
# SPECIAL PROJECT REPORT

**September 4, 2020**

## Dulles Silver Line Project (Phase II)

## Evaluation and Analysis of Precast Concrete

# 1.0 EXECUTIVE SUMMARY

## Findings

This report presents the results of an evaluation that OIG began in September 2018 of potential defects in concrete panels installed at various stations in the Silver Line Phase 2 (SLP2) project. To support this evaluation, OIG engaged a concrete expert and a contractor to inspect the precast concrete elements for evidence of cracking. The main findings reported by the consultants, which OIG adopts and discusses below, are:

1. OIG's inspections found 184 panels with a total of 342 cracks;

2. While not a perfect solution, proper application of the silane solution selected by the contractor will be sufficient if applied every 5 to 7 years, not 10 years, provided proper inspections are done periodically;

3. All cracks identified by OIG equal to or greater than 0.005 inches must be repaired before WMATA accepts the project;

4. Ensure that cracks less than 0.005 inches are thoroughly inspected during subsequent inspections after acceptance of the project;

5. The amount proposed for escrow by MWAA's contractor is flawed because it does not account for future repair of cracks, application of four or more coats versus two coats with each reapplication of the solution, replacement of panels, and other costs over and above normal maintenance costs and operation impact;

6. The first inspection of panels should occur one (1) year following the repairs of identifiable cracks. The inspection should be as comprehensive as DeSimone's (OIG's consultant) inspection; and

7. The solution applied on the cracked panels in the rail yard is acceptable; however, if it requires future applications, costs associated with those additional applications should be a consideration.

**Note: When OIG refers to MWAA we are referring to the Metropolitan Washington Airports Authority. When OIG refers to WMATA, the Washington Metropolitan Area Transit Authority, we are referring to Metro.**

## History

In 2014, MWAA began construction of the Silver Line Phase 2 (SLP2) project. The SLP2 project is under construction to complement and serve the transportation needs of the region's airports and expand the rail services for WMATA. Construction of Phase 2 of the Dulles Corridor Metrorail Project (Silver Line) is managed by MWAA. MWAA engaged Capital Rail Constructors (CRC) as the prime contractor for the construction of Package A of the Silver Line project. As part of the station construction, CRC subcontractor Universal Concrete Products (UCP) manufactured and supplied precast panels and concrete elements for the SLP2. WMATA is the future owner and becomes responsible for the safety, maintenance, and operation upon acceptance of the project by WMATA's Board of Directors.

WMATA's General Manager/CEO requested the OIG undertake a review of potentially defective concrete panels installed at the above grade stations of the SLP2 project. Those stations are Reston Town Center, Herndon, Innovation, Loudoun Gateway (formerly 606), and Ashburn (formerly 772). The concrete panels in question were not installed at the Dulles Airport Station.

In March 2016, a whistleblower complaint (Qui Tam) was filed in Federal Court in the Eastern District of Virginia (EDVA), which was ultimately unsealed. The first count of the March 2016 complaint alleged the following in pertinent part:

*"Defendants knowingly presented or caused to be presented claims to obtain payment for deficient concrete to the federal government.*
*Defendant UCP and the individual defendants presented or caused to be presented fraudulent claims by billing for deficient concrete.*
*Under its contract with **MWAA,** Capital Rail is required to inspect the work of its subcontractors, including UCP.*
*Even though a relator is not required to identify every conceivable detail of a fraud to satisfy Rule 9(b) and then, even if specific false claims were not alleged, Relator need only allege sufficient indicia of reliability. Relator has in fact alleged the who, what, where, when, and how of the fraud alleged in this Count:*

*Who - UCP, Capital Rail, and the individually named defendants*

*What - Defendants submitted claims for payment for concrete that it knew to be defective and failed to perform quality control testing on the same. The Defendants failure to provide acceptable concrete and concrete which adheres to specification in the Contract has already caused significant damage to the Dulles Project and is expected to negatively impact the project's completion schedule, thus leading to even further yet presently unquantifiable economic damages down the line.*

