cap this with gypsum roof overlay board, then install new single-ply roof membrane over this, per sect. V-5.5.2. If no conc. topping is needed over steel decking, install 1/2" gypsum roof overlay board over decking, then place tapered rigid insulation over this, cap this with gypsum roof overlay board, then install new single-ply roof membrane over this, per sects. V-5.4.2(B) and V-5.8.2.

Install double-layer fish'g. system over exist. or new water-table below railing per sect. V-5.4.2(A or B). Form sleeves in both fish'g. layers around new stl. dowels to flash these as well

Re-install exist. stone water-table pieces and secure these to conc. beam via epoxy-set dowels, or preferably, install new water-table pieces of pre-cast conc. reinforced with stainless steel bars, and secure these to new conc. via epoxy-set dowels per sect. V-5.4.2(B).

Secure column sects. & capitals together and to the foundations & beams by core-drilling, reinforcing, & grouting these per sect. V-5.2.2.

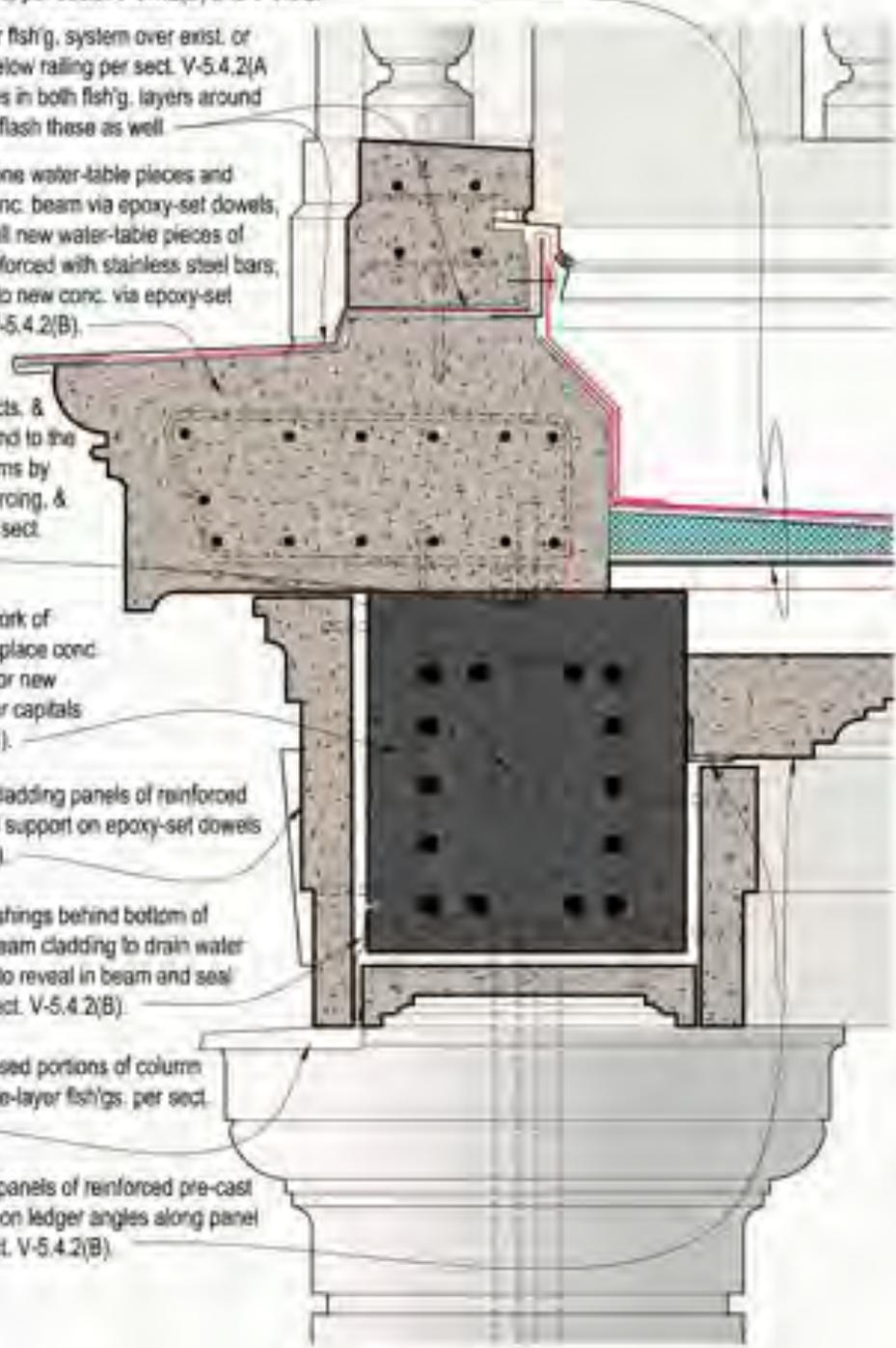
Install new framework of reinforced, cast-in-place conc. beams atop exist. or new column and pilaster capitals per sect. V-5.4.2(B).

