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November 12, 2019

Ranya El Sadawy, P.Eng.
Public Services and Procurement Canada
11 Laurier Street
Gatineau, Quebec K1A 0S5

Subject: LaSalle Causeway Counterweight Memorandum (DRAFT)

Dear Ranya,

The following is a Counterweight Memorandum as part of the LaSalle Causeway 2019 Comprehensive Detailed Annual Inspection (CDI) project for the LaSalle Causeway in Kingston, Ontario. The CDI was completed in accordance with Public Services and Procurement Canada (PSPC) Standing Offer EQ754-161365/001/PWL, Project Number R.090045.001.

Introduction

The Lasalle Causeway crossing consists of three bridge structures, a causeway, and ancillary structures and facilities. Due to abnormally high-water levels the CDI field work was scheduled in two phases, with Phase 1 generally including topside work and Phase 2 generally including water-based access and diving operations. Phase 1 was completed Wednesday August 14 to Friday August 16, 2019. Phase 2 was completed Wednesday October 23 to Friday October 25, 2019.

The CDI included visual inspection of the counterweight's visible elements. Through prior inspections it was noted that the sheet metal angles at the base of the counterweight cladding were retaining some disintegrated concrete and other deleterious loose debris. Should the CDI confirm a sizeable quantity of debris was present, our proposal included a provisional item to remove the angles to facilitate removal of the loose debris.

Observations

For the CDI access to the counterweight, other than the top surface, was via a self-propelled diesel operated manlift. Access to the top surface was via rope access.

Through inspection of the counterweight lower angle area, specifically the gap between the sheet metal cladding and counterweight, we observed varying amounts of debris bearing on the angles and soffit cladding. Comparatively, the north east area had the most amount of debris with the remaining areas having less to slightly less debris. All areas had some amount of debris.

We determined that the amount of debris warranted removal to reduce the risk of material falling onto the roadway below. We recommended activating the provisional item for removal of debris which was then approved by PSPC.

Concrete Removal

Removal of the debris was completed starting at 10:00 pm Wednesday October 30 and ending at 6:00 am Thursday October 31, 2019. Removal of the angles and debris was completed by GA Wright & Son. Single lane closures were provided by Beacon Lite. Parsons and PSPC were on site to observe the work, and a bridge operator was also present.

The work started at the south west corner and proceeded counterclockwise. The sheet metal cladding screw heads had a plastic cap that would break when a wrench was applied to remove them. The first alternative for removal was to grind off the heads, then a second more efficient method was to shear off the heads off with a chisel and hammer. Sometimes a vise grip was used to turn some of the screws. New self-tapping screws were installed when re-fastening the cladding. On the west and east side soffit there is a sheet metal hat section member about 0.5 meter in from the face running north south that the soffit cladding is fastened to. The top of the hat is fastened to the counterweight, and the hat legs are on the bottom fastened to the cladding. This section provides a gap between the counterweight and the cladding.

Debris was removed manually and using a pry bar and various tools. Debris, if present, was not removed beyond the hat section members as access was not possible without removing all the soffit cladding. However, based on very limited viewing beyond the hat section members via the cladding corrugations it did not appear there was excessive debris beyond those members. In some areas, if the side cladding was impacted debris would fall from within the gap. The debris was deposited into buckets and then transferred into the bed of a GA Wright pickup truck.

As observed during the CDI, the north east area had the most amount of debris with the remaining areas having less to slightly less debris, with all areas having some amount of debris. The north east area also had the most observed concrete section loss, with the corner area having the most loss which extended up approximately 300 mm. The debris appeared to consist of disintegrated concrete, aggregate, and possibly some organics as evidenced by blackish soil looking material. The organic looking material was generally located towards the south end of the counterweight on both the east and west sides. All the material was damp. A guestimate of the weight of material removed was in the 45 to 70 kg (100 to 150 lb.) range. See Photo 1.

Where visible the counterweight concrete was generally in poor condition exhibiting disintegration, spalling, efflorescence with and without stalactites and stalagmites. See Photo 2. There were areas of exposed and corroding reinforcing steel and wire mesh. The reinforcing steel bars were round, not deformed, which is reflective of the vintage of the structure. See Photo 3.