*Where - UCP's factories in Stowe, Pennsylvania*

*When - July 20I5 through present.*

*How - Defendants' precast concrete fails to meet the requirements specified in the contract with MWAA and fails to conform to industry standards. UCP and the individually named defendants are aware that their concrete is deficient but chose to conceal the deficiencies by falsifying test results. Capital Rail is either aware or, given the contract requirement that Capital Rail perform inspections of its subcontractors, should be aware of the conduct by UCP and the individually named defendants. When Defendants submit a claim for payment for deficient concrete, their conduct violates the FCA."*

The whistleblower complaint resulted in a settlement. Also, a criminal investigation was initiated, resulting in a UCP employee pleading guilty. OIG was not a part of these investigations; however, based on the allegations, OIG initiated a review of the deficiencies. The focus of concern relating to the concrete panels involved issues with water-cement ratio, air entrainment, concrete cover over steel reinforcement, and the Alkali-Silica Reaction (ASR).

On September 19, 2018, OIG announced its commencement of a review of the precast concrete panels produced by the concrete manufacturer, UCP, and later expanded the review scope to include other non-concrete areas of concern reported by management. OIG issued its first report, *Special Project Interim Report: Silver Line Phase 2 Review,* focused on non-concrete issues on March 5, 2020.

OIG engaged the services of Structural Services, Inc. (SSI), a consultant expert in concrete, to evaluate the issues identified above and the proposed solution recommended by the contractor. SSI's report is attached to this report. (**Exhibit 1**)

In January 2020, CRC advised OIG that they along with UCP conducted a one-day inspection and identified 25 panels with cracks. UCP classified these cracks as occurring due to handling when installed. Also, both MWAA and CRC advised OIG that they conducted inspections and identified cracks in panels.

As a result of the January 2020 disclosure, OIG engaged the services of DeSimone Consulting Engineers (DCE) to conduct a complete and thorough inspection of all panels to determine which ones were cracked or showed signs of corrosion. The results of this inspection provide WMATA with a baseline of the condition of the panels and may be used as a basis for future inspections. The results of DCE inspections are attached. **(Exhibit 2)**

This report presents the conclusions and recommendations of SSI based on their review and the results of DCE's inspections. Also, OIG proposes recommendations below that identify further actions to help protect WMATA from unnecessary operation and maintenance costs once WMATA's Board of Directors accepts the project.

## 2.0 SUMMARY OF OIG'S REVIEW

At the inception of OIG's review, the whistleblower had already filed the Qui Tam alleging multiple deficiencies as follows:

> *"UCP provides deficient concrete in two ways. First, its concrete fails to meet contract specifications relating to air entrainment and slump. Second, the stone being used as the aggregate is from an unapproved quarry that fails to meet other industry standard testing requirements, including alkali-silica reaction ("ASR") testing."*
>
> The Qui Tam also stated:
>
> *"Despite the fact that none of these batches met contract specification, UCP incorporated all of them into pre-cast slabs that were put to use on the Dulles Project."*

In an effort to address these issues, the contractor proposed the use of a silane solution to seal the panels and avoid moisture from getting inside and causing corrosion which would fail to meet the useful life of the panels. The corrosion could possibly cause the deterioration of the concrete and cause panels to fail. In some cases, the contractor was required to replace some panels that failed to meet contract specifications for minimum concrete cover.

MWAA and the contractor decided to apply a silane sealant to the exposed panels and elements. They selected a product and indicated they followed processes and procedures outlined by the solution manufacturer, to ensure that the warranty would not be voided by incorrect application. The application of two coats of the silane solution began in early 2019. Core samples were taken prior to and after the application of the sealant to determine if the level of penetration of the sealant was sufficient to properly seal the panels. On August 13, 2019, CRC advised OIG of the following results of the core sampling:

*"20 percent of the cores taken did not have sufficient sealant applied and required additional sealant for the warranty to stand. In addition, 10 percent were considered 'on the border'. To mitigate this issue, the contractor applied an additional two coats of sealant to meet the required level of penetration to the panels."*

As a result of this information, OIG issued a Management Alert to Metro's General Manager stating in part:

*"As a result of the matters uncovered regarding approximately 1500 concrete panels manufactured by a subcontractor and installed throughout Package A of the project, Metropolitan Washington Airports Authority (MWAA) and its contractor decided to apply a silane solution to the panels in an attempt to mitigate moisture from permeating the panels manufactured by the subcontractor.*