Install new beam cladding panels of reinforced pre-cast conc. and support on epoxy-set dowels per sect. V-5.4.2(B).

Install new drip flashings behind bottom of exterior pre-cast beam cladding to drain water out, set flashing into reveal in beam and seal with sealant per sect. V-5.4.2(B).

Cap weather-exposed portions of column capitals with double-layer fish'gs. per sect. V-5.2.2.

Install new ceiling panels of reinforced pre-cast conc. and support on ledger angles along panel perimeters per sect. V-5.4.2(B).



**Figure IV-5.4(2): Recommended Portico Roof Structure Reconstruction**

Note that this drawing is excerpted from the 12/31/10 report, and its notes reference sections of that report. Further, this drawing does not entirely align with the work described here.

## **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 Basis of Recommendations**

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.

Primary observations pertain to structural, general design, and condition considerations. With regard to structural issues, none of the stone railing pieces are mechanically connected to any other elements, and rely entirely on mortar bond to stay in place. Mortar bond has been largely compromised, and I could move a 200-pound piece directly above the stairs, illustrating the obvious seismic risk to pedestrians below.

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. Consequently, elements below are exposed to infiltration and damage, which are amply evident.

The railing has also been partly compromised by seismic damage and weathering, displaying cracks, displacement, surface erosion, some spalling, and loss of mortar bond and integrity.

### **5.5.2 Recommended Corrective Actions**

In brief, the issues needing corrective work include the following:

1. Absence of mechanical connections between the various railing elements.
2. Absence of mechanical connections between the railing elements and adjacent structure.
3. Greatly deteriorated, and in places completely destroyed, mortar bond.
4. Seismic damage, such as cracking, affecting a number of the railing pieces.
5. Variable surface erosion, spalling, and other weather-degradation of the railing pieces.

Two approaches, "restoration" or "replacement", were outlined in my 12/31/10 report. However, that report was based on a work scope to include only the portico. In view of the much larger scope of this project, only the technically preferable "replacement" approach is described here.

This work would begin by complete disassembly of the railing and supporting roof structure. After reconstruction and flashing of the roof-structure, per subsection IV-5.4.2, new pre-cast concrete pieces, reinforced with stainless steel and with an integral crystalline waterproofing, such as Kryton KIM admixture, matching the existing stone in configuration, color, and texture, would be epoxy-set over stainless steel dowels drilled and epoxy-set into the water table pieces.

A minimum of two dowels would be installed for each railing base piece. The double-layer flashing system atop the water table would be formed with up-turned sleeves to flash these penetrations, as described in subsection IV-5.4.2. The bottoms of the railing base pieces would be drilled with holes to receive these flashed dowels, and epoxy would be injected into these holes. The railing base pieces would then be set over a mortar bed.

The railing pieces against the building would be installed similarly. However, to limit infiltration, a double-layer flashing, consisting of a membrane capped with a copper flashing, would first be extended up the building wall to essentially isolate the vertical railing piece from the building face. Two stainless steel dowels per railing piece would be epoxy-set into the wall. The railing pieces would then be epoxy-set over these dowels.

