

12 November 2009

Mr. Lance Shepherd
Department of Personnel & Admin-
istration
State Buildings & Real Estate Pro-
grams
1313 Sherman Street
Suite 319
Denver, CO 80203

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Re: Colorado State Capitol

Dome
Bi-Annual Review
Project #200014.027

Dear Mr. Shepherd:

We have completed our detailed review of the upper and lower observation levels of the Capitol Dome. We walked this area on October 21, 2009 and photographed the conditions. The deterioration of materials has gotten worse since our observations on March 20 and March 26, 2009. Here are our findings:

UPPER OBSERVATION LEVEL:

The conditions on this level are growing worse as time passes. The most noticeable change in this area is the deteriorating coating on the cast iron. This coating is badly blistered in several areas and the deck is sprinkled with coating chips as they flake off. There are rust stains along the roof line and cracked coatings along the cornice indicating the presence of water and moisture. Water infiltration is also evident in the cracks and coatings along the joints of the entablatures. In some cases, the cast iron is rusting and creating large "pitted" areas. The fasteners are continuing to fail and some fastener heads are missing completely. There is strong evidence that the balustrades are moving due to freeze-thaw action.

LOWER OBSERVATION LEVEL:

The lower observation level conditions are deteriorating. The windows to access the exterior area continue to show dry rot which is weakening the wood. The fasteners in this area are telescoping. The coating conditions are still declining. The red primer is exposed and the missing areas of coating are now in larger patches, rather than small flakes. The columns are showing signs of water trapped between the metal and the coating.

