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Our File No. 17-7406

September 6th, 2017

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C/O Colliers Project Leaders
Dixon Weir, P.Eng.
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via email: Dixon.Weir@colliersprojectleaders.com

Attn: Mr. Dixon Weir, P.Eng.

Re: Apex Bridge Iqaluit Condition Assessment

Concentric was retained by the City of Iqaluit to complete a condition assessment of the Apex Bridge located in Iqaluit, Nunavut. This submission outlines the results of the assessment.

BACKGROUND

The Apex Bridge is situated at the entrance to Apex and carries the roadway over a watercourse, narrowing the roadway to one lane. Vehicles travelling out of Apex must yield the right of way to vehicles entering Apex.

Past condition assessments circa 2002 have performed structural analysis of the steel and timber members and have determined a load limit for the bridge of twenty-two (22) metric tonnes. Signage at one entrance to the bridge indicates a posted load limit of seventeen (17) metric tonnes.



Concentric's staff have been periodically monitoring the Apex Bridge since 1997. Concentric was most recently retained in 2014 (Concentric Project No. 14-5497) by the City of Iqaluit to visually assess and provide repair drawings for the bridge due to damage sustained from a vehicular impact. Concentric was not involved in supervision of the repair construction.

As part of the 2014 repair assessment, Concentric recommended another condition assessment be completed in 2016. Concentric is not aware of any condition assessment being completed on the Apex Bridge since 2014.

SCOPE OF ASSIGNMENT

The scope of our assignment has included the following activities:

- Review the relevant record documents. These include record drawings, original specifications, if available, and records of any major alterations/changes to the structure or any other systems that may influence the design.
- On-site visual inspection of the bridge superstructure and abutments to assess existing conditions and to identify any problems/concerns.
- Review any related exposure conditions and environmental influences.
- Review site specific characteristics and influences.
- Record all relevant observations and document conditions by photograph.
- Prepare a written report summarizing our observations, items of concern, and recommendations.
- Provide preliminary cost estimates, where possible, for recommended repairs.

DESCRIPTION OF STRUCTURE

The Apex Bridge consists of a Bailey bridge structure. Bailey bridges were designed for use in World War Two and can be assembled on site from identical pre-engineered segments. Each pre-engineered segment is approximately 3m in length and has pinned connections at each end allowing for quick assembly on site. Bailey bridges are versatile and easily adapted to most short or medium span applications. Bailey bridges are re-usable, cost effective, and simple to install making them excellent for use in temporary applications.

The Apex Bridge has an overall length of approximately 24m (80') with a clear span of 21m (69') crossing the watercourse. See photograph 1 in Appendix. The superstructure consists of two steel double trusses comprised of various steel sections. Each truss is made up of standard length sections pinned together. Double trusses are formed by fastening two trusses approximately 400mm (16") apart with steel lattice along the top surfaces, and by the deck structure near the bottom surface of the truss.

The bridge deck substructure consists of 250mm (10") deep wide flange beams spaced approximately 1.5m (5') apart spanning between each double truss. Steel channels span between each wide flange beam and are spaced every 300 mm (12"). The wide flange beams and steel channels form the bridge deck substructure. The bridge deck consists of two layers of timber construction. The first layer consists of 38x140 (2x6) timbers, tightly spaced, running across the bridge deck, followed by a wear course layer of 38x89 (2x4) timbers, tightly spaced, running the length of the bridge. Concrete abutments support each end of the bridge.



OBSERVATIONS

Concentric visually reviewed the Apex Bridge on August 23rd, 2017. During our onsite inspection, we did not observe any existing conditions that would threaten the immediate safety and/or serviceability of the Apex Bridge.

The following are observations resulting from our site visit:

- The bridge was in fair to poor condition.
- Erosion of soil was observed at the northwest and southwest corners of the bridge.
- Erosion of soil around the gabion baskets at the northwest abutment was observed. See photograph 2 in Appendix.
- The timber deck had eroded along the path of vehicle tires. Wear of the timber deck and exposed bolts/nails were observed. See photograph 3 in Appendix.
- The wood curb on either side of the bridge was in poor condition. See photograph 4 in Appendix.
- The majority of panel pins did not have the correct lock pins used. A variety of nails, bolts, and cotter pins were used instead of the 3/16" pins used during original construction. See photograph 5 in Appendix.
- Two of the horizontal bracing frames were missing at the north end of the bridge and were replaced with a steel angle welded in place. See photograph 6 in Appendix.
- One (1) horizontal bracing member on either side of the bridge had a bolt missing, while two (2) bolts on the east side were damaged due to impact. See photograph 7 in Appendix.
- The coating on all steel members has failed and allowing corrosion of the steel to develop. The steel below the bridge deck appears to have the most advanced development of corrosion. See photograph 8 in Appendix.
- The vertical member of the truss at the southwest corner was damaged by a vehicular impact in 2006 and a repair design was detailed in 2010. The repaired member differs from the design. See photograph 9 in Appendix.
- The guard rail at the southwest corner was damaged by a vehicular impact.
- It was noted that several transom locks were missing on both sides of the bridge (five (5) on the west side and six (6) on the east side). See photograph 10 in Appendix.
- It was noted that two (2) panel pins were missing at the northwest end of the bridge and the connection appeared to be welded instead.
- The vertical member of the truss at the southeast corner appeared to have minor damage from a vehicular impact.
- Signage was missing on the north side of the bridge.