The large railing “post” pieces would be installed over the base pieces in the same fashion, with a minimum of two stainless steel dowels epoxy-set into the base piece for each “post” piece, and the “post” pieces would be set in mortar over this base piece, with epoxy injected into receiving holes for the dowels. These “posts” would be rebuilt using this same method, with all pieces secured to underlying ones with two epoxy-set dowels in addition to a mortar bed.

The baluster pieces would then be installed in the same fashion, but with only one dowel per baluster piece.

The tops of these baluster pieces would then be drilled to receive epoxy-set dowels, one per baluster piece.

The railing cap would then be epoxy-set over the baluster pieces in the same fashion.

To limit weather degradation, the tops of the railing “posts” and the caps would be capped with double-layer flashings consisting of a membrane capped with a copper flashing. At least the outer edges of these cap flashings should be secured with continuous cleats. The inner edges may be secured with exposed fasteners, or with concealed cleats. The membrane flashings can consist of TPO or PVC roofing membrane, Cetco Core-Flash, or a self-adhered flashing, such as Grace Vycor Ultra. Due to the large exposed surfaces, the metal flashings would need to be fairly heavy-gage, such as 16 oz. copper.

Please refer to Figures IV-5.4(1 & 2) of the previous section for drawings depicting this work.

## 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 Basis of Recommendations

The roof slopes toward the building, as well as east and west from a central ridge toward two drains, which are recessed within deep sumps. No overflow drains are provided. The absence of overflow drains is counter to typical code requirements, and can lead to overloading, though this risk is quite limited in this case.

No through-wall flashings occur along the roof's junctures with the building face and with the outer portico edge. This is a major flaw, which allows any water within the masonry walls above this roof to migrate down into the roof below. Major degradation affects the entire underlying roof structure due largely to this problem. Through-wall flashings should have been incorporated along this roof-wall juncture to capture and drain this water back out onto the portico roof. Retrofitting of such flashings is inherently complicated by the header coursing in the brick, which may allow water to bypass even retrofitted flashings.

Three window sills occur very close to the roof surface. Their copper sill flashings penetrate under the aluminum windows, whose sills are sealed to these flashings, with no weep provisions. The proximity of the roof to the sills increases leak risk, particularly during wet snow periods.

The sealing of the copper sill flashings to the aluminum windows, and the absence of weep provisions, exacerbates leak risk, as drainage is precluded from under the window sills. The close proximity of copper flashings to aluminum windows may also pose added risk of corrosion.

The built-up roof is badly degraded, and is nearly completely delaminated from underlying copper along the building face. Consequently, this roof is ineffective.

### 5.6.2 Recommended Corrective Actions

This section provides guidance for corrective work at the roof, drains, and associated flashings.

In brief, the issues needing corrective work include the following:

1. Absence of through-wall flashings along roof-wall junctures.
2. Inadequate vertical clearance between roof top and adjacent window sills.
3. Inward roof slope toward the building, which increases snow build-up along the building face.
4. Absence of emergency overflow drains.
5. Degraded, failed roof membrane.

Recommendations to address these problems are depicted in Figures IV-5.6(2-4), and include:

1. Retrofit Through-Wall Flashings Along Roof-Wall Junctures

This work is described in greater detail in subsection IV-3.6.2, and is not repeated here. In brief, this involves retrofitting of through-wall flashings into the brick walls abutting the roof to intercept and drain water migrating downward within the masonry. See Figure IV-5.6(4).

2. Retrofit Through-Wall Flashings Below Perimeter Railings

This work is described in greater detail in subsection IV-5.4.2, and is not repeated here. In brief, this involves retrofitting of through-wall flashings atop the perimeter water table, to intercept and drain water migrating downward within the masonry railing and to protect the water table. See Figures IV-5.6(2 & 3).

3. Increase Vertical Clearance to Window Sills

This goal should be achieved by lowering the roof structure as recommended in subsection IV-5.4.2. If needed, the vertical clearance can be further increased by raising the window sills. If this becomes necessary, I recommend that these window sills be raised per subsection V-5.7.2 of my 12/31/10 report.

4. Modify the Roof Slope to Eliminate Slope Toward Building

Per subsection IV-5.4.2, the new roof slope would be provided with tapered rigid insulation. I recommend that this tapered rigid insulation slope from the north and south edges toward the roof centerline, at a slope of 3/8" per foot.