DOME BASE/ROOF LEVEL:

Conditions along the base of the dome are in dire need of repair. The ribs along the base of the dome (drum) are stained and rusting as well as pulling away from the drum. Water is collecting at the corners of the cast iron pilasters causing rust in the structure and staining the coating. There are areas on the drum sill that are cracked and almost rusted through. These areas will soon need the same repairs applied in late 2008 .

DOME WINDOWS:

Windows are damaged and continuing to rot. The caulk at the jambs and sills is coming apart. It appears there is leaking at the Upper windows of the Dome.



CONCLUSION:

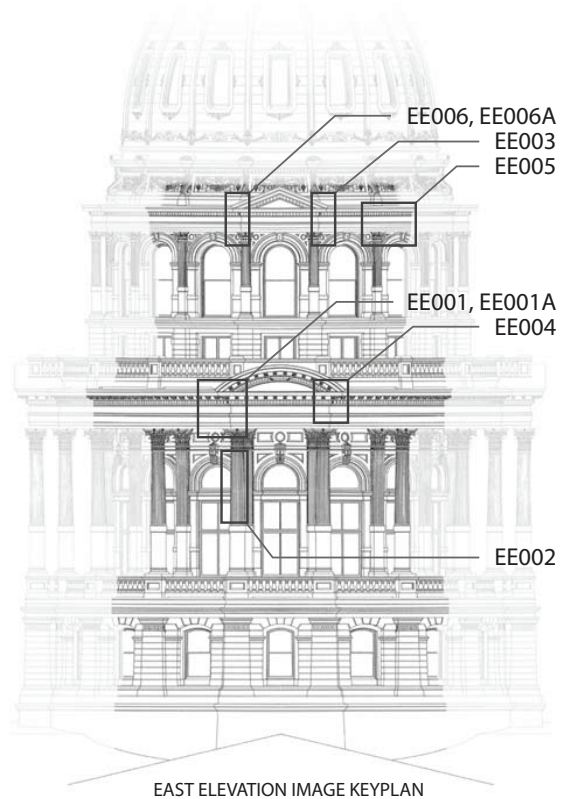
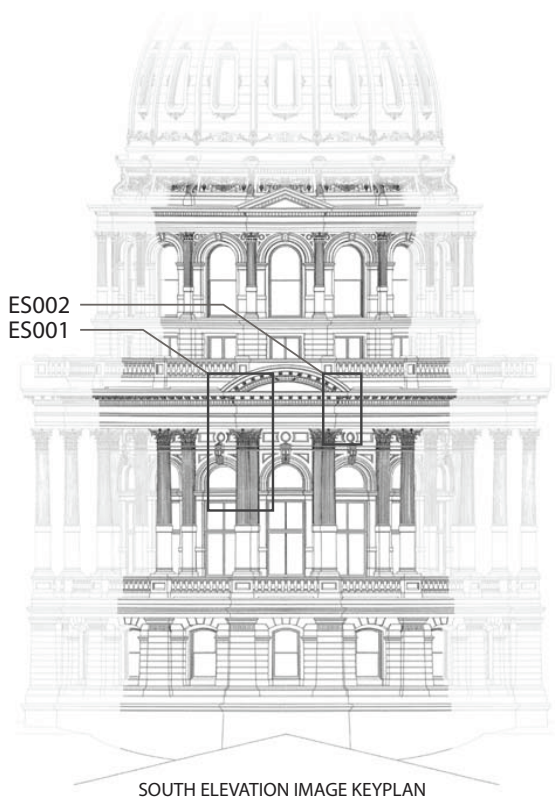
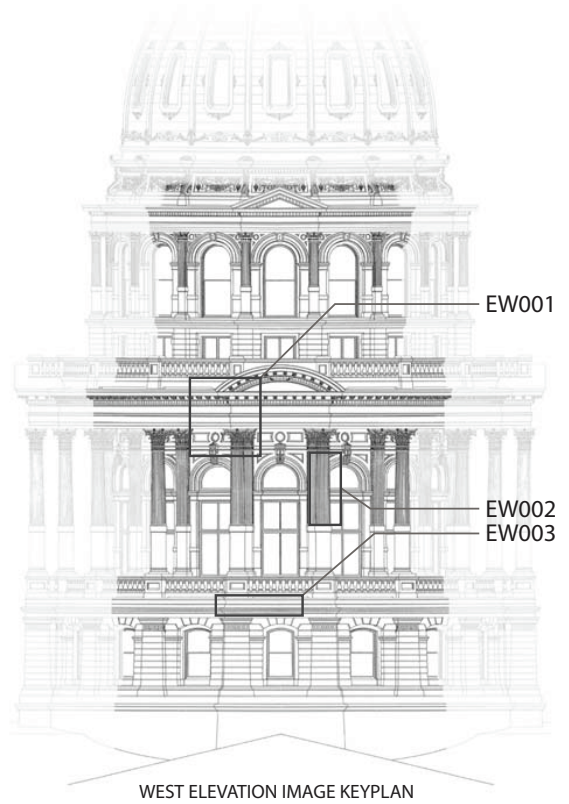
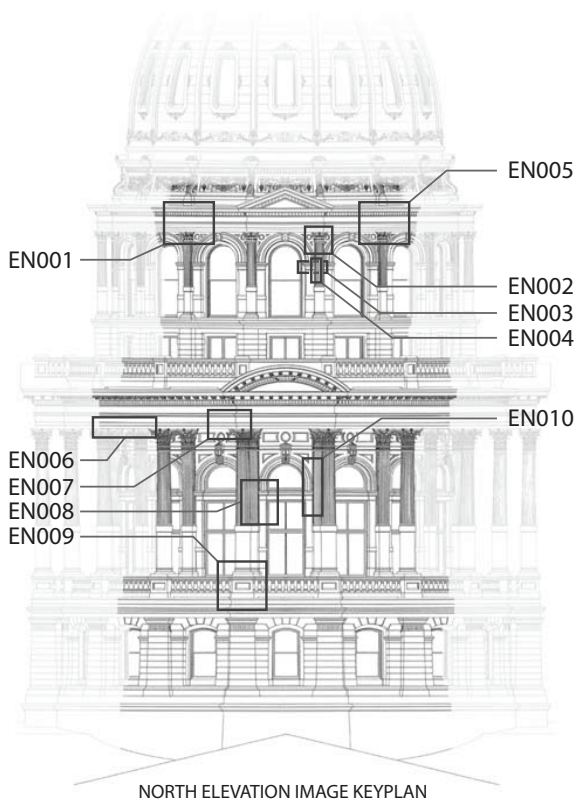
Since March 26, 2009 the materials (steel, cast iron, copper, galvanized steel and wood) on the Dome have continued to deteriorate. It is apparent that an immediate preservation project needs to be under taken .Without significant measures, more deterioration is inevitable. Spot repairs are no longer enough, as the widespread corrosion, fastener failure, movement as a result of freeze-thaw and water infiltration problems are beyond a simple “band-aid repair.” It is our recommendation that immediate action be taken to remedy the dire conditions of the Dome. The work will need to include removal of the metal coating, rust repairs, cast iron repairs and replacement, replacement of all steel fasteners with stainless steel fasteners, roof repairs, waterproofing and wood window restoration followed by the application of a new high tech metal coating.

