REPORT

Town of Outlook

TransCanada Trail Pedestrian Bridge
Preliminary Bridge Repair Design Report

April 2014

Certification Page

This report presents our findings regarding the Town of Outlook TransCanada Trail Pedestrian Bridge Preliminary Bridge Repair Design Report

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Executive Summary

The historic **Outlook TransCanada Trail Pedestrian Bridge** (the bridge) in Outlook, Saskatchewan is currently unsafe, and therefore closed to the public. The 100-year old bridge had been substantially damaged as a result of gradual sliding of the ground under the bridge approaches towards the river. The bridge is a landmark structure, frequently used by citizens and guests of the **Town of Outlook** (Outlook). The bridge is also a part of TransCanada Trail.

To repair this structure and to preserve it for the enjoyment of future generations, Outlook retained **Associated Engineering** (AE) to inspect the bridge, identify the items that need to be repaired, and provide a conceptual repair design and order-of-magnitude cost estimate for the repair work.

In this report we discuss two categories of repairs:

1. **Emergency Repairs:** Repairs required to make the bridge safe for public use. Emergency repairs are not intended to repair all deficiencies in the bridge. Regular inspections will be required to monitor its performance until the comprehensive repairs are complete.
2. **Comprehensive Repairs:** Repairs required following emergency repairs, to make the bridge safe and allow reliable performance of the bridge in the years to come. Repairs of damage and deterioration of the bridge that is not currently compromising the stability of the structure, but may result in significant problems in the future.

Based on our analysis described in the report, the order-of-magnitude cost for the repairs are:

- $3,550,000 for the Emergency Repairs.
- $2,000,000 for the Comprehensive Repairs (in addition to Emergency Repairs costs).

Once funding has been secured to repair the bridge, Outlook will be able to retain a design firm to complete the detailed design. We anticipate that this task will include a preliminary site visit, completion of a detailed design drawing package, preparation of specifications and tender documents, and providing technical support to Outlook during the tender process. Additionally, we have allowed for a detailed inspection, including materials testing, to determine the extent of required truss element repairs following installation of truss stabilization works during the construction phase (see Sections 7.1.2 and 7.1.3).

If Outlook can secure sufficient funding to complete both the emergency and comprehensive repairs outlined in Section 7, we recommend that the project be tendered as a single project. If the level of available funding is sufficient to perform the emergency repairs only, we recommend that the repairs are tendered as two separate projects; the emergency repairs as soon as possible and the comprehensive repairs at a later date when additional funding can be secured. We anticipate the emergency repairs can be completed in eight to eleven months, including design, tendering and construction.

Following the implementation of the repairs, annual inspections and maintenance will be required to provide continued safety of the bridge. This should be considered by Outlook when evaluating how to move forward.

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1 Introduction

1.1 PROJECT BACKGROUND

In October 2013, the **Town of Outlook** (Outlook) contacted **Associated Engineering** (AE) to perform a visual inspection of the **Outlook TransCanada Trail Pedestrian Bridge** (the bridge) over the South Saskatchewan River. The purpose of the inspection was to review the existing bridge elements and comment on their condition as well as provide recommendations on the safety of the bridge for further use.

Representatives from AE were **Nik Cuperlovic, P.Eng. (Specialist – Special Structures)** and **Stephen Chiasson, B.Sc.E., EIT** (Structural Engineer-In-Training), who performed a site inspection of the structure, which comprised a walkover review of the site from the superstructure and on the ground. The condition of the bridge and the findings of the inspection are described in our letter report titled: *Town of Outlook – TransCanada Trail Pedestrian Bridge – Visual Inspection,* dated November 6, 2013 (included in Appendix B). Our inspection concluded that several key components of the bridge structure were substantially damaged as a result of ongoing ground movement at the bridge approaches, particularly on the Outlook end (east side). Based on our inspection findings we concluded that the bridge in its present condition was not safe and should be closed immediately. Outlook has subsequently closed the bridge to the public.

Subsequent to the visual inspection, Outlook requested that AE perform a conceptual repair design to determine necessary bridge repairs required for future safe use of this historic structure. Nik Cuperlovic, P.Eng. (Specialist – Special Structures) and **David Ellis, EIT** (Structural Engineer-In-Training), from AE, performed a structural assessment of the structure and developed this preliminary repair design report, which involved the following tasks:

- A desktop review of the available bridge record drawings.
- A structural assessment of the bridge as a system.
- Developing a bridge conceptual repair design to address ongoing slope movements.
- Assembling a Class D cost estimate for the bridge repair work.
- Providing a cost estimate for the engineering services associated with the recommended repairs.
- Investigation of possible emergency repairs to restore safe bridge operation.
- Preparation of a preliminary design report.

This report presents our recommended remediation along with a Class D cost estimate (see Appendix C). We are providing a recommended budget cost for the emergency repair work, which will improve the condition of the bridge to allow safe use by pedestrians, as well as the cost for more comprehensive repair work that would extend the service life of the bridge.

2 Structure Description

The 3,002 ft (915 m) bridge spans over South Saskatchewan River near the Town of Outlook. This pedestrian bridge is a landmark structure very popular with the citizens and guests of Outlook.

The bridge consists of seven jump spans on the east (Town end) side of the bridge spanning a total of approx. 730 ft (222.5 m), four approach spans on the north side of the bridge spanning approximately 335 ft (102.2 m), and the main bridge spans consisting of eight 241'-8" (73.66 m) trusses for a total span of approximately 1936'-10" (590.3 m). The main bridge spans consist of eight 241'-8" (73.66 m) trusses, supported at either by concrete piers, approximately 156 ft (47.6 m) tall. The approach spans consist of twin steel built up I girders fixed at each support bent. The support bents consist of steel framing supported on individual concrete piers. The bearings at the base of each individual support bent are spherical bearings. The abutments at either end are massive concrete structures with concrete ballast walls.

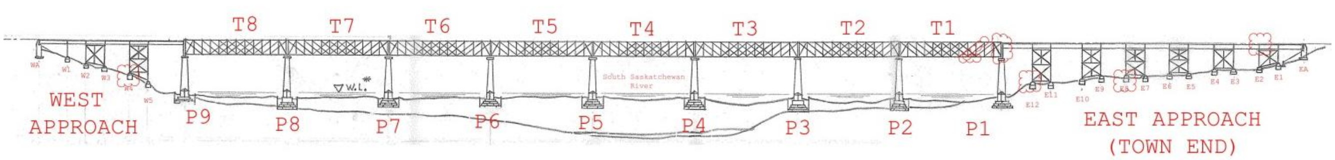


Figure 2-1
Outlook Bridge - Designations

The bridge was constructed by CP Rail (CPR) as a railway bridge. The bridge construction took place 1910 – 1912. The bridge spans were constructed from re-machined steel previously used in the Lachine Bridge in Quebec. The bridge officially opened in 1912. CPR operated, inspected and maintained the bridge until 1987, when CPR decided to cancel railway service over the bridge and re-direct the trains elsewhere. The bridge was not used until the late 1990's when CPR formally transferred the bridge ownership to the Town of Outlook. The bridge was then converted to a pedestrian bridge, using volunteer labour to construct the walkways and pedestrian railings. The structure subsequently became a part of the TransCanada Trail in 2003. No regular inspection and maintenance for the bridge was provided since 1987.

3 Background Information

The following information was available to us in preparation of this report:

- The condition of the bridge and the findings of the inspection are described in the Town of Outlook – TransCanada Trail Pedestrian Bridge – Visual Inspection letter dated November 6, 2013 by Associated Engineering (see Appendix B).
- End Stringer Shop Drawing, Dominion Bridge Co. Limited, marked 49530.
- Data for Normal Strains – Specification of Loading for 240 ft Deck Truss Spans, CP Rail, sketch X-10-118.
- St Lawrence River Bridge - Strain Sheet, Dominion Bridge Co. Limited, marked 51830.
- Assorted Drawings, CP Rail, drawing B.I.-570, B.I.-618, circa 1910.
- Stiffener Angles and Base Plates Drawing, The Canadian Bridge Co. Ltd., drawing 938-1, circa 1910.
- Assorted Bridge Drawings, The Canadian Bridge Co. Ltd., drawing 939, 939-A, 939-3 through 939-25, 939-27, 939-29, and 939-31 through 939-36, circa 1910.
- Location of Pier Members – Piers 7-15 Inc., CP Rail, circa 1911.
- Assorted Erection Drawings, The Canadian Bridge Co. Ltd., drawing 940-0 through 940-15, circa 1911.
- New Material Required for 240 ft Spans Sketch, CP Rail, drawing B.I.-1053, circa 1912.
- Jacking Girder for 240 ft Spans Sketch, CP Rail, drawing B.I.-2126, circa 1934.
- Rating Sheet for 240 ft Deck Truss Span, CP Rail, drawing B-2-657, circa 1934.
- Inspection Sketches, CP Rail, drawing B.I.-220 through B.I.-224, circa 1946.
- Detail for Reinforcing Piers 13 and 15, CP Rail, sketch B-2-847, circa 1946.
- Inspection Sketches, CP Rail, drawing B.I.-558 and B.I.-559, circa 1952.
- Temporary Repairs to Pedestals of Bent 5, CP Rail, drawing B.I.-2816-0 through B.I-2816-2, circa 1964.
- Inspection Sketch, CP Rail, drawing 1751, circa 1979.
- Proposed Rehabilitation General Arrangement, CP Rail, sketch M-528, circa 1984.
- Proposed New Crossing General Arrangement, CP Rail, drawing marked 65516, circa 1984.