A shallow cricket should also be installed along this centerline to drain water toward the drains, which would occur near the roof's east and west edges. Due to the portico roof's long, narrow configuration, this cricket would need to be quite shallow, near 1/16" per foot. This is less than ideal, but would work. A preferable approach would be to add a drain at the center of the roof, which would allow two roof crickets, each sloping at roughly 1/8" per foot. This would require adding a new drain line within the ceiling cavity. This appears feasible.

5. Add Overflow Drains

I recommend that one new overflow drain be added adjacent to each primary drain. These overflow drains should be essentially identical to the roof drains, but with a 2" tall stand-pipe screwed into the drain body to force the water level to rise 2" before these would begin draining water. Such overflow drains are readily available from J. R. Smith, Wade, Josam, and others.

The primary and overflow drains should be recessed within sumps, created by reducing the thickness of rigid insulation by at least 3/4" relative to adjacent roof surfaces. The sumps should be roughly 18"-24" wide and 36"-42" long. Figure IV-5.6(1) shows a possible overflow drain type.



□ Raised stand-pipe within overflow drain precludes drainage until water level rises to pipe top.

**Figure IV-5.6(1): Generally Appropriate Overflow Drain Type**

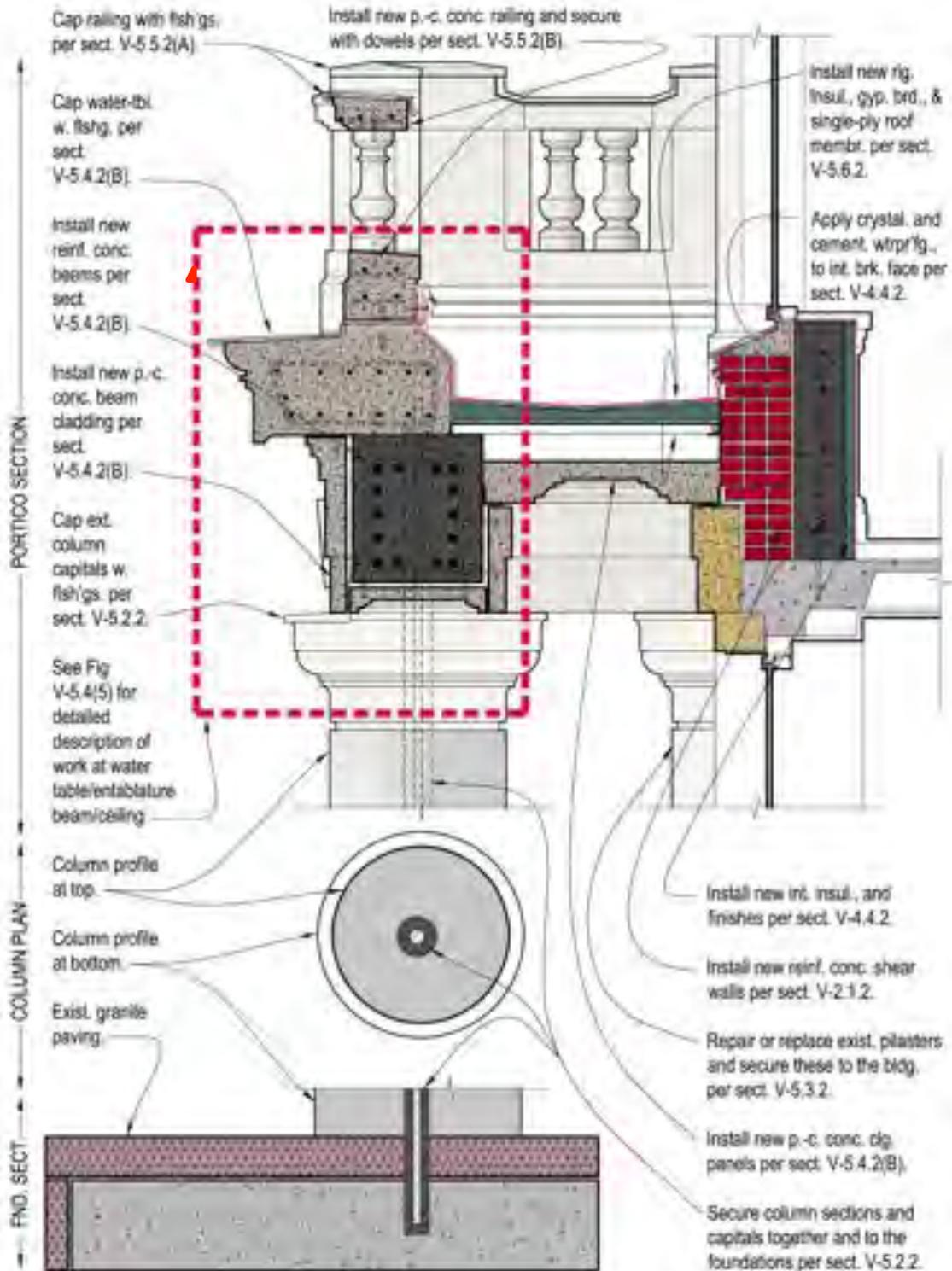
## 6. Replace Roof Membrane Assembly

The corrective work described in subsection IV-5.4.2 for the roof structure would result in the placement of tapered rigid insulation atop the portico roof to provide slope toward the portico centerline, away from the building, along with a shallow cricket along the centerline to direct water flow toward the roof drains.

Over this sloped insulation, install gypsum overlay roof board, such as ½" thick Georgia Pacific Dens-Deck. This can be screwed to the steel decking or it can be adhered to the insulation. Alternately, one could also loose-lay a non-woven polypropylene fabric, such as Sarnafil NWP, over the rigid insulation, in which case the membrane would need to be mechanically fastened.