Please review the attached photographs and comments.

Sincerely,

Mark A Wagner AIA
Senior Associate

Attachments: WJE Report dated November 12, 2009
Fentress Architects photographs and comments dated November 12, 2009
Key Plans



Viewed from the Roof

IMAGE EE001A, EE005, EN001



EE001A EE005 EN001 **OCT 2009**
The perimeter of the Lower Entablature is stained and rusting due to water infiltration in the cast iron.
A new crack can be seen in EE005.

IMAGE EE006



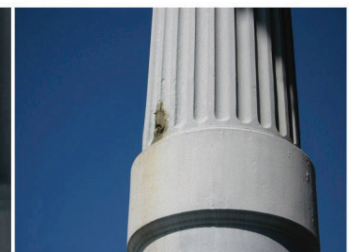
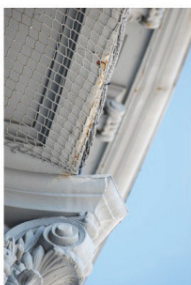
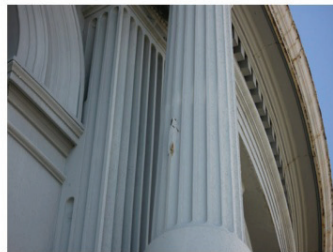
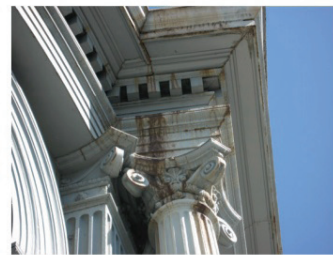
EE006A **OCT 2009** EE006 **JUN 2007**
Additional staining is seen on EE006 and EE006A compared to the June 2007 photograph

IMAGE EN002



OCT 2009

The column is separating from the Corinthian capital. Eventually pieces could break off and fall. Water will begin to migrate into this crack. Additional corrosion can be seen in the column flutes. See #EN008.
JPG on the contact sheet.