*The presence of moisture could cause Alkali Silica Reaction (ASR). ASR in concrete is a reaction between certain siliceous constituents in the aggregate and the alkali-sodium and potassium hydroxide released during the hydration of cement. ASR creates a gelatinous product that absorbs pore fluid and in so doing expands, inducing internal stress within the concrete. The gel will cause damage to the concrete if moisture is able to penetrate the surface of the concrete from an external source."*

OIG's Management Alert recommended:

*"Accordingly, until our report is issued, OIG recommends that:*

- *Based on the information known today, WMATA not accept the application of the silane solution, or any other measures short of complete replacement of the concrete panels, as a resolution of the issue.*

*If WMATA nevertheless decided to accept a resolution short of replacement of the panels, OIG in that event would recommend as a less desirable approach:*

- *That WMATA require any resolution to the issue of the panels be guaranteed by a warranty that would protect WMATA if such solution were to fail in future years while Phase 2 is in operation.*

- *That WMATA obtain sufficient funds from the contractor and/or MWAA to ensure that WMATA is compensated for any future maintenance and/or replacement of the panels in question. Such an arrangement should include the creation of an escrow account that would be controlled by WMATA and accessible as necessary to pay for maintenance or replacement of the panels.*

- *That WMATA obtain an indemnification/hold harmless agreement from MWAA and the contractor to protect WMATA from potential liability and cost in the event the panels failed and caused harm to a rider, employee or contractor or to the rail line itself."*

As of the date of the present report, OIG stands by the recommendations above regarding WMATA's acceptance of the panels.

After further application and testing of the panels, CRC advised OIG that they applied 4 to 5 coats of the sealant to non-brick panels and that they were able to achieve proper penetration. However, additional applications of a product to the panels will increase costs to WMATA above normal maintenance if it accepts the project. WMATA will need to account for those costs prior to acceptance. Also, as the recommendation states above, WMATA should ensure that the contractor provides sufficient funding to assure WMATA is compensated for any future maintenance and possible replacement of panels.

In January 2020, OIG received a letter from CRC written by UCP, the manufacturer of the panels in question. The letter said in part:

*"As per your request, I inspected cracks in precast panels on Friday, December 13, 2019. In attendance for my inspection was* [redacted]*.*

*Cracks consistent with handling of precast panels were observed in the following precast panels: 101, 214, 404, 1310, 1315, 2103, 2104, 2105, 2106, 2108, 2200, 2210, 2211, 2644, 2903, 2908,2932, 3070, 3123, 4234, 4245, 5209, 5834, and 5838." and;*

*"Panel 3099 was not observed to have cracks that were consist with handling in my opinion. The interior face of Panel 3099 was observed to have a CMU chase on the same side of the precast panel that cracks were observed on the exterior face. There were also several MEP conduits anchored to the interior face of Panel 3099. After my inspection at a later date, CRC investigated the inside of the CMU chase with a borescope.*

*The borescope revealed anchors had been installed into the back of the panel. It is my opinion the cause of the cracks in Panel 3099 is consistent with installation of the CMU chase and anchoring of MEP conduit. Based on my observations and the information provided by CRC, I have concluded the cracks in the subject precast panels are not the result of in-service loading. The observed cracks are consistent with handling or field installation operations. The cracks were not observed to be active in my opinion, and it is not anticipated the cracks will enlarge or lengthen substantially due to in-service loading. I recommend that the cracks should be repaired per UCP's previously approved standard crack repair procedures. The appropriate repair procedure should be selected based on the width of each subject precast panel crack."*

Prior to receiving this letter, OIG had not been advised nor were we aware that any cracks existed in the panels. In addition, we were not provided information on how many cracks were found in each panel. In an effort to obtain a proper baseline on the condition of the panels in relation to cracks, OIG hired DCE to identify how many panels have cracks and the width of each crack. Section 03 30 00 of the technical specifications for the construction project provides that cracks that are 0.005 inches or

greater must be repaired. In addition, it also states cracks smaller than 0.005 do not need to be repaired. Excerpts from the technical specifications are as follows:

*"Specific Repair Categories: The following types of concrete repair are intended for use as a standard process and are detailed in the sections that follow:*

*Concrete Microcracks (0.005 inches minimum)"* and it further provides:
*"Do not repair any crack that is less than 0.005 inches at its widest point."*

DCE inspected the 1603 panels in question during June and July 2020. Below are the results of those inspections.

