13. Exterior Skin Assessment

Overview

The subject building's exterior façade, comprised largely of a 1992 curtain wall system manufactured by Kawneer, was remedially repaired in 2006-2007. The repair work consisted of the following:

- Replacing all internal and external glazing gaskets, for all glass (vision and spandrel).
- Applying an external seal over the new external gaskets.
- Removing and re-applying sealant work within the framing joints (while the glass was removed).
- And other measures to deter water intrusion into the building past the exterior façade.

In addition to the repair and modification of the glazing systems, there was also considerable repair work carried out to rectify cracks which had appeared in the exterior faces of the precast concrete façade panels.

Based on a visual survey of the building, conducted on February 10th and 11th, 2009, repairs to the façade appear consistent with the remediation drawings and specifications. Observed repairs appeared in good condition, with no direct evidence of severe degradation or failure of remedial sealing being noted. Interior conditions were also found to be generally free of evidence of ongoing water intrusion.

These measures, while appearing to have generally deterred water intrusion into the building, have added to the maintenance regimen of the building. Frequent monitoring of important sealant measures is expected, as well as eventual sealant deterioration and failures due to differential movement and weathering, requiring removal and replacement. An expected maintenance summary for the exterior façade is included in the Recommendations for Future Maintenance (section E) of this report.

A. Assignment and Background

This Exterior Skin Assessment is intended to provide a detailed outline of the building's exterior façade, as required to establish a recommended course of maintenance and monitoring activities, together with any likely future repair works.

In order to do this, the report needs to identify the technical nature of the system detailing, as well as any repairs or modifications that have been carried out to date. This will help to identify any potential weaknesses in the original systems, and also to identify any special considerations that need to be made regarding future maintenance of the repair works.

Scope of Exterior Skin Assessment

This report addresses the building's exterior facades, which generally includes vertical surfaces. Where exterior building façades adjoin horizontal building assemblies or components, an evaluation of the horizontal surface was performed.

Areas where vertical to horizontal junctures occur and where an evaluation was performed include the Tower roof surface, terrace decks, and parking decks that abut the exterior building façade.

This report does not report on the general condition of the horizontal surfaces of the parking structure, exterior paving, helipad, or other similar horizontal surfaces.

Assessment Methodology
Thornton Tomasetti (TT) evaluated the building's exterior facade through the following tasks:

1. Performed a visual review of the building's exterior façade, and documented observations with photographs, as described below in section C.

2. Conducted cursory review of project drawings, as described below.

Documentation Review:
The primary documents reviewed for this report include two sets of drawings, relating to the exterior façade systems.

- Curtain Wall Shop Drawings (Revision 4, dated 11/25/1991, 57 sheets) from the original construction period, which was carried out in 1992 (under the direction of Dreyfuss & Blackford Architects). The shop drawings were prepared and submitted by Kawneer & Architectural Glass and Aluminum.

- Curtain Wall and Balcony Remediation drawings (Bulletin #1, dated 5/3/2006, 13 sheets, and some additional sheets photographed on-site) from the remedial works phase, which was carried out in 2006-2007. The drawings were prepared and issued for construction by McGinnis Chen Associates and LaCroix Davis.

Additionally, there are numerous façade investigation reports for this building which are available through publicly accessible websites. TT obtained several of these reports regarding the tower curtain wall, and utilized them as reference documents while studying the drawings, and preparing this report.

No documents or drawings were reviewed regarding the original design of the precast façade elements. Only minor references were found in the remediation drawings by McGinnis Chen, regarding the use of epoxy to repair cracks in the precast.

Limitations and Qualifications:
While this report is intended to outline the façade maintenance requirements for the next 30 years, it should be noted that there have already been considerable façade deficiencies during the initial 15 years of occupancy. These deficiencies, together with the recent extensive remedial works, have resulted in an altered exterior façade assembly whose future performance will rely upon periodic monitoring and expected maintenance over the course of the life of the building. The performance for such remediated facades cannot be predicted with certainty.

The findings, conclusions and opinions in this report are based on TT's limited site observations, document reviews, basic analysis, professional experience, and sound engineering practices. There were no invasive inspections, and thus there was no visual review of structural connections, anchors, firesafing, etc. Also, given that our visual observations were carried out in 'limited' quantities (there were no inspections from scaffolds or gondolas), our written observations may not fully represent the building's exterior conditions.