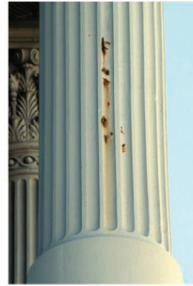
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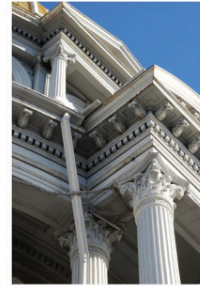
EN009.JPG



EN010 0907.jpg



EN010.JPG



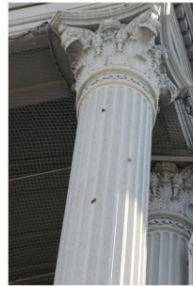
ES001.JPG



ES002.JPG



EW001.JPG



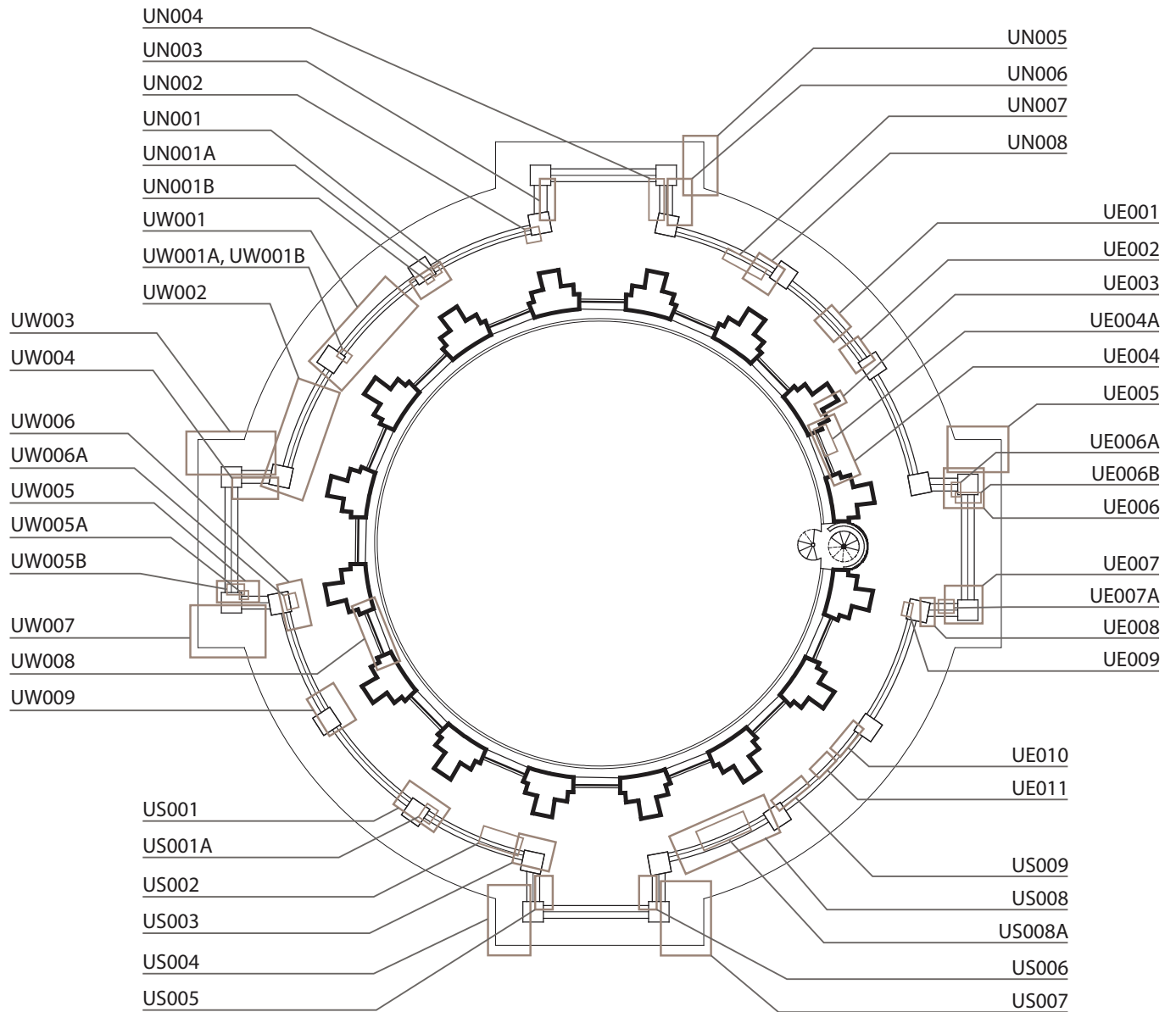
EW002.JPG



EW003.JPG



TYP INTERIOR.JPG



UPPER OBSERVATION LEVEL IMAGE KEYPLAN



Upper Observation Level

IMAGE UN001A



OCT 2009

MAR 2009

This condition at the balustrade has gotten worse since March 2009. You can now see daylight through the separation.

IMAGE UN003



OCT 2009

MAR 2009

JUN 2007

Coating failure has gotten worse since March 2009 on the balustrade railing

IMAGE UN006



OCT 2009



JUN 2007

Rusting and coating failure has gotten worse since 2007 on the balustrade railing cap

IMAGE UN008



OCT 2009

The top of balustrade railing cap is starting to separate. Fasteners are starting to pop.

IMAGE UW003



OCT 2009



SEP 2007

Coating failure and rusting has gotten worse since 2007 on the arched roof.

IMAGE UW005B



OCT 2009



MAY 2008

A detail of the separation and rusting at the balustrade railing cap shows increased separation since 2008. Photo above shows a rusted fastener.