4 Visual Inspection Conclusions

The deficiencies observed during our inspection are largely the result of ongoing ground movement at both the east and west riverbanks, notably the east (Town end) riverbank. Our inspection has revealed several structurally significant deficiencies on the bridge, including:

- Buckling and excessive deformation of bottom chord members and diagonals in truss T1, 3rd bay from the east end of the truss (see Figures 4-1 and 4-2; for designations see Figure 2-1).
- Buckling and significant deformation of bottom chord members in the 10th bay of trusses T1, T2 and T3.
- Approach girders colliding with and damaging the main span truss, bearing, and diaphragm at pier P1.
- Bearing anchors broken and excessive bearing movement at P1, and possibly more piers.
- Broken bearing anchors and loss of contact at concrete footings in East and West approach spans, at Bents W4, E1, E8, and E12.
- Loss of expansion at both abutments and piers P1, P2, P3, P4 (in part) and P9.
- Deformation (hump) in the top chord in span T1
- East approach superstructure sagging at the first bent.
- Damaged concrete pedestals in several approach span bents.

Figure 4-1
Buckling of Bottom Chord (T1 – Bay 3)

Figure 4-2
Buckling of Bottom Chord (T1 – Bay 3)

Based on the inspection findings described above, we concluded that the structure is not stable in the present condition. The bridge in the present condition cannot safely support the current loads being placed on it. Due to the structural deficiencies noted in our inspection report (see Appendix B), the way the bridge structure transfers the weight of the walking platform, pedestrian users, and its own self weight down to the bridge foundations is substantially different now than intended in the original design and cannot be readily relied upon.

High winds and winter snowfall may also be detrimental to the bridge in its current state and will make the structure more vulnerable. As the bridge cannot be relied upon to safely support the pedestrian load, we recommended the bridge be closed for pedestrian traffic.

5 Emergency and Comprehensive Repairs

In this report, we have identified several deficiencies that need to be repaired to allow the bridge to be safe for public use and to prevent against future damage. We have divided the repair work in the two categories:

1. **Emergency Repairs:** Repairs required to make the bridge safe for public use. Emergency repairs are not intended to repair all deficiencies in the bridge. Regular inspections will be required to monitor its performance until the comprehensive repairs are complete.
2. **Comprehensive Repairs:** Repairs required following emergency repairs, to make the bridge safe and allow reliable performance of the bridge in the years to come. Repairs of damage and deterioration of the bridge that is not currently compromising the stability of the structure, but may result in significant problems in the future.

The repair work identified in this report is based on our visual inspection findings. A detailed inspection, including materials testing to determine the extent of required truss element repairs, should be conducted immediately following installation of truss stabilization works during the construction phase (see Sections 7.1.2 and 7.1.3). A more detailed inspection may reveal serious defects we are currently unaware of, and additional repair work may therefore be required.

Present deficiencies in the bridge are primarily caused by ongoing ground movement at the bridge abutment. There is evidence that the ground movement accrued gradually throughout the life of the bridge; therefore, ground movement can be expected to continue in the future. As the cost of restraining the ground will be excessive, the detailed bridge repair design shall include provisions to accommodate future ground movement.

5.1 EMERGENCY REPAIRS

Based on the bridge inspection findings and subsequent bridge analysis (see Section 6 of this report), we have identified bridge components that need to be repaired to allow safe public use of the bridge:

- Repair or replace buckled bottom chords and diagonal members in span T1, 3rd bay from the east end of the truss (see Figures 4-1 and 4-2; for designations see Figure 2-1).
- Approach girders colliding with and damaging the main span truss, bearing, and diaphragm at Pier P1.
- Bearing anchors broken and excessive bearing movement at P1.
- Broken bearing anchors and loss of contact at concrete footings in East approach spans, at Bents E1, E8, and E12.
- Loss of expansion capacity at East abutment and Pier P1.
- Deformation (hump) in the top chord in span T1
- East approach superstructure sagging at the first bent.
- Damaged concrete pedestals approach span bents.

Locations requiring immediate attention to allow the safe use of the bridge and improve the stability of the bridge are designated on Figure 2-1, as well as in Appendix A of the report.

Following the emergency repairs, the bridge will be opened for public. Regular engineering inspections (once every six months) will be required to monitor its performance until comprehensive repairs have been completed.

5.2 COMPREHENSIVE REPAIRS

As the emergency repairs will not address all deficiencies on the bridge, we recommend that the comprehensive repairs be conducted. The comprehensive repairs will address risks of due to further deterioration of the structure and accommodate future ground movement. The scope of the comprehensive repairs will include the items noted in the inspection, but not included in the emergency repairs, including:

- Broken bearing anchors and loss of contact at concrete footings in West approach spans, specifically at Bent W4.
- Buckling and significant deformation of bottom chord members in the 10th bay of trusses T1, T2 and T3.
- Bearing anchors broken and excessive bearing at piers other than P1.
- Loss of expansion capacity at West abutment and pier P9, and at piers P2, P3, P4.
- Damaged concrete pedestals in several approach span bents.

During our site inspection, we also noted that the paint on the steel structure is deteriorated and flaking off throughout the bridge. Since we did not notice significant corrosion loss on the structure, and the cost of re-painting the bridge would be excessive (in the order of several millions of dollars), we do not recommend re-painting the bridge at this time. Furthermore, we do not anticipate that the bridge will require re-coating in the next ten to fifteen years; however, we recommend that the level of corrosion is monitored during future inspections.

After comprehensive repairs are complete, we anticipate that the bridge will need to be inspected annually to monitor its performance and identify any remedial measures to provide for continued safe use. If the bridge is found to be in good condition with minimal movement, the frequency of inspection can be reduced to once every two years.

6 Bridge Analysis

We performed structural finite element modeling of the bridge in order to better understand behaviour of the bridge in the present condition, understand possible causes of the noted deficiencies and determine approximate demands for the repair and strengthening elements. Based on the information provided on the drawings, we developed a computer model of a representative truss span in its original configuration using MIDAS Civil 3D Version 3.1 (Figure 6-1) in order to create a baseline for comparison.

Figure 6-1
Original Truss Configuration (Pin – Roller)

In addition to analyzing a representative truss span, we analyzed the east approach steel girder spans as a system in order to reasonable estimate the force exerted on Truss T1 by the approach girders resulting from the ongoing slope movements. By removing the vertical support of the down slope piers at each bent at the east approach (E2, E4, E6, E8, E10 and E12), we determined the maximum force that could be exerted on truss T1.

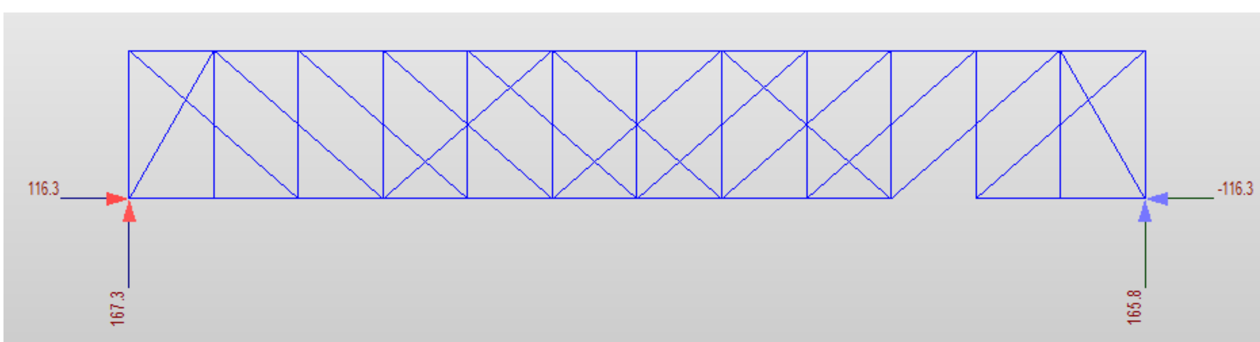


Figure 6-2
Current Truss Configuration (Pin – Pin with Buckled 3rd Bay)

In addition to the force exerted on the T1 truss end diaphragms by the approach girders, Pier P1 has moved towards the west by approximately 21” and as a result, the roller support at the east side of T1 has reached the maximum amount of travel and is bearing against the fixed approach span support leg. In order to reasonably estimate the force exerted on this fixed support (and the required jacking force to re-establish a gap between the bottom chord bearing and the approach support leg), we modeled the truss supports with pinned-pinned boundary conditions and removed the buckled 3rd bay, as shown in Figure 6-2.

The truss support conditions shown in Figure 6-2 vary significantly from the original design. Further analysis is essential at the detailed design phase to confirm that the proposed methodology for stabilizing the truss can be done safely and minimizes the risk of sudden release of energy.

The results on this analysis were used to determine the required capacity of temporary works in order to jack the approach spans to restore the proper configuration and load distribution and to re-establish clearance between the bridge spans. Section 7 describes our recommended bridge rehabilitation strategy.

7 Preliminary Bridge Repair Design

7.1 EMERGENCY REPAIRS

The Outlook TransCanada Trail Pedestrian Bridge has several significant structural issues that require targeted repair solutions. Careful consideration was given to the sequencing of our proposed intervention in order to safely release the significant forces that are currently present in the system and restore the initial structural configuration.

The structural issues identified during our visual inspection of the bridge are generally a result of ongoing approach slope settlement and movement. In addition to resolving the issues currently present, our bridge repair design was aimed at providing a cost effective means of safely addressing future settlement.

Our recommended conceptual repair sequence is summarized below; Sections 7.1.1 through 7.1.5 discuss the repair steps in greater detail and Figures 7-1 to 7-5 show schematics of the recommended repairs. Section 7.3 provides our Class D cost estimate for the prescribed intervention.