While TT's findings are summarized as of the date of issuance, should new information or additional documentation become available, TT may amend or revise its opinions and recommendations accordingly.

B. Description of the Building's Exterior

The building at 450 N Street in Sacramento, is a 25-story office building with an attached 4-level parking garage. Construction of the tower was reportedly completed in early 1993. The parking garage pre-dates the tower, and originally occupied the entire block. It was partially demolished and modified as a part of the tower's construction process.

Portions of the parking garage were also enclosed and modified at that time, so that the ground floor could be occupied by various programs, including a cafeteria and child care center on the west side of the tower.

Most of the tower's exterior enclosure is an aluminum curtain wall system, manufactured by Kawneer. The curtain wall consists of a gridwork of aluminum framing extrusions, together with insulated vision glass, and monolithic spandrel glass.

Other portions of the tower are enclosed with precast concrete panels. These primarily occur at the building's corners, and at the mechanical floors, and parapets. In some cases, the precast panels contain punched-windows, which are built using aluminum components and glazing similar to the curtain wall system.

The Tower roof appears to consist of an elastomeric coated membrane assembly that returns up the precast concrete parapet panel. Roof area drains and overflow drains are located approximately at the mid-point of the roof deck. Roof features that integrate with the roof membrane include steel parapet angle braces, roof davit supports for cleaning equipment, and miscellaneous conduit and utility penetrations.

Portions of the parking garage are also enclosed by an aluminum 'storefront' system, which is similar to the curtain wall system.

Tower Curtain Wall

The primary enclosure for the tower is an aluminum 'stick-system' curtain wall. In general, curtain walls are sub-divided into two categories: 'Unitized' systems, and 'Stick' systems.

Unitized systems are completely prefabricated, and installed on-site as a series of interlocking panels. Since the panels are pre-assembled in a clean factory environment, with controlled temperature and humidity, they can be assembled and glazed using fast-curing silicone sealants to create a highly durable and weatherproof enclosure.

Alternatively, 'Stick' systems are brought to site as a series of components, and are methodically assembled onto the building as a kit-of-parts. The aluminum extrusions (sticks) are installed to create a gridwork of framing, and then other components such as insulation and glass panels are installed as in-fill materials. In an effort to avoid workmanship defects, and to increase consistency, the weatherproofing for such systems usually rely on dry-fitted gaskets (rather than wet-applied sealants) at the perimeter of the glazing. These gasketed rebates also permit the glass to move somewhat freely within the frames, which allows for thermal expansion of the extrusions, and for various types of building displacements (eg: racking, slab deflections, etc.) However, since none of the framing, glass, or other components are pre-assembled off-site, the quality and weather-integrity of the final installation is still largely dependent on the quality of the field work.

The particular aluminum framing 'stick-system' used for this project was an "I-Beam" system, which consists of vertical mullion extrusions which resemble an I-Beam in cross-section profile. These systems capture the glazing on all four edges, and typically allow for glass replacement from the interior of the building. It is also relevant to note that internal covers are used on vertical mullions to create their rectangular architectural profile.

Level 23 Terrace Doors

The terrace doors and adjacent side-lites were built with aluminum and glass components to match the surrounding curtain wall. Water infiltration has reportedly occurred at these locations previously, and thus the doors, heads, sills, and framing were all re-designed and replaced during the remedial works phase.

Precast Concrete Panels

Portions of the tower are enclosed with precast concrete panels. Reportedly, the panels had numerous surface cracks, which were addressed during the remedial works phase. In connection with the examination of the precast panels at the roof level of the Tower, the inboard side of the parapet appeared to have been sealed with an elastomeric paint coating together with an elastomeric roof surface coating.

Podium Level Glazing

Level one and two of the tower, together with the ground floor of the parking garage, are enclosed with considerable quantities of 'storefront' glazing systems. Such glass and aluminum framing systems are very similar to 'stick-system' curtain walls, but their detailing usually implies that the system does not extend further than a single story height.

These glazing systems were also reportedly incurring water infiltration, and as such were modified during the remedial works. The modifications attempt to create a 'face-sealed' system, by applying exterior beads of sealants, and by adding silicone patches over the jointed interfaces of the aluminum framing.