IMAGE UW006



OCT 2009

This area is shown above in detail.

IMAGE US002



OCT 2009



MAR 2009

Coating failure, cap separation and rusting has gotten worse since March 2009.

IMAGE US008A



Additional coating failure is noticeable in the Oct. 2009 photo.

IMAGE UE002



Additional coating failure is noticeable in the Oct.2009 photo.

IMAGE UE004A



Paint is continuing to peel from the wood windows. Sealant is starting to deteriorate at the joint between the sill and jamb.

IMAGE UE005



Areas of coating failure have grown larger since May 2008.

IMAGE UE006A



A detail of displaced balustrade rail cap is shown above.

IMAGE UE008



A rusted fastener on the balustrade railing cap has lost its' filler material and coating. Eventually the head of the fastener will break off. This is condition that shows up frequently. See UE007A and UE009 on the contact sheet page 1 of 4.

CONTACT SHEET PAGE 1 of 4



UE001.JPG



ue002 0309.jpg



UE002.JPG



UE003.JPG



UE004.JPG



UE004A.JPG



ue005 0508.JPG



UE005.JPG



ue006 0309.jpg



UE006.JPG



UE006A.JPG



UE006B.JPG



UE007.JPG



UE007A.JPG



UE008.JPG



UE009.JPG



UE010.JPG



UE011.JPG

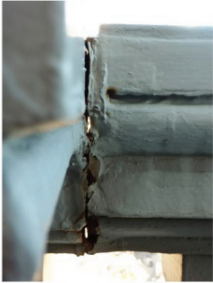


UN001.JPG



un001a 0309.JPG

CONTACT SHEET PAGE 2 of 4



UN001A.JPG



UN001B.JPG



UN002.JPG



un003 0309.jpg



un003 0607.JPG



UN003.JPG



un004 0309.jpg



UN004.JPG



UN005.JPG



un006 0607.JPG



un006 0907.JPG



UN006.JPG



UN007.JPG



UN008.JPG



US001.JPG



US001A.JPG



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US004.JPG



us005 0607.JPG

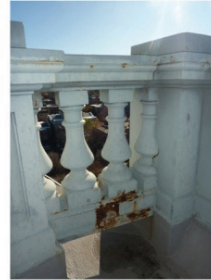
CONTACT SHEET PAGE 3 of 4



US005.JPG



us006 0607.JPG



US006.JPG



US007.JPG



us008 0309.jpg



US008.JPG



us008a 0508.JPG



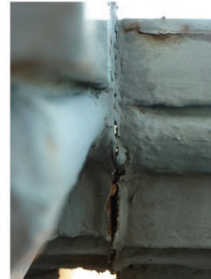
US008A.JPG



US009.JPG



UW001.JPG



UW001A.JPG



UW001B.JPG



UW001C.JPG



UW002.JPG



uw003 0907.JPG



UW003.JPG



UW004.JPG



UW005.JPG



UW005A.JPG



uw005b 0508.JPG

CONTACT SHEET PAGE 4 of 4



UW005B.JPG



UW006.JPG



uw006a 0309.jpg



uw006a 0508.JPG



uw006a 0907.JPG



UW006A.JPG



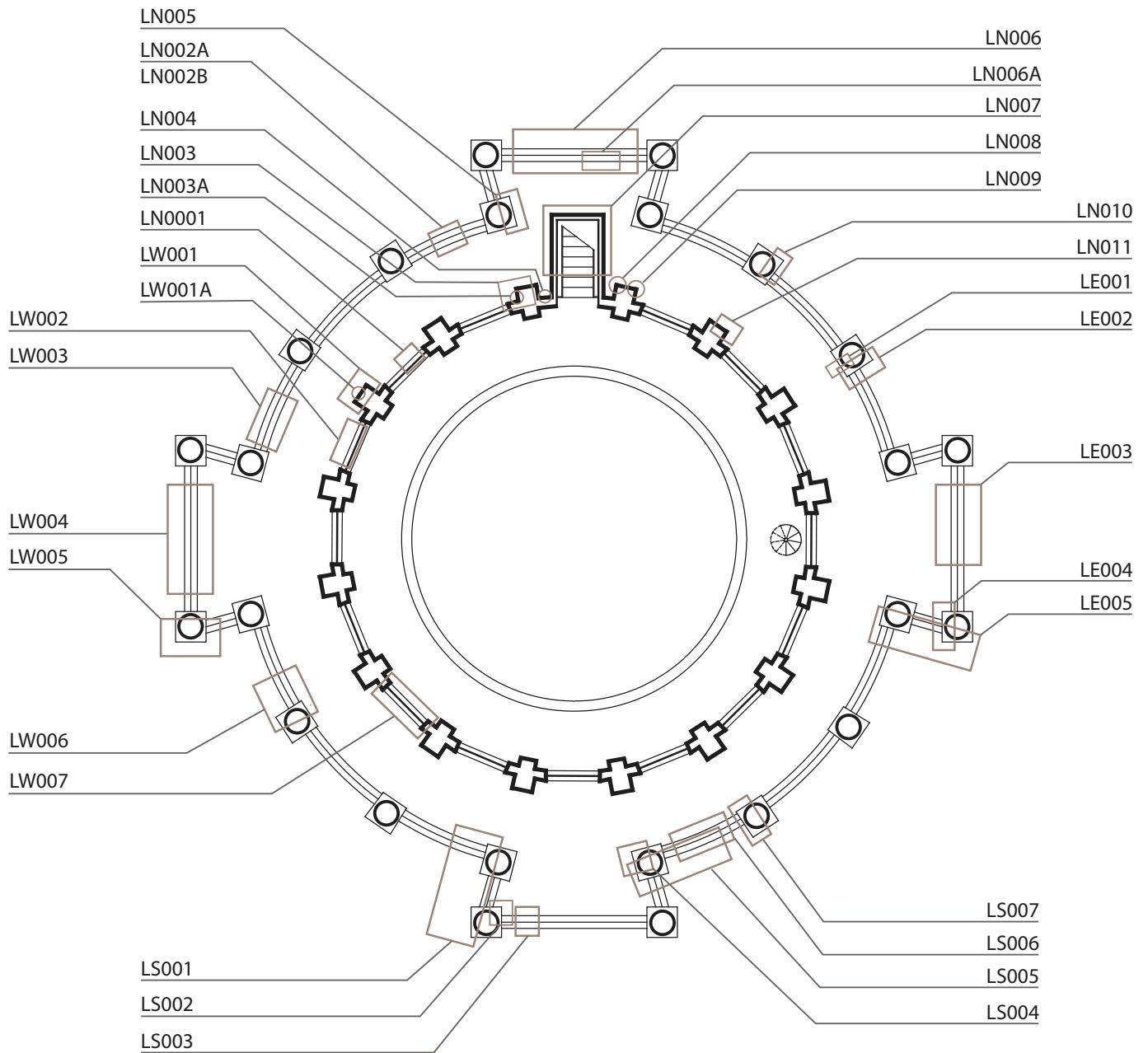
UW007.JPG



UW008.JPG



UW009.JPG



LOWER OBSERVATION LEVEL IMAGE KEYPLAN



Lower Observation Level

IMAGE LN002A, LN002B



Corrosion is apparent on both sides of the Long's Peak Marker on the Balustrade top rail. Water is seeping under the coating and causing further damage.

IMAGE LN003, LN003A



The coating on this column base is cracking badly. Water is infiltrating in these cracks and will cause more damage during the freeze thaw cycle.

IMAGE LW004



Large areas on top of the balustrade railing have lost the coating exposing the primer coat.

IMAGE L W005



OCT 2009

A vertical crack is visible along the side of this column base.

IMAGE L W006



OCT 2009

IMAGE LS001



OCT 2009

IMAGE LS002



OCT 2009

Shown above is additional evidence of the areas where coating is missing and peeling. Leaving the metal unprotected will subject it to further oxidation.

IMAGE LE001



OCT 2009

IMAGE LS003



OCT 2009

The crack in the column base has gotten bigger since March 2009. The cracks and rusting on the balustrade top rail has expanded as well.

IMAGE LS006



OCT 2009

IMAGE LS007



OCT 2009

Above is additional evidence of cracking and rusting on the balustrade and column bases.

IMAGE LE002



OCT 2009

Rust is forming due to the lack of coating on this column.

IMAGE LE005



OCT 2009



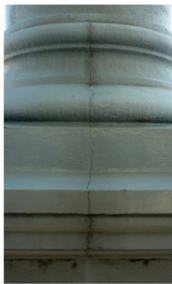
MAR 2009



SEP 2007

This column has been rusting for a long time and is getting worse and is reaching the point where the metal coating is cracking and releasing water collecting in the column. The moisture is also trapped against the metal in many areas.