In general, our recommended conceptual repair sequence includes:

- Preliminary site visit to gather additional information.
- Detailed design, preparation of specifications and tender documents.
- Tender process, design firm to provide tender support.
- Construct deadman behind East Abutment, install jacking brackets on approach girders and stress to activate the approach spans (see Figure 7-1).
- Install post-tensioning strands along T1 bottom chord to provide a redundant load path (see Figure 7-2).
- Have a licensed Professional Engineer conduct a detailed inspection of the bridge, including materials testing, to determine additional required repair needs.
- Pull approach span back towards abutment using post-tensioning bars, relieving pressure on main span truss and straightening approach span bents (see Figure 7-3).
- Cast a grout bearing plinth at the downslope piers at the approach bents to restore bearing (see Figure 7-4).
- Release the post-tensioning bars at the east abutment.
- Remove and replace the decking, stringers and end diaphragm / floor beam in Truss T1 above Pier P1.
- Extend approach girders above Pier 1 to rest on revised end diaphragm (see Figure 7-5).
- Reinforce truss in Span 2 (pending detailed inspection findings)
- Release the post-tensioning strands at the bottom chord of Truss 1
- Reinstate East Abutment, remove ties and deadman and construct new precast concrete block backwall.

7.1.1 East Abutment Modifications

The settlement and slope movement at the east approach has resulted in the east abutment contacting the approach span girders. While this was resolved in the past by chipping out the east abutment back wall to prevent the approach girders bearing against the back wall (see Figure 7-1), there is very little remaining movement. We propose to demolish the existing abutment backwall and reinstate a new backwall constructed of precast concrete blocks after the jacking operation and remainder of the repairs are complete.

In order to jack the approach spans towards the east abutment, a deadman footing should be constructed approximately 60 ft (18.29 m) east of the east abutment. Using Dywidag threadbars and fabricated steel brackets either side of each girder, the threadbars would be post-tensioned to 10% of ultimate capacity to engage the approach spans. Prior to post-tensioning the threadbars, we recommend that the approach span ties be installed to provide continuity over the approach bents and allow the jacking force to be distributed evenly between the approach bents (see Section 7.1.4).

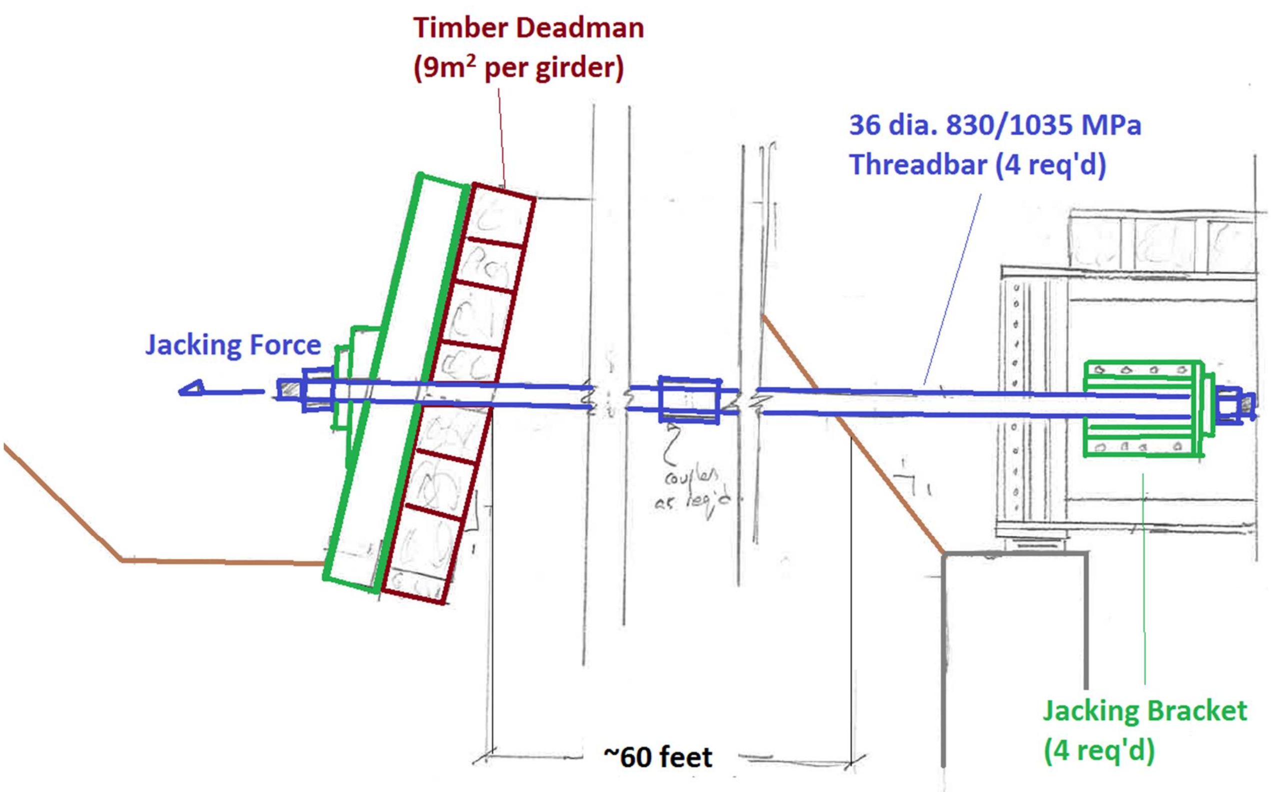


Figure 7-1
Abutment Deadman and Jacking Configuration

7.1.2 Truss Span Stabilization

Due to substructure movement, the east approach girders are currently colliding with the T1 truss end floor-beam. Prior to fully post-tensioning the approach girders and releasing this pressure, we recommend that the bottom chord is reinforced with sufficient post-tensioning strands to provide a redundant load path.

We recommend that the post-tension strands be installed in line with the bottom chord and end pins in order to minimize any induced moments in the end vertical member. In order for the brackets to be installed in line with the bottom chord, some modifications must be made to the existing roller bearings at Pier 1 (see Figure 7-2).

Once the T1 truss span has been stabilized, the structure will be safe to allow temporary access for a detailed inspection which will identify the extent of any additional repairs.

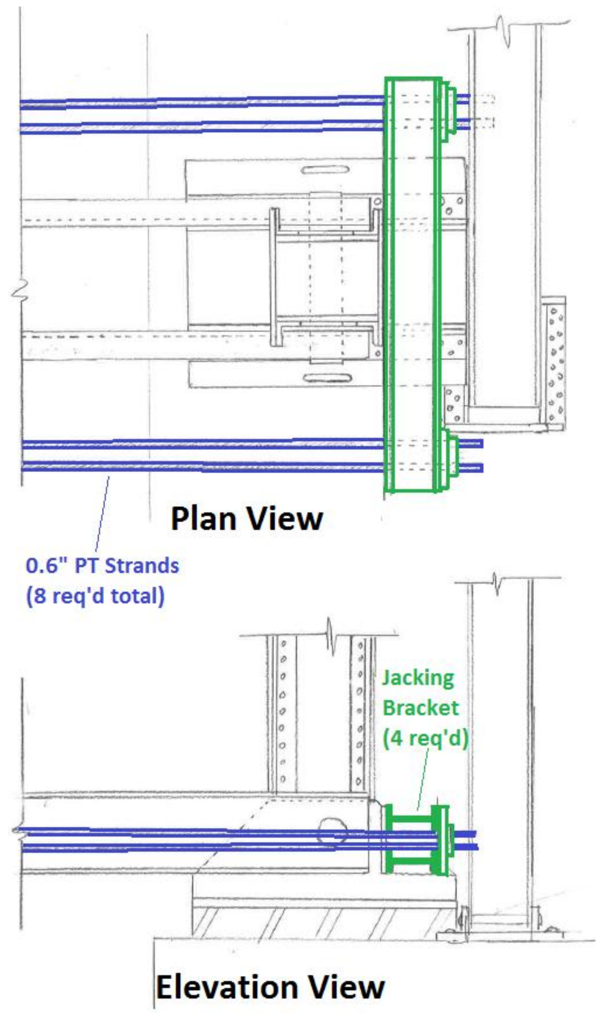


Figure 7-2
Truss Jacking Brackets

7.1.3 Detailed Inspection

Once the structure has been stabilized, we recommend that a detailed inspection of the bridge, including materials testing, is conducted by a licensed Professional Engineer to confirm specific repair needs. In particular, we recommend that the inspection include the following items:

- Inspect approach span bents.
- Inspect abutment and abutment bearings.
- Inspect bearings at all the piers.
- Inspect truss in span T1, conduct non-destructive testing for bucked bottom chord and diagonal members (three locations) and select other locations.
- Inspect and test buckled bottom chord members and bearings in the remaining spans.
- Prepare a report detailing immediate repair needs.

7.1.4 East Approach Span Jacking

Prior to jacking the east approach spans at the east abutment, the individual spans need to be tied together to maintain the existing gaps between each span and spread the force evenly through the steel approach bearings at the bent piers (see Figure 7-3). It may be necessary to provide a more robust connection between the approach girders and the approach bents, and we recommend this is addressed during the detailed design phase.