The two north east and south east facing access doors were opened to observe the interior space which was an empty chamber. The south east chamber concrete was sounded with a hammer, many areas were hollow or soft sounding, i.e. deep concrete disintegration, particularly on the south face, the soffit had pattern and alligator cracking with efflorescence and stalactites, and the floor had the best sounding concrete. See Photo 4. The north east chamber concrete was sounded with a hammer, some areas were hollow or soft sounding, i.e. deep concrete disintegration, particularly on the south face, the soffit had pattern and alligator cracking with efflorescence and stalactites, and the floor had the best sounding concrete. Overall, the concrete in the north space was in slightly better condition than the south space. Both hatch doors needed to be wedged into place to be closed, the hinges are loose and in poor condition.

2018 Bascule Bridge CDI Report (DRAFT)

With regard to the condition of the concrete, the 2018 CDI included obtaining concrete cores from the counterweight for observation and testing. A Draft report dated February 2019 has been submitted to PSPC for review. The concrete coring was completed by Capital Cutting and Coring and testing completed by Gemtec Consulting Engineers and Scientists. Gemtec's report dated November 2018 is appended to the 2019 CDI report.

A total of six 100 mm diameter cores ranging in depth from 126 mm to 611 mm were taken from the east and west faces. The average depth of the six cores was 320 mm. Due to the poor quality of the concrete in the cores extracted it was only possible to test a single core sample for compressive strength, Core #2, which was obtained from the west face, north end, top. The result indicated a compressive strength of 11.9 MPa at an approximate depth of 50 to 255 mm. Based on the MTO Structure Rehabilitation Manual, structural concrete with compressive strengths under 20 MPa is of poor quality. In general, and in relation to the core locations, the edges and particularly the lower portions of the counterweight are in poor condition, with the exception of Core #2 located in the upper region. See Figure 1.

Photo 1 Debris - Removed

Photo 2 Soffit - Efflorescence, Stalactites, Stalagmites, Typ.