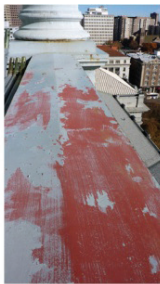
CONTACT SHEET PAGE 1 OF 2



LE001.JPG



LE002.JPG



LE003.JPG



LE004.JPG



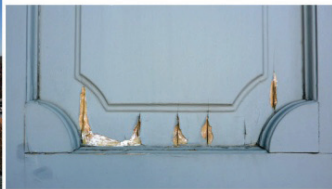
le005 0309.jpg



le005 0907.JPG



LE005.JPG



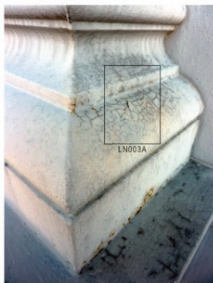
LN001.JPG



LN002A.JPG



LN002B.JPG



LN003.JPG



LN003A.JPG



In004 In007 0309.jpg



LN004.JPG



LN005.JPG



LN006.JPG



LN006A.JPG



LN007.JPG



LN008.JPG



LN009.JPG

CONTACT SHEET PAGE 2 of 2



LN010.JPG



LN011.JPG



LS001.JPG



LS002.JPG



Is003 0508.JPG



LS003.JPG



LS004.JPG



LS005.JPG



LS006.JPG



LS007.JPG



lw001 0309.jpg



LW001.JPG



LW001A.JPG



lw002 0607.JPG



LW002.JPG



LW003.JPG



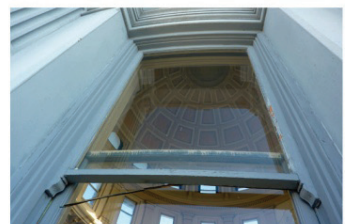
LW004.JPG



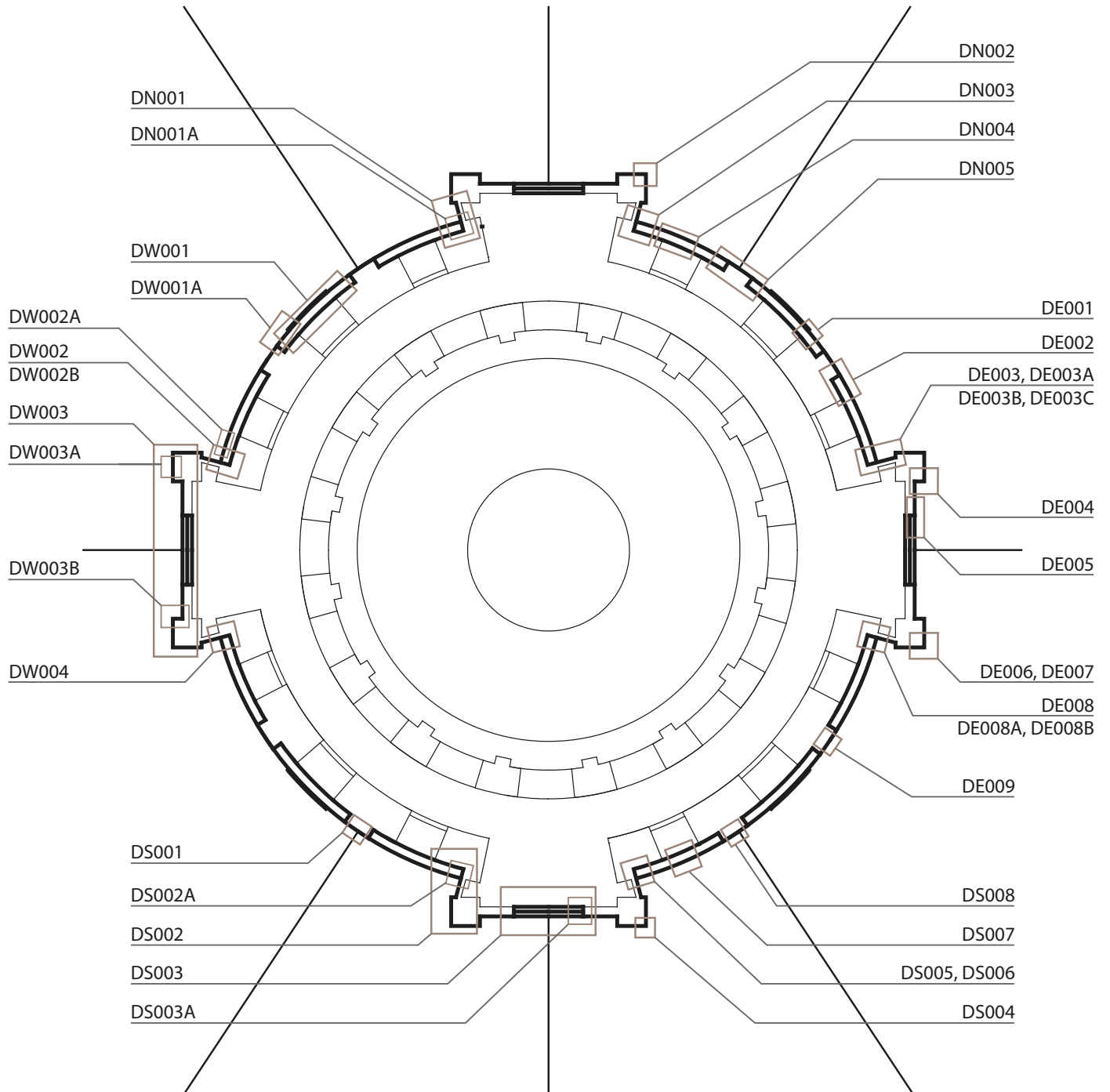
LW005.JPG



LW006.JPG



LW007.JPG



DRUM BASE/ROOF LEVEL IMAGE KEYPLAN

Dome Base/ Roof level

IMAGE DN001A



OCT 2009



IMAGE DN003



OCT 2009

Continuing staining and water infiltration behind the drum battens. Note that the battens are separating from the drum wall. Rusting and staining at the drum base cap. The rusty areas seen to the left of the dark patch will soon be rusted through and require the same kind patch.

IMAGE DW003



OCT 2009

Staining and rusting conditions appear on all four sides of the dome base.

IMAGE DW003A



OCT 2009

IMAGE DW003B



OCT 2009

Above you can see that the fastener is working it's way out. Water is getting into the rusty pits in the cast iron and causing the coating to peel.

IMAGE DW004



OCT 2009



OCT 2009

Down spout is rusting and coming loose from the building.

IMAGE DS003A



OCT 2009

Window frames are in bad shape as the wood is starting to rot

IMAGE DS006



OCT 2009

Water is getting behind the batten causing it to pull away from the drum wall.

IMAGE DS007



OCT 2009

Above is a detail of the deterioration that is seen on all sides of the drum. This condition will only get worse.

IMAGE DE002



OCT 2009

The drum cap is starting to pull away from the drum. Water is getting behind the batten from above.

IMAGE DE003A, DE003B



DE003A

OCT 2009

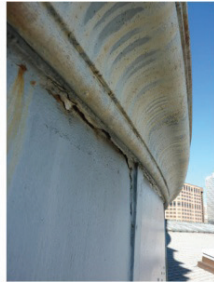
DE003B

Adjacent to this damaged down spout you can see that the sill is almost rusted through. This is adjacent to a patch that was applied in 2008. It appears that there has been blockage in the downspout and it froze within at some time.