**Panel Inspections**

The inspections were conducted of panels that were installed at the five (5) above grade stations. Those stations are:

1. Ashburn Station (formerly Route 772);
2. Loudoun Gateway Station (formerly Route 606);
3. Innovation Station;
4. Herndon Station; and
5. Reston Town Center Station.

None of the panels were installed at the Dulles Airport Station. Therefore, DCE did not conduct any inspection at that station. Below are the results of DCE's inspections:

| Station Name | Number of Panels | Total Cracked Panels | % of Panels with Cracks | Panels with Cracks ≥ 0.005 in | % of Panels with Cracks ≥ 0.005 in | Total Number of Cracks in Panels |
|---|---|---|---|---|---|---|
| **Ashburn Station** | | | 10.17 | | | 57 |
| **Completed** | 326 | 35 | | 34 | 10.43 | |
| **Partial** | 18 | 0 | | | | |
| | | | | | | |
| **Loudoun Gateway Station** | | | 12.45 | | | 49 |
| **Completed** | 224 | 30 | | 27 | 12 | |
| **Partial** | 17 | 0 | | | | |
| | | | | | | |
| **Innovation Station** | | | 11.81 | | | 54 |
| **Completed** | 257 | 31 | | 23 | 8.95 | |
| **Partial** | 14 | 1 | 7.14 | 1 | 7.14 | |
| | | | | | | |
| **Herndon Station** | | | 13.09 | | | 121 |
| **Complete** | 366 | 53 | | 36 | 9.84 | |
| **Partial** | 39 | 0 | | | | |

| Station Name | Number of Panels | Total Cracked Panels | % of Panels with Cracks | Panels with Cracks ≥ 0.005 in | % of Panels with Cracks ≥ 0.005 in | Total Number of Cracks in Panels |
|---|---|---|---|---|---|---|
| Reston Town Center | | | 9.94 | | | 61 |
| Complete | 327 | 34 | | 24 | 7.3 | |
| Partial | 15 | 0 | | | | |
| | | | | | | |
| Total Panels Inspected | 1603 | | | | | |
| Total Panels Cracked | | 184 | | | | |
| Percentage of Panels Cracked | | | 11.48 | | | |
| Total Number of Panels with Cracks ≥ 0.005 inches | | | | 145 | | |
| Percentage of Panels with Cracks ≥ 0.005 inches | | | | | 9.04 | |
| Total Number of Cracks | | | | | | 342 |

Before OIG engaged its contractor to do the inspections, both MWAA and CRC conducted separate inspections of the panels. CRC advised OIG that they found 57 panels that contained at least one crack. CRC provided OIG a list of those panels. In addition, MWAA advised OIG that they found 37 cracks in 26 panels. Two of these cracks are in roof coping pieces and all other cracks are in the wall panels. MWAA provided OIG with pictures identifying those cracks.

## Review: Structural Services Inc. (SSI)

OIG contracted the services of SSI, an industry leader in design and construction consulting, to complete an evaluation of precast concrete elements constructed for five (5) stations associated with the extension of the Silver Line rail system (Phase 2 Package A) and to opine on a recommended solution for cracks identified at certain buildings in the Dulles Rail yard (Phase 2 Package B).

The results of DeSimone's panel inspections were provided to SSI for review and assistance in completing SSI's evaluation.

### Package A (Above Grade Stations)

Package A consists of 6 above grade stations extending from Reston Town Center to Ashburn. SSI's evaluation was conducted on the following stations from East to West - Reston Town Center, Herndon, Innovation Station, Loudoun Gateway (formerly Route 606), and Ashburn (formerly Route 772). None of the panels in question were installed at the Dulles Airport Station and therefore no evaluation was conducted of that station.