Podium Level Roof Deck Flashing
The parking garage roof deck abuts the tower along the south and west facades. Along these two edges, there are parapets, flashing details, and expansion joints. Water infiltration reportedly occurred at these locations previously, and thus the details were modified and repaired during the remedial works phase.

C. Visual Review of the Exterior Facade

The visual review of the exterior skin was conducted by Thornton Tomasetti on February 10th and 11th, 2009. Observations were made by Bruce Arita, and Mark Dannettel, by reviewing portions of the building's interior (at the ground floor, roof, 23rd floor, and 22nd floor), and also by reviewing portions of the building's exterior (at the ground floor, roof, 23rd floor terraces, and the upper deck of the parking garage).

Tower Curtain Wall
While reviewing the interior, we did not observe any apparent deficiencies. The stick-system curtain wall appeared to have new interior gaskets along the inside surface of the insulated vision glass (see figure 3), which were installed as a part of the remedial glazing works.

While reviewing the exterior, we only noted very minor deficiencies, which are typical of any existing façade. We observed new exterior sealant cap seals over glazing gaskets, typical at all glass-to-framing joints. We also noted new silicone boots (expandable covers) at mullion expansion joints. Both of these items were identified as a part of the remedial glazing works.

Level 23 Terrace Doors
The revised terrace doors generally appear to be in good condition. The threshold designs have been modified and appear to tie-in with the drain methodology for the terrace deck. However, the sill heights still remain 'flush' with the upper surface materials of the roof. Water marks and stains on the aluminum sill plates indicate that water ingress is likely during extreme weather conditions.

We also noted minor degradation of seals around the doors and adjacent framing.

Precast Concrete Panels
The precast panels generally appear to be in good condition, but with considerable areas of injected epoxy, as was required to repair visible cracks in the exterior faces of the panels. It is not clear (or evident) if the cracks have any affect on the structural integrity of the panels, but we did not observe any rust staining, spalling, misalignments, or other signs of structural problems.

However, we did observe at least one crack in a precast panel which had not been repaired, on the east façade of the tower, near the ground floor. Any such cracks should be documented and repaired, in order to prevent further degradation of the panel.

Sealant joints between precast panels also appear to be in good condition.

The Tower roof appeared in generally good condition. Horizontal to vertical junctures were observed to be tight, well sealed, and in satisfactory condition. Roof membrane penetrations at steel parapet angle braces, conduit penetrations, and davit supports were noted to be in good condition.

The vertical surfaces of the parapet appeared to be in good condition. These surfaces were noted to be finished with an elastomeric coating.

Limited puddling of water was observed surrounding roof area drains, but horizontal surfaces elsewhere appeared generally free of ponded or puddled standing water.

Podium Level Glazing

The aluminum framed 'storefront' glazing systems generally appear to be in good condition. As noted above, they have been modified in the remedial works phase, as required to become face-sealed systems. As such, they now have silicone joints applied over their exterior gaskets, and silicone patches applied over any joints in the aluminum framing work.

Podium Level Roof Deck Flashing

As noted above, the parking garage roof deck abuts the tower along the south and west facades. Along these two edges, there are parapets, flashing details, and expansion joints which have been modified and repaired during the remedial works phase.

These joints and flashings appeared to be in good condition. We only noted that the east end of this roof-deck area terminates as a very low curb detail, and as such forms a large 'scupper' detail to allow overflow, in the case of any roof flooding. This overflow curb occurs directly above an area of curtain wall and a doorway on the east façade. In the event of roof flooding and overflow, this area of glazing and the doorway below, will likely incur water infiltration of some type.

D. Summary Assessment of the Exterior Facade

Given the building's history of reported water infiltration problems, the current condition of the exterior façade appears to be in relatively good condition. This can largely be attributed to the array of remedial façade works which were recently carried out in 2006-2007.

However, it should be recognized that the remedial works typically do not have the same level of long-term integrity, as the original construction works should have exhibited. This is particularly true for any exterior applied sealants, which modify the glazing systems to become 'face-sealed' systems. These types of sealant applications do not have long lifespans, and they will need to be regularly inspected, and replaced periodically.

Tower Curtain Wall

The basic tower curtain wall seems to be in good condition, in light of the recent remedial works which were carried out to replace internal and external weatherseal gaskets, to refurbish internal sealed joints of framing, and to install an additional exterior 'wet-seal'.