A new single-ply roof membrane should then be installed over this. This could be an EPDM membrane, as had been used elsewhere on this building, a TPO membrane, or a good quality PVC membrane, such as Sarnafil. Although there is some logic to using an EPDM membrane, to maintain consistency with other parts of the building, my tendency is to recommend either TPO or PVC. The basis for this recommendation is that TPO and PVC membrane laps are heat-welded, which is in my opinion a preferable, more-durable method than gluing, as is done with EPDM. Further, both TPO and PVC membranes have compatible membrane-coated sheet metal flashings, which appear to have some uses on this project. Suitable TPO membranes are made by Carlisle, Firestone, and others. Sarnafil, Cetco, and others make suitable PVC membranes. Regardless of specific membrane type, the membrane should be 60 mils thick.

The membrane can be secured with mechanical fasteners or by adhesion. If adhesion is used, the underlayment would need to be a board type, such as Georgia Pacific Dens-Deck, rather than a loose-laid fabric.



**Figure IV-5.6(2): Recommended Portico Roof Modifications**

Note that this drawing is excerpted from the 12/31/10 report, and its notes reference sections of that report. Further, this drawing does not entirely align with the work described here. For example, the stone cladding shown at the building face should be changed to pre-cast concrete cladding.

If conc. topping slab is placed atop steel roof decking, install new tapered rigid insulation over the topping slab, cap this with gypsum roof overlay board, then install new single-ply roof membrane over this, per sect. V-5.5.2. If no conc. topping is needed over steel decking, install 1/2" gypsum roof overlay board over decking, then place tapered rigid insulation over this, cap this with gypsum roof overlay board, then install new single-ply roof membrane over this, per sects. V-5.4.2(B) and V-5.8.2.

Install double-layer fish'g. system over exist. or new water-table below railing per sect. V-5.4.2(A or B). Form sleeves in both fish'g. layers around new stl. dowels to flash these as well

Re-install exist. stone water-table pieces and secure these to conc. beam via epoxy-set dowels, or preferably, install new water-table pieces of pre-cast conc. reinforced with stainless steel bars, and secure these to new conc. via epoxy-set dowels per sect. V-5.4.2(B).

Secure column sects. & capitals together and to the foundations & beams by core-drilling, reinforcing, & grouting these per sect. V-5.2.2.