SSI's report indicated in part:

*"Multiple deficiencies have been identified in the precast panels fabricated by UCP for the Silver Line Expansion project. The deficiencies include the following:*

- *Using a separate test not required by the project specifications, aggregates from the Denver Quarry are shown to be potentially deleteriously reactive at one (1) year.*

- *Combined testing by DRP, WJE and CLT indicates the air content of as many as 45 of the 69 (approximately 65%) concrete core samples examined appear to fall below the minimum value specified for air on the project.*

- *DRP and CTL report a wide variation of w/cm, leading SSI to conclude that UCP did not consistently produce precast panels with the required w/cm ratio.*

- *The concrete cover in the concrete panels does not conform to the 1.5-inch requirement of the project specifications. ACI 318 requirements for plant-precast concrete exposed to an aggressive environment do not appear to be consistent.*

- *The proximity of reinforcing to the surface of the concrete increases the potential for an intersection of a crack with the reinforcing. In the event a crack intersects or coincides with the reinforcing, the potential for corrosion increases. EVONIK literature for Protectosil® CIT leads us to conclude that the product cannot be expected to protect reinforcing exposed to cracks that exceed 0.015 inches in width or are not dormant. Cracks cannot be dormant if exposed to thermal expansion and contraction, as will be the case for these precast panels. It is likely that the corrosion process will occur at some locations where wide or active cracks intersect the reinforcement in the panel face during the life of the structure.*

- *The initial proposal by Capital Rail Constructors (CRC), and all subsequent communications are based on the cost of the original sealer application of two coats of product. Since testing by EVONIK has shown that four coats of Protectosil® CIT are required to protect reinforcing at locations where there are no cracks, it would appear to SSI that the use of the original cost as a basis for calculations is flawed.*

- *The use of the silane sealer on this project is not a perfect solution. Protectosil® CIT cannot be relied upon to protect reinforcing at active cracks or at cracks wider than 0.015 inches in width. The CRC proposal does not appear to anticipate the cost of regular visual inspections to identify and remediate panels that have begun to corrode. It also does not include the cost of remediation in the event corrosion is identified.*

- *Concerns about the efficacy of galvanostatic pulse testing of twenty-one (21) panels as a means of identifying the corrosion, potential or actual, of all exposed precast panels led to two separate visual crack inspections of all accessible precast panels.*

- *The measures taken by UCP, CRC, and MWAA to improve the quality of the precast panels fabricated by UCP after February 23, 2017 were generally ineffective.*

**SSI recommends the following for Package A (Above Grade Stations):**

*"If the panels are accepted, SSI's recommendation is that WMATA accept the CRC proposal to properly apply and maintain a silane sealer to each of the exposed precast panels.*

*Assuming cracks wider than 0.005" in the DeSimone reports have been repaired, SSI recommends periodic visual inspections of each of the stations to identify rust-staining of the concrete, which is a precursor to physical damage because of corrosive expansion of the reinforcing.*

*The first inspection should take place a year following completion of crack repairs, with following intervals determined by observations made during the first post-crack repair inspection.*

*Assuming little or no evidence of corrosion during the first post-crack repair inspection, subsequent intervals of 3-to-5 years between inspections will allow identification and remediation of any problem areas during the life of the structure.*

*If the panels are accepted, consider modifying funds in escrow account to accommodate the future cost of additional coats of sealer at each application, the cost of regular visual inspections, and the cost of remediation in the event corrosion is identified."*

Figure 1 below shows panel inspection by entity with percentage of panels that have cracks or deficiencies.