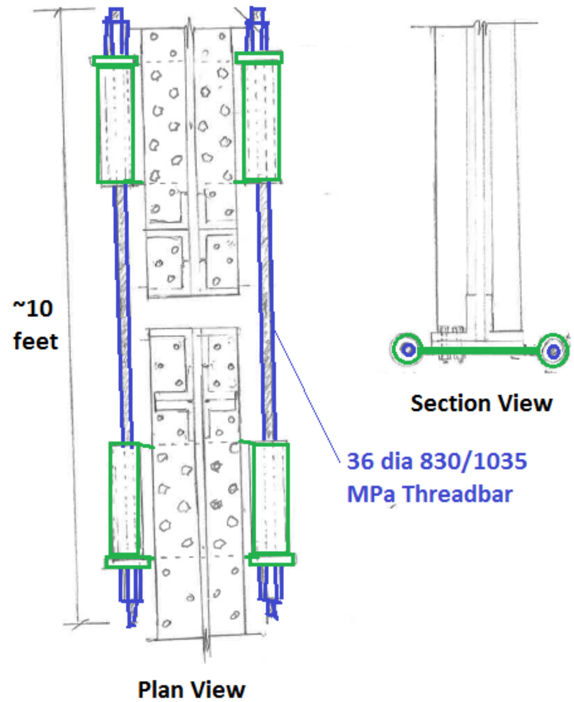


Figure 7-3
Approach Girder Ties

Using the span and bent weights provided on the bridge record drawings, we determined the anticipated required jacking force at the abutment. Jacking should continue until there is a visible gap between the approach span girders and the T1 truss end diaphragm.

7.1.5 Anticipated Repairs Required

There is significant settlement of the downslope piers at the bents at the east approach (see Figures 7-4). After jacking the east approach spans towards the approach, bearing should be reinstated at the bent piers by installing steel shims. Large gaps or damaged bent piers should be repaired by a concrete overlay. This will restore support to both bent legs.

Once the bearings are shimmed tight against the approach bent legs, the jacks at the east approach can be released. The force in the post-tensioning bars should be slowly reduced and the condition of the structure monitored continuously during the operation.

Figure 7-4
Settlement of Downslope Piers (E8 Shown)

Additionally, the settlement has resulted in the approach girders bearing against the truss span stringer end diaphragm of truss T1, damaging the end diaphragm and stringers. Once support at the downslope piers is reinstated, it will remove the large force currently being exerted on the truss end diaphragms.

The damaged stringers and end diaphragm in Bay 1 of truss T1 should be replaced to restore the original capacity. Additionally, we recommend that the approach span support bent above Pier P1 be removed and the approach span extended to rest on a steel diaphragm beam spanning between the end vertical members of the T1 truss (see Figure 7-5). A new bearing allowing horizontal movement should be installed at this time to allow for any future movement of the approach span towards the river.

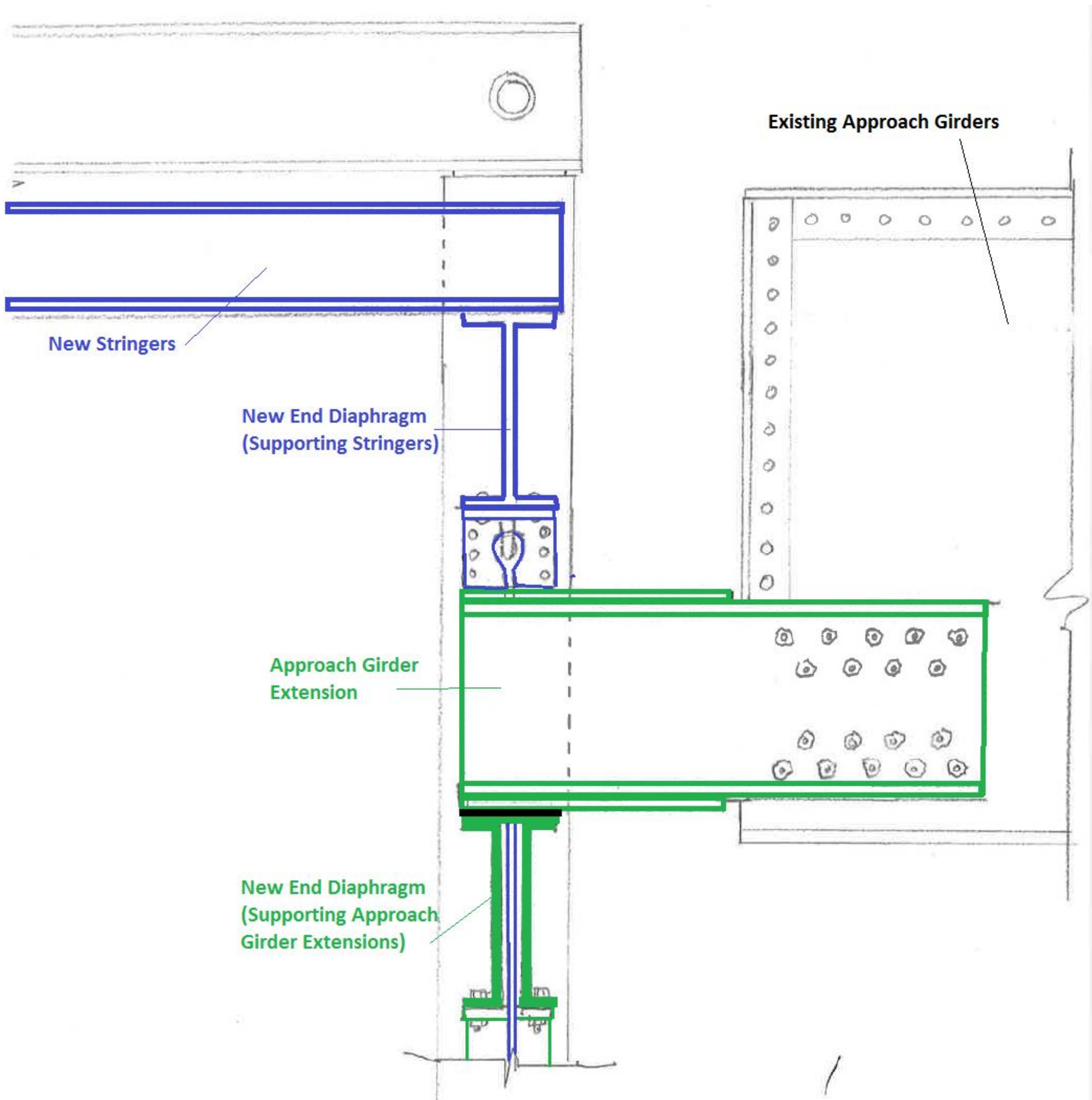


Figure 7-5
Extension of Approach Girders and New Support Diaphragm at Pier 1

Due to the movement of Pier P1, the truss roller bearing above Pier P1 has closed the 21” gap between the bearings at the time of construction and has contacted the fixed bearing supporting the approach support leg. This removal of the capability of additional movement has resulted in the compression and buckling of the bottom chord. Once the support of the approach spans has been transferred to the truss end verticals, the truss roller bearings should be removed and replaced with a suitable replacement bearing. This operation will involve the installation of a jacking frame and will require that the truss span is sufficiently lifted to allow the replacement of the bearings. This operation will likely be performed prior to releasing the temporary post-tensioning along the bottom chord.

Our detailed inspection will determine in detail the repair needs for the T1 truss; however, we anticipate that the buckled 3rd bay will need to be replaced at a minimum. The damaged bay can be replaced with a permanent replacement consisting of post-tensioning strands prior to releasing the temporary post-tensioning installed in line with the bottom chord.

7.2 COMPREHENSIVE REPAIRS

The repairs described in Sections 7.1 are the minimum requirements needed to reinstate structural stability and reliable load paths for the bridge structure. In addition to these required repairs, we anticipate that the following possible additional work may be required:

1. Retrofit of West Abutment with pulling the West approach span (similar to procedure outlined above for the East Approach).
2. Replacement of bearings at P2, P3, P4, P8, P9.
3. Reinforcing of the 10th bay of the bottom chord in Truss span 1, 2 and 3.
4. Jacking the east approach span up at E2 to straighten vertical alignment of the span.

A detailed inspection as described in Section 7.1.3 would provide a more refined list of recommended repair options. It is recommended that consideration be given to performing these additional repairs and modifications during the same time period as the minimum required repairs.

7.3 CLASS D COST ESTIMATE

A Class D cost estimate provided in this report is defined by the Canadian Institute of Quantity Surveyors as: *“Based on a full description of the preferred option, construction / design experience, and market conditions, this estimate should be sufficient for making a reasonable investment decision, and obtaining preliminary project approval.”*

In the preparation of this cost estimate we have assumed that the detailed inspection will not uncover significant defects in the structure. Additionally, consistent with a Class D cost estimate, we have assumed a contingency of 35%. Our cost estimate to complete the intervention detailed in Sections 7.1 is $3,550,000, including contingency, detailed design and full time construction monitoring.

While we have not performed a detailed estimate of the other recommended repairs described in Section 7.2, we estimate that the emergency repairs and the comprehensive repairs can be performed for approximately $5,500,000. This amount includes an allowance for the additional design, which would be required.

Table 7-1 summarizes our cost estimate for the emergency repairs. A more detailed breakdown of our cost estimate for the emergency repairs can be found in Appendix C.

Table 7-1
Emergency Repairs – Class D Cost Estimate Summary

Work Item	Cost Estimate
Mobilization and Demobilization	$210,000
Abutment Post-Tensioning	$126,600
Abutment Modifications	$91,250
Approach Span Modifications	$501,000
Truss Post-Tensioning	$250,200
Truss Modifications	$534,880
Overhead, Risk, Profit and Mark- up	$510,400
Estimated Construction Cost	**$2,230,000**
Class D Estimate Contingency (35%)	$781,000
Detailed Design, preparation of Tender Documents	$310,000
Detailed Inspection (Materials Testing)	$20,000
Temporary Works Design	$50,000
Construction Monitoring (Assumed 135 Days)	$150,000
Total Estimated Project Cost (Excluding Taxes)	**$3,550,000**

7.4 PROJECT TIMELINE RECOMMENDATIONS

Once funding has been secured to repair the bridge, Outlook will be able to retain a design firm to complete the detailed design. We anticipate that this task will include a preliminary site visit, completion of a detailed design drawing package, preparation of specifications and tender documents, and providing technical support to Outlook during the tender process. Additionally, we have allowed for a detailed inspection, including materials testing, to determine the extent of required truss element repairs following installation of truss stabilization works during the construction phase (see Sections 7.1.2 and 7.1.3).