CONTACT SHEET PAGE 1 of 2



DE001.JPG



DE002.JPG



DE003.JPG



DE003A.JPG



DE003B.JPG



DE003C.JPG



DE004.JPG



DE005.JPG



DE006.JPG



DE007.JPG



DE008.JPG



DE008A.JPG



DE008B.JPG



DE009.JPG



DN001.JPG



DN001A.JPG



DN002.JPG



DN003.JPG



DN004.JPG



DN005.JPG

CONTACT SHEET PAGE 2 of 2



DS001.JPG



DS002.JPG



DS002A.JPG



DS003.JPG



DS003A.JPG



DS004.JPG



DS005.JPG



DS006.JPG



DS007 SILL.JPG



DS008.JPG



DW001 patch.JPG



DW001A patch.JPG



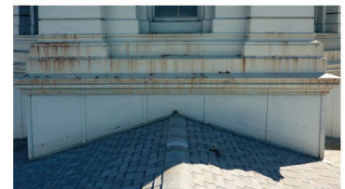
DW002.JPG



DW002A.JPG



DW002B.JPG



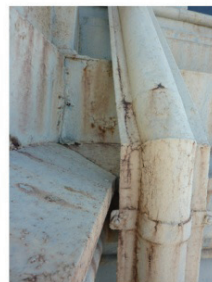
DW003.JPG



DW003A.JPG



DW003B.JPG



DW004.JPG

November 12, 2009

Mr. Mark Wagner
Fentress Architects
421 Broadway
Denver, CO 80203

Re: Colorado State Capitol Dome
WJE No. 2008.0718

Dear Mr. Wagner:

Wiss, Janney, Elstner Associates, Inc. (WJE) visited the Colorado State Capitol building on October 26, 2009. The purpose of this visit was to visually assess the condition of the dome and monitor the previously observed deterioration, discussed in our letter report dated November 11, 2008. Representatives of the State of Colorado, Fentress Architects, and WJE were present during this visit.

The survey was performed from accessible levels of the dome. No ladders, lifts, swingstages, or other means of access were utilized to gain up-close access to soffits or other areas of concern.

Upper Observation Level

Several areas of ponding water were observed on the deck at each cardinal direction (Figure 1). Ponding water caused by inadequate slope of the decking can lead to accelerated deterioration of the coating, which will allow water into the cast iron structure causing further deterioration.

The coating on the balustrade has failed at several areas, leading to surface corrosion of the cast iron (Figure 2). This condition is widespread across the entire Upper Observation Level. The material over many top rail fasteners has deteriorated, leaving exposed fastener heads to corrode (Figure 3).

Differential movement of balustrade elements was observed at several locations. It was not readily apparent what was causing this movement. WJE installed a gauge over the displaced rail at the north balustrade to determine if the movement is ongoing (Figure 4).

A previously observed crack was noted at the northwest façade above the Upper Observation Level (Figure 5). The crack is visually similar to the condition noted in our November 11, 2008 report (Figure 6). However, it should be understood that we did not observe this piece up close and have no way of knowing if this element is secure. Moisture can migrate into the crack and subsequent freeze/thaw cycles may render this element a fall hazard.

Temporary deck coating repairs are beginning to fail (Figure 7). Elastomeric coating was installed as a temporary repair to minimize the amount of water reaching the cast iron. Water is migrating under the coating from cracks adjacent to the temporary repairs and is causing them to fail.

The paint on the wood window sashes is severely deteriorated (Figure 8). The paint protects the wood and glazing materials from the atmospheric elements. When it becomes compromised as it currently is,

the wood is not adequately protected and deterioration occurs. When the glazing materials become compromised, water infiltration can occur. If left unabated, deteriorated wood sashes combined with deteriorated glazing materials may lead to an inadequately contained glass lite.

Lower Observation Level

The coating on the balustrade has failed at several areas (Figure 9). A crack was observed through the top rail of the balustrade at the south elevation. WJE installed a gauge over the crack to determine if the crack is moving (Figure 10).

The column bases exhibit cracking and corrosive staining (Figure 11). Snow, ice, and water collect at the bases of the columns and accelerate deterioration at these areas. The drawings reviewed by WJE do not clearly indicate how the cast iron elements at the columns are fabricated. Depending on how the cast iron elements are fastened, this condition may result in a compromised structural attachment of the cast iron column elements. Further investigation into the attachment of the column covers is warranted.

Similar to the Upper Observation Level, the paint on the wood window sashes at the Lower Observation Level is severely deteriorated (Figure 12). The wood is deteriorated and cracked at several locations.

A separation exists at the fascia piece on the west façade above the Lower Observation Level (Figure 13). This condition was also observed on November 3, 2008 (Figure 14). Due to accessibility constraints, we could not verify if this element is secure. This fascia piece is not contained by the installed netting, thus it is a potential fall hazard.

The cast iron façade was observed from the interior stairwell. Water staining and deterioration was observed at the interfaces between cast iron pieces (Figure 15).

Drum Base

Severe corrosive staining exists along the entire base of the drum (Figure 16). Water from the upper levels cascades down the drum base. Severe deterioration of the cast iron has occurred at reentrant corners adjacent to downspouts. At five areas, the cast iron material deteriorated through its entire thickness. An EPDM membrane was installed over the openings caused by this deterioration as a temporary repair to minimize the amount of water entering these locations (Figure 17).

The windows at the drum base are more severely deteriorated than the upper levels. The paint and glazing are deteriorated and the wood sashes are deteriorating.

