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HIGHWAY BRIDGE INSPECTION FOR PARKS CANADA IN ATLANTIC PROVINCES

St. Peters Canal National Historic Site
Volume 1 of 2
Bridge Inspection Report

MRC

Consultants in Transportation

February 2007

PARKS CANADA

ST. PETERS CANAL

NATIONAL HISTORIC SITE

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VOLUME 1 of 2

BRIDGE INSPECTION REPORT

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EXECUTIVE SUMMARY

McCormick Rankin Corporation was retained by Public Works and Government Services Canada (PWGSC) to undertake an inspection of the St. Peter’s Canal Bridge. The inspection was completed on October 3, 2006.

The inspections were completed following the process and procedures set out in the Bridge Inspection Manual 2001 (BIM2001). Visual Inspections were augmented by hammer soundings and probing to assess the current conditions of the various structure components. The inspection was completed as a Comprehensive Inspection. The access for inspection was scaffolding on a barge for the span over the canal, and scaffolding and ladders for the remaining sections.

The bridge is in fair condition with an overall condition rating of 3. The chord members are the main components of concern, as numerous reinforcements were completed to the chord members by welding, a practice generally not desirable on movable bridges. The bottom chords also exhibited medium to severe corrosion particularly at the panel points. Numerous perforations were noted in the lacing bars and the chord flange.

The evaluation of the bridge (under separate cover) indicated the bridge to have adequate structural capacity when evaluated in accordance with the CHBDC. This also accounts for the average section loss noted in the bottom chords.

MRC has recommended that a detailed electrical, mechanical and structural steel inspection, be completed within the next year. The inspection would also include non-destructive testing of fatigue sensitive details. The cost of the inspection is estimated at $20,000.

A detailed inspection of the north bottom chord is also recommended. This inspection would require the removal of the concrete counterweights to facilitate the inspection. The cost of this inspection, including counterweight removal, is estimated at $20,000.

1. INTRODUCTION

McCormick Rankin Corporation was retained by PWGSC to undertake a detailed comprehensive inspection the St. Peter's Canal Bridge for Parks Canada.

The inspection was conducted to the requirements of PWGSC Bridge Inspection Manual 2001. Access was provided by Superport Marine, using scaffold on a barge for the span over the canal. Otherwise access was provided by scaffold and ladders for "hands on" inspection.

Field Inspection was carried out under the supervision of Doug Dixon, P. Eng. The field work was completed under the leadership of Philip Wu, P. Eng. With assistance from Vernu Sivakkolundu, E.I.T.

The field work was completed on October 3, 2007.

This report presents the following:

a) standard bridge inspections forms following the BIM complete with ratings for material condition (MCR) and performance condition (PCR);

b) photographs of the observed condition of the bridge;

c) cost estimates to repair the identified conditions.

The cost estimate is divided into:

a) Immediate Remedial Works for Safety Reasons;

b) Urgent Remedial Works (within two years) ; and

c) Rehabilitation Work within the Next Five (5) Years.

We have further recommended additional Engineering Studies or Surveys (Destructive and Non-Destructive Testing) where MRC has deemed such works appropriate.

Under separate cover (Volume 2) is the result for the Structure Evaluation in accordance with the Canadian Highway Bridge Design Code (CHBDC), CSA S6-00, Chapter 14.

2. BACKGROUND

The St. Peter's Canal Bridge is a steel through truss swing bridge with an open steel grating, except at the end panel of the counterweight span, where a concrete slab was installed. The structural steel floor system consisted of deck grating support beams overlying longitudinal stringers supported on transverse floor beams.

The bridge was constructed circa 1936 and rehabilitated in 1982, 1991 and 1997/1998.

The 1982 rehabilitation included the installation of new decking and steel beam guide rails on the bridge. The decking consisted of concrete slab at the counterweight span (between nodes 2W and 3W), and open steel grating at the remaining sections.

In 1991, the structural steel was cleaned and coated.

The 1997 rehabilitation included the following: patch repairs to the abutments and pier; removed, inspected, and refurbished the pintle assembly; improved approaches by installing steel beam guide rails, approach parapet walls, and traffic loop detectors; and, reinforced various truss diagonals and top chords.

This inspection was a visual structural inspection (augmented with limited non-destructive testing) to assess the condition of the bridge, identify immediate needs and to assist in the identification of future needs and current loading deficiencies.