If Outlook can secure sufficient funding to complete both the emergency and comprehensive repairs outlined in Section 7, we recommend that the project be tendered as a single project. If the level of available funding is sufficient to perform the emergency repairs only, we recommend that the repairs are tendered as two separate projects; the emergency repairs as soon as possible and the comprehensive repairs at a later date when additional funding can be secured. We anticipate the emergency repairs can be completed in eight to eleven months, including design, tendering and construction.

We anticipate the project can be completed in eight to eleven months, and that the durations shown below represent a reasonable project schedule:

Detailed Design, including preparation of Tender Documents	4 Months
Tendering Period	1 Month
Construction, including Detailed Inspection (Materials Testing)	6 Months

The above project timeline is based on the assumption that the Outlook will decide to retain a design firm to design the bridge repair design and issue a tender to select a contractor to repair the bridge.

8 Bridge Operation (Moving Forward)

Based on the findings of our 2013 visual assessment, and the bridge analysis performed as part of this pre-design report, we recommend that the structure not be re-opened to public use without emergency repairs as described above being performed.

As described in Section 7.1 above, our emergency repair design sequence discusses tasks that are the minimum requirements in order to reinstate structural stability and provide reliable load paths. In order for the structure to be used safely by the public this emergency repair procedure (or similar) needs to be performed as a minimum, and we recommend that the further comprehensive repairs described in Section 7.2 be implemented. The emergency repairs are not intended to repair all deficiencies in the bridge and regular inspections will be required to provide continued safety of the bridge until comprehensive repairs are completed.

If the level of available funding is sufficient to perform the emergency repairs only, we anticipate the east approach spans and the T1 truss span can be opened as a minimum. The results of the detailed inspection, including materials testing, will confirm whether the remaining truss spans are safe to be opened for pedestrian use. Given the on-going movement of the structure, if the comprehensive repairs are not performed, the deterioration will progress with time to a level which necessitates the closure of the bridge.

Following the completion of comprehensive repairs, budgeting will be required for annual inspections, repair and maintenance for continued safety of the bridge. This should be considered by Outlook when evaluating how to move forward. Associated Engineering would be happy to discuss this further with Outlook if requested.

Closure

This report was prepared for the **Town of Outlook** to present our **Preliminary Design for the Rehabilitation of the Outlook TransCanada Trail Pedestrian Bridge** over the South Saskatchewan River.

The services provided by **Associated Engineering (Sask.) Ltd.** in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering (Sask.) Ltd..

Prepared by:

David Ellis, EIT
Project Engineer

Reviewed by:

Nik Cuperlovic, P.Eng.
Specialist – Structures

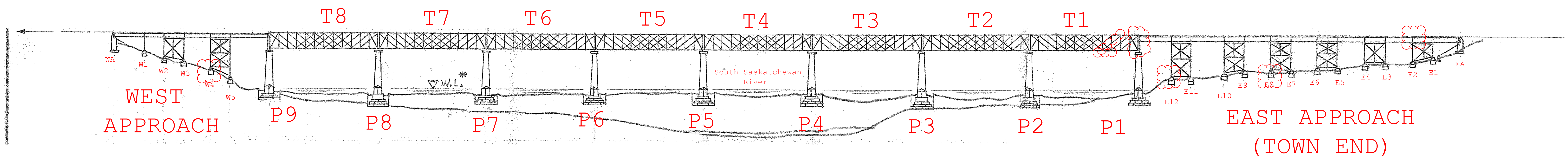
Submitted by:

Stephen Chiasson, B.Sc.E., EIT
Project Manager

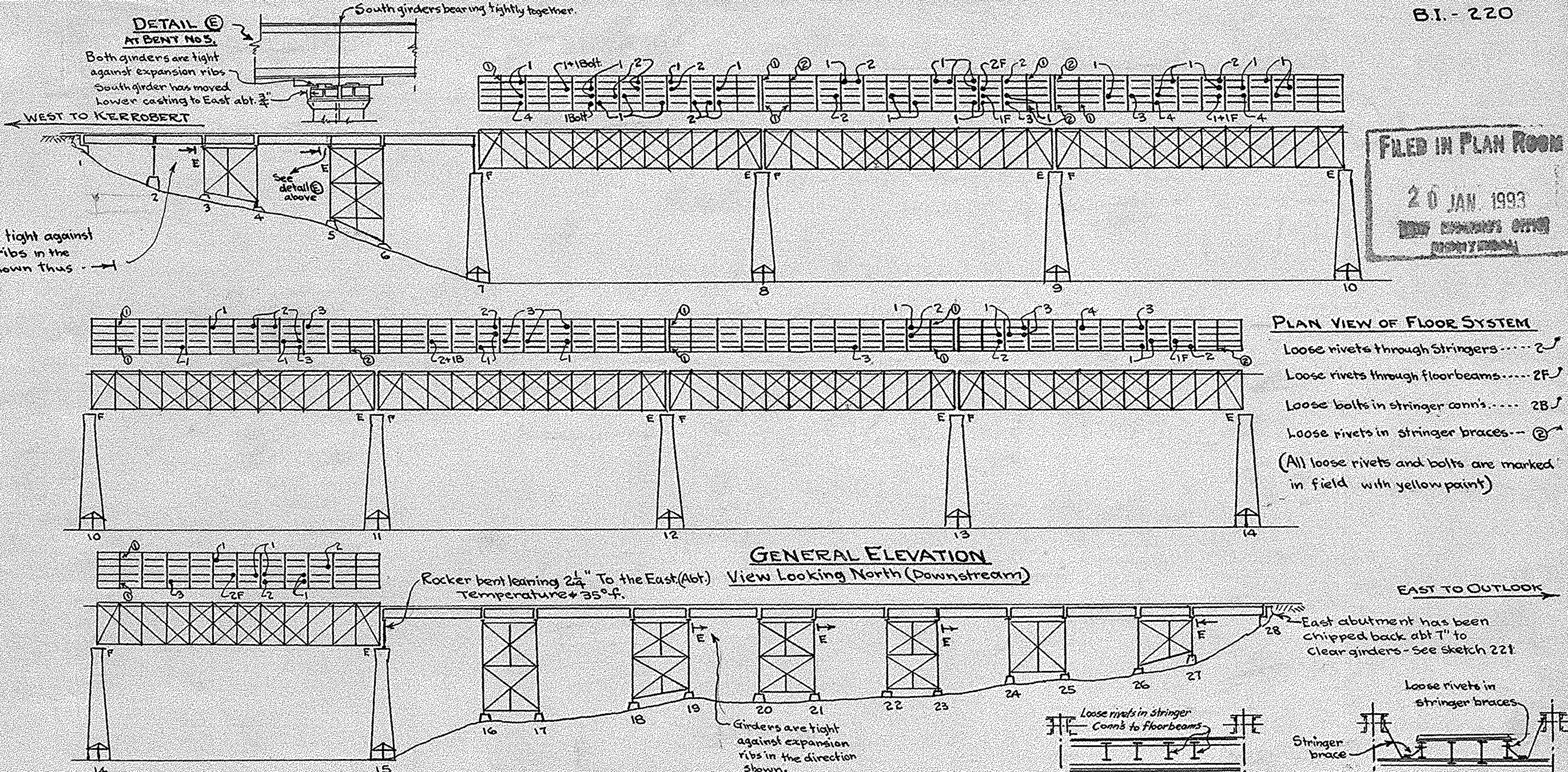
DE/NC/SC/skn

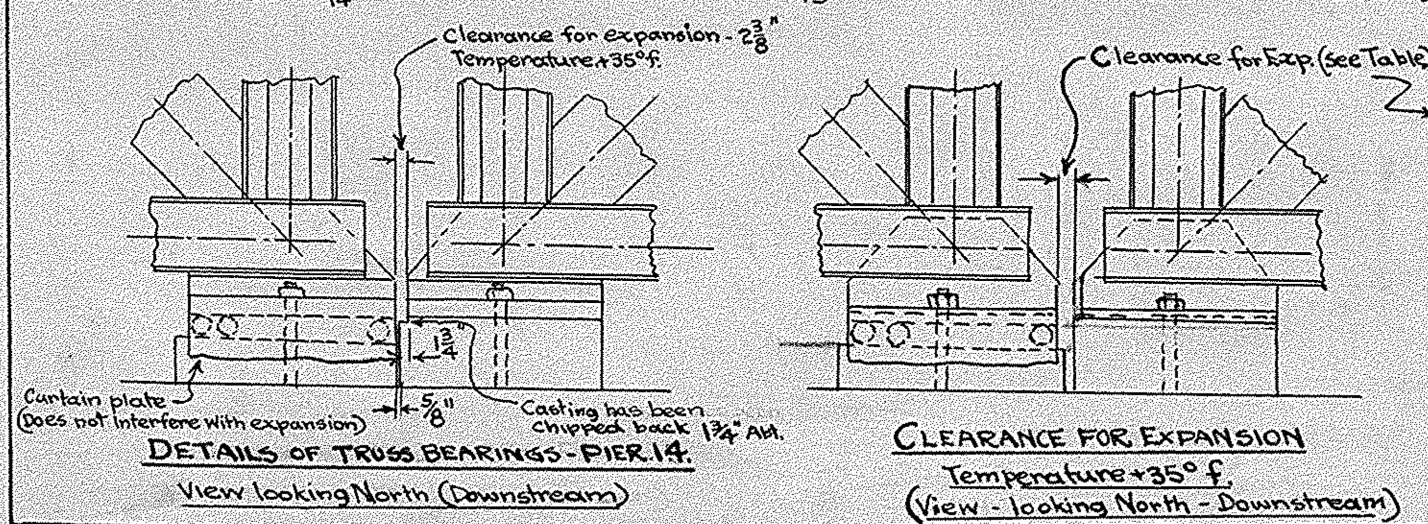
Appendix A - General Arrangement Drawing