DISCUSSION AND RECOMMENDATIONS

Based on the conditions observed during our site visit, we have the following recommendations for the Apex Bridge:

Short Term 2017

- Supplementary engineered fill is required on the edge of the roadway approaches near the northwest and southwest corners of the bridge to combat the localized granular washouts.
- The wood curbs on either side of the bridge are in poor condition no longer functioning as intended and should be replaced. The curbs help protect the bridge from vehicle impact and future damage.
- The damaged and missing bolts used to fasten the horizontal brace frames on top of the structural frames should be replaced.



- The signage on the north side of the bridge should be reinstated.

A construction budget for the short-term repairs is estimated to be \$10,000 plus applicable tax.

Annual

We recommend that the Apex Bridge be inspected annually given its condition and past history of impact damage from vehicles. Annual inspection will help ensure the bridge is performing to an acceptable standard in terms of public safety, comfort and serviceability.

A budget for annual inspection is estimated to be \$10,000 plus applicable tax.

2-3 Year Repair Program (2019)

The Apex Bridge has been in service for over sixty (60+) years and has historically experienced numerous vehicle impacts, overloaded vehicles, and continued exposure to the elements. This type of bridge is best suited for temporary service and was never designed or constructed for long term service. The bridge has performed adequately over the bridge's service life with occasional refurbishments of paint coatings, deck rehab/ replacement, and localized repair to structural members. The last rehabilitation of the bridge was completed in 2011 and focused on replacement of the wood deck and localized repairs. Given the age of the bridge, it is now nearing the end of its lifespan and requires a major rehabilitation program, we recommend planning for repairs within the next 2-3 years as follows:

- The timber deck's top wear course should be replaced.
- The lock pins should be replaced at all locations where they are missing or have the incorrect lock pin (nails, bolt, etc).
- The stability of the gabion baskets at the northwest abutment should be restored. This will likely require installation of supplemental gabion baskets.
- The missing transom locks on both sides of the bridge should be replaced.
- Replace the missing horizontal bracing frames at the north end of the bridge to match the original configuration.
- The damaged vertical truss members that have been locally reinforced should be removed and replaced with new to match the original configuration.
- Damaged guardrails should be repaired/ replaced.
- The steel structure should be abrasive blast cleaned to remove corrosion and the entire structure should be recoated.

A construction budget for the 2-3 year repair program is estimated to be \$400,000 plus applicable tax. This estimate has not included for any special protection of the watercourse that may be required. Historically the bridge has required rehabilitation every 10 years requiring varied degree of effort and capital investment. We recommend that the City budget an estimated \$250,000 for ongoing bridge rehabilitation every 10 years while the bridge remains in service. This estimated cost does not include costs of emergency repairs which historically have been required every few years.

It is the City's prerogative to defer or advance maintenance and/or repairs to their facilities, based on considerations that we may or may not be privy to. An absent or inadequate preventative maintenance program may accelerate deterioration, resulting in repairs being required sooner than projected or anticipated, perhaps at greater cost than originally estimated. Deferral of recommended repairs may also result in collateral deterioration and/or damage, which can inflate repair costs considerably.



Replacement/ Decommissioning

Consideration should be given to the long-term service requirement of this bridge as it was originally designed to be of temporary use. As time passes, the bridge will continue to age and maintenance costs are expected to increase. The next rehabilitation program should extend the service life of the bridge considerably, however, we recommend planning for the eventual replacement of this bridge.

Consideration could be given to upgrading the by-pass road to a point where it becomes the primary roadway into Apex. The by-pass road would likely need to be significantly upgraded to meet the requirements of modern road and culvert construction with respect to flood water levels and preventing washout of this route. The feasibility of this is not known at this time, this option may not be possible forcing the bridge to be replaced.

Another option would be decommissioning vehicle traffic on this bridge and reducing it to pedestrian/ snowmobile traffic only however the benefit to the community would need to first be evaluated.

LIMITATIONS

Concentric prepared this report for the sole benefit of the City of Iqaluit. This report was prepared exclusively for the purposes, project, and site locations outlined in the report. The report is based on information provided to, or obtained by, Concentric as indicated in the report, and applies solely to site conditions existing at the time of the site investigations. No structural calculations were performed as part of this scope of work.

Concentric is not a professional cost estimator or construction contractor, nor should Concentric's estimates of construction costs be considered equivalent to an estimate prepared by a professional cost estimator or construction contractor. Preparation of a construction cost estimate requires making a number of assumptions as to actual conditions that may be encountered on site. Factors over which we have little or no control include the contractor's methodology, economic volatility, the construction season, inclement weather, and the supply and demand of raw materials, finished goods, and labour. Construction cost estimates are considered budgetary figures only, based on recent industry data and experience on similar projects. The actual costs of construction may vary considerably from what has been estimated.

Should there be any questions, please contact the undersigned.

Yours sincerely,

Concentric Associates International Incorporated

Taylor Rivers, EIT
Designer

Steve Parker, P.Eng.
Lead Project Manager



Appendix A - Photographs



Photograph 1 – Overview of Apex Bridge structure.



Photograph 2 – Erosion around the gabion baskets at the north-west abutment.



Photograph 3 – Wear of the timber deck – note the exposed nail.



Photograph 4 – Damaged wood curb on the east side of the bridge.



Photograph 5 – Incorrect lock pin used in the panel pin.



Photograph 6 – Missing horizontal bracing member at north end of the bridge.



Photograph 7 – Missing bolt in the horizontal bracing member.



Photograph 8 – Corrosion on steel framing below the timber deck.



Photograph 9 – Damaged vertical member that has been repaired.
The repair differs from the design detailed in 2010.



Photograph 10 – Missing transom lock on the interior truss (left).
Note the transom lock in view on the exterior truss (right).