**Figure 1**

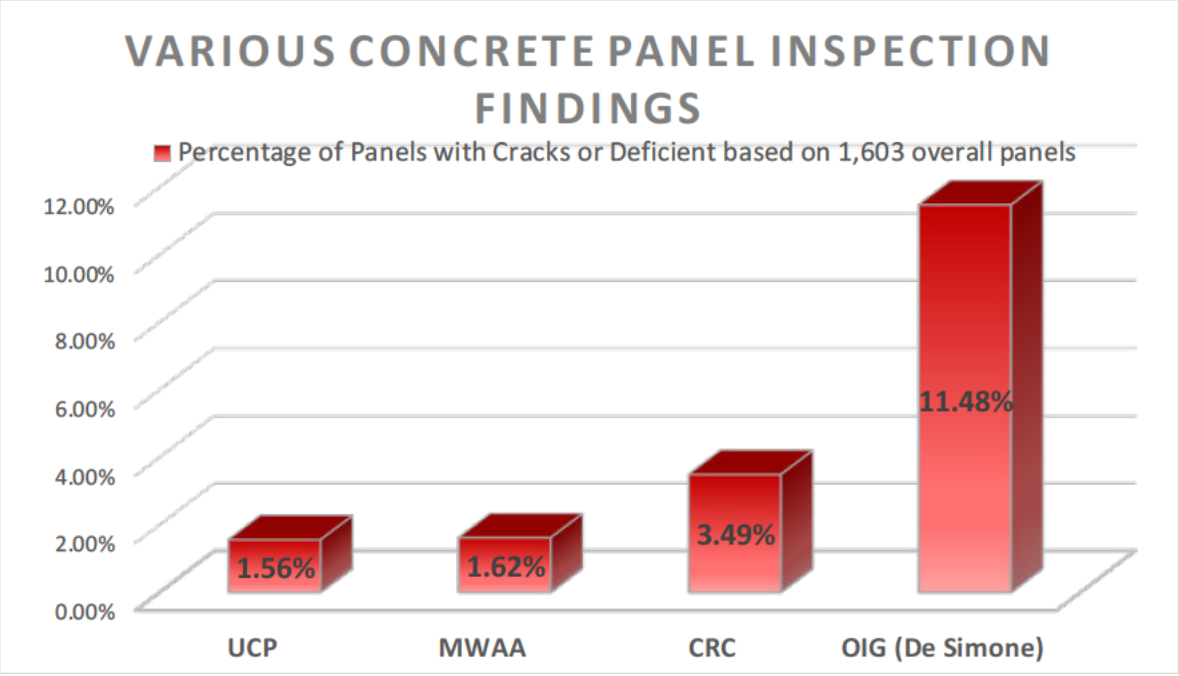
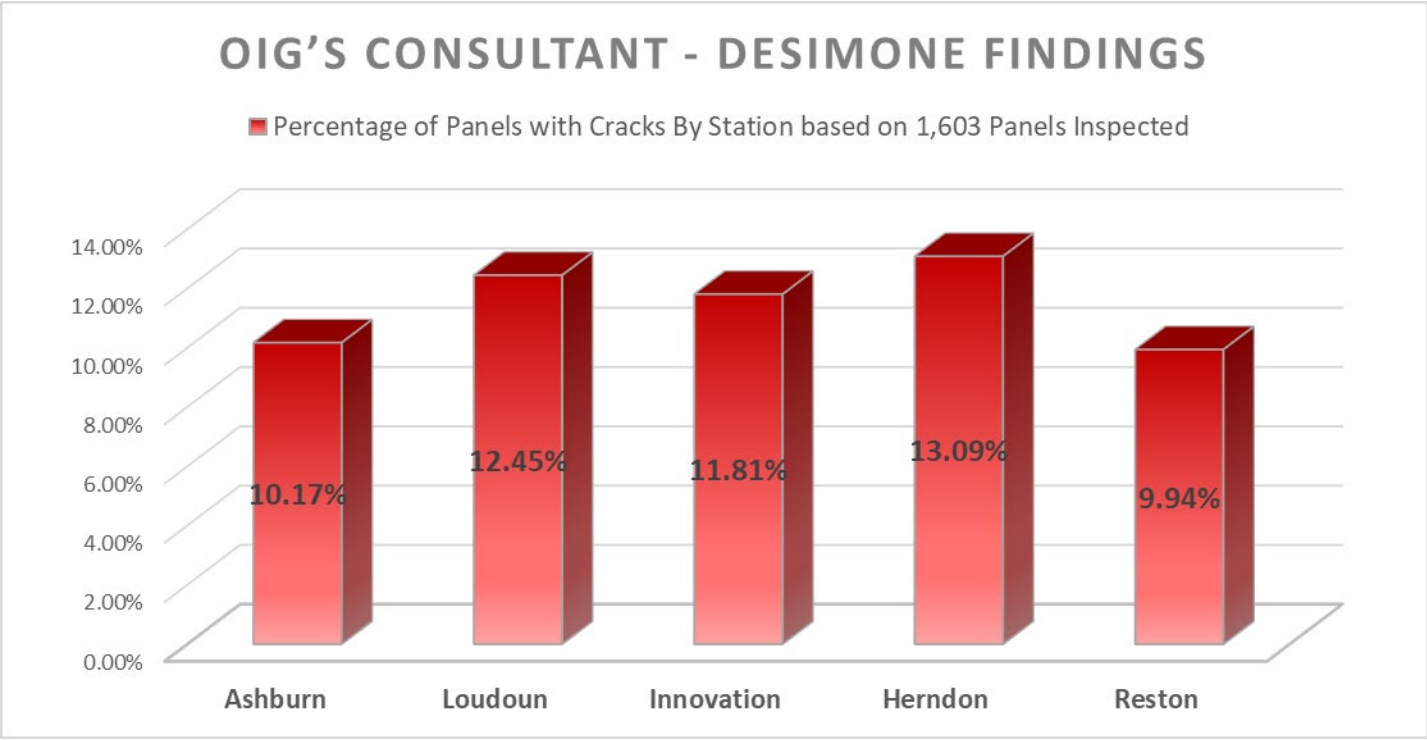