Truss bays labelled from east end of each truss span

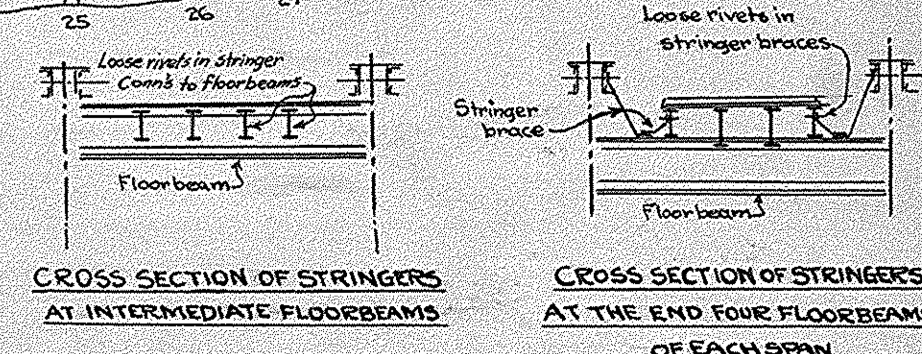


Town of Outlook TransCanada Trail Bridge
General Arrangemnt





Pier No.	Clearance	
	North Truss	South Truss
7	No Exp.	No Exp.
8	1 1/2	2 1/4
9	3"	3"
10	1 3/4	2 1/2
11	3 5/8	3 5/8
12	2	1 7/8
13	2 3/8	2 3/8
14	2 3/8	2 3/8



BRIDGE 0.84 KERROBERT SUBDIVISION

INSPECTED SEPT 25 - OCT 10, 1946

To accompany report dated Oct. 15, 1946

T.J.B.

Appendix B - 2013 Inspection Report Letter

Associated Engineering
GLOBAL PERSPECTIVE.
LOCAL FOCUS.

Associated Engineering (Sask.) Ltd.
1 - 2225 Northridge Drive
Saskatoon, SK, Canada, S7L 6X6

TEL: 306.653.4969
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November 6, 2013
File: 2013-4388.00.A.01.00

Jill Rafoss
Recreation Director
Town of Outlook
Box 158
400 Saskatchewan Avenue West
Outlook, SK S0L 2N0

Re: TOWN OF OUTLOOK
TRANSCANADA TRAIL PEDESTRIAN BRIDGE
VISUAL INSPECTION

Dear Jill:

Further to your request for structural engineering services, on October 31, 2013 two representatives of Associated Engineering performed a visual review of the Outlook TransCanada Trail Pedestrian Bridge. We have determined that several key components of the bridge structure are substantially damaged as a result of ground movement at the bridge abutment, particularly on the Outlook end (east side). In our opinion, the bridge in its present condition is potentially unstable. **The bridge is not safe and should be closed immediately.**

The following report documents our findings for the visual inspection of the Town of Outlook TransCanada Trail Pedestrian Bridge located in Outlook, Saskatchewan.

1 INTRODUCTION

1.1 OBJECTIVE

In October 2013, the Town of Outlook contacted Associated Engineering to perform a visual inspection of the Outlook TransCanada Trail Pedestrian Bridge over the South Saskatchewan River. The purpose of the inspection was to review the existing bridge elements and comment on their condition as well as provide recommendations on the safety of the bridge for further use.

1.2 BACKGROUND

The Bridge was originally constructed and owned by CP Rail (CPR). Construction of the substructure began in 1910 and was nearly completed by the end of 1911. The bridge spans were constructed from re-machined steel from the Lachine Bridge in Quebec. The bridge officially opened in 1912 and the last official train crossed the bridge in 1987. The bridge sat dormant until the late 1990's when CPR formally sold it to the Town of Outlook. The bridge was then converted to a pedestrian bridge, and a part of the

TransCanada Trail in 2003 using volunteer labor to construct the walkways and pedestrian railings. A General Arrangement Drawing from CP Rail for a Proposed Rehabilitation, dated May 11, 1982 was available for review prior to the inspection.

The bridge consists of seven jump spans on the east side of the bridge spanning a total of approx. 730 ft (222.5 m) and four approach spans on the north side of the bridge spanning approximately 335 ft (102.2 m). The approach spans consist of twin steel I girders fixed at each support bent. The support bents consist of steel framing supported on individual concrete pilasters. The bearings at the base of each individual support bent are spherical bearings. The abutments at either end of the bridge consist of concrete ballast walls.

The main bridge spans consist of 8 – 241'-8" (73.66 m) trusses for a total span of approx. 1936'-10" (590.3 m). The trusses are supported at either end by concrete piers, approx. 156 ft (47.6 m) tall. The trusses are fixed at each end with a nominal gap of approx. 6" (150 mm) between spans.

2 VISUAL INSPECTION

Associated Engineering representatives Nik Cuperlovic, P.Eng (Specialist – Special Structures) and Stephen Chiasson, B.Sc (Structural Engineer-In-Training) conducted an inspection of the bridge on October 31, 2013 from 9:30 am – 4:30 pm. The inspection involved a walkover of the bridge from the pedestrian walking platform, as well as investigation from below on both the east and west riverbank slopes. A close proximity inspection and detailed survey of the bridge were not included in the scope of this inspection. The inspection involved a visual review of both bridge abutments, the five north jump span steel support bents and bearings, the 12 east jump span support bents and bearings, as well as a visual review of the main trusses and jump span girders. Photos, site notes, and approximate measurements were recorded during the inspection.

Observations from the visual inspection are discussed by element below. Photos have been included in the text for clarity, and a complete set of annotated photos are attached. For clarity the abutment and approach span support bents, as well as the main truss spans and piers have been labeled. The naming convention can be found on the attached General Arrangement Drawing.

2.1 MOVEMENT OF THE RIVERBANK

From our inspection we observed several signs that show movement of the riverbanks towards the river. These signs included breaks in the concrete grade beam surrounding the east approach, recent re-leveling of the east approach, gaps between bearings, the addition of shim plates at the bearings below many of the east support bents, as well as relative vertical movement between east approach spans. The gaps between bearing plates, shim plates thicknesses, relative moment of the footing towards the river, and the vertical displacement between east approach spans for each support bent were recorded and are discussed further in Section 2.2 and 2.3.

From discussion with two Town Council members during the inspection, we understand there have been several breaks in a waterline located on the riverbank slope. Town Councilors also mentioned that there have been documented issues at the Town pool (located at the base of the east riverbank slope) due to ground movement.

2.2 WEST ABUTMENT / JUMP SPANS

From our review, we noted that the anchor bolts at the abutment bearings were bent back from movement of the approach spans (**Photo 1**). Approx. 1" (25 mm) of movement was recorded.

Photo 1 - Bent Anchor Bolts at West Abutment

We also noted that concrete from behind the end plate of each approach span girder had been chipped away over time to make room between the girders and the abutment ballast wall (**Photo 2**).

Photo 2 - Chipped Concrete Ballast Wall at West Abutment

Approach Span bearings at supports W1, W2, W3, & W5 had no shim plates or gaps between the bearing plates. However, both bearings at support W4 showed signs that the support bents are no longer bearing on the concrete footing, including gaps between the spherical bearing plates, as well as shim plates at the north bearing. The north bearing had 3-1/2"(90 mm) of shim plates below the spherical bearing sole plate as well as an approx. 1-1/4" (30 mm) gap between bearing plates (**Photo 3**).

Photo 3 - North Bearing at Steel Bent W4

The south bearing had a small gap between the bearing plates (shown by sliding a piece of paper between plates (**Photo 4**).

Photo 4 - Gap between Plates at W4 South Bearing

2.3 EAST ABUTMENT / JUMP SPANS

Similar to the west approach spans, similar items were recorded on the east side of the bridge. The abutment ballast wall had approx. 12" (300 mm) of concrete chipped away to make room between the girders and the concrete ballast wall (**Photo 5**).

Photo 5 - Chipped Concrete at East Abutment Ballast Wall

As mentioned in Section 2.1 the bearings below the east support bents had gaps and shim plates throughout the much of the approach spans. The gaps between bearing plates, shim plates thicknesses, and relative moment of the footing towards the river for each support bent are recorded below:

- E1 – ¾" (19 mm) gap, 3" (75 mm) of shim plates added, approx. 2" (50 mm) or relative moment between the bearing and the footing;
- E2 - 3" (75 mm) of shim plates added, approx. 2" (50 mm) or relative moment between the bearing and the footing;
- E7 – 3.5" (87 mm) of shim plates added, ½" (13 mm) of relative movement;
- E8 – 4.5" of shim plates, 4.5" (113 mm) gap between bearing plates 3.75" (94 mm) of relative movement (**Photo 6**);
- E9 – 4.5" (113 mm) of shim plates, no gap between bearing plates, ½" (13 mm) of relative movement;
- E10 - 4.5" (113 mm) of shim plates, no gap between bearing plates, ½" (13 mm) of relative movement;
- E11 – 3" (75 mm) of shim plates, no gap between bearing plates;
- E12 – ¾" (19 mm) of shim plates, ½" (13 mm) gap between bearing plates, 1" (25 mm) of relative movement.