In general the identification of other deficiencies have not formed part of our assignment. Deficiencies in horizontal and vertical alignment of the approaches or the superelevation or sight distance of the roadway have not been assessed However, MRC has included brief comments on these matters. Functional deficiencies as well as other non-structural issues have generally not been part of our investigations.

3. CONDITION RATING SYSTEM

3.1 General

This section describes the principles and general application of the condition rating system used to assess observed defects in the materials and performance of individual components of a bridge, and the overall or general condition rating for the entire structure as a whole. Also included are guidelines for the application of a priority code for recommended repairs. Observations were augmented with non-destructive test methods such as hammer sounding, chain drags, and the use of ultrasonic gauges to obtain material thickness measurements.

For all concrete components, the surface conditions were observed and recorded. Exposed concrete decks received a chain drag to identify delaminated concrete. Barriers, parapets, sidewalks, piers and abutments were sounded using either normal hammer sounding techniques, chain dragging, or using a Delam® 2000 Rotary Delamination Hammer.

MRC undertook random cover meter readings to assess the depth of concrete cover over the reinforcing steel. This is useful information to use in determining repair quantities and repair strategies. The Team also used concrete crack indicators to assess the width of cracks.

Steel components were inspected as per the BIM. Section loss from corrosion was recorded using callipers or micrometers. So too were the material thickness either side of the corroded area to record "as rolled" thickness. MRC also examined several steel components using an ultrasonic thickness gauge. Significant corrosion pits were recorded. Rivets and bolts were inspected particularly for section loss of rivet heads (from corrosion) or broken connectors due to rust jacking on built up members. MRC reviewed all Class C or worse details.

In the BIM, the material and performance condition rating comprises a numerical system in which a number from 1 to 6, (1 = very severe defect and 6 = new condition) is assigned to each component of the structure based upon the severity of the material defects or the ability of a component to perform its function within the structure. Both material and performance defects perceived are considered from all components. The numerical rating assigned to a particular component(s) reflects the most severe condition of material defects or reduction of performance observed. The component(s) condition rating was assigned without consideration of the importance of the component(s) within the structure.

Components not visible or inaccessible at the time of inspection were noted. The provision necessary for inspection (access, traffic control, etc.) were identified and arrangements made for proper inspection to be carried out.

In addition to the condition rating, each defect is given a summary priority code for remedial action and scheduling. The priority code comprises an alpha character indicative of the urgency and nature of the required repairs to a component or the need for more detailed inspection. Recognition of the importance of the component within the structure was reflected in the assigned priority rating.

The general condition rating of the structure as a whole was based on the most severe component condition rating with some subjective modifications to reflect the importance of the component within the structure; taking also into account the load carrying capacity of the component as determined under the Load Evaluation which is provided under separate cover.

3.2 Bridge Inspection Manual Condition Rating System

The following text is taken from the 2000 inspection reports provided by PWGSC. It has been edited to ensure its relevance to the BIM 2001 Manual and the work as completed by MRC.

3.2.1 Condition Rating for Components of a Structure

Both material and performance defects were considered for all component(s). The numerical rating assigned to a particular component reflected the most severe condition of material defects or reduction of performance.

3.2.2 Material Condition and performance Rating for Components of a Structure

The material condition rating for the components of a structure represent the condition of the component based upon observed defects in the materials of the component.

The application of the material condition rating system to components depends on the type, location and severity of the defects.

The material condition rating represents the worst observed material condition of the component and is based on any one or a combination of the guidelines given under that rating. The inspector recorded the observed material defects and identified the cause producing those defects wherever possible. The inspector takes measurements to quantify the extent and general location of the defects for all components.

The performance condition rating for components of a structure describes the condition of the component based upon its ability to perform its intended function in the structure.

In most cases, the performance defect of a component is closely related to, or attributable to, defects in the component materials as material defects often lead to performance defects. The severity of the performance defect is not necessarily the same as the severity of the material defect. The performance condition rating was assigned on the basis of the approximate capacity of the component to perform its intended function within the structure and the classification of the component, i.e. primary secondary or auxiliary.

In some cases, performance defects exist due to defects in design or construction and may not be directly related to material defects. Also, performance defects in a component may be the result of unexpected behaviour of the structure or due to performance defects in other components of the structure. The inspector recorded the observed reduction in performance and the causes producing those effects wherever possible.