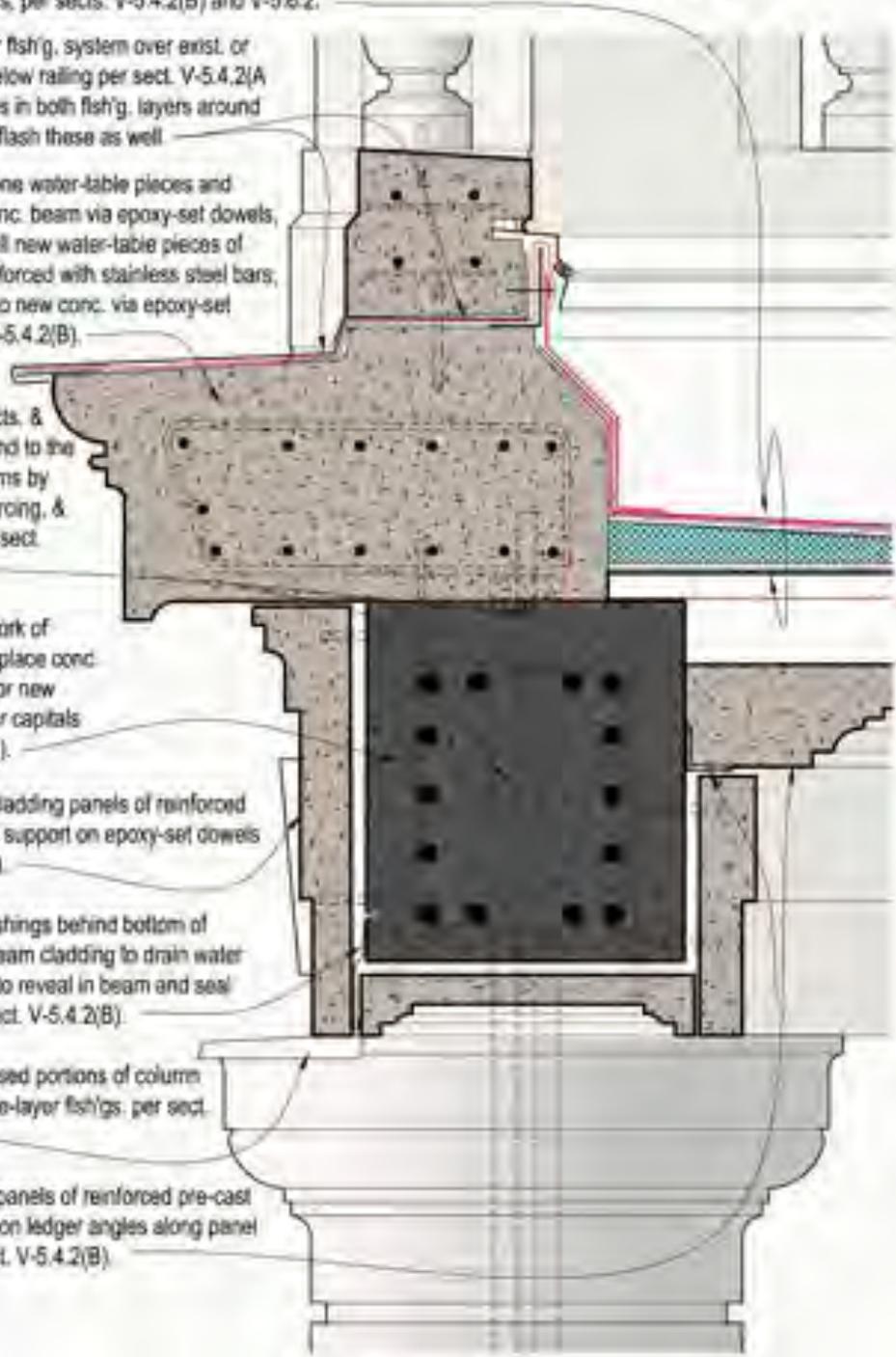
Install new framework of reinforced, cast-in-place conc. beams atop exist. or new column and pilaster capitals per sect. V-5.4.2(B).

Install new beam cladding panels of reinforced pre-cast conc. and support on epoxy-set dowels per sect. V-5.4.2(B).