Photo 3 Soffit – South East Region

Photo 4 Chamber - South East

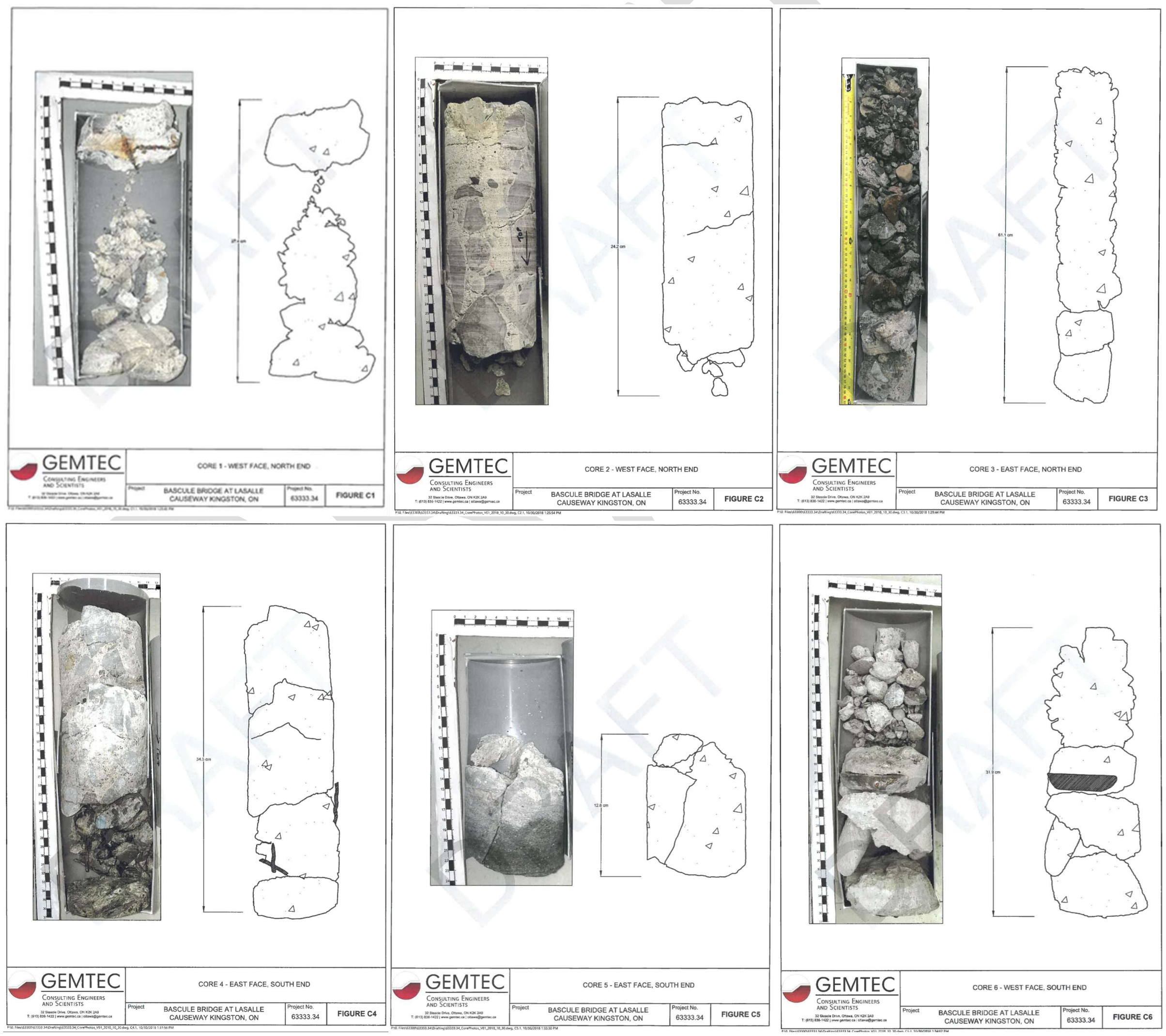

Figure 1 Cores – Core # 1 to 6 Cross Sections

Summary of Observations

Observations from previous inspections and testing, the current 2019 CDI, and during the recent concrete removal all indicate that the concrete is generally in poor condition. It appears the concrete is in slightly better condition in the upper regions and increases in degradation towards the lower regions. There is an unknown with regard to the condition of the concrete within the counterweight mass. The six cores taken in 2018 had an average depth of 320 mm. The chambers provide a view into the mass but only offer a visual indicator through the condition of the chamber surfaces.

Considering the condition of the concrete, particularly in the lower regions, and with degradation that is continuing and possibly accelerating, there is an increasing risk that a portion or portions of concrete can break away from the mass. The concrete is reinforced with round bar reinforcing steel and wire mesh that provide some containment, but those elements are also degrading through corrosion and are in a weakened state.

From available drawings it appears there are three triangular shaped steel frames spanning east west within the counterweight that provide structure and support for the concrete. The drawings are dated and may not fully reflect the current configuration of the counterweight; however, they are likely indicative of the general structure. See Figure 2.