Figure 2 below shows percentage of panels with cracks by station.

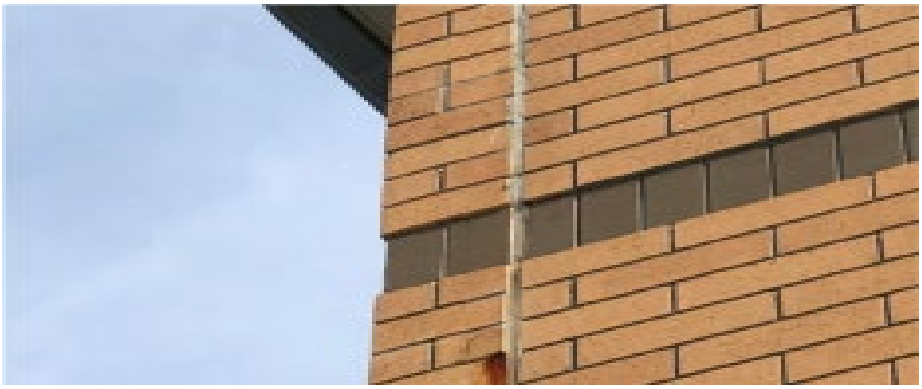
**Figure 2**



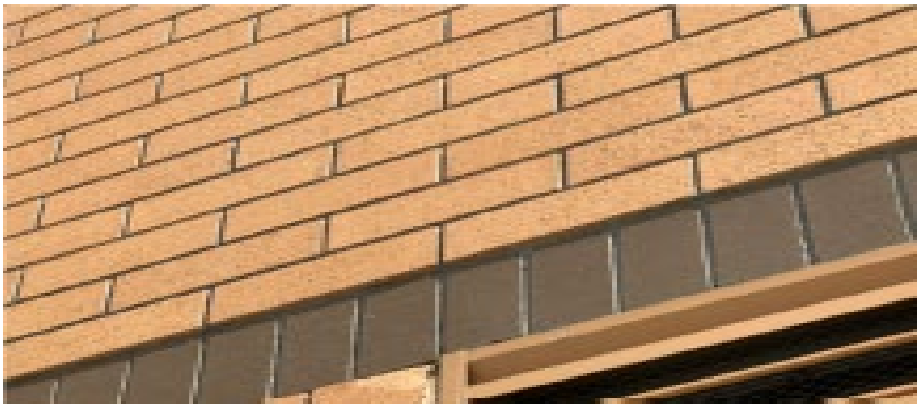

**<u>Other Identifiable Issues with Panels</u>:**
WMATA OIG's inspection consultant identified 184 panels with one or more cracks. In addition, the consultant noted other issues including but not limited to spalling, corrosion and efflorescence. Below are examples. Additional pictures of the 184 panels are contained as exhibits in this report. These panels must be repaired prior to acceptance by WMATA.