Install new drip flashings behind bottom of exterior pre-cast beam cladding to drain water out, set flashing into reveal in beam and seal with sealant per sect. V-5.4.2(B).

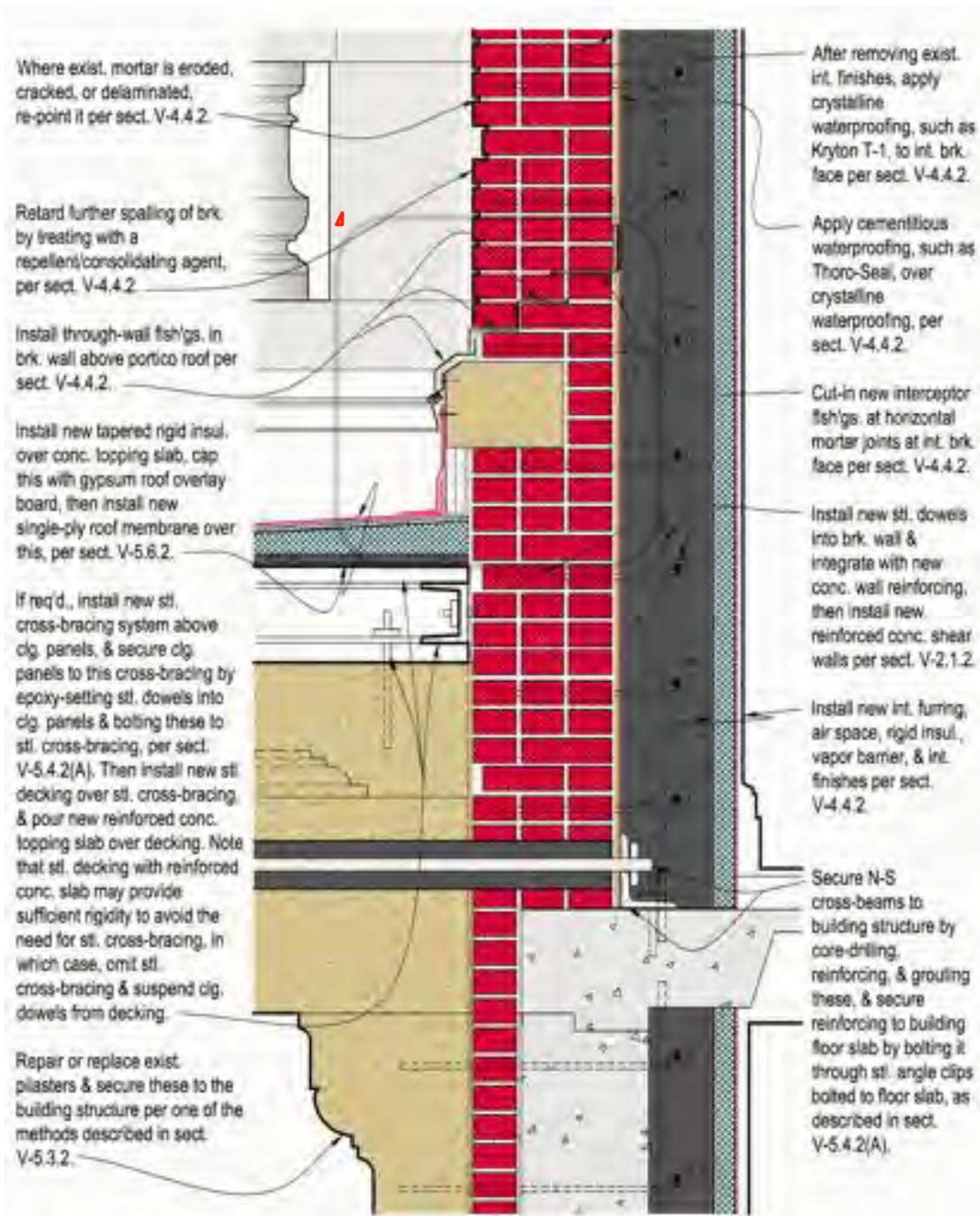
Cap weather-exposed portions of column capitals with double-layer fish'gs. per sect. V-5.2.2.