While the remedial repairs appear to be in sound condition at the time of this report, there can occur over time maintenance-related issues specific to the type of system and repairs introduced at the façade.

These issues include:

- Generally, wet seal applications will degrade over time based on numerous factors, including installation, design, and exposure. Other factors influencing the longevity of the wet seal applications involve future movement (lateral racking) of the building and thermal expansion at extrusions, which typically manifests itself earliest at spandrels. Given these factors, we anticipate that the wet seals at the curtain wall will need to be replaced within 10-15 years after the date of installation.

- Specifically, differential movements of the aluminum framing and glazing will occur over time, creating conditions where wet seal failures at alternating levels of spandrels may be expected. The south and west walls are particularly vulnerable due to thermal expansion from solar exposure. Sealant failures should be expected within 5-10 years after installation at these facades. It should be noted that these facades, and their contributing silicone sealant quantities, constitute approximately 12% (or about 1/8th) of the total length of silicone joints in the curtain wall.

Sealant failures may not directly result in water infiltration (due to the system of compressed gaskets), but it will become more likely, and thus the seals should be removed and replaced as they begin to deteriorate.

Level 23 Terrace Doors

Exterior doors at 23rd floor (to access exterior roof terraces) are generally in good condition, together with recent remedial works. Minor deficiencies in the sealant works at the framing are apparent. Also, the sills remain extremely low, relative to exterior roof level, and periodic water infiltration through the actual doorways should be expected (see figure 5). Occasional repairs for interior finishes adjacent to the doorways should be anticipated, over the lifespan of the building.

Lastly, bi-level drains at the deck on the 23rd floor appear to have been repaired together with the curtain wall repairs, and appear to be operating properly. These should also be monitored and maintained regularly, in an effort to prevent flooding at the low-height door sills.

Precast Concrete Panels

Basic tower precast concrete panels are likely in good condition, together with recent epoxy injection repairs, based on exterior appearances (see figure 6). The need for further repairs will be determined by carrying out periodic inspections.

Although the original panels seemed to have suffered from extensive quantities of exterior cracks, there does not seem to be any evidence that new cracks are continuing to appear in significant quantities.

Podium Level Glazing
The storefront glazing systems, together with recent remedial repairs, are in good condition. However, the method of remediation (by using face-seals, and silicone patches) will likely have a relatively short life-span (of less than 10-15 years).

Podium Level Roof Deck Flashing
Repairs at podium roof deck (adjacent to top deck of parking garage) are likely in good condition. However, it should be noted that if there is any roof flooding (due to clogged drains), there will be considerable discharge of water at the east end, which will likely cause water infiltration at the small area of low-parapet, and perhaps the glazing areas and entry door located directly below.

E. Recommendations

Annual cleanings of the entire building exterior are strongly recommended. Sealant joints and any shelf-like surfaces are natural collectors for dirt and pollutants. When mixed with water, these pollutants can cause degradation to sealants, glass, and other materials. By cleaning the façade regularly, the lifespan of materials and details can be extended.

Additionally, note that the following recommendations are based on assumptions for normal weathering and building movements. If the building experiences any significant seismic events, these maintenance and repair recommendations will likely need to be increased.

Tower Curtain Wall

1. Maintenance:
   Bi-annual (once every 24 months) interior and exterior inspections of curtain wall should be carried out as follows:

   - Interior visual check for evidence of leaks, at 25% of typical floors, and 100% of non-typical floors. Examine ceiling finishes for leaks, at all areas beneath roof areas, mechanical floors, and exterior decks.

   - Exterior check for degradation of sealants, and overall structural integrity of glazing, cappings, etc., by using at least one 'drop' on each face of building. (A 'drop' refers to the use of a suspended scaffold or gondola which is hung from davits at the rooftop parapets, in order to traverse a single 'bay' of the façade for the entire height of the building. For this building, it would require approximately 32 drops to fully examine the entire tower façade.)

2. Repair & Replacement:
   Exterior gaskets and sealant will need to be replaced periodically, at alternating levels of spandrel panels, on the south and west facades. We estimate this to be approximately 13,000 linear feet of sealant joints. This will likely need to be carried out within 3-8 years (5-10 years from date of recent repair works).

   Exterior gaskets and sealant will need to be replaced periodically at all framing/glazing joints, on all facades. We estimate this to be approximately 100,000 linear feet of sealant joints. This will likely need to be carried out within 8-13 years (10-15 years from date of recent repair works).