Photo 6 - Bearing Movement at E8 (Similar for Other Bents)

Footings at E3, E4, E5, and E6 did not show any signs of movement, nor were there any shim plates or visible gaps.

As mentioned in Section 2.1, from our visual review of the east approach span elevations (recorded with a laser level), we determined that there has been movement between spans; particularly between E2 and E3, where a visible dip was recorded, with a relative dip of over 18" (450 mm) between supports (**Photo 7**).

Photo 7 - Elevation Difference between Adjacent Approach Spans (East Approach)

2.4 MAIN TRUSS SPANS

From a review of the main truss spans from the walking deck, we recorded that the main span bearings at pier P1 have clearly failed since they were unable to accommodate excessive relative movement of approximately 21" (530 mm) and have collided with the most easterly truss (T1) (**Photo 8**), damaging the end plan brace and breaking the riveted connections (**Photo 9**).

Photo 8 - Movement of East Approach Span at P1

Photo 9 - Damage to End Plan Brace on T1

Buckling of the bottom truss chord was recorded on truss T1 in the 3rd bay and 10th bay from the east end of the truss respectively (see General Arrangement plan). The 10th bay exhibited only a small bow in the bottom chords while the 3rd bay exhibited significant buckling (**Photo 10**).

Photo 10 - Buckled Bottom Chord Bracing (3rd Bay T1)

At the location of the 3rd bay a hump also exists in the truss of approximately 15" (375 mm) relative to the end of the truss (**Photo 11**) as a result of pressure from the east approach spans.

Photo 11 - Hump in Truss T1 due to Movement of Approach Span

The 10th bay of both truss T2 and T3 exhibited buckled bottom chords. In addition to the buckling of truss chords, there was no gap between trusses T1 & T2, and T2 & T3, and only an approx. 1-5/8" (40 mm) gap between T3 & T4. A nominal gap of 6" (150 mm) was noted between trusses at the west end, as described earlier.

The main span bearings at pier P1 have clearly failed since they were unable to accommodate excessive relative movement of approximately 21" (530 mm).

3 CONCLUSIONS

The deficiencies witnessed during our inspection are the result of ground movement at both the east and west riverbanks, notably the east riverbank. Our inspection has revealed several structurally significant deteriorations on the bridge, including:

- Buckling and excessive deformation of bottom chord members and diagonals in truss T1, 3rd bay from the east end of the truss.
- Buckling and significant deformation of bottom chord members in the 10th bay of trusses T1, T2 and T3.
- Approach girders colliding with and damaging the main span truss, bearing, and diaphragm at pier P1.
- Bearing anchors broken and excessive bearing movement at P1, and possibly more piers. Broken bearing anchors and loss of contact at concrete footings at Bents W4, E1, E8, and E12.

Based on the inspection finding described above, we conclude that the structure is not stable at this time. The bridge in the present condition cannot safely support the current loads being placed on it. Due to the structural deficiencies noted in Section 2 of the report, the way the bridge structure transfers the weight of the walking platform, pedestrian users, and its own self weight down to the bridge foundations is substantially different now than intended in the original design and cannot be readily relied upon.

We cannot confirm that the bridge has the ability to safely support the load in its present condition. High winds and winter snowfall will also be detrimental to the bridge in its current state and will make the structure more vulnerable. **As the bridge cannot be relied upon to safely support the pedestrian load, we recommend the bridge be closed for traffic.**

4 RECOMMENDATIONS

Based on the results of our inspection we recommend the following:

- **The bridge should be closed immediately.** It cannot be relied upon in its current condition and we recommend that pedestrian access to the bridge to prohibited, including access under the bridge.

- We recommend that the Town of Outlook retain an engineering firm to prepare a preliminary bridge repair design, and provide a Class D (order of magnitude) cost estimate for the repair. As a part of the repair design, the Engineer may need to conduct a close proximity visual inspection and survey of the bridge to confirm the condition of main truss span pier bearings, buckled bottom chord members, bracing and diaphragms and other components. The Class D cost estimate will help the Town make appropriate decisions regarding future use of the bridge, and apply for Federal and provincial funding.

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- As part of the preliminary design the engineer should investigate possible interim repairs that will ensure safe bridge operation until the final repairs are complete; possibly with restricted load and provision that the bridge shall be closed in case of strong wind or heavy snow load.

- Once the Town secures funding for the repairs, we recommend that the Town retains an engineer to prepare a detailed repair design for the bridge.

- Once the repair design is complete, we recommend that the Town solicits competitive bids for the bridge repair work from three reputable and experienced bridge contractors and award the contract for the repair work to one of them. The construction work shall be supervised by a Professional Engineer experienced in this type of work. Considering the complexity of the bridge and difficult access at the locations where repairs are required, we anticipate that the engineering and construction budget to repair the bridge could approach a seven figure fee.

- As the ground movement at the two bridge abutments that caused the structural damage can be expected to continue into the future, we recommend that funding be made available to inspect the structure annually after the bridge is repaired. Based on the performance of the bridge, the frequency of the inspections can possibly be reduced in the future.

The Outlook Bridge is a historic structure, important for citizens and visitors of the Town of Outlook and a part of the TransCanada Trail. As such we do not recommend demolition of this structure. However, if the Town decides not to proceed with the repairs, we recommend that the controlled demolition and removal of the bridge in order to prevent an accidental collapse be discussed with the provincial government.

Based on the currently available information, we envision that the bridge repair shall include the following:

- Repair of buckled bottom chord members, diagonals, plan bracing and diaphragms.
- Re-establishing the proper clearance between the bridge spans.
- Jacking of the bridge to ensure proper configuration and load distribution.
- Repair or replacement of all the damaged bearings in main spans and approach spans, including the anchor bolts.
- Strengthening of cracked bridge concrete footings at approach span.
- Provisions to accommodate future ground movement as the movement of the ground under the bridge approaches appears to be an ongoing process.

5 CLOSURE

Our recommendations are based on the visual review of the existing bridge on the day of our inspection. The scope of this investigation did not permit the physical examination and confirmation of all structural components of the existing bridge. In some instances it has been necessary to apply some interpretations and engineering judgment. If new information comes to light which might influence our conclusions, we would request to be informed so that we may reassess our recommendations.

Respectfully submitted,

Prepared by:	Reviewed by:
Stephen Chiasson, B.Sc., Engineer-In-Training Project Manager	Carma Holmes Carma Holmes, P.Eng. Structural Engineer

SC/mp

Nikola Cuperlovic, P.Eng (BC)
Specialist – Special Structures

Enclosures: Outlook Designations
Photos

Certification Page

This report presents our findings regarding the Town of Outlook TransCanada Trail Pedestrian Bridge Visual Inspection.

PROFESSIONAL ENGINEER
C.R. HOLMES
MEMBER 10020
2013-11-06
YR. MN. DAY
SASKATCHEWAN

Seal

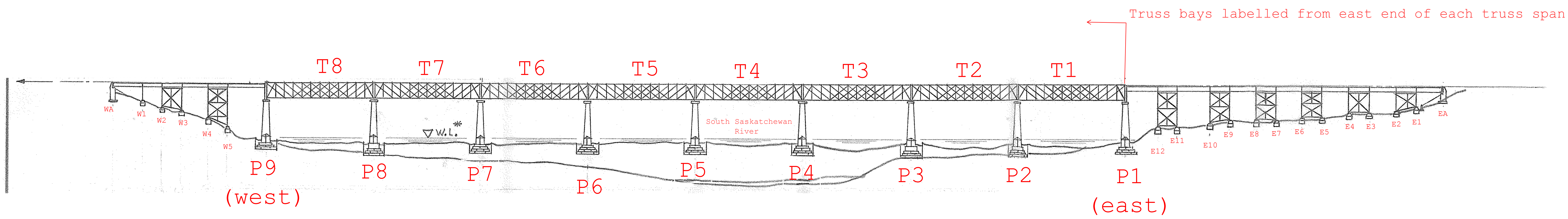
ASSOCIATION OF PROFESSIONAL ENGINEERS
AND GEOSCIENTISTS OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
ASSOCIATED ENGINEERING (SASK.) LTD.
NUMBER
C116
Permission to Consult Held By:

Discipline	Sask. Reg. No.	Signature
STRUCT - BRIDGES	10020	CHolmes

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF

Signature: ____________

Date: Nov. 6/2013



Town of Outlook TransCanada Trail Bridge
General Arrangemnt

TOWN OF OUTLOOK
TRANSCANAD TRAIL PEDESTRIAN BRIDGE
SUMMARY OF INSPECTION MEASUREMENTS

WEST APPROACH SPAN FIELD MEASUREMENTS						
	WA	W1	W2	W3	W4	W5
Relative Elevation at t/o Deck (in)	-	-	-	-	-	-
Gap at u/s of Bearing (in)	n/a	n/a	n/a	n/a	1.25	-
Shim Plate Thickness on u/s of Bearing (in)	n/a	n/a	n/a	n/a	3.5	-

EAST APPROACH SPAN FIELD MEASUREMENTS													
	E12	E11	E10	E9	E8	E7	E6	E5	E4	E3	E2	E1	EA
Relative Elevation at t/o Deck (in)	+8.50	+8.50	+7.00	+7.00	+16.25	+16.00	+23.00	+23.00	+26.00	+27.75	+8.50	+12.75	+0.00
Gap at u/s of Bearing (in)	0.5	n/a	n/a	n/a	4.5	n/a	n/a	n/a	n/a	n/a	n/a	0.75	n/a
Shim Plate Thickness on u/s of Bearing (in)	0.75	3	4.5	4.5	4.5	3.5	n/a	n/a	n/a	n/a	3	3	-