Install new ceiling panels of reinforced pre-cast conc. and support on ledger angles along panel perimeters per sect. V-5.4.2(B).



**Figure IV-5.6(3): Recommended Portico Roof Modifications**

Note that this drawing is excerpted from the 12/31/10 report, and its notes reference sections of that report. Further, this drawing does not entirely align with the work described here.



**Figure IV-5.6(4): Retrofitting of Through-Wall Flashings Above Portico Roof**

Note that this drawing is excerpted from the 12/31/10 report, and its notes reference sections of that report. Further, this drawing does not entirely align with the work described here. For example, the stone portico elements shown should be changed to pre-cast concrete.

## **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 interior architectural elements affected by the seismic retrofit and exterior wall renovation, which primarily impacts interior faces of exterior walls.

#### **6.1.1 Basis of Recommendations**

The needed structural work will require removal of interior finishes of exterior walls, which will impact the interior wall finishes and abutting floors and ceilings. This will necessitate restoration of the interior finishes.

#### **6.1.2 Recommended Corrective Actions**

The interior faces of the exterior walls will be replaced with gypsum board assemblies as illustrated elsewhere in Part IV. The finishes for the walls will match the existing finishes.

Where removal of adjacent walls, flooring and ceiling finishes is required as part of the seismic retrofit and exterior renovation they will be reinstalled, patched or repaired to match the existing finishes.

The retrofit and renovation will affect adjacent walls, flooring and ceilings to a limited extent; patching and repair of these areas will be included.

## **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 Basis of Recommendations**

The needed structural work will require removal of interior finishes of exterior walls, which will also expose and impact embedded mechanical systems. This will necessitate some mechanical work, as well as allowing upgrades to mechanical systems where these become exposed.

#### **7.1.2 Recommended Corrective Actions**

The heating system piping and registers will be replaced per a 1998 design. The system will be converted to hot water from the existing steam heating. The new system will allow for a change from the cast iron radiators that heat with steam to hot water convectors. The 2010 boilers will be converted to hot water when all the devices are replaced.

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.

The plumbing systems will not be affected except in minor instances where plumbing is located on an exterior walls or an interior wall that is required to be retrofitted.

The fire sprinkler system will not be affected by the new work.

## **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 by other seismic retrofit work.

#### **8.1.1 Basis of Recommendations**

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 Recommended Corrective Actions**

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.

## 9. ESTIMATED CONSTRUCTION COST OF OPTION 1

### 9.0. General

This section presents the summarized construction cost estimate for Option 1, which is based on the full cost estimate prepared by HMS, Inc., with subsequent modifications by Jensen Yorba Lott Inc., and PL:BECS.

As this Option 1 attempts to retain as much of the existing masonry as possible, it possesses an inherently higher degree of uncertainty concerning possible costs. For example, while Options 2 and 3 would replace 100% of all existing brick cladding, Option 1 may need to replace 5%, or perhaps 10%, of the existing brick at different locations, and this uncertainty precludes a high degree of precision. For this reason, the assumed contingency for phases 2 and 3 of the Option 1 approach is 33% higher than the corresponding contingencies for Options 2 and 3.

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

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

### 9.1. Estimated Construction Cost of Option 1

The estimate is broken down by the 3 construction phases

Construction Phase 1 is scheduled for May to December 2013. This phase will consist of seismic reinforcing and renovation of the Portico along with repairs to the ground floor structure in the crawl space and providing drainage in the crawl space.

Construction Phase 2 is schedule for May to December 2014. This phase will consist of seismic reinforcing of the south wall from the foundations to the roof along with restoration of the exterior south wall assembly. The work will also include replacing the steam heating system on the south wall with a hydronic heating system.

Construction Phase 3 is schedule for May to December 2015 and May to December 2016. This phase will consist of seismic reinforcing of the east, west and north walls from the foundations to the roof along with restoration of the remaining exterior wall assemblies. The work will also include replacing the steam heating system in the remainder of the building with a hydronic heating system.

The cost of the three construction phases follows:

Construction Phase 1: \$ 1.1 million.

Construction Phase 2: \$ 4.8 million.

Construction Phase 3: \$ 12.2 million.

**Total: \$ 18.1 million.**