Level 23 Terrace Doors

1. Maintenance:
   Visual inspections of the door areas should be carried out together with the curtain wall inspections. Bi-level drains at the deck on the 23rd floor should be inspected annually for occlusions and debris.

2. Repair & Replacement:
   Since the door sills remain extremely low (relative to exterior roof level), periodic water infiltration through the actual doorways should be expected. This may require occasional repairs for interior finishes adjacent to the doorways, over the lifespan of the building.

   Exterior gaskets and sealant will need to be periodically replaced at all framing/glazing joints, on all four elevations. This should be carried out in conjunction with any re-sealing work being done for the adjacent curtain wall.

   Additionally, critical sealant joints along horizontal surfaces (head details, sill details, etc.) will likely need to be replaced or repaired at intermediate periods.

Precast Concrete Panels

1. Maintenance:
   Bi-annual (once every 24 months) exterior inspections of precast panels:

   - Exterior check for degradation of sealants, and overall structural integrity of panel, by using at least one drop (as described above) at each corner of the tower. Also inspect for integrity of the existing epoxy repairs, and inspect for any new cracks or propagation of existing cracks.

   - Exterior visual check for overall structural integrity and alignment of panels. Inspection should be carried out for 100% of precast panels, by using binoculars and simple photography.

2. Repair & Replacement:
   Further repairs using injected epoxy should be anticipated during the lifetime of the building. Since these repairs will be needed at sporadic locations, and at random time intervals, it is not practical to establish an anticipated schedule for

repair work. However, we do note that any observed cracks in the precast should be repaired as soon as possible, as required to prevent further (and more serious) degradation of the panel.

Exterior sealant joints for the precast are relatively limited, when compared with the quantities of curtain wall framing. If any sealant defects are observed within the precast areas, the seals should likely be repaired locally (at the area of failure).

Tower Roof

1. Maintenance:
   Bi-annual (once every 24 months) roof inspection and maintenance:

   - Examine condition of drains, drain screens, and overflows for debris buildup and adequacy of flow. Localized maintenance repairs should be expected at roof area drains given limited ponding surrounding these components.

   - Examine condition of roof membrane coating and return up vertical surfaces. Inspect and maintain seal of the membrane at roof penetrations including steel parapet angle braces, conduits, and davit supports.

   - Examine the vertical parapet surfaces for blistering elastomeric coatings, tears or abrasions, or other distress to the surface coating. Identify and re-coat localized areas as required.

2. Repair & Replacement:
   The age of the roof assembly is unknown and a replacement cost value cannot be determined at this time.

Podium Level Glazing

1. Maintenance:
   Bi-annual (once every 24 months) interior and exterior inspections of storefront glazing:
   - Interior visual check for evidence of leaks at all podium floors. Examine ceiling finishes for leaks, at all areas beneath roof areas, mechanical floors, garage decks, and other exterior decks.
   - Exterior check for degradation of sealants, and overall structural integrity of glazing, cappings, etc., by using ladders or scaffolds at numerous locations on each face of podium.
2. Repair & Replacement:
   Exterior gaskets and sealant will need to be periodically replaced at all framing/glazing joints, on all facades. We have not estimated this quantity of linear joints at this time. This work will likely need to be carried out in conjunction with the curtain wall repairs, within 8-13 years (10-15 years from date of recent repair works).

Podium Level Roof Deck Flashing

1. Maintenance:
   Interior inspections for evidence of water infiltration should be carried out on the 3rd floor, directly beneath the areas of expansion joints between the tower structure and the parking garage.

   Exterior visual inspections of the joints should be carried out together with the curtain wall inspections. Bi-level drains at the deck on the 4th floor should be inspected annually for occlusions and debris.

2. Repair & Replacement:
   Repairs to flashing and related sealants is likely at the east end of the roof deck, at the low parapet condition. The detail involves multiple precast components, and movement joints, and as such is susceptible to long-term degradation. This small area of repair work will likely need to be addressed every 10-15 years.