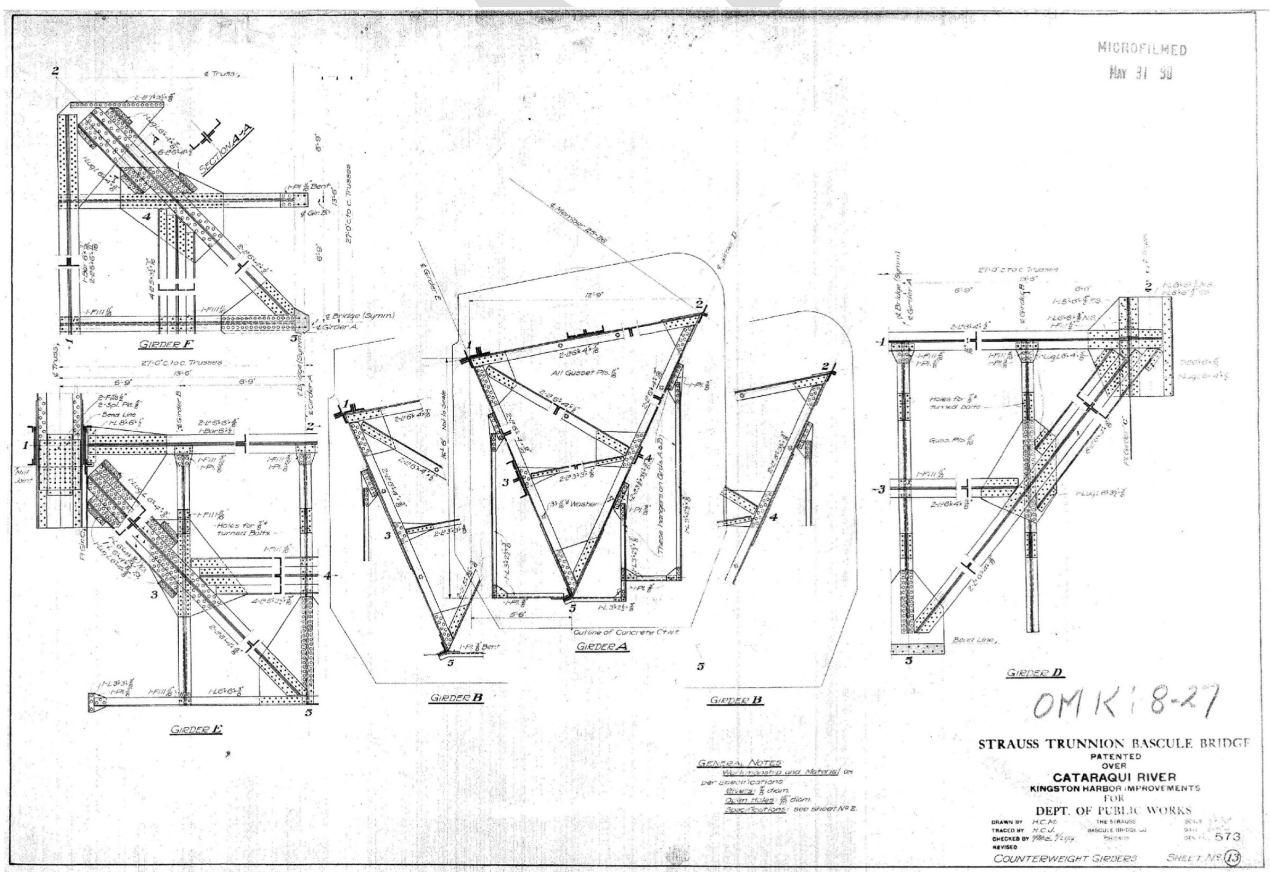

Figure 2 Counterweight Structural Steel

Recommendations

Based on current and past observations of continuing degradation of the counterweight concrete, and with an increasing risk that a portion or portions of concrete can break away from the mass, we recommend further investigations to enable the determination of short and long-term remedial strategies.

The following provides a framework of recommendations for discussion and consideration;

1. Investigation; Build on the existing inspection and condition survey data via obtaining additional concrete deep cores to provide insights into the condition of the interior mass of the counterweight. The cores should be of relatively small diameter, in the 50 mm range, to reduce the risk of intersecting or damaging internal reinforcing steel and other structural elements. The cores should extend to approximately the centre of the counterweight if taken from the east and west faces, or full depth if taken from one face. Coring procedures should be confirmed with a provider(s) of this service as part of the investigation planning.

   As the three triangular shaped steel frames (Girders A and B in the original design drawings) span east west within the counterweight, it follows that the cores should be taken in an east west direction, but care needs to be taken to avoid the two inclined steel frames (Girders D and E in the original design drawings) that span north-south. There are also numerous threaded rods running north-south to be considered. A mapping exercise based on existing drawings to document the internal structure is recommended to aid in determining suitable core locations.

   Schedule; This work can potentially be scheduled during the winter to spring months of 2019-2020 depending on weather conditions, etc. Operations would be configured for cold weather work. The voids left by coring operations could have the open end(s) plugged, or suitable cold weather grout could be used to fill the voids in their entirety.

2. Short Term; Depending on the results of the coring, remove the cladding to inspect the concrete. Remove loose material within reasonable limits, complete necessary localized repairs, and “wrap” the counterweight to provide temporary additional support to the concrete. Considering the sensitivity of the structure to weight distribution to remain balanced, this could be achieved using lightweight advanced composite materials such as glass or carbon fiber sheets.

   Schedule; Depending on the results of the investigation, this work could be considered for completion during the upcoming trunnion rehabilitation. The work could also be coordinated with the deck replacement that is currently being studied or scheduled independently of other works. However, the schedule should consider that time is of the essence with the increasing risks associated with the continuing counterweight deterioration.

3. Long term; The results of the recent CDI’s, further investigation via deep cores, and removal of the cladding would then provide a basis for determination of long-term remedial strategies. These could include major rehabilitation or replacement.

   Schedule; The schedule would be dependent on a number of factors such as condition of the counterweight, scheduling of other works, life span of short-term works, budgeting, etc.

Sincerely,

(Brian Wood)