PIER FIELD MEASUREMENTS									
	P9	P8	P7	P6	P5	P4	P3	P2	P1
Approximate Gap Between Truss Spans (in)	6	6	6	6	6	1.5	0	0	-15

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_01 - Looking west across bridge from east approach

20131031 - Photo_02 - Looking west down east approach spans

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Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_03 - Looking west from east riverbank below bridge

20131031 - Photo_04 - Looking west down walking deck over main truss spans

Associated Engineering

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_05 - Looking west at truss T1 from east approach span

20131031 - Photo_06 - Looking east down west approach spans

Associated Engineering

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_07 - No gap between main truss spans, typical for 3 locations

20131031 - Photo_08 - Buckled bottom truss chords on truss T1 bay 3

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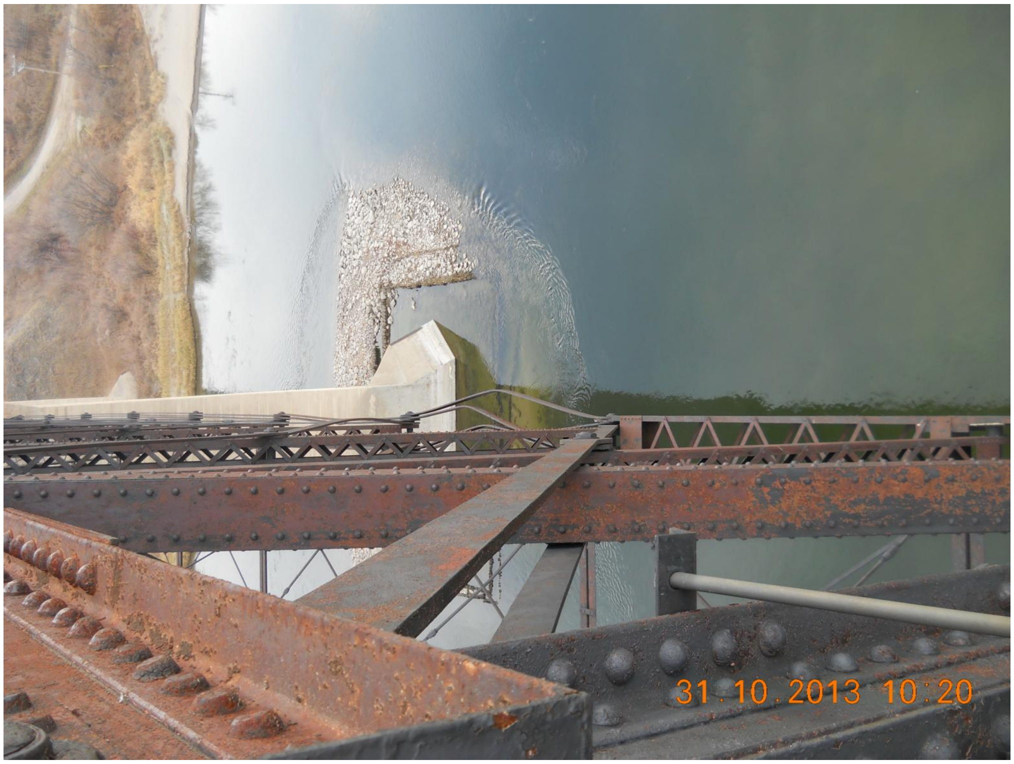

20131031 - Photo_09 - Buckled bottom truss chords on truss T1 bay 10

20131031 - Photo_10 - Buckled bottom truss chords on truss T1 bay 10

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_11 - Buckled bottom truss chords on truss T2 bay 10

20131031 - Photo_12 - Buckled bottom truss chords on truss T1 bay 3

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_13 - Collision between truss T1 and east approach spans at pier P1

20131031 - Photo_14 - Failed bearing at pier P1

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20131031 - Photo_15 - Looking down at collision between truss T1 and east approach spans at pier P1

20131031 - Photo_16 - Deformed bracing at east end of truss T1 from collision with approach spans

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013

20131031 - Photo_17 - Shim plates added below bearing seat at west approach span support, typical 2 locations

20131031 - Photo_18 - Gap between spherical bearing plates at W4 south bearing

20131031 - Photo_19 - Movement of west approach span girders at west abutment

20131031 - Photo_20 - Significant gap between bearing plates at support bent E8

20131031 - Photo_21 - Significant gap between bearing plates at support bent E8

20131031 - Photo_22 - Gap between bearing plates, typical for several east approach bent supports

Town of Outlook
TransCanada Trail Pedestrian Bridge
Inspection Report
October 31, 2013


20131031 - Photo_23 - Shim plates below bearing seat, typical several locations

20131031 - Photo_24 - Shim plates below bearing seat, typical several locations

Associated Engineering

Appendix C - Class D Cost Estimate

Associated Engineering	**Client:** **City of Outlook** **Project:** **Outlook Pedestrian Bridge** **Truss Bridge Rehabilitation** **Details:** Class D Cost Estimate **File:** 20134388.00.E.06.00	**Prepared by:** DE **Reviewed by:** NC/SC **Date:** April 1, 2014 **Submission:** Preliminary Design Report

Item No.	Item	Unit	Approx. Quantity	Unit Cost	Extended Amount
1.0	**Mobilization**				
1.1	Mobilization and Demobilization (10%)	LS	1	$160,000	$160,000
1.2	Tree Removal	LS	1	$50,000	$50,000
				Sub-Total	**$210,000**
2.0	**Abutment Post-Tensioning**				
2.1	Girder Weldments	kg	1,100	$18.00	$19,800
2.2	36ø 830/1035 MPa Hot Rolled Threadbar	m	90	$20.00	$1,800
2.3	Misc. Threadbar Accessories	ea	4	$200	$800
2.4	Deadman Weldments	kg	1,100	$18.00	$19,800
2.5	Deadman Excavation / Fill	m^3	80	$150	$12,000
2.6	Deadman Supply, Installation and Removal	ea	2	$25,000	$50,000
2.7	Stressing Operations	mhrs	320	$70	$22,400
				Sub-Total	**$126,600**
3.0	**Abutment Modifications**				
3.1	Abutment Backwall Demolition	m^2	8	$2,000	$16,000
3.2	Abutment Excavation / Fill	m^3	35	$150	$5,250
3.3	Abutment Back Wall	ea	1	$25,000	$25,000
3.4	Abutment Bearings (Incl. Installation)	ea	2	$15,000	$30,000
3.5	Abutment Ramp	ea	1	$15,000	$15,000
				Sub-Total	**$91,250**
4.0	**Approach Span Modifications**				
4.1	Approach Span Traveller (access)	LS	1	$75,000	$75,000
4.2	Supply Approach Girder Span Ties (Steel Only)	ea	24	$2,600	$62,400
4.3	36ø 830/1035 MPa Hot Rolled Threadbar	m	150	$20.00	$3,000
4.4	Misc. Threadbar Accessories	ea	24	$200	$4,800
4.5	Paint Removal	LS	1	$15,000	$15,000
4.6	Install Approach Girder Span Ties	mhrs	1,440	$70	$100,800
4.7	Pier Repairs and Grout Plinth	ea	12	$20,000	$240,000
				Sub-Total	**$501,000**
5.0	**Truss Post-Tensioning**				
5.1	Install / Remove Truss Access	LS	1	$150,000	$150,000
5.2	Truss Strongbacks (4 req'd)	kg	1,900	$18.00	$34,200
5.3	0.6" Steel P/T Strand (Supply)	m	667	$2.00	$2,000
5.4	Misc. Strand Accessories (Supply)	LS	8	$1,000	$8,000
5.5	Install and Stress	mhrs	800	$70	$56,000
				Sub-Total	**$250,200**

Client:	**City of Outlook**	**Prepared by:** DE
Project:	**Outlook Pedestrian Bridge** **Truss Bridge Rehabilitation**	**Reviewed by:** NC/SC
Details:	Class D Cost Estimate	**Date:** April 1, 2014
File:	20134388.00.E.06.00	**Submission:** Preliminary Design Report

Item No.	Item	Unit	Approx. Quantity	Unit Cost	Extended Amount
6.0	**Truss Modifications**				
6.1	Removal of Bay 1 Deck and Stringers	mhrs	224	$70	$15,680
6.2	Repl. Bay 1 Stringers and End Diaphragms (Supply and Inst)	kg	2,300	$12.00	$27,600
6.3	Temp. Support and Adjust Approach Girders at Pier	LS	1	$50,000	$50,000
6.4	Approach Girder Extensions	kg	1,000	$18.00	$18,000
6.5	Approach Girder Bearings and Diaphragm	ea	2	$25,000	$50,000
6.6	Removal of Approach Girder Support Leg	mhrs	480	$70	$33,600
6.7	Truss Span Bearing Modifications + Installation	ea	2	$70,000	$140,000
6.8	Existing Truss Repairs	LS	1	$200,000	$200,000
				Sub-Total	**$534,880**

NET CONSTRUCTION COST	**$ 1,720,000**
Overhead (10%)	$172,000
Profit and Markup (10%)	$166,400
Risk (10%)	$172,000
CONSTRUCTION COST	**$ 2,230,000**
Class D Estimate Contingency (35%)	$781,000
Detailed Design (14%)	$310,000
Detailed Inspection, including Materials Testing	$25,000
Temporary Works Design	$50,000
Construction Monitoring (Assumed 135 Days)	$150,000
TOTAL PROJECT COST (Excluding taxes)	**$ 3,550,000**