Exterior Skin Photographs and Figures

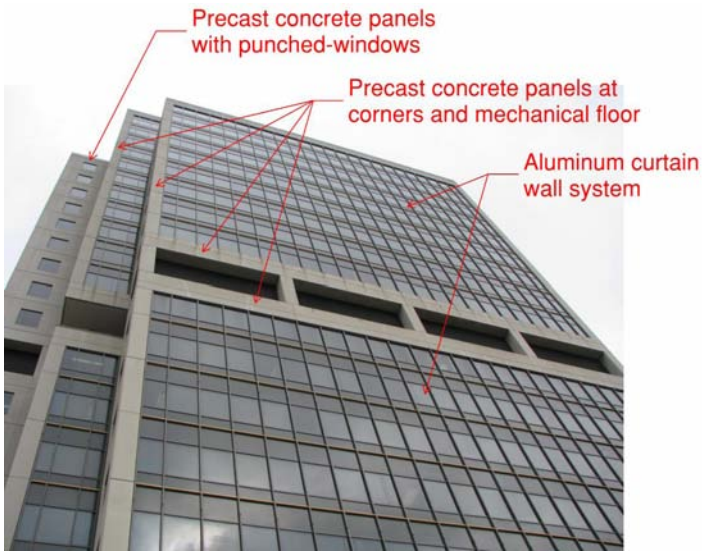

Figure 1: Photo of tower's exterior enclosure.

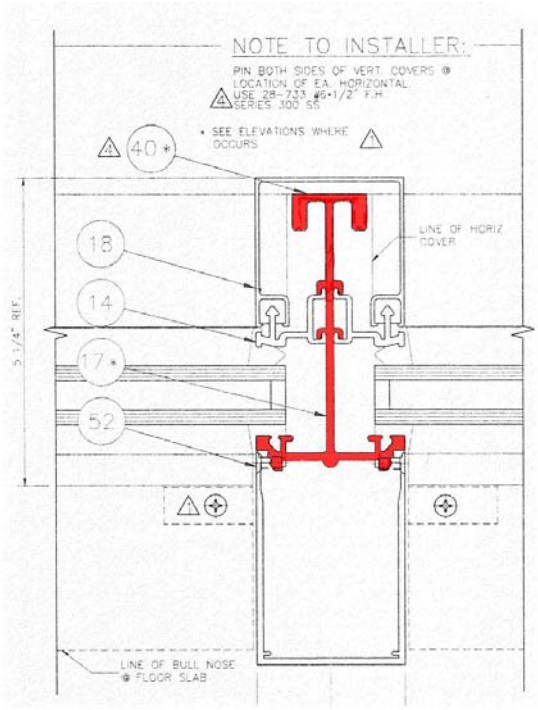

Figure 2: "I-Beam" system of vertical mullion.

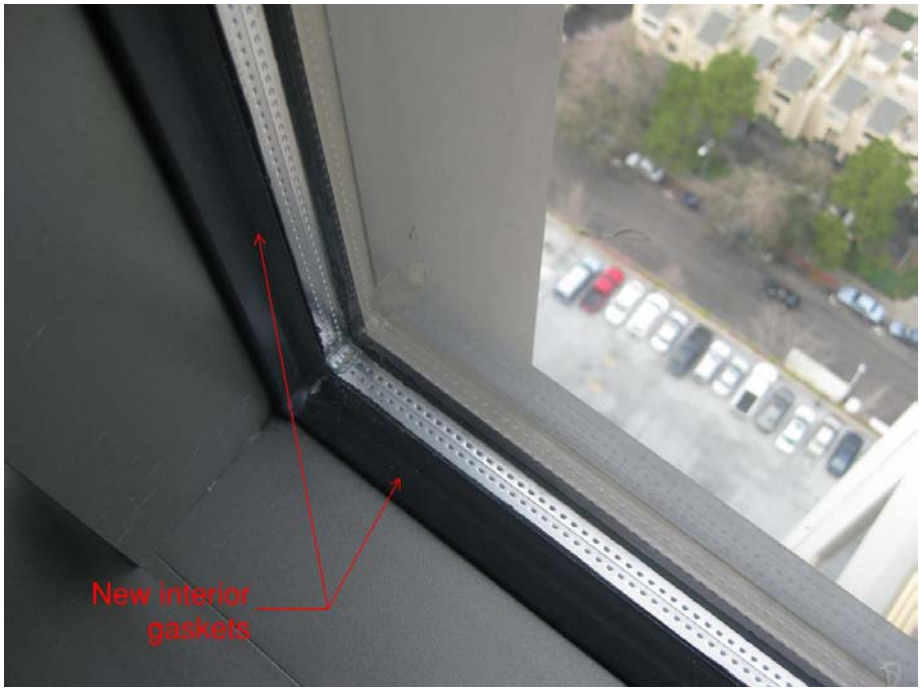

Figure 3: Photo of tower curtain wall from inside.