Conclusions

Based on our most recent site visit, we believe that the deterioration of the cast iron façade elements is increasing at an exponential rate. We feel a holistic approach should be taken to restore the dome and drum. Several temporary repairs have been implemented to try and minimize further deterioration. During this visit, we observed many of these temporary repairs that have failed due to moisture migration under the repair from adjacent conditions.

Until the dome can be restored in this manner, we recommend performing bi-annual site visits to monitor its condition. If any issue proves to be an imminent hazard to pedestrians, remedial action should be taken to remove the hazard. Based upon what future site visits reveal, a close-up inspection of the dome may be warranted. Additional remedial repairs may also be warranted based on future visits. However, it should be understood that the effectiveness of remedial repairs will be minimal.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.



Daniel A. Gach, AIA, NCARB
Senior Associate



Figure 1. Ponding water observed on deck of Upper Observation Level.



Figure 2. Deterioration of the balustrade at the Upper Observation Level.



Figure 3. Exposed fastener heads at the balustrade's top rail on the Upper Observation Level.

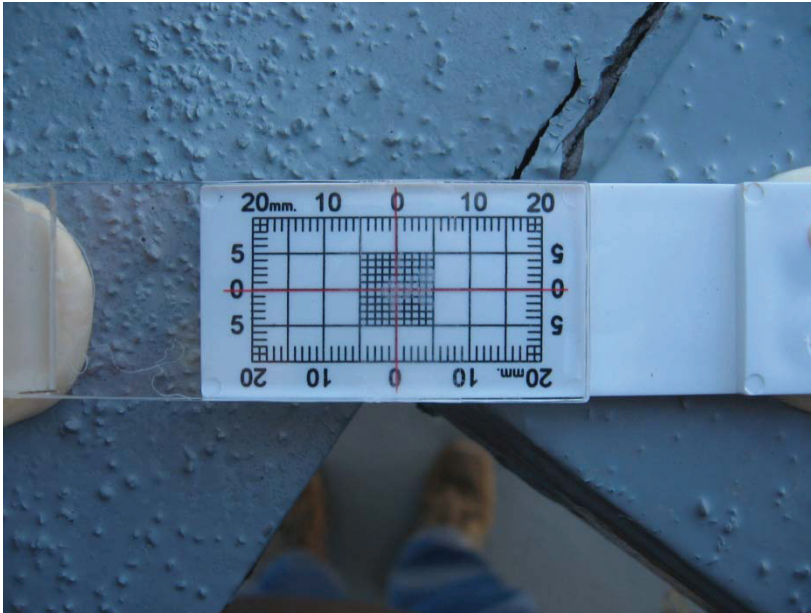


Figure 4. Movement gauge installed at the north rail on the Upper Observation Level.



Figure 5. Cracked cast iron element above the Upper Observation Level.



Figure 6. Cracked cast iron element above the Upper Observation Level observed on November 3, 2008.

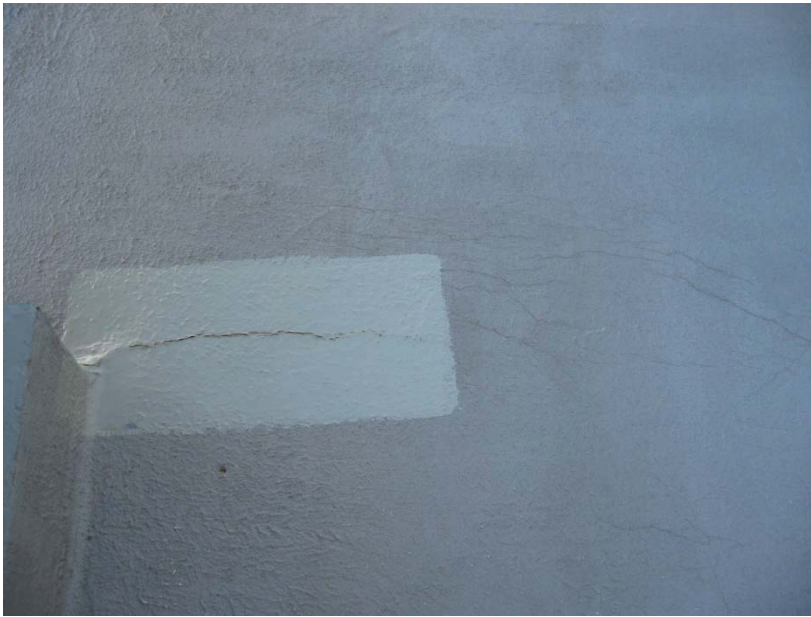


Figure 7. Temporary deck coating repair has failed at the Upper Observation Level. Note cracking of deck coating adjacent to repair area.



Figure 8. Typical deterioration of the wood sashes observed on the Upper Observation Level.



Figure 9. Failed coating at the balustrade of the Lower Observation Level.



Figure 10. Movement gauge installed over cracked balustrade at Lower Observation Level.



Figure 11. Deterioration and corrosive staining at column bases on Lower Observation Level.



Figure 12. Deteriorated sash of operable window at Lower Observation Level.



Figure 13. Separation of fascia element above Lower Observation Level.



Figure 14. Fascia separation observed on November 3, 2008.



Figure 15. Water infiltration staining and corrosion at interior stairwell below Lower Observation Level.



Figure 16. Staining at the base of the drum.



Figure 17. EPDM membrane installed over severely deteriorated cast iron reentrant corner.