3.3 Code for Priority of Component Repair of a Structure

The priority code assigned to each component is one of the following:

- U Urgent, requires immediate attention and remedial measures to ensure public safety.
- M Required work to be done as part of routine annual maintenance.
- S Further study/investigations/surveys required prior to initiating repair program.
- A Repair and/or replacement to be done in less than 1 year.
- B Repair and/or replacement to be done in less than 3 years.
- C Repair and/or replacement to be done in less than 5 years.
- D Condition to be reassessed at the next inspection.

All components were assigned a priority code indicative of the urgency and nature of recommended repairs or need for further inspection. Performance related deficiencies were considered to be of higher priority than material related defects. Nevertheless, the objectives of the recommended rehabilitation program was to address, where possible all material and performance related defects.

Recognition of the importance of the component within the structure was reflected in the priority rating assigned. Recognition of the importance of the component was achieved by the classification of all components as either primary, secondary or auxiliary. The classification is generally along traditional structural behaviour except for non-structural components.

When the component condition rating indicated a significant level of deterioration or loss of performance, yet the recommended repairs are assigned a low priority, a brief written explanation is provided noting the component classification and nature of the deficiency.

3.3.1 Numeric Condition Rating of Structure

The general condition rating of a structure is an indicator of the most severe material or performance defects of a primary component or a modified indicator of the most severe material or performance defects of a secondary or auxiliary component, with some subjective modification to reflect the importance of the component within the structure and its load carrying capacity from the results of the Load Evaluation Rating.

The general condition rating of the structure consists of the lowest number from 1 to 6 obtained from the condition rating for the components of the structure as follows:

a) The lowest rating of a primary component;

b) The lowest rating of a secondary component plus one;

c) The lowest condition rating of an auxiliary component plus two (not to be less than 4).

The addition of "plus one' in b), and "plus two" in c), is to reflect the somewhat lesser importance of the secondary and auxiliary component(s) relative to the primary component(s) rating.

4. DISCUSSION AND RECOMMENDATIONS

The bridge is in fair condition with an overall condition rating of 3.

The bottom chords are the main components of concern. The bottom chords exhibited medium to severe corrosion particularly at the panel points. Numerous perforations were noted in the lacing bars and the chord flange. We also noted that numerous reinforcements were completed to the chord members by welding. Moveable bridges are subject to load reversals, resulting in stress reversals in many members at some point during the movement of the bridge. Welded repair/reinforcement is generally not desirable in the tension zone, due to fatigue issues, and particularly to those members subject to stress reversal. In addition, welding results in shrinkage and residual stresses in the reinforcement.

We would recommend that a detailed structural steel inspection, including non-destructive testing, be completed within the next year. The work should also include the inspection of the electrical and mechanical components. The cost of the inspection is estimated at $20,000. Since the concrete counterweights were installed on the north bottom chord, we would recommend that a detailed inspection of the north bottom chord be completed. This would involve the removal of the concrete counterweights to facilitate the inspection. The cost of that inspection, including the removal of the counter weights, is estimated at $20,000. We have included a sample Non-Destructive Testing Plan in Appendix E.

The evaluation of the bridge (under separate cover) indicated the bridge to have adequate structural capacity when evaluated in accordance with the CHBDC. The capacity to demand ratio for stringers is nominally below 1.00 (C/D = 0.97), therefore we do not recommend the bridge be posted. The evaluation of the bottom chords indicated a capacity to demand ratio of 1.24. Therefore accounting for an average section loss of 15% to 20% as observed in the field, the bottom chords have adequate structural capacity.

We have recommended reinforcements to the bottom chords at the panel points due to medium to severe corrosion with localized perforations at the chord flange and lacing bars. The extent of the reinforcements should be based on further structural steel inspection. The work is estimated at $780,000 including engineering and contract administration.

The coating is also approaching the end of its life. We would recommend that the structural steel be cleaned and coated after all necessary repairs and reinforcement to the structural steel are completed. We have not provided a cost estimate to complete the cleaning and coating, as it is anticipated that the work is beyond the five (5) year time frame.

At both approaches to the bridge, the horizontal alignment is generally poor. A crest vertical curve is also noted at the west approach to the bridge. The poor alignment combined with obstructions from vegetation resulted in limited sight distance of the traffic signals and various warning signs.

The steel beam guide rail at the west approach was in good condition. The height of the steel beam guide rail was measured to be 600mm. The various transition and end treatment details are not in accordance with the standards. An independent memo is appended to the end of this report.

APPENDIX A
Bridge Inspection Reports