Figure 4: Photo of tower curtain wall from outside.

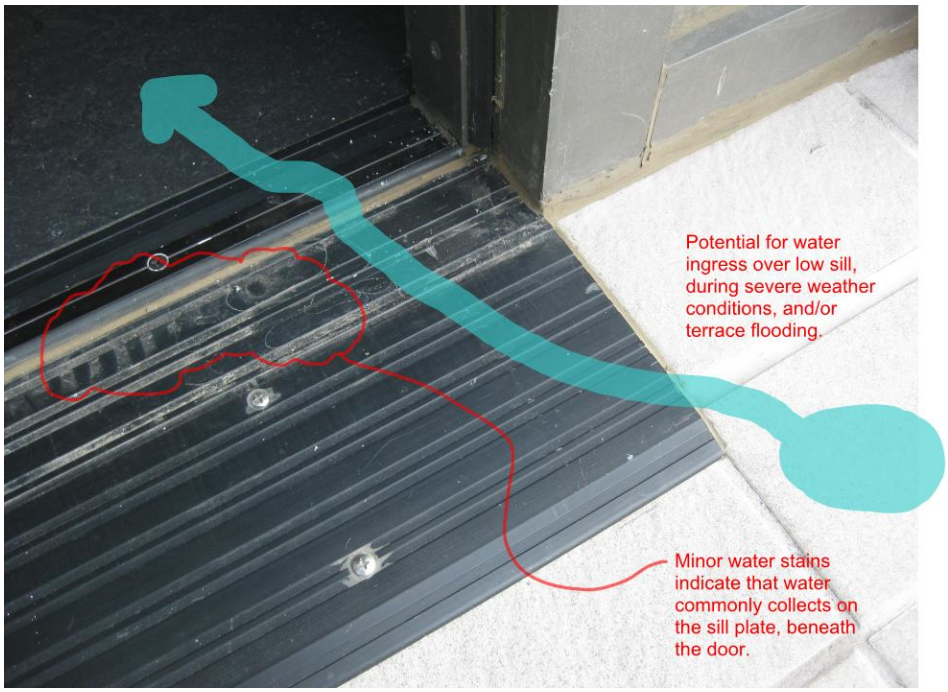

Figure 5: Photo of terrace door sill at Level 23.

Figure 6: Photo of exterior faces of precast concrete panels

Figure 7: Photo of aluminum framing at podium level.

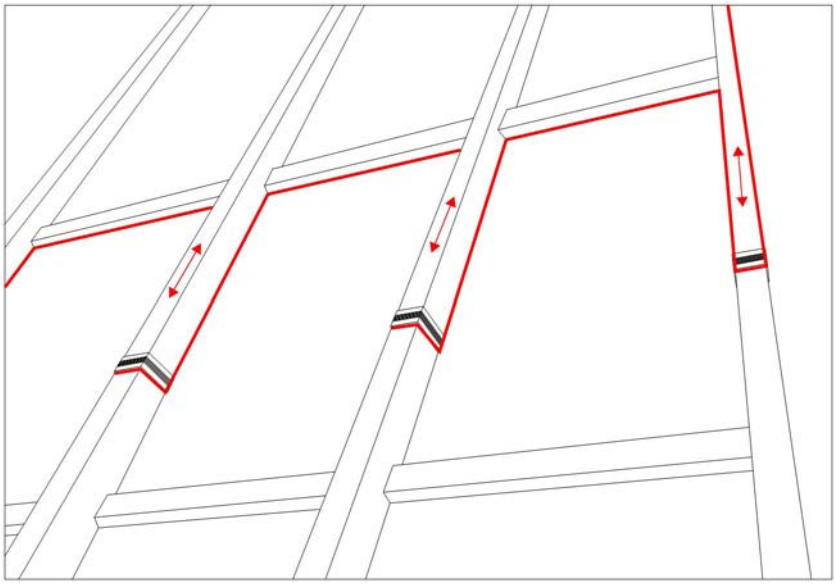
Figure 8: Movement joints of tower curtain wall.