Herndon - Figure 16: Crack at Panel 2539. Source: DeSimone

Ashburn:  Figure 8: Piece of precast concrete panel cut-out at panel 5125. Source: DeSimone



Reston:  Figure 14: Corrosion observed at the exterior of Panel 3321. Source: DeSimone



Reston:  Figure 15: Spalling of brick masonry noted at Panel 3322. Source: DeSimone

Herndon:  Figure 11: Efflorescence at Panel 2538. Source: DeSimone

Innovation: Figure 7: Edge of panel outboard and not flush with adjacent panel at Panels 200, 201. Source: DeSimone

Ashburn:  Figure 5: Voids in the brick mortar at Panel 5209. Source: DeSimone

**Package B (Rail Yard)**

The original product that was being considered to seal the panels at the rail yard was a product called Sikagard 670W. SSI states the following relating to this product:

*"Product literature for Sikagard 670W indicates that it is not to be used over moving cracks. Since the cracks that have formed in the precast panels at the Dulles Yard will be subject to thermal movements, this product is not appropriate for the proposed application."*

SSI also indicated in the report:

*"The most recent correspondence – an email from [redacted] with the Dulles Corridor Metrorail Project – indicates that the product now under consideration is Sikagard 550W, but the IRR has not yet been closed because they are waiting for the results of a life cycle analysis by HP to confirm the frequency of re-application.*

*Adhesion tests by Sika on sample areas confirm the product will adhere successfully with, or without, the use of a primer. The product data sheet for Sikagard 550W indicates it is suitable for bridging cracks, so functionally it would be an appropriate product for the application.*

*Aside from the necessary frequency of re-application, which should be provided by the HP analysis, the primary question which must be answered is the extents of the application. The product data sheet states that the product comes in 469 standard colors and that color matching is available. It would appear, since the cracks are located at the base of the panels, that the coating might not be required for the entire panel surface."*

*"SSI FINDING: The cracks in the precast panels at the Dulles Yard are consistent with restraint of movement of the concrete in response to thermal and normal drying shrinkage. Cracks of this type are of no structural consequence but do provide a means of egress for moisture in the panels. The prevention of moisture entering the panels will mitigate the possibility of corrosion of the panel reinforcing at some point in the future."*

SSI recommends the following for panels at the rail yard:

"SSI's recommendation is that the design-builder HP proposal to apply Sikagard 550W on the exterior face of the precast panels be accepted. The area to which the protective acrylic coating will be applied, the frequency of reapplication, and cost of reapplication all need to be established prior to final acceptance." (**HP has already applied the product to the precast panels**)

OIG recommends that if the WMATA Board of Directors decide to accept the project, the General Manager/Chief Executive Officer take the following actions prior to acceptance:

1. Require MWAA and CRC to provide WMATA with the profile of every panel. This should include:

    a. All Panel numbers and location by station;
    b. Drawings of all panels by station identifying location of cracks;
    c. Depth of each panel;
    d. Number of coats of silane solution applied to each panel;
    e. Number of cracks on each panel with width of crack and whether or not they have been repaired;
    f. Pictures of each crack;
    g. Costs associated with repairing cracks; and
    h. Identification of cracks that were not repaired.

2. Require CRC to repair every crack identified either by UCP, MWAA, CRC, OIG or anyone else that are $\geq$ 0.005 inches or greater;
3. Ensure that cracks less than 0.005 inches are thoroughly inspected during subsequent inspections after acceptance of the project;
4. Require MWAA and CRC to provide WMATA with documentation identifying the process used for repairing cracks in Package A;
5. The first inspection of panels should occur one (1) year following the repairs of identifiable cracks. The inspection should be as comprehensive as DeSimone's (OIG's consultant) inspection;
6. Reapply the silane solution or other similar product determined to be suitable every 5-7 years and not 10 years as recommended by the contractor;
7. Require MWAA and CRC to readdress amounts offered in the escrow account considering costs to repair or replace panels, application of additional coats of solution, costs for inspecting the panels and other costs over and above normal maintenance costs; and
8. While Hensel Phelps (contractor for the Rail Yard) has already applied the suggested solution on cracks in the rail yard buildings, they should remit funds to cover future coats that would be considered over and above normal maintenance costs;
9. If not already repaired, instruct MWAA and CRC to repair panels identified in the section entitled, "*Other Identifiable Issues with Panels*".

## TO REPORT FRAUD, WASTE, OR ABUSE

**Please Contact:**

**Email:** hotline@wmataoig.gov

**Telephone:** 1-888-234-2374

**Address:** WMATA
Office of Inspector General
Hotline Program
500 L'Enfant Plaza, S.W., Suite 800
Washington, D.C. 20024